DEFIANCE COUNTY BOARD OF COMMISSIONERS
DEFIANCE COUNTY LANDFILL
PHASES 8 AND 9 BAT CELLS AND SUPPORT STRUCTURES CONSTRUCTION

# SITE WORK

## DIVISION II

# DEFIANCE COUNTY SOLID WASTE SANITARY LANDFILL PHASES 8 AND 9 CELLS AND SUPPORT STRUCTURES CONSTRUCTION

## 13207 CANAL ROAD
## DEFIANCE, OHIO 43512

## DECEMBER 2025

*PREPARED FOR*
DEFIANCE COUNTY BOARD OF COMMISSIONERS
500 COURT STREET
DEFIANCE, OHIO 43512

Mannik Smith GROUP

# SITE WORK

# DIVISION II



It is recommended that the Bidder use the following specifications and Attachment I in conjunction with detailed requirements provided in the Contract and Bid Documents, Construction Drawings and the current QA/QC Plan for Defiance County.

The Bidder shall immediately contact the Engineer if these specifications, dimensions or details are in conflict or if the Bidder finds an error, omission or inconsistency. The Bidder shall be responsible for using incorrect specifications, materials and bid amounts.

# SECTION 02213

# ADDED GEOLOGIC MATERIAL

RESERVED

(THIS SECTION BLANK)

# SECTION 02214

# STRUCTURAL FILL

## PART 1 – GENERAL

Work covered shall consist of all activities including labor, materials, tools, equipment, incidentals, and services necessary for construction of structural fill, including movement, backfilling, grading, compacting and related items to the limits indicated in the plans and specifications or as directed by the engineer.

This section contains the requirements for structural fill including material selection, placement, compaction, and finishing for preparation for placement of the Recompacted Soil Liner (RSL) and/or otherwise bring specific areas to elevations required to install the RSL for geomembrane placement.

### 1.1 SECTION INCLUDES

A. Borrow source certification testing

B. Construction Quality Control (CQA)

C. Structural fill material

D. Structural fill material requirements

E. General requirements

F. Placement and compaction

G. Clay moisture content adjustment

H. Failed tests

I. Drainage

J. Surface finish

K. Agency approval

### 1.2 RELATED SECTIONS

A. Section 01050 – Field Engineering

B. Section 01320 – Submittals

C. Section 01410 – Testing and Testing Laboratory Services

D. Section 02218 – Landfill Materials Handling

1.3 REFERENCES

A. ASTM D 420 - Site Characterization for Engineering, Design, and Construction Purposes

B. ASTM D 422 - Particle Size Analysis of Soils

C. ASTM D 698 - Laboratory Compaction Characteristics of Soil Using Standard Effort

D. ASTM D 1556 - Density and Unit Weight of Soil in Place by the Sand-Cone Method

E. ASTM D 2216 - Laboratory Determination of Water (Moisture) Content of Soil and Rock

F. ASTM D 2487 - Classification of Soils for Engineering Purposes

G. ASTM D 2922 - Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)

H. ASTM D 3017 - Water Content of Soil and Rock In Place by Nuclear Methods (Shallow Depth)

I. ASTM D 4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils

J. ASTM D 1557 - Laboratory Compaction Characteristics of Soil Using Modified Effort.

K. OEPA Guidance Document 605, Repair of Penetrations into the Liner, Barrier, or Added Geologic Material

1.4 SUBMITTALS

A. The Contractor shall submit information, reports, and documentation in accordance with Section 01320.

1.5 BORROW SOURCE CERTIFICATION TESTING

A. Owner's representative completed sampling and testing of borrow soil sources. Material sampling and subsequent analysis results have been provided to and approved by Ohio EPA for use in this project.

B. All soil materials have been prequalified for use for the Project work.

C. Information on pre-qualified borrow sources shall be provided by the Engineer. At a minimum, this information shall include:

1. The type and estimated quantity of soil in each soil block from the borrow area

2. A topographic map of the borrow source indicating extent and depth of excavation for each grid

1.6 CONSTRUCTION QUALITY CONTROL

A. Field inspection and testing by the Construction Quality Assurance (CQA) Consultant shall be performed under provisions of this specification and Section 01410 – Testing and Laboratory Testing Services, the Project's CQA Plan and the requirements specified by Ohio EPA's Prequalification approval of grid soils.

B. Field measurements by means accepted as industry standard shall be performed by the Contractor to verify proper total thicknesses. Thickness measurements for each layer placed shall at a minimum be collected at the points shown within the Construction Drawings at an approximate frequency of a 100 X 100 ft grid established and maintained for layout purposes (See Section 01050 – Field Engineering).

C. The maximum thickness of lifts shall be twelve (12) inches (loose). Each lift shall be tested for compaction and moisture to determine if the lift's properties comply with Ohio EPA requirements. Lifts constructed thicker than twelve (12) inches loose or use improper compaction criteria for the soil, shall be considered unacceptable and shall require removal and re-construction using proper thickness and compaction criteria, at no cost to the Owner.

D. Visual inspections not limited to the following shall be performed and documented by CQA Consultant in Daily Field Reports noting:

1. The character and condition of the placement surface

2. Water content, density, and other pertinent physical properties of compacted soils including visual/sensory screening for contamination

3. Loose and compacted thicknesses

4. The equipment used and number of passes required to compact each lift

5. Lift scarification and bonding procedures, where appropriate

6. Effects of equipment on the construction surface

E. The following in-situ testing for structural fill shall be conducted by CQA Consultant:

| Property | Standard | Minimum Frequency |
|---|---|---|
| Nuclear Moisture Content | ASTM D 3017 | 5 tests/acre/lift |
| Nuclear Density | ASTM D 2922 | 5 tests/acre/lift |
| Thickness Measurement | Industry Standard | 100 foot grid |
| "Speedy" Moisture Content | ASTM D 4944 | As Required by Engineer |

F. All fill shall be placed to within -0.2 to 0 ft. of the grades depicted in the drawings.

G. The Contractor shall observe and document the activities described in this Section and items detailed in the approved Contractor Quality Control Plan (CQC) as applicable.

## PART 2 – PRODUCTS

### 2.1 STRUCTURAL FILL MATERIAL

A. Material shall be obtained from the site's approved borrow area, as directed by the Engineer or CQA Consultant each day.

B. Structural fill shall consist of pre-qualified soils that Ohio EPA has approved for use during this project. The soil borrow area has been tested, approved and has an assigned set of criteria for compaction, passes, moisture, and CQA measurements.

C. Structural fill material shall meet the appropriate requirements for use on this project.

D. The Engineer or CQA Consultant may, at any time during the Contract Time, request or perform additional soils testing to confirm the structural fill construction meets the specified requirements. The Contractor shall bear the costs of any failing tests.

2.2 STRUCTURAL FILL MATERIAL REQUIREMENTS

A. Structural fill shall comply with the following:

1. Shall be prequalified

2. Consist of durable rock for rock fills only where indicated and if required

3. Be free of debris, foreign material, and deleterious material

4. Not be comprised of solid waste

B. Once placed, structural fill shall not have any abrupt changes in grade that may result in damage to the composite liner system.

PART 3 – EXECUTION

3.1 GENERAL REQUIREMENTS

A. The Contractor shall place structural fill where necessary to ensure the subgrade in PHASES 8 AND 9 conforms to the lines, grades, and thickness depicted on the drawings.

B. The Contractor shall place structural fill composed of prequalified soil on the base/floor and sidewalls to the extent necessary to construct the necessary overlying components. The soil material shall be obtained from the approved grid or stockpile as directed by the CQA Consultant and/or Engineer.

3.2 PLACEMENT AND COMPACTION

A. The soil shall be placed at a maximum loose lift thickness in accordance with Ohio EPA specifications.

B. All clods, lumps or rocks greater than 3 inches in diameter shall be broken down or removed to provide a uniform acceptable texture soil.

C. Lifts shall be compacted using a Caterpillar 825 sheep foot compactor or Engineer approved equivalent in accordance with Ohio EPA specifications. These are reproduced in the following table:

| Test | Standard | Specification |
|---|---|---|
| Relative Density | ASTM D 698 | 95.0 % of MDD |
| Relative Density | ASTM D 1557 | 90.0 % of MDD |

| Test | Standard | Specification |
|---|---|---|
| Relative Moisture | ASTM D 1557 | +/- 4% of OMC |
| Lift thickness | Industry Standard | Max.12 inch loose |
| No. of passes with compactor | | NA |

MDD = Maximum Dry Density
OMC = Optimum Moisture Content

D. The Contractor shall have the CQA Consultant test every lift at the locations and frequencies specified by the CQA Plan. Determination of passing or failing acceptability of the lift shall be the responsibility of the CQA Consultant and/or the Engineer, with their determination as final.

E. Penetration through the soil resulting from density and moisture testing shall be sealed with bentonite or a bentonite/soil mixture in accordance with the Ohio EPA's document "Repair of Penetrations in Recompacted Soil Liners" by the responsible party.

F. Each lift shall be tested for proper compaction in accordance with the CQA Plan and Ohio EPA requirements before successive lifts are applied. Subsequent lifts shall not be placed unless and until approved by the CQA Consultant.

G. Lifts that fail the acceptance criteria shall be repaired or removed and replaced by the Contractor until the lift is determined to be acceptable in accordance with the CQA Plan. All costs associated with the repair or removal and replacement of unacceptable lifts shall be the responsibility of the Contractor. Subsequent lifts shall not be placed unless and until approved by the CQA Consultant.

H. Lifts applied by the Contractor without obtaining approval from the CQA Consultant for the previous lift shall be removed at no expense to the Owner.

I. The Contractor shall be responsible for protection of the completed or partially completed Structural fill from excessive moisture, freezing, desiccation, and all other damage

J. Daily work shall extend a distance no greater than is possible to maintain moist soil conditions and continuous operations. Desiccation and crusting of the lift surface shall be avoided.

K. If desiccation and crusting of the lift surface occurs prior to placement of the next lift, this area shall be sprinkled with water and then scarified and tested for moisture content to ensure uniform moisture before placement of the next lift.

## 3.3 CLAY MOISTURE CONTENT ADJUSTMENT

A. The Contractor shall be required to dry the soil material or apply water as necessary to obtain the required moisture or other requirements of the specifications. The application of water to the soil material shall be accomplished at the borrow source area insofar as is practical.

B. Moistening

1. The Contractor shall moisturize soil material via the addition of water and mix with sufficient energy and allow enough time to evenly distribute the water throughout the soil matrix.

2. Uniform water distribution shall be obtained by disking material after water has been applied.

3. Water may be applied by sprinkling the materials after loose placement if necessary.

4. If the top surface of the preceding layer of structural fill becomes too dry to allow a suitable bond, it shall be scarified and moistened prior to the placement of the next lift.

C. Drying

1. The Contractor shall spread soil material in a designated area and disk during weather conducive to effective drying.

2. Soil material that is too wet when placed shall either be removed or dried to the specified moisture content prior to compaction.

3. The Contractor shall secure the drying operation from the effects of weather by stockpiling and/or smooth drum sealing.

4. Moisture content in dried material shall be verified after disking ensuring uniform moisture distribution.

## 3.4 FAILED TESTS

A. In the event that a portion of structural fill material does not meet the compaction criteria, the Contractor shall re-compact the lift within the area bounded by other compaction tests meeting the criteria, and re-test at no cost to the Owner.

B. In the event of subsequent failure(s), the entire area failing shall be reworked or removed and replaced by the Contractor. The location and quantity of removed materials shall be documented by the Contractor and CQA Consultant. All work associated with removal and subsequent placement and testing shall be at no cost to the Owner.

C. Materials permitted to desiccate, placed at densities lower than the specified minimum density, at moisture contents outside the specified range, or otherwise not conforming to the requirements of these specifications shall be reworked by disking and recompaction to meet the requirements or removed and replaced by acceptable material. The replacement material and surface upon which it is placed shall conform to all requirements of this specification and be tested in accordance with relevant Project specifications.

D. Questions concerning the accuracy of any single test shall be addressed by re-testing in the same or adjacent location in the same lift. Questions concerning the accuracy of the testing equipment shall be addressed by utilizing other equipment or methods for confirmation purposes.

## 3.5 DRAINAGE

A. At all times during construction, the Contractor shall temporarily provide, place, and maintain ample means and devices with which to promptly remove and properly dispose of all water, snow, and ice entering the excavation. Excavations shall be kept dry until the structures, pipes, appurtenances to be built therein have been completed to an extent that they shall not be damaged.

B. All water pumped or drained from the work shall be disposed in a manner satisfactory to the Owner, without undue interference with the Owner's operations or other work, or damage to property.

END OF SECTION 02214

# SECTION 02215

# RECOMPACTED SOIL LINERS

## PART 1 – GENERAL

Work covered shall consist of all activities including labor, materials, tools, equipment, incidentals, and services necessary for construction of Recompacted Soil Liners (RSL) including; movement, backfilling, grading, compacting, and associated items to the limits indicated in the plans and specifications or as directed by the engineer.

### 1.2 SECTION INCLUDES

A. Borrow source certification testing

B. Construction Quality Control

C. Recompacted soil liner material

D. Prequalified material classification

E. Recompacted soil liner requirements

F. General requirements

G. Placement and compaction

H. Soil moisture content adjustment

I. Failed tests

J. Drainage

K. Surface finish

L. Agency approval

### 1.3 RELATED SECTIONS

A. Section 01050 – Field Engineering

B. Section 01320 – Submittals

C. Section 01410 – Testing and Testing Laboratory Services

D. Section 02218 – Landfill Materials Handling

E. Section 02270 – Construction Erosion and Sediment Control

1.4 REFERENCES

A. ASTM D 420 - Site Characterization for Engineering, Design, and Construction Purposes

B. ASTM D 422 - Particle Size Analysis of Soils

C. ASTM D 698 - Laboratory Compaction Characteristics of Soil Using Standard Effort

D. ASTM D 1556 - Density and Unit Weight of Soil in Place by the Sand-Cone Method

E. ASTM D 2216 - Laboratory Determination of Water (Moisture) Content of Soil and Rock

F. ASTM D 2487 - Classification of Soils for Engineering Purposes

G. ASTM D 2922 - Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)

H. ASTM D 3017 - Water Content of Soil and Rock In Place by Nuclear Methods (Shallow Depth)

I. ASTM D 1557 - Laboratory Compaction Characteristics of Soil Using Modified Effort

J. ASTM D 4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils

K. OEPA Guidance Document 605, Repair of Penetrations into the Liner, Barrier, or Added Geologic Material

1.5 SUBMITTALS

A. The Contractor shall submit information, reports, and documentation in accordance with Section 01320.

1.6 BORROW SOURCE CERTIFICATION

A. Owner's representative completed sampling and testing of borrow soil sources. Material sampling and subsequent analysis results have been provided to and approved by the Ohio EPA for use in this project.

B. All soil materials have been prequalified for use for the Project work.

C. Information on prequalified borrow sources shall be provided by the Engineer. At a minimum, this information shall include:

1. The type and estimated quantity of soil in each soil block from the borrow area

2. A topographic map of the borrow source indicating extent and depth of excavation for each grid

D. A Best Fit Line of Optimums (BFLO) curve has been developed for soils being used for RSL construction of Phases 8 and 9. The BFLO curve dictates acceptable parameters of a passing test for RSL construction.

## 1.7 CONSTRUCTION QUALITY CONTROL

A. Field inspection and testing by the CQA Consultant shall be performed under provisions of this Specification and Section 01410 – Testing and Laboratory Testing Services, the Project's QA/QC Plan and the requirements specified by Ohio EPA's Prequalification approval of the grid soils.

B. Field measurements by means accepted as industry standard shall be performed by the Contractor to verify proper total layer thicknesses. Thickness measurements for each layer placed shall be at a minimum collected at the certification points indicated in the Construction Drawings which are spaced approximately at a frequency of a 100-ft by 100-ft grid established and maintained for layout purposes (See also Section 01050 – Field Engineering).

C. The maximum thickness of lifts shall be determined by the compaction equipment utilized. For a Caterpillar 825 or 815 or Al-Jon compactor (large compactor), the maximum allowable lift thickness is eight (8) inches (loose). For a Caterpillar 563/CP56, (smaller compactor) the maximum allowable loose lift is six (6) inches. Each lift shall be tested for compaction and moisture to determine if the lift's properties comply with Ohio EPA and project requirements. Lifts constructed thicker than eight (8) inches loose (or six (6) inches compacted) when using a large compactor, or constructed lifts thicker than six inches loose (four inches compacted) when using a smaller compactor, or improper compaction criteria for the soil grid used, shall be considered unacceptable and shall require removal and re-construction using proper thickness and compaction criteria. All lifts shall be placed and compacted in accordance with the procedures established by the approved Test Pad.

D. Visual inspections not limited to the following shall be performed and documented by CQA Consultant in Daily Field Reports noting:

1. The character and condition of the placement surface
2. Water content, density, and other pertinent physical properties of compacted soils including visual/sensory screening for contamination
3. Borrow grid/soil block identification number used for each lift that day
4. Loose and compacted thicknesses
5. The equipment used and number of passes required to compact each lift as it meets approved test pad construction procedures
6. Lift scarification and bonding procedures, where appropriate
7. Effects of equipment on the construction surface

E. The following in-situ testing of the Recompacted Soil Liner shall be conducted by CQA Consultant:

| Property | Standard | Minimum Frequency |
|---|---|---|
| Nuclear Moisture Content | ASTM D 3017 | 5 tests/acre/lift |
| Nuclear Density | ASTM D 2922 | 5 tests/acre/lift |
| Thickness Measurement | Industry Standard | 100 foot grid |
| "Speedy" Moisture Content | ASTM D 4944 | As Required by Engineer |

F. Recompacted Soil Liner shall be placed to within 0.0 to + 0.2 ft. of the total thickness depicted in the drawings but not less than the required thickness.

## PART 2 – PRODUCTS

### 2.1 RECOMPACTED SOIL LINER MATERIAL

A. RSL material shall be obtained from the site borrow area grid(s). The Contractor shall obtain from the Engineer or CQA Consultant, the borrow grid(S) to be used for each item each day prior to the start of that day's work.

B. RSL shall be constructed from pre-qualified soils that Ohio EPA has approved for use during this project. Each borrow grid has been tested, approved and has an assigned set of criteria for compaction, moisture, and CQA measurements. Soil used for compaction shall not have stones exceeding two inches in any dimension, significant organic matter, and/or debris.

C. RSL material shall meet the appropriate requirements for use on this project.

D. The Engineer or CQA Consultant may, at any time during the Contract Time, perform further soils testing to confirm the RSL construction meets the specified requirements. The Contractor shall bear all the costs of any failing tests.

### 2.2 PREQUALIFIED MATERIAL CLASSIFICATION

A. RSL material shall meet the requirements of OAC 3745-27-08(D).

B. The RSL shall have a maximum permeability of $1x10^{-7}$ cm/s after compaction.

### 2.3 RECOMPACTED SOIL LINER REQUIREMENTS

A. The RSL material shall meet the following specifications:

1. 100% of the particles having a maximum dimension not greater than 2-inches
2. Not greater than 10% of the particles, by weight, having a dimension greater than 0.75-inches
3. Be free of debris, foreign material, and deleterious material
4. Not be comprised of solid waste

B. Once placed, RSL shall not have any abrupt changes in grade that may result in damage to the composite liner system.

C. The above specifications shall be modified to the extent necessary to comply with specifications dictated by the approved test pad.

## PART 3 – EXECUTION

### 3.1 GENERAL REQUIREMENTS

A. The Contractor shall place RSL to the lines, grades, and thickness depicted on the drawings.

B. Upon completion of the excavation, fill placement, and preparation of PHASES 8 AND 9 subgrade to the lines and grades specified on the Construction Drawings, the Contractor shall place three (3) feet of recompacted clay composed of prequalified soil material on the base/floor and sidewalls to the extent depicted on the drawings. The soil liner material shall be obtained from the approved grid(s) as directed by the CQA Consultant and/or Engineer.

C. The method of compacting lifts shall be the same as that used to construct the applicable test pad(s), or as approved by Ohio EPA and specified by the Engineer. Approved procedures include equipment type, and number of passes. Information on approved test pad procedures and construction techniques shall be provided by the Engineer.

## 3.2 PLACMENT AND COMPACTION

A. The soil shall be placed at a maximum loose lift thickness in accordance with the approved test pad specifications and uniformly compacted.

B. All clods greater than 3 inches in diameter shall be broken down or removed by means of harrowing, disk or other appropriate equipment to provide a uniform acceptable soil texture.

C. All rocks greater than 2 inches in diameter shall be removed by means of harrowing, disk or other appropriate equipment to provide a uniform acceptable soil texture.

D. Lifts shall be compacted using either a Caterpillar 825 sheep foot compactor, Caterpillar 815 sheeps foot compactor, Caterpillar CP 56 sheep foot compactor, or equivalent in accordance with the approved test pad specifications. These are reproduced in the following table:

| Test | Standard | Specification |
|---|---|---|
| Relative Density | ASTM D 1557 | 91.6 % of MDD or BFLO |
| Relative Moisture | ASTM D 1557 | +0.6% of OMC or BFLO |
| Lift thickness | Industry Standard | Cat 825 - Max.8 inch loose<br>Cat 815 – Max 8 inch loose<br>Cat CP 56 - Max 6 inch loose |
| No. of contacts with compactor | | Cat 825 - Minimum of 6<br>Cat 815 – Minimum of 6<br>Cat CP 56 – Minimum of 10 |

MDD = Maximum Dry Density
OMC = Optimum Moisture Content

The Contractor shall allow the CQA Consultant to test every lift at locations and frequencies specified by the CQA Plan. Determination of passing or failing acceptability of the lift shall be the responsibility of the CQA Consultant and/or the Engineer, with their determination as final.

E. Penetration into the soil resulting from density and moisture testing shall be sealed with bentonite or a bentonite/soil mixture in accordance with the Ohio EPA's document "Repair of Penetrations in Recompacted Soil Liners" by the responsible party.

F. Each lift shall be tested for proper compaction in accordance with the CQA Plan and Ohio EPA requirements before successive lifts are applied. Subsequent lifts shall not be placed unless and until approved by the CQA Consultant.

G. Lifts that fail the acceptance criteria shall be repaired or removed and replaced by the Contractor until the lift is determined to be acceptable in accordance with the CQA Plan and Ohio EPA requirements. All costs associated with the repair or removal and replacement of unacceptable lifts shall be the responsibility of the Contractor. Subsequent lifts shall not be placed unless and until approved by the CQA Consultant.

H. Lifts applied by the Contractor without obtaining approval from the CQA Consultant for the previous lift shall be removed at no expense to the Owner.

I. The Contractor shall be responsible for protection of the completed or partially completed soil liner from excessive moisture, freezing, desiccation, and all other damage.

J. Daily work shall extend a distance no greater than is possible to maintain moist soil conditions and continuous operations. Desiccation and crusting of the lift surface shall be avoided.

K. If desiccation and crusting of the lift surface occurs prior to placement of the next lift, this area shall be sprinkled with water and then scarified and tested for moisture content to ensure uniform moisture before placement of the next lift.

## 3.3 SOIL MOISTURE CONTENT ADJUSTMENT

A. The Contractor shall be required to dry the soil material or apply water as necessary to obtain the required moisture or other requirements of the specifications. The application of water to the soil material shall be accomplished at the borrow source area insofar as is practical.

B. Moistening

1. The Contractor shall moisturize soil material via the addition of water and mix with sufficient energy and allow enough time to evenly distribute the water throughout the soil matrix.

2. Uniform water distribution shall be obtained by disking material after water has been applied.

3. Water may be applied by sprinkling the materials after loose placement if necessary.

4. If the top surface of the preceding layer of RSL material becomes too dry to allow a suitable bond, it shall be scarified and moistened to a depth required prior to placement of the next lift.

C. Drying

1. The Contractor shall spread soil material in a designated area and disk during weather conducive to effective drying.

2. Soil material that is too wet when placed shall either be removed or dried to the specified moisture content prior to compaction.

3. The Contractor shall secure the drying operation from the effects of weather by stockpiling and/or smooth drum sealing.

4. Moisture content in dried material shall be verified after disking to ensure a uniform moisture distribution.

D. Maintenance of Finished RSL

1. The top surface of the completed RSL shall be maintained by smooth drum rolling and application of moisture as needed to prevent desiccation of the RSL.

3.4 FAILED TESTS

A. In the event that a portion of RSL material does not meet the compaction criteria, the Contractor shall re-compact the lift within the area bounded by other compaction tests meeting the criteria, and re-test at no cost to the Owner.

B. In the event of subsequent failure(s), the entire area failing shall be reworked or removed and replaced by the Contractor. The location and quantity of removed materials shall be documented by the Contractor and CQA Consultant. All work associated with removal and subsequent placement and testing shall be at no cost to the Owner.

C. Materials permitted to desiccate, placed at densities lower than the specified minimum density, at moisture contents outside the specified range, or otherwise not conforming to the requirements of these specifications shall be reworked by disking and recompaction to meet the requirements or removed and replaced by acceptable material. The replacement material and surface upon which it is placed shall conform to all requirements of this specification and be tested in accordance with relevant Project specifications.

D. Questions concerning the accuracy of any single test shall be addressed by re-testing in the same or adjacent location in the same lift. Questions concerning the accuracy of the testing equipment shall be addressed by utilizing other equipment or methods for confirmation purposes.

3.5 DRAINAGE

A. At all times during construction, the Contractor shall temporarily provide, place, and maintain ample means and devices with which to promptly remove and properly dispose of all water, snow, and ice entering the excavation. Excavations shall be kept dry until the structures, pipes, appurtenances to be built therein have been completed to an extent that they shall not be damaged.

B. All water pumped or drained from the work shall be disposed in a manner satisfactory to the Owner, without undue interference with the Owner's operations or other work, or damage to property.

3.6 SURFACE FINISH

A. The Contractor shall utilize a smooth drum roller to proof roll the final grade to ensure that a smooth, rock and debris free surface is created to provide a non-yielding, firm, moist foundation for geomembrane placement.

B. The finished surface shall be free of:

1. Rocks exceeding 2 inches in any dimension

2. Protrusions larger than 1/4 inch

3. Wheel ruts, depressions, or raveling deeper than 1 inch

4. Cracks

5. Wet spots and/or puddles

6. Voids

C. The Contractor shall be responsible for repair of any damage to the finished surface. The Contractor shall be responsible for repair of any damage to the RSL.

D. The Contractor shall maintain the finished surface until additional engineered components are placed above it. All RSL surfaces shall be subject to daily approval by the Engineer and the CQA Consultant through completion of the installation/construction of the overlying materials.

E. The Contractor shall coordinate and maintain access for the Contractor/Installer from the geosynthetic staging area to the deployment area if necessary.

F. The Contractor shall repair all ruts or other damage to the finished surface caused by the Contractor/Installer's Low Ground Pressure (LGP) equipment (contact pressure < 5 psi) or any other equipment used.

## 3.7 APPROVAL

A. The RSL shall be inspected by both the CQA Consultant and the Geomembrane Installer just prior to installation of the geomembrane. All stones, debris and surface damage greater than ½" in size, angular rocks or other sharp objects must be removed and/or repaired, including filling of voids left from removing objects. Liner installed prior to Installer's approval shall be removed at the Contractor's expense.

B. After the CQA Consultant and Geomembrane Installer approve the surface preparation, the Geomembrane Installer will provide the Contractor written approval and the Engineer may grant authorization to begin installation of the HDPE Liner system. Ohio EPA is expected to visit the project area throughout the construction project. Ohio EPA typically visits cell construction projects just prior to and during geomembrane installation. Ohio EPA may also inspect the geomembrane sub base. If Ohio EPA objects to an unsatisfactory sub base, the Contractor, with input from the Engineer, if necessary, will determine what must be done to achieve an acceptable sub base. If the objection is based on the appearance or CQA data for the RSL, the Contractor shall make the appropriate correction, including removing and reconstructing at no cost to the Owner, any portion of the RSL the Ohio EPA has determined to be unacceptable. It is very important that the RSL is constructed correctly; that the moisture and compaction requirements are met; that CQA results demonstrate compliance with the applicable specifications and requirements; the surface of completed portions of RSL are properly maintained and the RSL surface is prepared for Ohio EPA at any time during geomembrane installation.

END OF SECTION 02215

# SECTION 02218

# LANDFILL MATERIALS HANDLING

## PART 1 – GENERAL

Work covered shall consist of all activities including labor, materials, tools, equipment, incidentals, and services necessary for proper handling of encountered wastes including; excavation, backfilling and associated activities to the limits indicated in the plans and specifications or as directed by the engineer.

It is expected that waste or leachate will be encountered within the PHASES 8 AND 9 excavations near the existing Phase 1/7 and 2/7 tie-in. This section describes the excavation and backfilling of existing waste/residue materials and cover soil should it become necessary. The specifications are intended to give a general description of what is required, but may not address all variations that may occur during excavation.

### 1.1 SECTION INCLUDES

A. Protection

B. Construction quality control

C. General requirements

D. Health and safety considerations

E. Waste/residue excavation

F. Water management

G. Documentation

### 1.2 RELATED SECTIONS

A. Section 01020 – Special Project Procedures

B. Section 01030 – Contractor Safety and Health

C. Section 01050 – Field Engineering

D. Section 01320 – Submittals

E. Section 02270 – Construction Erosion and Sediment Control

### 1.3 REFERENCES

A. The Contractor shall comply with:

1. 29 CFR 1910.120 Occupational Safety and Health Administration (OSHA) Code for Site Control

2. 29 CFR 1926 OSHA Subpart P and Section 23 of EM 385-1-1

3. 58 CFR 49200 9/22/93 - Comprehensive Environmental Response, Compensation and Liability Act CE RSLA "off-site" rule

1.4 SUBMITTALS

A. The Contractor shall submit information, reports, and documentation in accordance with Section 01320.

B. The Contractor shall submit to the Engineer:

1. Landfill Excavation and Regrading Plan in conformance with Federal, State and local regulations, and the Site Safety Plan

2. The sequence and schedule of excavation activities

C. In the event waste is encountered, Contractor shall immediately notify and submit to the Engineer:

1. Weekly reports documenting the quantity and areal extent of the cut and fill area, including estimates of waste exposed and removed

2. A final report once removal is complete indicating in-place elevation data for the surface of the re-graded waste if waste was exposed

3. A list of Equipment to be used for waste removal

4. Proposed methods for minimizing exposed waste/residue materials and surface water run-on

5. Proposed methods for water/leachate management

6. Proposed mitigation measures to be implemented in the event excessive odors are encountered

1.5 PROTECTION

A. Excavations shall be protected as specified in OSHA 29 CFR 1926 Subpart P and Section 23 of EM 385-1-1.

B. All required and necessary precautions shall be taken to protect workers from exposure to excavation of waste/residue.

C. Surface water run-on shall be directed away from open excavations and permitted to leave the work area in accordance with provisions in Section 02270 – Construction Erosion and Sediment Control. The use of constructed berms along the top of the slopes is permitted.

D. The Contractor shall prevent the off-site migration of surface or ground water runoff that has contacted waste or that carries sediment. The Contractor shall devise a plan to minimize runoff of contacted waters during construction re-grading compatible with Section 02270 – Construction Erosion and Sediment Control. Such contacted water may be managed in accordance with the provisions outlined in Paragraph 3.4 of this Section.

E. Contractor shall take appropriate measures to prevent damaging to existing Monitoring Wells/Piezometers that are intended to remain and existing liner system components in Phases 1 and 2.

1.6 CONSTRUCTION QUALITY CONTROL

A. Field inspection and testing by the Construction Quality Assurance (CQA) Consultant shall be performed under provisions of this specification and Section 01410 – Testing and Laboratory Testing Services, the Project's CQA Plan and the requirements specified by Ohio EPA's Prequalification approval of grid soils.

B. Field measurements by means accepted as industry standard shall be performed by the Contractor to verify volume of waste relocated. Contractor shall allow Engineer access to the bottom of waste after excavation has been completed to allow for survey of the surface (if safe to enter the excavation) to facilitate documenting the amount of waste relocated. Contractor shall provide CQA Consultant with daily load counts of material removed and taken to the working face.

C. Visual inspections not limited to the following shall be performed and documented by CQA Consultant in Daily Field Reports noting:

1. Area location of waste/residue excavation and physical properties of waste/residue materials (moisture, consistency, and density)

2. Estimated volume of waste removed for disposal

3. Excessive odors and/or mitigation measures implemented by the Contractor

4. Leachate and/or leachate management efforts implemented by the Contractor.

PART 2 – PRODUCTS

Not used.

PART 3 – EXECUTION

3.1 GENERAL REQUIREMENTS

A. The Contractor shall take all reasonable measures to avoid or otherwise minimize the exposure of waste materials during construction.

B. The Contractor shall comply with Ohio EPA regulations and inspectors directives.

3.2 HEALTH AND SAFETY CONSIDERATIONS

A. The Contractor shall perform all handling of waste/residue and excavation water in accordance with Section 01030 – Contractor's Safety and Health Plan.

B. The Contractor shall decontaminate all equipment that was used to handle contaminated waste/residue before leaving the site in accordance with the Contractor's approved Site Safety Plan (SSP) and Section 01700 – Work Close Out.

C. The Contractor shall provide all necessary safety personnel and equipment, including protective gear, emergency equipment, monitoring equipment, and decontamination facilities required for handling waste/residue in accordance with the Contractor's approved SSP.

D. Smoking and open flames are prohibited in area of exposed waste.

## 3.3 WASTE/RESIDUE EXCAVATION

A. The Construction of PHASES 8 AND 9 shall be performed as specified on the Construction Drawings. If waste/residue is excavated the Contractor shall immediately notify the Engineer.

B. Waste encountered within the PHASES 8 AND 9 construction limits shall be removed and transported to the working face of the landfill for disposal.

C. The Contractor shall not expose waste/residue deposits in excess of the quantity that can be excavated and placed in one working day. The Contractor shall operate only one excavation in any area of the site by excavating to final waste/residue zone grades in one working day unless a larger area can be exposed without causing problems or complaints from off-site. The Contractor shall excavate waste/residue by means of approved procedures and equipment. Normal earthwork excavation shall be used wherever possible. The excavated material shall be placed within the site's active landfill cell, as directed by the Owner's representative.

D. The Contractor shall perform excavation to a stable slope. No cliffing of waste is allowed.

E. The Contractor shall avoid excessive disturbance of the excavated waste/residue, to control the release of odors and landfill gas. In the event of excessive and wide spread odors, the Contractor shall provide measures to mitigate the odors such as interim soil cover, foam, or a tarpaulin as directed and approved by the CQA Consultant.

F. At the completion of the Work, all soil used as interim cover that contains waste shall be placed within the limits of the active disposal cell area as directed by the Engineer. All soil excavated with the waste/residue, shall be placed within the active cell limits or be used as cover material.

G. The Contractor shall employ construction techniques and equipment which prevents any adverse environmental impact and which comply with Section 01030 – Contractor's Safety and Health Plan. In the event the Engineer determines that the Contractor is employing inappropriate procedures or equipment, the Engineer shall issue a written order establishing the limits of acceptable procedures and noting acceptable equipment. The Contractor shall revise procedures or use approved equipment at no additional cost to the Owner.

## 3.4 WATER MANAGEMENT

A. The Contractor shall manage contaminated water (leachate) within the excavation of waste/residue and maintain productivity. Surface water run-off that comes into contact with open excavation waste materials or mixes with contaminated water shall be removed and placed into the on-site leachate line.

B. Perched liquid may be encountered within waste and typically is caused by water/leachate being trapped at shallow depths on top of clayey interim cover layers within the waste/residue. Perched liquid, if encountered, shall be removed and pumped into the site's leachate collection system or drained back into the waste mass if this can be done safely.

C. Any water that accumulates in the excavation and comes into contact with landfill material shall be classified as leachate. The Contractor shall notify the Engineer of the presence of water in the excavation. Where required or determined necessary, water shall at a minimum be pumped to a portable containment system, on-site leachate collection system or other approved method. Discharge of leachate to open ditches or storm water conveyances shall be prohibited.

3.5 DOCUMENTATION

A. If waste materials are encountered during excavation, the Contractor shall provide the Engineer with documentation verifying that location, depth, extent, excavation amount, handling, storage, transportation and disposal of these materials were performed in accordance with all applicable local, state and federal regulations.

END OF SECTION 02218

# SECTION 02219

# SOIL STOCKPILING

## PART 1 – GENERAL

The Contractor shall comply with this specification for stockpiling overburden material. Soils for the construction of the soil liner have been pre-approved by Ohio EPA. It is anticipated that the Contractor shall excavate these soils from the grids specified by the CQA Consultant each day, and off load the soil into the work area. However, if the Contractor desires to stockpile soils prior to placement or needs to perform soil preparation prior to final placement, then stockpiling of those materials shall also comply with this specification.

Work covered shall consist of all activities including labor, materials, tools, equipment, incidentals, and services necessary for soil stockpiling, movement and associated appurtenances to the limits indicated in the plans and specifications or as directed by the engineer. This section describes material delivery and construction of soil stockpiles on-site or adjacent to the existing landfill. The specification is intended to provide a general description of the requirements for soil stockpiling but may not address the details required for the proper handling, placement, and maintenance of all the various soil types or situations that may be encountered. For situations outside the scope of this Section, the Contractor shall discuss with the CQA Consultant the Contractor's proposal.

### 1.1 SECTION INCLUDES

A. Stockpile construction

B. Stockpile maintenance

### 1.2 RELATED SECTIONS

A. Section 01020 – Special Project Procedures

B. Section 01050 – Field Engineering

C. Section 01410 – Testing and Testing Laboratory Services

D. Section 01320 – Submittals

E. Section 02270 – Construction Erosion and Sediment Control

F. Section 02920 – Vegetative Cover for Post-Construction

### 1.3 REFERENCES

Not applicable

### 1.4 SUBMITTALS

A. The Contractor shall submit information, reports, and documentation in accordance with Section 01320.

B. If the Contractor wishes to stockpile soil materials for more than 7 days, outside the areas designated in the Construction Drawings, the Contractor shall submit the following to the Engineer:

1. A haul route plan

2. A plan drawing showing the proposed locations of the stockpile area indicating:

   a. The approximate extent and depth of the stockpile

   b. The entrances, exits, and haul road layout

   c. Locations and details of Erosion and Sediment Control Measures including that associated with the approved Storm Water Pollution Prevention Plan

3. Any other relevant materials

PART 2 – PRODUCTS

Not used

PART 3 – EXECUTION

3.1 STOCKPILE CONSTRUCTION

A. The Contractor shall deliver materials to the site in accordance with Section 01020 – Special Project Procedures.

B. The Contractor shall construct stockpiles in accordance with the Engineer approved stockpiling plans and specifications. Prequalified soils shall not be mixed unless specifically approved by the CQA Consultant or Engineer.

C. The Contractor shall provide, install, and maintain soil and erosion control measures in accordance with Section 02270 – Construction Erosion and Sediment Control, during the stockpiling activities and following the completion of each stockpile.

D. The Contractor shall provide and install access roads and truck/pan turnaround areas for access to the stockpile locations.

E. The Contractor shall place materials for stockpiling in loose lifts not exceeding 18 to 24 inches.

F. The Contractor shall exercise care to ensure that contaminated materials or other deleterious materials are not incorporated into stockpiles.

G. The Contractor shall segregate topsoil from other soil stockpiles.

H. Materials incorporated into the stockpile, in violation of the Specification requirements, shall be removed by the Contractor at his expense.

I. The stockpile slopes shall be no greater than 2H:1V for soil.

## 3.2 STOCKPILE MAINTENANCE

A. The Contractor shall grade stockpiles daily when stockpiling activities are in progress to prevent ponding or build-up of surface water on or near the stockpile.

B. The Contractor shall track-walk at a minimum, each lift on the stockpile to prevent water and ice or snow infiltration/ accumulation.

C. The Contractor shall regrade and roll surfaces of the stockpile as necessary at the conclusion of each day's activity to seal the stockpile.

D. The Contractor shall protect stockpiles so that stockpiled material remains in a condition suitable for use in the project.

E. The Contractor shall move surplus materials to on-site stockpiles before placement of liner system components.

F. The Contractor shall ensure all stockpiles used for the Work are graded to shed water and allow for adequate access for site personnel prior to leaving the site.

END OF SECTION 02219

# SECTION 02225

# TRENCHING AND BACKFILLING

## PART 1 – GENERAL

Work covered shall consist of all activities including labor, materials, tools, equipment, incidentals, and services necessary for trenching, backfilling, grading and associated appurtenances to the limits indicated in the plans and specifications or as directed by the engineer.

### 1.1 SECTION INCLUDES

A. Construction quality control

B. Existing structures and utilities

C. Fill materials

D. Health and safety considerations

E. Preparation

F. Trench excavation

G. Foundation materials for pipe

H. Granular bedding and backfill for pipe

I. Trench backfill

### 1.2 RELATED SECTIONS

A. Section 01030 - Contractor Safety and Health Plan

B. Section 01320 - Submittals

C. Section 01410 - Testing and Testing Laboratory Services

D. Section 02218 – Landfill Materials Handling

E. Section 02231 - Crushed Aggregate and Fills

F. Section 02715 - HDPE Collection and Transport Pipe

G. Section 02720 - Corrugated Polyethylene Pipe

### 1.3 REFERENCES

A. ASTM C 33 - Specification for Concrete Aggregate

B. ASTM C 136 - Sieve Analysis of Fine and Coarse Aggregate

C. ASTM D 698 - Laboratory Compaction Characteristics of Soil Using Standard Effort

D. ASTM D 2487 - Classification of Soils for Engineering Purposes

E. ASTM D 2922 - Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)

F. ASTM D 3017 - Moisture Content of Soil and Rock In Place by Nuclear Methods (Shallow Depth)

G. ASTM D 1557 - Laboratory Compaction Characteristics of Soil Using Modified Effort

H. State of Ohio, Department of Transportation, Construction and Material Specifications, (most current version).

1.4 SUBMITTALS

A. The Contractor shall submit all information, reports, and documentation in accordance with Section 01320.

B. The Contractor shall submit conformance test results for gradation and compaction of bedding and backfill material(s) in accordance with Section 02231 – Crushed Aggregate and Fills.

C. The Contractor shall submit procedures and shop drawings, if necessary, for support of existing utilities and provision of temporary utility services.

1.5 CONSTRUCTION QUALITY CONTROL

A. Field inspection by CQA Consultant shall be performed under provisions of this Specification and Section 01410 - Testing and Laboratory Testing Services.

B. The CQA Consultant shall survey the final in-place locations, dimensions, and elevations of all trenches, including; those for pipes, utilities, appurtenant structures, and existing utilities encountered in trench excavations. Field survey data shall be collected in accordance with Section 01050 - Field Engineering, at a minimum of every 100-ft along the trench alignment and at changes of grade. Invert elevations at inlets, outlets, and structures shall also be recorded.

C. Visual inspections shall be performed and documented by the Quality Assurance Consultant in Daily Field Reports.

D. The Contractor shall observe and document the activities described in this Section and items detailed in the approved Contractor Quality Control Plan (CQC).

1.6 EXISTING STRUCTURES AND UTILITIES

A. Known locations of existing surface and underground utilities on or adjacent to the work are depicted on the Construction drawings. This information has been obtained from existing records and is not guaranteed to be correct or complete as depicted.

B. The Contractor shall be fully and solely responsible for verifying and locating all underground utilities.

C. The Contractor shall be responsible for repair of any and all utilities disturbed, destroyed, damaged and/or interrupted in the event utilities or services are impacted by construction equipment.

D. All repair and/or restoration of utility services shall be at no cost to the Owner.

E. The Contractor shall hand-locate existing underground utilities in the work areas. The Contractor shall use Ohio Utilities Protection Service (OUPS). Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, contact the Engineer immediately for instructions as to procedures to be taken.

F. The Contractor shall adequately support and protect all existing or temporary utilities to remain in place during trenching and backfilling operations. The Contractor shall immediately restore utilities, broken or otherwise damaged, to the satisfaction of the utility Owner, at no expense to the Owner. Cooperate with the Owner and utility companies in keeping respective services and facilities in operation.

## PART 2 - PRODUCTS

### 2.1 FILL MATERIALS

A. Granular Bedding and Backfill: ODOT No. 9 in accordance with Section 02231 - Crushed Aggregate and Fills

B. Granular Cushion & Backfill: ODOT No. 57 in accordance with Section 02231 - Crushed Aggregate and Fills

C. Compacted Soil Trench Backfill: Material conforming to Section 02214 – Structural Fill

## PART 3 - EXECUTION

### 3.1 HEALTH AND SAFETY CONSIDERATIONS

A. Contractor shall perform all trench-related excavation, installation, and backfilling in accordance with the Contractor's Safety and Health Plan.

B. The conditions in the trench may be hazardous due to landfill gas generated by the refuse and the unpredictable nature of the materials on the excavation slopes. The hazardous conditions may exist in areas of the trench excavated in refuse and in areas of the trench in native soils. Contractor shall include provisions in the Contractor's Safety and Health Plan that pertains to safety of persons working in or in proximity to on-site trench excavations.

C. No entrance to the trench shall be made without proper care for health and safety. This shall include at a minimum: continuous monitoring and positive ventilation of the trench, contingencies for worker removal, and adequate shoring or bracing of the excavation as required in accordance with OSHA regulations.

D. The Contractor shall be responsible for all workers' safety and the safety of all persons who may come into proximity trenches.

E. The Contractor shall restrict and prevent any unauthorized entrance to the excavation at all times while the trench is open.

F. During pipe and manhole installation and until grates, trash racks, manhole covers or other entrance restriction are fully installed, the Contractor shall also restrict and prevent any unauthorized entry into the drainage pipes or appurtenances including inlets and manholes.

G. The "Competent Person" shall inspect all trenches prior to entrance by workers in accordance with all applicable and relevant OSHA safety considerations, regulations and standards.

3.2 PREPARATION

A. Prior to beginning trenching operations, the Contractor shall:

1. Identify the required lines, levels, contours and datum

2. Implement measures to protect existing structures and utilities which are designated to remain in accordance with Paragraph 1.6 of this section.

3. Implement measures to protect benchmarks and other existing features designated to remain from excavation equipment and vehicular traffic

B. The CQA Consultant shall perform all needed as-built location surveying and the Contractor shall coordinate and provide access in order to accomplish this.

3.3 TRENCH EXCAVATION

A. Trenches shall generally be excavated through native soil but may at times go through waste/residue. The approximate limits of waste/residue are depicted on the drawings. The Contractor shall handle all waste/residue and associated water in accordance with Section 02218 – Landfill Materials Handling and Section 01030 - Contractor's Safety and Health Plan. All areas where waste or residue is found shall be immediately reported to the Engineer.

B. The Contractor shall comply with the following for shallow trench excavation:

1. Excavate to required depth and grade

2. Cut trenches sufficiently wide to enable installation of the utilities. The nominal trench width below the pipe crown shall be 18 inches, or as indicated on the drawings.

3. Do not undercut trench walls.

4. Cut trench walls above the top of the pipe as dictated by soil type and safety requirements. Provide shoring and bracing as required to maintain safe Working conditions in compliance with OSHA requirements.

5. Place Geotextile, as indicated on the drawings

3.4 FOUNDATION MATERIALS FOR PIPE

A. In native soils, excessively soft subgrade materials (unconfined compressive strength less than 1.0 ton/sq. ft.) shall be removed from the trench bottom as directed by the Engineer, to a maximum depth of

3 ft. below the pipe invert. Replace the material with granular ODOT No. 1 materials or as directed by the Engineer.

## 3.5 GRANULAR BEDDING AND BACKFILL FOR PIPE

A. The Contractor shall place granular bedding and support materials in excavated portions of the trench alignment as indicated on the Construction Drawings and as follows:

1. Bedding material shall be placed at a minimum of 6 inches around the pipe, up to the spring line in such a manner as to provide adequate side support and to prevent lateral movement of the pipe.

2. The bedding material shall be consolidated into place by hand or by mechanical movement. The Contractor shall use care not to damage or "float" the pipe during bedding material placement.

B. The Contractor shall place granular backfill and support materials in excavated portions of the trench alignment as indicated on the Construction Drawings and as follows:

1. Place granular backfill a minimum of 6 inches around and 6 inches above the crown of the pipe unless otherwise depicted on the Construction Drawings.

2. Place backfill in maximum 12-inch loose lifts and lightly compact using a vibratory plate or a vibratory backhoe compactor attachment. The Contractor shall use care not to "float" the pipe during granular backfill placement.

## 3.6 TRENCH BACKFILL

A. Trench Backfill shall consist of the materials specified in this paragraph unless otherwise depicted on the Construction Drawings and shall be to the lines and grades depicted on the drawings unless otherwise specified.

B. General Trench Backfill (when pipe crown is within 3 ft. of base grade):

1. The Contractor shall place and compact granular backfill in accordance with Paragraph 3.5 of this section.

2. Place woven geomembrane filter fabric above granular backfill.

3. Place compacted soil backfill material in maximum twelve (12)-inch loose lifts.

4. Place and compact material as required to a minimum of 90 percent of maximum dry density as determined by and in accordance with ASTM D 1557 (Modified Proctor).

5. Maintain moisture content of trench backfill between -4 to +4% of the optimum moisture content and as necessary to attain required compaction density.

6. Do not backfill over soft or frozen ground. The Contractor shall provide material to stabilize subgrade as required prior to installation.

END OF SECTION 02225

# SECTION 02231

# CRUSHED AGGREGATE AND FILLS

## PART 1 – GENERAL

Work covered shall consist of all activities including labor, materials, tools, equipment, incidentals, and services necessary for backfill, grading and associated appurtenances to the limits indicated in the plans and specifications or as directed by the engineer.

### 1.1 SECTION INCLUDES

A. Source certification

B. Construction quality control

C. Materials

D. Subgrade preparation

E. Geotextile placement

F. Aggregate placement

G. Aggregate compaction

### 1.2 RELATED WORK

A. Section 01320 – Submittals

B. Section 01410 – Testing and Testing Laboratory Services

C. Section 02225 – Trenching & Backfilling

D. Section 02245 – Geotextile Filter Fabric

### 1.3 REFERENCES

A. ASTM C 136 - Sieve Analysis of Fine and Coarse Aggregates

B. ASTM D 75 - Practice for Sampling Aggregates

C. ASTM D 3042 - Carbonate Aggregates - Insoluble Residue Test

D. ASTM D 4644 - Slake Durability of Shale and Similar Weak Rocks

E. State of Ohio, Department of Transportation, Construction and Material Specifications, (most current version)

1.4 SUBMITTALS

A. The Contractor shall submit information, reports, and documentation in accordance with Section 01320.

B. The Contractor shall submit all required conformance testing for all crushed aggregate materials including gradation where applicable and certify that the aggregate meets the requirements specified.

C. The Contractor shall submit manufacturer's conformance testing data for geotextile materials used.

1.5 SOURCE CERTIFICATION

A. The Contractor or material Supplier shall arrange for sampling and testing of potential aggregate sources. Material sampling and testing shall be performed by a qualified testing laboratory in accordance with an approved Field Sampling Plan. The following index tests shall be performed on a sample of each crushed aggregate material:

| Property | Standard | Minimum Frequency |
|---|---|---|
| Sieve Analysis | ASTM C 136 | 1 per source |
| Insoluble Residue | ASTM D 3042 | 1 per source |
| Slake Durability | ASTM D 4644 | 1 per source |

1.6 CONSTRUCTION QUALITY CONTROL

A. Field inspection and testing shall be performed by the Contractor under provisions of this Specification and Section 01410 – Testing and Laboratory Services.

B. Field measurements by means accepted as industry standard shall be performed by the Owner's CQA Representative to verify proper total cover layer thicknesses.

C. Visual inspections of aggregate placement shall be performed by the Owner's CQA Representative and documented in Daily Field Reports.

D. The Owner's CQA Representative shall perform in-situ testing per Section 02225 – Trenching & Backfilling.

E. The Owner's CQA Representative shall obtain conformance samples of each crushed aggregate materials in accordance with ASTM D 75 and perform the following testing:

| Property | Standard | Minimum Frequency |
|---|---|---|
| Sieve Analysis | ASTM C 136 | 1 per 10,000 $yd^3$/source |

F. Crushed Aggregate shall be placed by the Contractor to within ±0.1 ft. of the total thickness depicted in the Construction Drawings.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Aggregate Quality/Durability:

1. Crushed Aggregate shall be clean, crushed stone or crushed gravel free of an excess of thin or elongated pieces, soil material, frozen material, vegetation, or deleterious substances, and meeting general requirements of ODOT 703.01.

2. Crushed Aggregate shall be classified as Type I in accordance with ASTM D 4644.

3. Crushed Aggregate utilized in the leachate collection system shall have a carbonate content less than five percent (<5%) by weight, as established by ASTM D 3042, at a pH of 4.0. The Contractor may propose alternate materials that have comparable standards and test results for the Engineer's approval.

B. Aggregate gradation requirements shall conform to AASHTO M 43 or ODOT size designations called out in the drawings and shall be used in accordance with the following applications:

| | Size | Application |
|---|---|---|
| 1 | No. 1 | Gabion Mattress and Coarse Foundation material |
| 2 | No. 57 | Drain Trenches, Granular Cushion material, and Granular Backfill |
| 3 | No. 9 | Pipe Bedding |
| 4 | No. 2 | Perimeter Road Sub-base |
| 5 | No. 304 | Perimeter Road Top Dressing |

C. Where necessary, geotextile shall be provided in accordance with Section 02245 – Geotextile Filter Fabric.

## PART 3 – EXECUTION

### 3.1 SUBGRADE PREPARATION

A. The Contractor shall check subgrade for conformity with grade and cross section and regrade as necessary to meet required tolerances.

### 3.2 GEOTEXTILE PLACEMENT

A. The Contractor shall place geotextile in accordance with Section 02245.

### 3.3 AGGREGATE PLACEMENT

A. The Contractor shall place the material on the foundation or previously placed layer in a manner to minimize segregation and damage to the geotextile (in accordance with Section 02245), and to facilitate spreading in a uniform layer.

B. The Contractor shall place materials as specified or as directed by the Engineer.

### 3.4 AGGREGATE COMPACTION

A. The Contractor shall compact aggregate as specified or as directed by the Engineer to achieve density requirements.

END OF SECTION 02231

# SECTION 02232

# LEACHATE COLLECTION SYSTEM
# GRANULAR DRAINAGE LAYER

## PART 1 – GENERAL

Work covered shall consist of all activities including labor, materials, tools, equipment, incidentals, and services necessary for the installation of the granular drainage layer for the leachate collection system including; movement, backfilling, grading and associated items to the limits indicated in the plans and specifications or as directed by the engineer.

### 1.1 WORK INCLUDED

A. General Characteristics

B. Placement of granular drainage material

C. Equipment

D. Placement of drainage layer

E. Survey control tolerances

### 1.2 RELATED SECTIONS

A. Section 02715 – HDPE Collection and Transport Pipe

B. Section 02245 – Geotextile Filter Fabric

C. Section 02231– Crushed Aggregate and Fills

D. Section 01050 – Field Engineering

E. Section 01320 – Submittals

F. Section 01410 – Testing and Testing Laboratory Services

### 1.3 REFERENCES

A. ASTM D 422 – Particle Size Analysis of Soils

B. ASTM D 2434 – Test Method for Permeability of Granular Soils (constant head)

C. ASTM D 3042 – Insoluble Residue in Carbonate Aggregates

### 1.4 SUBMITTALS

A. The Contractor shall submit all information, reports, and documentation in accordance with Section 01320.

B. The Contractor shall submit to the Engineer samples of sand and gravel prior to use for testing by the CQA Consultant in accordance with the CQA Plan.

PART 2 – PRODUCTS

2.1 General Characteristics

A. The drainage material shall be non-carbonate material, either manufactured or natural, that is free of debris or organics.

B. The drainage material shall contain no more than five (5) percent by weight of carbonate, as measured by ASTM D 3042-97 at a pH of 4.0.

C. The drainage materials shall have no more than five (5) percent by weight of particles passing through the #200-mesh sieve (as measured by ASTM D 422-63).

D. NOTE: The gradation and angularity of the selected drainage material will have an effect on the material required for the cushion layer.

2.2 Permeability

A. The drainage material shall have a minimum permeability of 1.0 cm/sec.

PART 3 – EXECUTION

3.1 PLACEMENT OF GRANULAR DRAINAGE MATERIAL

A. The Contractor shall place leachate collection gravel over leachate collection lateral pipes as depicted on the project Construction Drawings. The drainage layer materials shall be placed around the pipe so that the geotextile fabric wrap on the pipe and the pipe are not damaged. Damaged geotextile wrap and pipe shall be removed and replaced at no cost to the Owner.

B. Granular drainage material as part of the leachate collection system shall be placed by the Contractor on the geotextile bedding (bedding/cushion layer) as depicted on drawings. No granular material shall be placed directly on the HDPE liner.

C. The Contractor shall place granular drainage material on side slopes as depicted on the drawings. The drainage layer must be a minimum of 12-inches thick.

D. Any potentially damaging gravel shall be removed by the Contractor from the granular drainage layer material prior to placement.

E. The Contractor shall protect all leachate collection pipes from mechanical damage.

F. The drainage material shall be placed as promptly as possible, but not until all underlying layers have been properly constructed, tested, and documented as complete.

G. To maintain the drainage layer and protect it from clogging with fines that migrate downward from the refuse and daily cover, a geotextile layer shall be placed above the drainage layer.

H. The geotextile shall be installed per manufacturer's recommendations.

3.2 EQUIPMENT

A. The Contractor shall operate hauling and placement equipment on a minimum of 5-feet of granular drainage material (temporary roads). The granular roads shall be spaced so that spreading of the drainage material shall result in a one-foot thick layer.

B. No equipment shall be used over the HDPE geomembrane liner or the pipe(s) that shall cause any damage to the pipes or liner. No dozers or similar equipment, including wheeled vehicles or track units shall be used directly on the HDPE geomembrane liner, cushion geotextile or pipes.

C. The Contractor shall spread the granular materials using a low ground pressure bulldozer which applies a contact pressure of less than 5 psi.

D. The Contractor shall exercise special care such that the equipment used shall not damage the HDPE geomembrane by handling, trafficking, and leakage of hydrocarbons (such as gasoline or oil) or other means. Defects in material installation arising from the use of equipment shall be repaired at no cost to the Owner.

E. The trucks used to transport the granular drainage material over the geotextile shall be equipped with high flotation tires.

F. The operators of all equipment used in transporting or spreading the granular drainage material shall be advised to start, stop, and turn, gradually. Trucks shall not be permitted to operate on slopes of ten percent or greater.

G. The Contractor shall place material such that the granular material is pushed perpendicular to the geotextile seams, from the upper sheet to the lower sheet. Care shall be taken to keep the granular material from separating the geotextile seams.

H. Rubber tired vehicles shall not be permitted on the drainage layer material after placement, nor shall "pivot" turns be permitted.

I. The granular drainage layer shall not be compacted by the Contractor.

J. Alternate placement methods may be required by the CQA Consultant, depending on the properties and characteristics of the granular drainage layer.

K. The Contractor shall verify that the top of the granular drainage layer conforms to the minimum thickness and slopes of the Contract Documents prior to notifying the CQA Consultant that the area is ready for certification surveying.

3.3 PLACEMENT OF DRAINAGE LAYER

A. The Contractor shall notify CQA Consultant and the Engineer at least the day before the initiation of leachate collection system installation activities.

B. Personnel working on placement of leachate collection system shall not smoke, wear damaging shoes, or engage in other activities that could damage the underlying HDPE geomembrane.

C. The Contractor shall protect the drainage material from the intrusion of fines (i.e. material <#200 sieve) during construction through appropriate sedimentation control measures. Any drainage material placed which exhibits evidence of excessive fines shall be removed and replaced with appropriate material.

D. The CQA Consultant shall document that the Contractor uses appropriate methods to ensure that no damage to the underlying geosynthetic material occurs, no excessive wrinkles in the underlying geosynthetic form, and that no unacceptable materials are placed.

E. Immediately prior to placing the granular drainage layer, the bedding geotextile shall be inspected for cuts, tears, or areas of other damage. All cuts tears, or damaged areas shall be repaired at no cost to the Owner.

F. The CQA Consultant shall inspect the geotextile and geomembrane prior to installing any materials over the geosynthetic, and shall document the condition of the surfaces. Folds or wrinkles must be "stretched out" prior to installation of any overlying materials. Where possible, folds or wrinkles shall be removed by realignment of the materials, otherwise they shall be cut out patched and repaired.

G. No material shall be placed when free water is standing on the surface of the area where the material is to be placed. The area shall be kept dry during granular material placement. Material placed around structures and piping shall be brought up evenly on all sides.

H. The granular material shall be placed in a single lift and spread to the required thickness using a wide-track, low ground pressure dozer or other suitable earthmoving equipment.

I. Alternate placement methods may be required by the CQA Consultant, depending on the properties and characteristics of the granular drainage layer.

## 3.4 SURVEY CONTROL TOLERANCES

A. The Contractor shall be responsible for all surveying (other than as-built surveys) associated with the work. The CQA Engineer or Owner's Surveyor may perform independent surveying. However, independent surveying does not relieve the Contractor of his responsibility to layout, control and document the work.

B. The Contractor shall complete the leachate collection system construction within the following tolerances:

1. Elevations:

   a. Leachate collection pipe, ±0.05 feet

   b. Leachate side slope riser pipes, ±0.05 feet

2. Locations:

   a. Leachate collection pipe, ±0.05 feet

   b. Leachate sump, field alignment to horizontal casing, ±0.05 feet

END OF SECTION 02232

# SECTION 02240

# ANCHOR TRENCH

## PART 1 - GENERAL

Work covered shall consist of all activities including labor, materials, tools, equipment, incidentals, and services necessary for the proper anchoring of synthetic liner materials including; backfill, grading, and compaction and associated items to the limits indicated in the plans and specifications or as directed by the engineer.

### 1.1 WORK INCLUDED

A. Delivery, storage, and handling of materials

B. Fill

C. General requirements

D. Drainage

E. Material processing

F. Material placement

G. Backfilling

H. Material compaction

I. Fill protection

J. Quality assurance

### 1.2 RELATED SECTIONS

A. Section 02215 – Recompacted Clay Liner

B. Section 02242 – HDPE Geomembrane

C. Section 02245 – Geotextile Filter Fabric

D. Section 01050 – Field Engineering

E. Section 01320 – Submittals

F. Section 01410 – Testing and Testing Laboratory Services

### 1.3 REFERENCES

A. ASTM D 422 – Particle Size Analysis of Soils

B. ASTM D 2434 – Test Method for Permeability of Granular Soils (constant head)

C. ASTM D 3042 – Insoluble Residue in Carbonate Aggregates

1.4 SUBMITTALS

A. The Contractor shall submit information, reports, and documentation in accordance with Section 01320.

1.5 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

A. Material shall be excavated, handled and transported at the site to minimize the production of dust.

PART 2 – PRODUCTS

2.1 FILL

A. The material to be used for the fill is to be obtained from the excavation of the anchor trench or excavated from the stockpile and placed according to the drawings, and compacted in accordance Section 02231– Structural Fill.

PART 3 – EXECUTION

3.1 General Requirements

A. The anchor trench shall be excavated by the Contractor to the lines, width, and depth as depicted on the drawings prior to deployment of the HDPE geomembrane.

B. If the anchor trench is excavated in earthen material that is subject to desiccation, no more than the amount of trench required for the installation of the HDPE geomembrane in one day shall be excavated by the Contractor to minimize desiccation potential.

C. No large rocks or clay clods shall be permitted to underlie the HDPE geomembrane.

D. Loose soil and/or clay clods shall be removed from the anchor trench by the Contractor after excavation and prior to installation of geosynthetic material.

3.2 DRAINAGE

A. Water shall not be allowed to stand, or soften the soil, in the anchor trench. Backfilling of anchor trenches will be conducted by the Contractor.

B. At all times during construction, the Contractor shall temporarily provide, place, and maintain ample means and devices with which to promptly remove and properly dispose of all water, snow, and ice entering the trench. The trench excavation shall be kept dry so that geosynthetics shall not be damaged.

C. All water pumped or drained from the work shall be disposed in a manner satisfactory to the Owner's Representative, without undue interference with other work or damage to pavements, other surfaces or property.

3.3 MATERIAL PROCESSING

A. The Contractor shall process the backfill material (if needed) incorporating the following minimum steps.

1. Moistening - The backfill should be moisturized via the addition of water and mixed with sufficient energy to distribute the water throughout the soil matrix evenly. The final moisture content of the backfill shall be within the range permitted for placement and compaction of liner material.

2. Drying - the backfill shall be spread in a designated area away from the work. The backfill shall be spread and disked or mixed so as to open and expose as much soil surface area as possible. The drying operations should be conducted in weather conducive to effective drying. Contractor shall secure the drying operation from the effects of weather by stockpiling and or smooth drum sealing.

3.4 MATERIAL PLACEMENT

A. The material shall be placed in continuous lifts approximately twelve (12) inches (maximum) in thickness (loose measure).

B. The final surface of the placed and compacted fill should be smooth.

3.5 BACKFILLING

A. The anchor trench shall be backfilled by the Contractor to the lines and grades depicted on the drawings.

B. Backfilling of the anchor trench can affect geosynthetic material bridging at the toe of the slope, consideration shall be given to backfill the anchor trench at its most contracted state; preferably in the cool of the morning or extended periods of overcast skies.

C. Care shall be taken by the Contractor when backfilling the trench to prevent any damage to the HDPE geomembrane system.

3.6 MATERIAL COMPACTION

A. Compaction shall be accomplished in accordance with Section 02214 – Structural Fill.

3.7 FILL PROTECTION

A. The Contractor shall protect the backfilled trench from the effects of weather.

B. The Contractor shall maintain the surface and repair any damage until the Owner's or Owner's representative acceptance of the work.

C. The Contractor shall allow the Owner or Owner's representative to inspect the compacted fill layers before subsequent lifts are constructed.

3.8 QUALITY ASSURANCE

A. Field inspection and testing shall be performed under provisions of this Specification and Section 01410. An independent third party shall be engaged by the Owner to provide quality assurance testing and documentation according to the Construction Quality Assurance Plan (CQAP).

END OF SECTION 02240

# SECTION 02242

# HDPE GEOMEMBRANE

## PART 1 – GENERAL

Work covered shall consist of all activities including labor, materials, tools, equipment, incidentals, and services necessary for the procurement and installation of all required materials for the proper installation of the 60 mil HDPE geomembrane liner and associated appurtenances to the limits indicated on the plans and specifications or as directed by the engineer.

This section contains details concerning the manufacture, fabrication, and installation of high density polyethylene (HDPE) liner membrane for a component of the landfill liner system. The requirements of the Contract Documents, including the General Conditions, Division I - General Requirements and ODOT Specifications apply to this section, except as modified herein

### 1.1 WORK INCLUDED

A. Description

B. Quality assurance

C. Product delivery, storage, and handling

D. Warranty

E. HDPE geomembrane

F. Fabricated seams and field seams

G. Sandbags

H. Earthwork

I. Liner membrane placement

J. Geomembrane field seaming

K. Materials in contact with geomembrane

### 1.2 RELATED SECTIONS

A. Section 01320 – Submittal

B. Section 01410 – Testing and Testing Laboratory Services

C. Section 02215 – Recompacted Soil Liner

D. Section 02245 – Geotextile Filter Fabric

E. Section 02676 – Cell Leachate Collection System

1.3 REFERENCES

A. ASTM D 638 - Test Method for Tensile Properties of Plastics

B. ASTM D 792 - Specific Gravity (Relative Density) and Density of Plastics by Displacement

C. ASTM D 1004 - Initial Tear Resistance of Plastic Film and Sheeting

D. ASTM D 1238 - Flow Rates of Thermoplastics by Extrusion Plastometer

E. ASTM D 1505 - Density of Plastics by the Density-Gradient Technique

F. ASTM D 1603 - Carbon Black in Olefin Plastics

G. ASTM D 4437 - Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembrane

H. ASTM D 4833 - Index Puncture Resistance of Geotextiles, Geomembrane, and Related Products

I. ASTM D 5199 - Measuring Nominal Thickness of Geotextiles and Geomembrane

J. ASTM D 5397 (Appendix A) - Environmental Stress Crack Resistance of Polyolefin Geomembrane Using Single-Point Notched Constant Tensile Load Test

K. ASTM D 5994 - Measuring the Core Thickness of Textured Geomembrane

L. GRI GM6 - Standard Practice for Pressurized Air Channel Test for Dual Seamed Geomembrane

M. GRI GM12 - Asperity Measurement of Textured Geomembrane using a Depth Gage

N. GRI GM13 – Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Textured Geomembranes

1.4 SUBMITTALS

A. The Contractor shall submit information, reports, and documentation in accordance with Section 01320.

B. The Contractor shall submit to the Owner laboratory qualification and experience.

C. The Contractor shall submit the following information concerning raw materials:

1. Copies of quality control certificates issued by resin supplier

2. Production date(s) of HDPE, or other resin

3. Reports on tests conducted to verify quality of HDPE resin used to manufacture liner membrane rolls assigned to the Site. The Report shall indicate compliance with the requirements in Part 2.

4. A statement that no reclaimed polymer is added to the resin during manufacture of the actual liner membrane to be used in this project.

D. The Contractor shall submit the following information concerning liner membrane roll production:

1. Copies of the manufacturer's quality control certificates indicating compliance with requirements in Part 2.

2. Copies of the manufacturer's product literature or cut sheet for each material used at the Site.

E. The Contractor shall submit the following information concerning fabrication:

1. Copies of the quality control certificates indicating compliance with requirements of Part 2.

2. Copies of the manufacturer's product literature or cut sheet for each material used at the Site.

F. The Contractor shall submit copies of the installation layout (shop drawing) identifying placement patterns and seams both fabricated and field seams, as well as any variance and additional details which deviate from engineering drawings. Layout shall be adequate for use as construction plan and shall include information such as dimensions and details.

G. The Contractor shall submit the installation schedule as part of Construction Progress Schedule.

H. The Contractor shall submit a list of personnel performing field seaming operations and supervising the liner membrane installation, along with pertinent experience information.

I. The Contractor shall submit copies of the subgrade acceptance form for each day the subgrade is exposed during liner installation.

J. The Contractor shall submit a description of the seaming apparatus and methods to be used for installation and seam testing.

K. Prior to installation, the Contractor shall submit to the Owner for review and approval the Contractor's/Installer's internal QA/QC plan for liner membrane installation.

L. During liner installation the Contractor shall remit the following:

1. Quality control documentation including but not limited to daily field reports, seam testing and repair data, and destructive testing results

M. After liner installation is complete, the Contractor shall remit the following:

1. Liner membrane installation certification. See requirements of this Section.

2. Copy of warranty obtained from manufacturer/fabricator/Contractor/Installer.

1.5 DESCRIPTION

A. Scope of Work

1. Work includes the manufacture, fabrication, supply, and installation of high density polyethylene (HDPE) liner membrane material for lining of the landfill BAT PHASES 8 AND 9.

2. Work shall include liner in BAT PHASES 8 AND 9 Sub-base grade bottom, sidewalls, and additional areas.

3. Work shall include but not be limited to quality control testing (test seams, nondestructive seam continuity testing, and destructive seam strength testing/reporting), and final preparation of record drawing and showing a constructed panel layout and repair locations.

## 1.6 QUALITY ASSURANCE

A. Quality Assurance Program:

1. The Manufacturer/fabricator/Contractor/Installer shall agree to participate in and conform to all items and requirements of a quality assurance program as outlined in this specification.

2. A third party laboratory, retained by the Owner or CQA Consultant, shall perform destructive and conformance testing.

B. Field inspection and testing shall be performed under the provisions of this Specification and Section 01410 – Testing and Testing Laboratory Services.

C. Qualifications

1. The manufacturer shall have at least five (5) years continuous experience in manufacture of HDPE liner membrane rolls and/or experience totaling 2,000,000 square feet of manufactured HDPE liner membrane rolls for at least ten complete facilities.

2. The fabricator shall have a least two years continuous experience in fabrication HDPE liner membrane liners and/or experience totaling 2,000,000 square feet of fabricated HDPE liner membrane liners for at least ten completed facilities.

3. Liner Contractor/Installer:

a. The Contractor/Installer shall have a least five years continuous experience in installation of HDPE liner membrane and/or experience totaling 2,000,000 square feet of installed HDPE liner membrane for at least ten completed facilities.

b. Personnel performing seaming operations shall be qualified by experience or by successfully passing seaming tests as directed by the Owner. At least one seamer shall have experience totaling a minimum of 1,000,000 square feet of HDPE liner membrane using same type of seaming apparatus in use at Site. The most experienced seamer, "master seamer," shall provide direct supervision, as required, over less experienced seamers.

## 1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Transportation:

1. The Contractor shall handle liner membrane rolls or blankets by appropriate means so as to cause no damage during transporting or unloading. Prior to shipping, all appropriate documentation as required by Section 1.4 must be provided by the Contractor/Installer and approved by the Owner.

2. It remains the responsibility of the Contractor/Installer to ensure proper protection and storage of materials until such time as the installation is accepted by the Owner or his authorized representative.

B. On-Site Storage:

1. The liner membrane shall be protected according to the guidelines set forth herein.

2. The liner membrane rolls shall be labeled according to manufacturer's manifest and shall be recorded by the Contractor in daily field logs. These labels shall remain prominent until use.

1.8 WARRANTY

A. The Manufacturer and Contractor/Installer shall provide a 20-year warranty on HDPE material and a 2-year warranty on installation and seaming from the date of substantial completion of the project.

PART 2 - PRODUCTS

2.1 HDPE GEOMEMBRANE

A. Liner membrane shall consist of:

1. Textured 60-mil HDPE liner within the PHASES 8 AND 9 BAT Cells.

B. Resin

1. Manufactured liner membrane shall consist of new, first-quality resin, designed and manufactured specifically for the intended purpose.

2. HDPE resin without carbon black or anti-oxidants shall not be used and shall meet the specifications set forth by GRI GM-13 and Table 02242-1 and the resin shall be virgin material with no more than 10% re-work. If re-work is used, it must be of the same formulation as the parent material.

3. No post-consumer resin of any type shall be added to the formulation.

C. 60-mil (1.5 mm) thick HDPE liner membrane shall:

1. Meet the specifications of Table 02242-1 and GRI GM-13

2. Consist of non-reinforced HDPE containing a maximum of one percent by weight additives, filler or tenders

3. Contain carbon black for ultraviolet light resistance

4. Not have striations, roughness, pinholes or bubbles on surface

5. Be produced so as to be free of holes, blisters, non-dispersed raw materials or any sign of contamination by foreign matter

6. Be supplied in rolls.

D. A Panel is the unit area of liner membrane to be seamed in field.

1. A Panel is a roll or portion of roll cut in field.

2. Panel size shall be determined by the Contractor/Liner Membrane Contractor/Installer shop drawings, approved by the Owner, showing layout and dimensions of panels in structure.

E. Panel Label, Identification, and Instructions

1. Labels on each roll or blanket shall identify thickness of material, length and width of roll, manufacturer, and instructions to unroll material, and identify manufacturers/fabricators batch number.

2. The Contractor shall designate each roll with a panel number (identification code) consistent with layout plan. Panel is unit area of liner membrane to be seamed in field (e.g., one roll may be cut into several panels). Position panels on-site as depicted in layout drawings.

3. The Contractor shall follow the instructions on boxes or wrapping containing liner membrane materials to ensure panels are unrolled in the proper direction for seaming.

4. All panels shall be labeled appropriately to ensure cross-referencing to manufacturing data.

F. Workmanship And Appearance

1. Textured liner membrane shall generally have uniform texturing appearance. It shall be free from agglomerated texturing material and such defects that would affect the specified properties of the liner membrane.

2. General manufacturing procedures shall be performed in accordance with the manufacturer's internal quality control guide and/or documents.

## 2.2 FABRICATED SEAMS AND FIELD SEAMS

A. Fabricated seams and field seams for 1.5 mm (60-mil) thick liner membrane shall meet the specifications set forth by the most recent version of GRI GM-13 of Table 02242-1.

B. Destructive seam tests shall be run on five (5) replicate specimens. To be acceptable, five (5) out of five (5) replicate samples shall pass seam strength and peel adhesion criteria.

C. The approved seaming process is extrusion welding or double fusion weld. Each Contractor/Installer shall submit for approval, details of specific apparatus to be used.

D. Resin used for extrusion welding shall be HDPE produced from same resin as liner membrane. Physical properties shall be same as those of resin used in manufacture of HDPE liner membrane.

2.3 SANDBAGS

A. Sandbags shall consist of sewn nylon or reinforced bag containing approximately 30 pounds of sand each.

PART 3 - EXECUTION

3.1 EARTHWORK

A. General

1. The Contractor shall provide in writing that the finished surface on which liner membrane is to be installed is acceptable, free of stones and debris and in a firm, non-yielding condition. This form shall be referred to as the Subgrade Acceptance Form.

2. After the surface is completed and prior to installation of the HDPE Liner, Ohio EPA shall inspect and approve the surface for liner installation. If the Ohio EPA requires additional preparation of the surface after their inspection(s), the Contractor shall immediately perform such work at no cost to the Owner. The Ohio EPA shall re-inspect the surface and approve installation.

3. After the RSL finished surface is accepted by Contractor/Installer, it shall be the Contractor/Installer's responsibility to indicate to the Contractor any change in supporting soil condition that may require repair work. Special care must be taken to maintain the prepared soil surface. Daily observations shall ascertain effects of surface desiccation cracking upon integrity of soil liner. Damage to the prepared surface caused by this installation shall be repaired at the Contractor's expense.

4. The Contractor shall not place liner membrane in an area that has become softened by precipitation. (i.e., unconfined compressive strength less than 1.0 tsf).

5. It shall be the Contractor's responsibility to repair at no-cost to the Owner, damage to the prepared surface caused by a Contractor's/Installer's activity on the soil liner once it is in place and accepted, which is not authorized by the Engineer or his designated representative.

B. The construction of the Anchor Trenches shall follow the details in the drawings and specifications and in accordance with Section 2240 – Anchor Trench.

3.2 LINER MEMBRANE PLACEMENT

A. No placement of liner membrane shall be done until the Owner receives Ohio EPA's approval of the surface. The Contractor shall not begin any installation of geomembrane liner until receiving the Engineer's written notification that Ohio EPA has approved the surface for liner installation.

B. Placement of liner membrane shall consist of:

1. Textured 60-mil HDPE liner within the PHASES 8 AND 9 BAT Cells.

C. The Contractor shall install panels using one of the following:

1. Place all or several panels prior to seaming any panel.

2. Place panels one at a time and seam each panel immediately after its placement.

3. Any combination of above.

D. Weather Conditions

1. The Contractor shall not place panels at ambient temperature below 5C (40F) without performing proper procedures recommended by the manufacturer. Ambient temperature is measured 18 inches from liner surface.

2. The Contractor shall not place panels during precipitation, in presence of excessive moisture (e.g., fog, dew), in area of ponded water or during excessive winds.

E. Placement

1. The Contractor's equipment shall not damage liner membrane by handling, trafficking, leakage of hydrocarbons or other means.

2. The personnel working on liner membrane shall not smoke, wear damaging shoes or engage in other activities, which could damage the liner membrane.

3. The method used by the Contractor to unroll panels shall not cause scratches or crimps in liner membrane and shall not damage supporting soil.

4. Method used by the Contractor to place panels shall minimize wrinkles (especially differential wrinkles between adjacent panels).

5. The Contractor shall place adequate loading (e.g., sandbags), that is not likely to damage the liner membrane, to prevent uplift by wind (in case of high winds, continuous loading recommended along edges of panels to minimize risk of wind flow under panels). Sandbags shall be left in place at the end of the project at edges of last panel along all side slopes.

6. Direct contact with liner membrane shall be minimized; i.e., liner membrane in traffic areas shall be protected by geotextile, extra liner membrane or other suitable materials.

F. Liner Membrane Penetration

1. Penetrations in the liner membrane liner shall be constructed in accordance with liner manufacturer's specifications and in accordance with Contractor/Installer's QA/QC plan under the direct observation of the CQA Consultant .

G. Damage

1. Any panel which, in the judgment of CQA Consultant, becomes seriously damaged shall be replaced by the Contractor at no cost to the Owner. Less serious damage shall be repaired according to manufacturer's specifications.

2. The Contractor shall remove rejected damaged panels or portions of rejected damaged panels from work area. It shall be the Contractor and Contractor/Installers responsibility to do so if panels are rejected on the basis of supplied materials information or damaged due to the Contractor/ Contractor/Installers negligence during installation.

## 3.3 GEOMEMBRANE FIELD SEAMING

A. Seam Layout by the Contractor shall be as follows:

1. In general, seams shall be oriented parallel to line of maximum slope, i.e., oriented along, not across, the slope. In corners and odd-shaped geometric locations, the number of field seams shall be minimized.

2. No horizontal seam shall be less than 10 feet from the toe of slope.

3. No more than one horizontal seam per slope length on side slope shall be allowed.

B. Overlapping and Temporary Bonding by the Contractor shall be as follows:

1. Panels shall be overlapped by a minimum of 4 inches.

2. Procedure used to temporarily bond adjacent panels together shall not damage liner membrane; in particular, temperature of air at nozzle of any spot welding apparatus shall be controlled such that liner membrane is not damaged.

3. No solvent or adhesive shall be used.

C. Seam Preparation by the Contractor shall be as follows:

1. Prior to seaming, the seam area shall be wiped clean and free of moisture, dust, dirt, debris of any kind, and foreign material.

2. If seam overlap grinding is required, the process shall be completed according to manufacturer's instructions and in a way not damaging to the liner membrane. The need for grinding and the method to be used shall be submitted in writing to the Owner's representative 30 days prior to start of this work for approval by the Owner. If abrasive buffing is required (extrusion type welds only), all buffing shall be performed using No. 80 grit or finer sandpaper. The grinding shall be performed so that any and all grind marks are perpendicular to the edge of sheet.

3. Seams shall be aligned with the least possible number of wrinkles and "fish mouths".

D. Seaming Equipment and Products used by the Contractor shall adhere to the following:

1. General

a. Approved processes for field seaming is extrusion welding or double fusion weld. Proposed alternate processes shall be documented and submitted in writing to the Owner's representative 30 days prior to installation for approval by the Owner.

b. Only apparatus specifically approved by the liner manufacturer for its intended purpose (by make and model) shall be used.

c. Seams shall meet specifications for fabricated seams.

2. Extrusion Process

a. The welding apparatus will be equipped with gauges giving temperature in apparatus and at nozzle.

b. The Contractor will provide documentation regarding HDPE extrudate and certify that extrudate is compatible with manufacturer's specifications.

c. The Contractor shall provide alternate, operable seaming apparatus on-site at all times. Equipment used for seaming shall not damage liner membrane and protect liner membrane from damage in heavily trafficked areas.

3. Double Fusion Process

a. The apparatus shall operate to heat the areas to be joined and apply sufficient pressure to ensure the seam requirements are met.

b. The Contractor shall provide documentation that the apparatus is operating according to the manufacturer's specifications.

c. The Contractor shall provide alternate operable seaming apparatus compatible with the project requirement on-site at all times.

E. Weather Conditions for Seaming

1. Ambient air temperature is measured eighteen inches above the liner membrane surface.

2. No seaming shall be attempted below 5ºC (40ºF) or above 40ºC (104ºF) without implementing proper protection or pre-heating procedures as recommended by the manufacturer or directed by the Owner.

3. Between 5ºC (40ºF) and 10ºC (50ºF), seaming shall be possible if liner membrane is preheated by either sun or hot air device, or if there is not excessive cooling resulting from wind.

4. Above 10ºC (50ºF), no preheating shall be required.

5. Liner membrane shall be dry and protected from wind damage.

6. In the event of seaming below 5ºC (40ºF), the Contractor/Installer shall certify in writing that low temperature seaming procedure does not cause any physical or chemical modification to liner membrane that shall generate any short or long term damage to liner membrane.

F. The Contractor shall adhere to the general seaming procedures:

1. Seaming shall extend to outside edge of panels to be placed in anchor trench.

2. If required, the Contractor shall provide a firm substrate by using a flat board, or similar hard surface directly under seam overlap to achieve proper support.

3. The Contractor shall cut fish mouths or wrinkles at seam overlaps along ridge of wrinkle in order to achieve flat overlap. Seam cut fish mouths or wrinkles and any portion where overlap is inadequate shall then be patched with oval or round patch of same liner membrane extending minimum of six inches beyond cut in each direction.

G. The Contractor shall perform trial welds testing in accordance with the manufacturer's recommendations, the installer's QA/QC Plan and the following:

1. Trial welds shall be made on fragment pieces of liner membrane liner to verify seaming conditions are adequate. Test seams shall be made at beginning of each seaming period, at the Owner's or Owner's representative discretion. Also, each seamer shall make at least two test seams each day, one in the morning and the other in the afternoon, under the direct observation of the CQA Consultant.

2. Trial weld samples shall be at least 3 feet long by one foot wide with seam centered lengthwise. A minimum of five (5) specimens each 1-inch wide, shall be removed from the trial weld sample. Specimens are to be field tested in shear and peel, by tensiometer and no sample shall fail in seam. If test seam fails, entire operation shall be repeated twice. If additional test seam fails, seaming apparatus or seamer shall not be accepted and shall not be used for seaming until deficiencies are corrected. Two consecutive successful trial wells shall be achieved following a failed test strip.

H. The Contractor shall perform nondestructive seam continuity testing in accordance with the manufacturer's recommendations, the installer's QA/QC Plan and the following:

1. Contractor shall nondestructively test field seams over their full length using vacuum test for extrusion welds or air testing for fusion welds. Continuity testing shall be done as seaming work progresses, not at completion of field seaming. All testing shall be done in accordance with liner manufacturer's specifications and in accordance with Contractor/Installer's QA/QC plan under the direct observation of the CQA Consultant.

2. The Contractor shall complete all required repairs.

3. Following procedures shall apply to locations where seams cannot be nondestructively tested, as determined by Owner.

   a. All such seams shall be cap-stripped or reconstructed by the Contractor with same liner membrane materials.

   b. If seam is accessible to testing equipment prior to final installation, seam shall be nondestructively tested by the Contractor prior to final installations.

   c. If seam cannot be tested prior to final installation, seaming operations shall be observed by the CQA Consultant for uniformity and completeness. Destructive test samples may be collected and tested at the CQA Consultant's discretion.

4. Vacuum Testing (for single weld production seams and extruded repairs for double weld production seams)

    a. Equipment shall consist of the following:

        i Vacuum box assembly consisting of rigid housing, transparent viewing window, and soft neoprene gasket attached to bottom, port hole or valve assembly, and vacuum gauge

        ii Steel vacuum tank and pump assembly equipped with pressure controller and pipe connections

        iii Rubber pressure/vacuum hoses with fittings and connection

        iv Bucket and wide paint brush or sponge applicator

        v Soapy Solution

    b. The following procedures during testing shall be followed:

        i Energize vacuum pump and reduce tank pressure to approximately ten inches of mercury, (i.e., 5 psi absolute).

        ii Wet strip of liner membrane approximately twelve inches by forty-eight inches with soapy solution.

        iii Place box over wetted area.

        iv Close bleed valve and open vacuum valve.

        v Ensure leak-tight seal is created.

        vi For period of not less than fifteen seconds, examine liner membrane through viewing window for presence of soap bubbles.

        vii If no bubble(s) appear, close vacuum valve and open bleed valve, move box over next adjoining area with minimum 6-inch overlap, and repeat process.

        viii Mark areas where soap bubbles appear with date, time, and tester's initials. Indicate specifically the area that requires repair.

5. Air testing (for fusion welding)

    a. Equipment shall consist of the following:

        i Air compressor capable of producing 30 psi for not less than five (5) minutes.

        ii Pressure gauge graduated in no greater than 1 psi increments, capable of registering minimum of 30 psi.

iii Markers capable of writing on liner.

b. The following procedures during testing shall be followed:

i Seal one end of the seam to be tested.

ii Insert needle or other approved pressure feed device through the sealed end of the channel created by the double wedge fusion weld.

iii Energize the air pump to verify the unobstructed passage of air through the channel.

iv Seal the other end of the channel.

v Energize the air pump to a pressure between 25 and 30 psi, close valve, allow two minutes for the injected air to come to equilibrium in the channel, and sustain pressure for approximately five (5) minutes.

vi If pressure loss exceeds 3 psi, or pressure does not stabilize, locate faulty area, repair and retest.

vii If pressure does not drop below the acceptable value after five (5) minutes, cut the air channel open at the opposite end from the pressure gauge. The air channel should deflate immediately indicating that the entire length of the seam has been tested.

c. Requirements for seam:

i The testing should be performed by the Contractor/Installer under the direct observation of the CQA Consultant in accordance with procedures outlined in "Pressurized Air Channel testing for Dual Seamed Geomembrane" Geosynthetic Research Institute Test Method GM-6.

ii Pressure loss shall not exceed 3 psi in five (5) minutes.

iii The location of seam failure can be located by progressively narrowing the length of seam tested.

iv Seams which fail the air test must be cap stripped or reconstructed along the entire length of failed seam. Repairs and retesting must be to the satisfaction of the Owner.

l. The Contractor shall perform destructive seam strength testing in accordance with the manufacturer's recommendations, the installer's QA/QC Plan and the following:

1. The following location and frequency specifications shall be adhered to:

a. Conduct minimum of one test location for every 500 lineal feet of seam. THIS INCLUDES ALL FUSION AND EXTRUSION SEAMING FOR THE PROJECT;

INCLUDING INITIAL WELDING, SEAMING FOR REPAIRS, AND ANY OTHER SEAMING FOR THE PROJECT.

b. Maximum frequency of test locations shall be agreed upon by the Contractor and the Owner prior to commencement of installation.

c. Additional test locations, not to exceed agreed upon maximum frequency, shall be determined during seaming at the Owner's or Owner's representative discretion. Selection of such locations may be prompted by suspicion of excess crystalline, contamination, offset welds or any other potential cause of imperfect welding.

d. The Contractor/Installer shall not be informed in advance of locations where seam samples shall be taken.

2. The following sampling procedures shall be adhered to:

a. Cut samples as seaming progresses in order to obtain laboratory test results prior to completion of liner installation. Number each sample and identify samples number and location on panel layout drawing.

b. Immediately repair holes in liner membrane resulting from destructive seam sampling. Test continuity of new seams in repaired area according to nondestructive seam continuity testing.

3. The destructive sample size shall be a minimum of 12 inches wide by 43 inches long with seam centered lengthwise. Cut a minimum of three 5-inch wide strips from the sample and test in field by tensiometer, for peel. Cut remaining sample into three equal parts (minimum 12 inches each) and distribute as follows:

a. One portion to the Contractor for laboratory testing minimum 12 inches by 12 inches.

b. One portion for independent laboratory testing, minimum 12 inches by 12 inches.

c. One portion to the Owner for archive storage, minimum 12 inches by 12 inches.

J. The Contractor shall perform laboratory/field testing in accordance with the manufacturer's recommendations, the installer's QA/QC Plan and the following:

1. Test for "seam strength" and "peel adhesion" according to ASTM D 6392. Minimum acceptable values are indicated in Part 2 - Seam Properties. Test at least five (5) replicate specimens for each test method. To be acceptable, five out of five (5) replicates shall pass seam strength and peel adhesion criteria in Part 2. In addition, the average value for the five (5) specimens must meet the specified seam strength. Report test results to the Owner's representative as soon as they become available.

2. Procedures for Destructive Test Failure:

a. Following procedures shall apply whenever sample fails destructive testing:

i Reconstruct seam between failed location and any passed test location by cap strip or replacing seam entirely; or

ii Retrace welding path to intermediate location, at 10 feet minimum from location of failed test, and take small sample for additional field test. If this additional sample passes test, then seam shall be reconstructed between that location and original failed location. If this sample fails, then process shall be repeated.

iii In any case, acceptable seams shall be bounded by two passed test locations (i.e., above procedure shall be followed in both directions from original failed location), and one sample for destructive testing shall be taken within reconstructed area.

b. In event that sample fails laboratory destructive test (whether conducted by independent laboratory or by the Contractor's laboratory), then above procedures shall be followed considering laboratory tests exclusively. Since final seam must be bounded by two passed test locations, it may then be necessary to take one or more samples for laboratory testing in addition to one required in reconstructed seam area.

c. Additional laboratory destructive testing required as a result of failing tests shall be performed at the Contractor's expense.

K. The Contractor shall repair defects in accordance with the manufacturer's recommendations, the installer's QA/QC Plan and the following:

1. Identification: Broom or wash liner membrane if amount of dust or mud inhibits inspection.

2. Evaluation: Nondestructively test each suspect location in seam and non-seam areas. Repair each location, which fails nondestructive testing. The Contractor/Installer shall be responsible for documenting the location and final repair status of any seam.

3. Repair Procedures:

a. Repair tears or pinholes by seaming or patching.

b. Repair blisters, larger holes, non-dispersed raw materials, and contamination by foreign matter by patching.

c. Surfaces of HDPE to be patched shall be abraded no more than one hour prior to repair.

d. Seams used in repairing patches shall be approved extrusion welded seams and may be subjected to same destructive test procedures as outlined for other seams.

e. Patches shall be round or oval in shape, made of same liner membrane, extend minimum of 6 inches beyond edge of defects, and applied using approved methods only.

4. Seam Reconstruction Procedures:

a. Seam reconstruction for extrusion welding process shall be achieved by grinding existing seam and re-welding new seam.

b. Seam reconstruction for fusion process shall be achieved by cutting out existing seam and welding in replacement strip or applying cap strip.

5. Verification of Repairs:

a. Test each repair nondestructively.

b. Repairs passing nondestructive test shall be taken as indication of adequate repair.

c. Failed tests indicate repair shall be redone and retested until passing test results.

d. All locations of repairs and repair test results shall be documented by the Contractor/Installer.

L. The Contractor shall adhere to the following liner membrane acceptance standards:

1. The Contractor shall retain ownership and responsibility for liner membrane until acceptance by the Owner. Liner membrane shall be accepted by the Owner when:

a. Installation is finished

b. Documentation of installation completed, including inspector's final report

c. Verification of adequacy of field seams and repairs, including associated testing, is complete

2. Upon completion, the Contractor shall submit at a minimum, but not limited to, the following information:

a. A certification statement issued by the Contractor/Installer that the liner membrane was installed in accordance with the manufacturer recommended specifications, as applicable to the project.

## 3.4 MATERIALS IN CONTACT WITH GEOMEMBRANE

A. General

1. Materials in contact with the geomembrane shall be installed carefully by the Contractor to minimize damage. Additional loosely placed geotextile sections may be used as protection for liner membrane, if approved by the Engineer.

2. Clamps, clips, bolts, nuts or other fasteners used by the Contractor to secure liner membrane to each appurtenance shall have life span equal to or exceeding liner membrane.

3. The CQA procedures defined are only intended to ensure that the installation of these materials does not damage the geomembrane. Additional CQA procedures (not part of this specification) may be necessary to ensure that the complete cover system is designed and

constructed in such a way as to ensure proper performance and that all components of the system perform as intended.

B. Granular Materials

1. Placement of granular materials on liner membrane by the Contractor shall not proceed at ambient temperature below 5ºC (40ºF) without proper procedure recommendations from the manufacturer.

2. Equipment used for placing granular material shall not be driven directly on liner membrane.

3. The Contractor shall place granular material in such a manner that liner membrane damage is unlikely.

Table 02242-1
60 mil HDPE Liner Membrane and Seaming Properties
GRI GM 13 Rev 11 – 12/14/2012

| PROPERTY | ASTM METHOD | UNITS | VALUE |
|---|---|---|---|
| DENSITY | D792 or D1505 | g/cm | 0.94 (min) |
| THICKNESS (MIN. AVE)<br>Smooth/<br>Lowest individual of 10 values | D5199 | Mil | 60 (nom)/<br>54 (min) |
| Textured/<br>Lowest individual for 8 of 10 values | D5994 | Mil | 60 (nom)/<br>54 (min) |
| ASPERITY HEIGHT (TEXTURED)[1] | GM12 | Mil | 16 |
| TENSILE PROPERTIES[2]<br>Yield Strength | D6693 Type IV | lbs./inch | 126 (min) |
| Break Strength | D6693, Type IV | lbs./inch | 228 (min smooth)<br>90 (min text) |
| Yield Elongation | D6693, Type IV | percent | 12 (min) |
| Break Elongation | D6693, Type IV | percent | 700 (min smooth)<br>100 (min text) |
| TEAR RESISTANCE (MIN AVE) | D1004, Die C | lbs. | 42 (min) |
| PUNCTURE RESIST (MIN AVE) | D4833 | lbs. | 108 (min smooth)<br>90 (min text) |
| STRESS CRACK RESISTANCE[3] | D5397 | hr | 500 |
| CARBON BLACK CONTENT | D4218 | percent | 2-3 |
| CARBON BLACK DISPERSION | D5596 | | A-1/A-2 |
| HIGH PRESSURE OXIDATIVE INDUCTION TIME<br>(min. ave.) | D5885<br>D3895 | min | 400<br>100 |
| OVEN AGING at 85 ºC @<br>HIGH PRESSURE OIT (min ave.)<br>% RETAINED AFTER 90 DAYS | D5721<br>D5885 | percent | 80 |
| UV RESISTANCE [4] @ HIGH PRESSURE OIT (min. ave.)<br>% RETAINED AFTER 1600 hrs. | GM 11<br>D5885 | percent | 50 |
| FRICTION ANGLE (with subgrade and clay liner)[5] | D5321 | degrees | 23 |
| FRICTION ANGLE (with sand)[5] | D5321 | degrees | 23 |

| PROPERTY | ASTM METHOD | UNITS | VALUE |
|---|---|---|---|
| SEAM STRENGTH[6] | | | |
| Seam Shear Strength | D6392 | lbs./in | 120 (min) |
| Seam Elongation at Break | D6392 | % | 50 (min) |
| Seam Peel Strength | D6392 | lbs./in | 91 (min) |
| Seam Peel Separation | D6392 | % | 25 (min) |

1 All readings need to be 16 mils minimum

2 Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction. Yield elongation is calculated using a gage length of 1.3 inches Break elongation is calculated using a gage length of 2.0 inches

3 P-NCTL test is not appropriate for testing geomembrane with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials. The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.

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

5 See Engineer for appropriate testing conditions

6 Seam strength must meet requirements on most recent edition of GRI-GM19a "Seam Strength and Related Properties of Thermally Bonded Homogeneous Polyolefin Geomembranes/Barriers" SM

END OF SECTION 02242

# SECTION 02243

# CUSHION GEOTEXTILE LAYER

## PART 1 – GENERAL

Work covered shall consist of all activities including labor, materials, tools, equipment, incidentals, and services necessary for the installation of the bedding geotextile (cushion layer) directly on the approved, installed HDPE geomembrane to the limits indicated in the plans and specifications or as directed by the engineer.

### 1.1 SECTION INCLUDES

A. Construction quality control

B. Quality assurance

C. Delivery, storage, and handling

D. Non-woven geotextile

E. Installation

F. Seams and overlaps

G. Repairs

H. Placement of leachate collection drainage materials over geotextile

### 1.2 RELATED SECTIONS

A. Section 01410 – Testing and Testing Laboratory Services

B. Section 02225 – Trenching and Backfilling

C. Section 02231 – Crushed Aggregate and Fills

### 1.3 REFERENCES

A. ASTM D 1117 – Methods of Testing Nonwoven Fabrics

B. ASTM D 3786 – Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method

C. ASTM D 4354 - Sampling of Geosynthetic for Testing

D. ASTM D 4355 - Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)

E. ASTM D 4439 - Terminology for Geotextiles

F. ASTM D 4491 - Water Permeability of Geotextiles by Permittivity

G. ASTM D 4533 - Trapezoidal Tearing Strength of Geotextiles

H. ASTM D 4595 - Tensile Properties of Geotextiles by the Wide-Width Strip Method

I. ASTM D 4632 - Grab Breaking Load and Elongation of Geotextiles

J. ASTM D 4751 - Determining Apparent Opening Size of Geotextiles

K. ASTM D 4833 - Index Puncture Resistance of Geotextiles, Geomembrane, and Related Products

L. ASTM D 4873 - Guide for Identification, Storage, and Handling of Geotextiles

M. GRI GT12(a) – Test Methods and Properties for Nonwoven Geotextiles Used as Protection (or Cushioning) Materials

## 1.4 SUBMITTALS

A. The Contractor shall submit information, reports, and documentation in accordance with Section 01320.

B. Pre-Certification Submittals: The Contractor shall submit the following to the Engineer for approval:

1. Manufacturer's written certification that the Geotextiles meet the physical and hydraulic properties listed in Part 2 of this section

C. Pre-Construction Submittals: The Contractor shall submit the following to the Engineer within 5 days of the shipment date:

1. Written list of the specific rolls to be shipped to the project site

2. Manufacturer's Quality Control data for rolls to be shipped to the project site

## 1.5 CONSTRUCTION QUALITY CONTROL

A. Field inspection and testing shall be performed under the provisions of this Specification and Section 01410 – Testing and Testing Laboratory Services.

B. The Contractor shall perform visual inspection for installation damage and conformance with the specifications.

C. The Engineer may, at any time during the Contract, request additional testing of geotextile delivered to the site to ensure conformance with the properties. The Manufacturer shall bear the costs of any failing tests.

1. Geotextile samples that do not comply with properties specified in this Section shall result in:

a. Rejection of the roll from which the sample was obtained. The Manufacturer shall remove and replace any rejected rolls at no additional cost to the Owner.

b. An additional conformance test, at no additional cost to the Owner, of a sample obtained from a roll within the same lot as the rejected roll(s), bounded by rolls with acceptable Manufacturer's Quality Control testing or conformance testing.

c. Additional sample testing may be performed, at the Manufacturer's discretion and expense, to more closely identify any non-complying rolls and/or qualify individual rolls.

1.6 QUALITY ASSURANCE

A. Testing shall be performed under the provisions of this Specification and Section 01410 – Testing and Testing Laboratory Services.

B. The Manufacturer/fabricator/Contractor/Installer shall agree to participate in and conform to all items and requirements of a quality assurance program as outlined in this specification.

C. A third party laboratory, retained by the Owner or CQA Consultant, shall perform destructive and conformance testing.

1.7 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping

1. The Contractor shall ensure geotextile is supplied in rolls wrapped individually in relatively impermeable and opaque protective covers.

2. The Contractor shall ensure geotextile rolls are marked or tagged with the following information:

a. Product identification information (Manufacturer's name and address, brand product code)

b. Lot number and roll number

c. Roll length, width, and weight

B. Storage and Protection

1. Unloading, on-site handling, and storage of the Geotextile are the responsibility of the Contractor.

2. The Contractor shall provide on-site storage area(s) for Geotextile rolls from time of delivery until installation.

3. The Contractor shall store and protect the geotextile from mud, dirt, dust, water, and exposure to ultraviolet light, heat, and other sources of damage.

4. The Contractor shall preserve the integrity and readability of geotextile roll labels.

## PART 2 - PRODUCTS

### 2.1 NON-WOVEN GEOTEXTILE

A. Non-woven geotextile shall consist of continuous filament needle-punched or staple fiber non-woven polyester or polypropylene fabric oriented into a stable network that retains its relative structure during handling, placement, and long-term service.

B. The contractor shall submit material properties (gradation) for the LCS granular material ahead of selecting the cushion layer material. Based on the gradation a factor of safety will be determined for the protection provided by an 8 oz, 10 oz and 12 oz cushion layer. The Engineer will provide feedback to the contractor as to which weight of geotextile cushion fabric will be acceptable.

C. For the geotextile protection layer placed beneath the leachate collection system gravel, the minimum average roll values shall meet or exceed the criteria contained in the specifications of Table 02243-1 and GRI GT12(a)

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Geotextile procurement, transportation, storage, handling and installation shall be the responsibility of the Contractor. Any damaged or unacceptable material shall be replaced at no additional cost to the Owner.

B. Wrappings protecting geotextile rolls shall be removed by the Contractor less than one hour prior to unrolling the geotextile. After the wrapping has been removed, the geotextile shall not be exposed to direct sunlight for more than 10 days (unless otherwise approved by the Engineer).

C. Geotextile shall be securely anchored by the Contractor and then rolled in such a manner as to continually keep the geotextile sheet in tension.

D. Geotextile shall be weighted with sandbags or the equivalent by the Contractor. Such sandbags shall be installed during placement and shall remain until replaced.

E. If white colored geotextile is used, precautions shall be taken by the Contractor against "snow blindness" of personnel.

F. The Contractor shall take any necessary precautions to prevent damage to underlying layers during placement of the geotextile.

### 3.2 SEAMS AND OVERLAPS

A. Seams of geotextile used for wrapping trench backfill and drainage media shall be overlapped by the Contractor as indicated on the drawings. The Contractor shall not introduce debris or foreign matter into the stone being wrapped during backfilling operations.

B. Geotextile shall be overlapped a minimum of six (6) inches. All seams shall be sewn with a double thread lock stitch or two rows of single thread chain stitch using sewing machines appropriate for field use.

C. Yarns and fibers used by the Contractor to secure the geotextile shall by polymeric, shall be as chemically and UV resistant as the geotextile, and shall have design life equal to or exceeding that of the geotextile. The thread shall be of contrasting color to the geotextile to facilitate seam inspection. Documentation on the type of thread and seaming technique to be used shall be submitted for review by the CQA Consultant prior to construction.

## 3.3 REPAIRS

A. Holes or tears in the fabric shall be repaired with a fabric patch made from the same geotextile. Patches shall provide a minimum overlap of 24 inches in all directions and be anchored as necessary. Should any tear exceed 10 percent of the width of the roll, that roll shall be removed from the slope and replaced.

B. The Contractor shall carefully remove any soil or other materials that may have penetrated the torn geotextile.

## 3.4 PLACEMENT OF LEACHATE COLLECTION DRAINAGE MATERIALS OVER GEOTEXTILE

A. The Contractor shall not drive vehicles directly on the geotextile. Damage to the geotextile and/or underlying components of the liner system shall be the responsibility of the Contractor.

B. The Contractor shall place leachate collection drainage materials on top of the geotextile cushion layer in a manner that prevents damage to both the geotextile and underlying geomembrane.

Table 02243
Bedding/Cushion Geotextile Properties

| PROPERTY* | ASTM METHOD | UNITS | VALUE |
|---|---|---|---|
| MASS/UNIT AREA | D5261 | oz./yd$^2$ | 8 |
| GRAB TENSILE STRENGTH | D4632 | lbs. | 203 |
| TRAPEZOIDAL TEAR | D4533 | lbs. | 79 |
| CBR PUNCTURE STRENGTH | D6241 | lbs. | 440 |
| UV RESISTANCE (MIN) | D4355 | Percent[1] | 50 |

* All values are MARV unless noted otherwise
[1]Percent Strength retained after 500 hr exposure

END OF SECTION 02243

# SECTION 02245

# GEOTEXTILE FILTER FABRIC

## PART 1 – GENERAL

Work covered shall consist of all activities including labor, materials, tools, equipment, incidentals, and services necessary for the procurement and installation of the geotextile filter fabric on the leachate collection system granular drainage layer and associated items to the limits indicated in the plans and specifications or as directed by the engineer.

### 1.1 SECTION INCLUDES

A. Construction quality control

B. Quality assurance

C. Delivery, storage and handling

D. Non-woven geotextile

E. Installation

F. Seams and overlaps

G. Repairs

H. Placement of waste materials over geotextile

### 1.2 RELATED SECTIONS

A. Section 01320 – Submittals

B. Section 01410 – Testing and Testing Laboratory Services

C. Section 02211 – Sub-Base Layer

D. Section 02225 – Trenching and Backfilling

E. Section 02231 – Crushed Aggregate and Fills

F. Section 02275 – Riprap

G. Section 02276 – Gabions

### 1.3 REFERENCES

A. ASTM D 1117 - Methods of Testing Nonwoven Fabrics

B. ASTM D 3786 - Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method

C. ASTM D 4354 - Sampling of Geosynthetic for Testing

D. ASTM D 4355 - Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)

E. ASTM D 4439 - Terminology for Geotextiles

F. ASTM D 4491 - Water Permeability of Geotextiles by Permittivity

G. ASTM D 4533 - Trapezoidal Tearing Strength of Geotextiles

H. ASTM D 4595 - Tensile Properties of Geotextiles by the Wide-Width Strip Method

I. ASTM D 4632 - Grab Breaking Load and Elongation of Geotextiles

J. ASTM D 4751 - Determining Apparent Opening Size of Geotextile

K. ASTM D 4833 - Index Puncture Resistance of Geotextiles, Geomembrane, and Related Products

L. ASTM D 4873 - Guide for Identification, Storage, and Handling of Geotextiles

M. GRI GT13 – Test Methods and Properties for Geotextiles Used as Separation Between Subgrade Soil and Aggregate

1.4 SUBMITTALS

A. The Contractor shall submit all information, reports, and documentation in accordance with Section – 01320.

B. Pre-Certification Submittals: The Contractor shall submit the following to the Engineer for approval:

1. Manufacturer's written certification that the Geotextiles meet the physical and hydraulic properties listed in Part 2 of this section

C. Pre-Construction Submittals: The Contractor shall submit the following to the Engineer within 5 days of the shipment date:

1. Written list of the specific rolls to be shipped to the project site

2. Manufacturer's Quality Control data for rolls to be shipped to the project site

1.5 CONSTRUCTION QUALITY CONTROL

A. Field inspection and testing shall be performed under the provisions of this Specification and Section 01410 – Testing and Testing Laboratory Services.

B. The Contractor shall perform visual inspection for installation damage and conformance with the specifications.

C. The Engineer may, at any time during the Contract, request additional testing of geotextile delivered to the site to ensure conformance with the properties. The Manufacturer shall bear the costs of any failing tests.

1. Geotextile samples that do not comply with the properties specified in this Section shall result in:

a. Rejection of the roll from which the sample was obtained. The Manufacturer shall remove and replace any rejected rolls at no additional cost to the Owner.

b. An additional conformance test, at no additional cost to the Owner, of a sample obtained from a roll within the same lot as the rejected roll(s), bounded by rolls with acceptable Manufacturer's Quality Control testing or conformance testing.

c. Additional sample testing may be performed, at the Manufacturer's discretion and expense, to more closely identify any non-complying rolls and/or qualify individual rolls.

## 1.6 QUALITY ASSURANCE

A. Testing shall be performed under the provisions of this Specification and Section 01410 – Testing and Testing Laboratory Services.

B. The Manufacturer/fabricator/Contractor/Installer shall agree to participate in and conform to all items and requirements of a quality assurance program as outlined in this specification.

C. A third party laboratory, retained by the Owner or CQA Consultant, shall perform destructive and conformance testing.

## 1.7 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping

1. The Contractor shall ensure geotextile is supplied in rolls wrapped individually in relatively impermeable and opaque protective covers.

2. The Contractor shall ensure geotextile rolls are marked or tagged with the following information:

a. Product identification information (Manufacturer's name and address, brand product code)

b. Lot number and roll number

c. Roll length, width, and weight

B. Storage and Protection

1. Unloading, on-site handling, and storage of the Geotextile are the responsibility of the Contractor.

2. The Contractor shall provide on-site storage area(s) for Geotextile rolls from time of delivery until installation.

3. The Contractor shall store and protect the geotextile from mud, dirt, dust, water, and exposure to ultraviolet light, heat, and other sources of damage.

4. The Contractor shall preserve the integrity and readability of geotextile roll labels.

## PART 2 - PRODUCTS

### 2.1 NON-WOVEN GEOTEXTILE

A. Non-woven geotextile shall consist of continuous filament needle-punched or staple punched non-woven polyester or polypropylene fabric oriented into a stable network that retains its relative structure during handling, placement, and long-term service.

B. For the geotextile protection layer placed above the leachate collection system gravel or sand, the Contractor shall furnish a Class 1 (high survivability) an eight (8) ounce geotextile whose minimum average roll values meet or exceed the criteria contained in the specifications of Table 02245-1 and GRI GT13.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Geotextile procurement, transportation, storage, handling and installation shall be the responsibility of the Contractor. Any damaged or unacceptable material shall be replaced at no additional cost to the Owner.

B. Wrappings protecting geotextile rolls shall be removed by the Contractor less than one hour prior to unrolling the geotextile.

C. Geotextile shall be securely anchored by the Contractor and then rolled in such a manner as to continually keep the geotextile sheet in tension.

D. Geotextile shall be weighted with sandbags or the equivalent by the Contractor. Such sandbags shall be installed during placement and shall remain until replaced.

E. If white colored geotextile is used, precautions shall be taken by the Contractor against "snow blindness" of personnel.

F. The Contractor shall take any necessary precautions to prevent damage to underlying layers during placement of the geotextile.

### 3.2 SEAMS AND OVERLAPS

A. Seams of geotextile used for wrapping trench backfill and drainage media shall be overlapped by the Contractor as indicated on the drawings. The Contractor shall not introduce debris or foreign matter into the stone being wrapped during backfilling operations.

B. Geotextile shall be overlapped a minimum of six (6) inches. All seams shall be sewn with a double thread lock stitch or two rows of single thread chain stitch using sewing machines appropriate for field use.

C. Yarns and fibers used by the Contractor to secure the geotextile shall by polymeric, shall be as chemically and UV resistant as the geotextile, and shall have design life equal to or exceeding that of the geotextile. The thread shall be of contrasting color to the geotextile to facilitate seam inspection. Documentation on the type of thread and seaming technique to be used shall be submitted for review by the CQA Consultant prior to construction.

## 3.3 REPAIRS

A. Holes or tears in the fabric shall be repaired with a fabric patch made from the same geotextile. Patches shall provide a minimum overlap of 24 inches in all directions and be anchored as necessary. Should any tear exceed 10 percent of the width of the roll, that roll shall be removed from the slope and replaced.

B. The Contractor shall carefully remove any soil or other materials that may have penetrated the torn geotextile.

Table 02245
Filter Geotextile Properties (Class 1, High Survivability)

| PROPERTY* | ASTM METHOD | UNITS | VALUE |
|---|---|---|---|
| MASS/UNIT AREA | D5261 | oz./yd$^2$ | 8 |
| GRAB TENSILE STRENGTH | D4632 | lbs. | 203 |
| TRAPEZOIDAL TEAR | D4533 | lbs. | 79 |
| CBR PUNCTURE STRENGTH | D6241 | lbs. | 440 |
| UV RESISTANCE (min) | D4355 | Percent[1] | 50 |
| AOS (max) (O95)[2] | D4751 | mm | 0.22 |
| PERMITIVITY (min)[2] | D4491 | s$^{-1}$ | 0.1 |

* All values are MARV unless noted otherwise
[1]Percent strength retained after 500 hr exposure
[2]after AASHTO M288-96

END OF SECTION 02245

# SECTION 02270

# CONSTRUCTION EROSION AND SEDIMENT CONTROL
# (Storm Water Pollution Prevention)

## PART 1 – GENERAL

Work covered shall consist of all activities including labor, materials, tools, equipment, incidentals, services and fees necessary for appropriate construction erosion and sediment control, installation of BMPs, and otherwise ensure compliance with all applicable federal, state and local requirements related to storm water quality and runoff from disturbed areas and related controls and BMPs to the limits indicated in the plans and specifications or as directed by the engineer.

### 1.1 SECTION INCLUDES

A. Materials

B. Techniques

C. General requirements

D. Installation

E. Maintenance during construction

F. Removal

### 1.2 RELATED SECTIONS

A. Section 02216 – Sub-Base Layer

B. Section 02218 – Landfill Materials Handling

C. Section 02219 – Stockpiling

D. Section 02231 – Crushed Aggregate and Fills

E. Section 02245 – Geotextile Filter Fabric

F. Section 02272 – Erosion Control Fabric

G. Section 02275 – Riprap

### 1.3 REFERENCES

A. United States Environmental Protection Agency Storm Water Management for Construction Activities Summary Guidance, October 1992

B. Rainwater and Land Development Manual, Ohio Department of Natural Resources - Division of Soil and Water Conservation, 1996

C. United States Department of Agriculture, Soil Conservation Service (SCS), Water Management and Sediment Control for Urbanizing Areas, March, 1987

D. Defiance County Landfill NPDES Permit

1.4 SUBMITTALS

A. The Contractor shall submit information, reports, and documentation in accordance with Section–01320.

B. An Erosion and Sediment Control Plan or Storm Water Pollution Prevention Plan (SWP3) shall be developed by the Contractor and approved by the Engineer before site disturbance begins. This plan shall address materials, methods, and procedures to be utilized to meet provisions of the Contract Documents and satisfy federal, state, and local requirements. The Erosion and Sediment Control Plan is subject to review and approval by the Ohio EPA.

C. In accordance with Ohio Revised Code (ORC) 6111 and provisions of the Federal Water Pollution Control Act, the Contractor shall be required to prepare a SWP3 for proposed construction activities related to the construction effort. The SWP3 shall be prepared in general conformance with Ohio EPA Authorization for Storm Water Discharges Associated with Construction Activities permit requirements. Proposed Best Management Practices (BMPs) shall conform to *Rainwater and Land Development* (ODNR 1996) and applicable local requirements and standards.

D. The Contractor shall submit a complete and accurate Notice of Intent (NOI) application form and appropriate fee at least 21 days prior to the commencement of construction activity. The SWP3 addresses control measures to be implemented as part of this design to minimize storm water pollution from the construction activities.

E. The Contractor shall submit manufacturer cut sheets on proposed erosion/sediment control products.

F. The Contractor shall submit weekly inspections reports in accordance with the approved SWP3 for the inspection and maintenance of erosion and sediment control BMPs.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Silt Fence: Mirafi 100X, or equal

B. Crushed Aggregate: in accordance with Section 02231 – Crushed Aggregate

C. Sand Bags

D. Straw bales shall not be used on this project

2.2 TECHNIQUES

A. Drainage swales shall be constructed by the Contractor to control surface runoff and minimize erosion, directing storm water to permanent or temporary letdown structures. Ditches or swales approaching letdown structures shall be cut below the spillway elevation to trap sediment.

B. Silt fence, rock check dams, or temporary erosion control fabric linings shall be placed within drainage swales by the Contractor to reduce runoff velocities and erosion, where necessary.

C. Perimeter erosion and sediment control barriers shall be installed by the Contractor around the site, as necessary, to control sheet flow run-on and runoff.

D. Existing vegetation shall be preserved during construction by the Contractor to the extent possible, to minimize erosion and retain sediments.

E. The Contractor shall maintain good housekeeping measures which shall be implemented to maintain a clean and orderly work environment. Good housekeeping measures include but are not limited to:

1. Regular pickup and disposal of garbage and waste material

2. Routine inspection for leaks or conditions that could lead to discharges of petroleum or chemicals or contact of storm water with raw materials, intermediate materials, waste materials, or products

3. Performance of preventative maintenance on construction equipment to ensure equipment is in proper operation and to detect potential leaks before they occur

4. Ensuring the project health and safety requirements are understood by employees and Contractors

5. Ensuring an on-site spill kit is available and spill cleanup procedures are understood by employees and Contractors

6. Establishing storage areas away from direct traffic routes to prevent accidental spills

## PART 3 - EXECUTION

### 3.1 GENERAL REQUIREMENTS

A. The Contractor shall be responsible for the installation and maintenance of erosion and sediment control barriers and BMPs throughout the duration of the project and for the removal of such BMPs when the project work is complete and following the submittal and approval of the Notice of Termination (NOT) to the Engineer and Ohio EPA.

B. The Contractor shall be responsible for preventing eroded products from being deposited at locations outside the limits of the work.

C. The Contractor shall be responsible for repairing and restoring erosion areas to original conditions.

D. Prior to construction activities, the Contractor shall inspect all storm water controls and document proper placement. Weekly inspections of all storm water controls and BMPs shall be performed by the Contractor and documented on a *Storm Water Pollution Prevention Site Inspection Report*. At a minimum, the Contractor also shall inspect the storm water controls within 24 hours after any storm event greater than 0.5 inches (12.7 mm) of rain per 24 hour period in accordance with (OHC000002 Part III.G.2.f.i).

E. Erosion and sediment control barriers must be constructed, stabilized, and functional prior to site disturbance within the tributary areas of these barriers, including stockpiles.

F. Exposed areas, including stockpiles but excluding the re-graded waste/residue surface that shall be undisturbed for more than 30 days shall be stabilized by the Contractor as follows:

1. Disturbed areas at finished grade shall be stabilized with permanent seeding.

2. Disturbed areas not at finished grade shall be stabilized with temporary seeding. During non-germinating periods, mulch shall be applied to temporary seeding.

G. The Contractor shall provide all survey services.

3.2 INSTALLATION

A. The Contractor shall install erosion and sediment control barriers prior to beginning any land disturbing activities.

B. The Contractor shall locate erosion and sediment control barriers, as necessary as follows:

1. Downstream from disturbed areas where sheet and/or rill erosion may occur

2. Within temporary or permanent drainage swales

3. Upstream of temporary or permanent drainage structures and/or letdown structures

4. Hydraulically down gradient of site construction activities

5. Other locations as determined by the Contractor to prevent sediment migration

C. The Contractor shall install erosion and sediment control barriers as follows:

1. Silt Fence: as indicated on the drawings

2. Crushed Aggregate: for use in construction of rock check dams, stabilized entrances, and inlet protection

3. Temporary Erosion Control Fabric: in accordance with the manufacturer's recommendations

4. Riprap: for use in construction of temporary letdowns, as depicted on the drawings

5. In accordance with these specifications and approved SWP3

6. Straw bales shall not be used

3.3 MAINTENANCE DURING CONSTRUCTION

A. Erosion and sediment control barriers shall be properly maintained by the Contractor until permanent seeding has been established or until landfill construction has proceeded to a point that the barriers are no longer necessary.

B. Maintenance by the Contractor shall include weekly inspections of all erosion and sediment control barriers and after rainfall events exceeding one-half (0.5) inches.

C. All preventative and remedial maintenance, including cleanout, repair, replacement, re-grading, reseeding, re-mulching, and re-netting, shall be performed by the Contractor immediately as follows:

1. Silt Fence: Remove accumulated sediments to keep the fence functional or when the accumulations reach 1/2 the fence height. Repair any undercutting or erosion of the toe anchor immediately with compacted backfill. Follow the manufacturer's recommendations for replacing fabric due to weathering.

2. Construction Entrance: Maintain the aggregate thickness by adding material. At the end of each construction day, remove all sediment deposited on public roadways and return it to the construction site.

3. Rock Check Dams: Remove accumulated sediments, if any. Repair any undercutting or erosion at the toe apron and/or around the ends of the check dam. Maintain the center to promote flow over the check dam.

D. BMP Performance Evaluation – The Contractor shall conduct an evaluation of all installed BMPs to determine performance and functionality on a weekly basis. In the event additional BMPs or controls are required, the Contractor shall install the necessary control. If it is determined that a particular control is no longer necessary, it may be removed following notification to the Engineer.

3.4 REMOVAL

A. The Contractor shall remove construction erosion and sediment control barriers when permanent seeding has been established or when landfill construction has proceeded to a point that the barriers are no longer necessary.

B. Sediment deposits remaining after the erosion and sediment control barriers are no longer required shall be dressed by the Contractor to conform to the existing grade, prepared, and seeded.

END OF SECTION 02270

# SECTION 02271

# DUST CONTROL

## PART 1 - GENERAL

Work covered shall consist of all activities including labor, materials, tools, equipment, incidentals, and services necessary to provide appropriate dust control for the duration of the project.

This section details measures taken by the Contractor to conduct operations and maintain the project site including off-site storage, borrow, and stockpile areas and the public and private (haul road) roads in between so as to minimize the creation and dispersion of dust. Dust control shall be used throughout the course of the work.

### 1.1 WORK INCLUDED

A. Water

B. General requirements

C. Water application

### 1.2 REFERENCES

A. Section 01500 – Construction Facilities and Temporary Controls

B. Section 01560 – Maintenance of Work Site

C. Section 02270 – Construction Erosion and Sediment Control

## PART 2 - PRODUCTS

### 2.1 WATER

A. Water shall be available to the Contractor from on-site ponds for dust control.

## PART - EXECUTION

### 3.1 GENERAL REQUIREMENTS

A. The Contractor shall be responsible for all dust control within the limits of construction. Water spraying/misting shall be used as necessary to maintain compliance with all applicable permits and requirements. Water used for dust control shall be clean (i.e., obtained from on-site sources with approval of the Engineer). The use of additives is not permitted.

B. The Engineer reserves the right to require additional dust control measures or to stop work, when high winds create excessive dust. Contractor shall be responsible for dust monitoring by visual indications. Water shall not be used in such quantities as to cause ponding and/or runoff or causing the generation of leachate.

C. The Contractor shall implement strict dust control measures during active construction periods on-site, at off-site storage and stockpile areas, haul roads and public roads.

D. These Control measures shall generally consist of water applications that shall be applied a minimum of once per day during dry weather or more often as required by the Owner or Owner's representative.

E. Where required, the Contractor shall remove soil tracked, spilled or otherwise deposited upon public roads by construction equipment during construction activities. Removal shall be accomplished via street sweeping or an equivalent method.

F. Sweeping or pushing sediments toward nearby ditches shall be prohibited. All sediments tracked shall be removed by the Contractor from off-site areas and returned to the source area.

3.2 WATER APPLICATION

A. For water application to soil surfaces, the Contractor shall:

1. Utilize spraying equipment to provide complete coverage of surfaces with water

2. Apply water without interfering with earthmoving equipment or on-site operations

3. Keep areas damp without creating nuisance conditions such as ponding or affecting compaction requirements for cover soils

4. Apply water spray in a manner to prevent movement of spray beyond site boundaries.

END OF SECTION 02271

# SECTION 02601

# HDPE MANHOLES

## PART 1 – GENERAL

Work covered shall consist of all activities including labor, materials, tools, equipment, incidentals, and services necessary for the installation of HDPE manhole structures and associated appurtenances at locations indicated in the plans and specifications or as directed by the engineer.

### 1.1 SECTION INCLUDES

A. HDPE material specifications

B. Physical properties of HDPE compound

C. LS4 meter vault specifications

D. General requirements

E. Handling of materials

F. Flanged connections

G. Pipe joining

H. Equipment mounting

I. Direct burial installation

### 1.2 RELATED SECTIONS

A. Section 02225 - Trenching & Backfilling.

B. Section 02676 – Leachate Collection and Removal System

C. Section 02715 – HDPE Collection and Transport Pipe

### 1.3 REFERENCES

A. See below

### 1.4 SUBMITTALS

A. The Contractor shall submit all information, reports, and documentation in accordance with Section 01320.

B. The Contractor shall submit certification that the HDPE material meets the specifications.

C. The Contractor shall submit manufacturer's data and details of following items for approval:

1. The fabricator of the manholes shall submit drawings showing the position of the inlets, outlets and the overall dimensions along with any other special features such as manways, ladders, etc.

2. The fabricator shall submit data indicating that the manholes meet the requirements of ASTM F 1759, "Design of High Density Polyethylene (HDPE) Manholes for Subsurface Applications". The manhole should be proven to have acceptable design for the following areas:

   a. Ring Compressive Strain

   b. Combined Ring Compressive and Ring Bending Strain

   c. Ring Buckling

   d. Axial Stain

   e. Axial Buckling

   f. Thickness of the bottom based on depth and groundwater. Thickness should be based on acceptable stress and deflection amounts.

3. Calculations supporting these requirements will be part of the submittal package.

4. The fabrication technician shall perform work in accordance to butt fusion of high-density polyethylene per ASTM D2657 and for extrusion and hot air welding per ASTM C 1147. The fabricator shall submit the written quality assurance program used during fabrication of the manholes. The fabricator may be required to submit their overall QA/QC program for fabricating thermoplastic structures, the welding certification program for the fabrication technician per ASTM C 1147 and the facility safety program.

5. The manholes and pipe shall be tested with water or air. The structure shall be determined to be leak free before shipping. A written certification shall be sent to the engineer certifying the manholes are leak free. The test results shall become part of the submittals. An identification plate indicating, the job number, testing data, and when built and by whom, shall be attached to the manhole.

## PART 2 – PRODUCTS

The pipe for the manholes shall be made from high-density polyethylene (HDPE) resins meeting the following requirements:

### 2.1 HDPE MATERIAL SPECIFICATIONS

A. HDPE Material – The HDPE material supplied under this specification shall be high density, high molecular weight. The HDPE material shall conform to ASTM D-3350-02 with minimum cell classification values of 345464 C. Earlier versions of this specification will not be accepted.

### 2.2 PHYSICAL PROPERTIES OF HDPE COMPOUND

A. Density - the density shall be no less than 0.955 gm/ccm, as referenced in ASTM 1505.

B. Melt Index - the melt index shall be no greater than 0.15 gms/10 minutes when tested in accordance with ASTM 1238-Condition 3.2.3.

C. Flex Modulus - flexural modulus shall be 110,000 to less than 160,000 psi as referenced in ASTM D 790.

D. Tensile Strength at Yield – tensile strength shall be 3,200 to less than 3500 psi in accordance with ASTM D 638.

E. Slow Crack Growth Resistance shall be per ASTM F 1473 (PENT Test). The results shall be greater than 100 hours.

F. Hydrostatic Design Basis shall be 1,600 psi at 23 degrees C when tested in accordance with ASTM D 2837.

2.3 LS4 METER VAULT SPECIFICATIONS

A. The LS4 meter vault shall be constructed of HDPE pipe with an ID of 72 inches. The service conditions will determine the class of pipe. The manufacturer shall provide calculations to verify the wall thickness to be used.

PART 3 – EXECUTION

3.1 GENERAL REQUIREMENTS

A. The bottom thickness of the manholes will be determined in accordance with ASTM F 1759 and shall not be less than 2 inches. Calculations must be provided to justify the thickness of the bottom.

B. The inlets and outlets shall be extrusion welded on the inside and outside using good welding practice. Gussets shall be attached at 90, 180, 270, and 360 degrees around the inlets and outlets.

C. All manhole connections larger than 4” nominal OD pipe shall be butt fusion welded; electro fusion welded, or flanged connections. For 4” OD pipe and smaller threaded transition fittings can also be used as well as the acceptable connections listed.

D. Gas tight manholes shall be factory tested with 5 psi air for 30 minutes (with a 15 minute pressure equalization period).Non-gas tight manholes shall be factory tested with water. The hydrostatic test shall be conducted by filling the structure with water and checking for leaks. Minimum test duration will be one hour. If air is used, 2 to 5 psi shall be used for 30 minutes. Data showing the structures to be leak-free will be supplied. The Owner or his representative may request to observe the test and/or review the test procedure specifics.

E. The ladders in the manholes, if specified, shall conform to OSHA requirements.

F. Top of the manhole shall be built to the requirements of the drawings. The minimum sheet thickness shall be 1" for non-traffic areas. If air testing is required, flanged tops or manways will be required. Reinforced concrete pads spanning the HDPE manhole will be required when HDPE manholes are used in traffic areas. A traffic rated frame and cover will be required. A professional engineer shall approve the design of the concrete pad. Those calculations must be included in the submittal.

G. Where large changes in temperature are expected, restraints shall be designed as an integral part of the manhole by the fabricator/manufacturer to prevent strain at the inlets or outlets. These restraints shall be cast into a concrete collar around the pipe. Anti-flotation and/or anti-settling anchor collars, if required, shall be designed as an integral part of the manhole by the fabricator/manufacturer of the manhole. Shop drawings, approved by the specifying engineer, shall be required for restraints, anchors, collars, etc. that are designed by the manhole fabricator/manufacturer prior to acceptance of the HDPE structures.

3.2 The high-density polyethylene manhole may be rejected for failure to meet any of the requirements of this specification. HANDLING OF MATERIALS

A. HDPE manholes shall be stored by the Contractor on clean, level, and dry ground to prevent undue scratching or gouging of the pipe. The handling of HDPE manholes shall be done in such a manner that there is no damage. Nylon slings are often used. The Contractor shall follow all manufacturers' instructions for handling.

3.3 FLANGED CONNECTIONS

A. Flange adapters (where shown in the drawings) shall be attached by the Contractor to HDPE manhole inlets and outlet stubs during fabrication by butt fusion welding per ASTM D 2657. A ductile iron back up ring will be used with each flanged connection. The rings will use a standard ANSI 150# bolt pattern. Check the drawings for materials required for corrosive conditions.

1. Bolts shall be tightened in a "star pattern" to recommended torque values.

2. Bolts must be tightened a second time after 24 hours to insure a positive seal.

3. Gaskets are not required on HDPE to HDPE connections.

3.4 PIPE JOINING

A. HDPE pipe shall be joined using butt fusion. All butt fusion welds shall be made as described in ASTM D 2657. Electro fusion welding can be used for making pipe welds. Hot air and extrusion welding are not permitted for pipe joining. All pipe and fittings welds shall be made using a data logger. The Contractor shall maintain records of the temperature, pressure, and graph of the fusion cycle.

B. Fused segments of pipe shall be handled so as to avoid damage to the pipe. Limit bending of the pipe welded to fittings or manholes. Nylon slings are preferred.

3.5 EQUIPMENT MOUNTING

A. Special provisions must be made when mounting pumps in an HDPE manhole. Bolting directly to the wall of the HDPE structure is never recommended.

3.6 DIRECT BURIAL INSTALLATION

A. The Contractor shall ensure the trench and trench bottom shall be constructed in accordance with ASTM D-2321, Section 6, Trench Excavation, and Section 7, Installation. The HDPE manhole shall be installed on a stable base consisting of 12" of Class I materials compacted to 95% proctor density per ASTM F

1759, Section 4.2. All required safety precautions for manhole installation are the responsibility of the Contractor.

B. The embedment materials shall be Class I or Class II materials as defined by ASTM D2321, Section 5, Materials. Class I materials are preferred. Backfill and bedding materials shall be free of debris.

C. Bedding of the manhole shall be performed in accordance with ASTM D 2321, Section 7.2. Compaction shall conform to Section 7.5 and 7.51.

D. Backfilling shall be shall be done to conform to the ASTM F 1759, Section 4.2, “Design Assumptions”. This Specification indicates that backfill shall extend at least 3.5 feet beyond the edge of the manhole for the full height of the manhole and extend laterally to undisturbed soils. Compaction shall be to 90% proctor density.

E. H-20 Highway Loads- Reinforced concrete pads spanning the HDPE manhole will be required when HDPE manholes are used in traffic areas. A traffic rated frame and cover will be required. A drawing showing key design features must be submitted as indicated in Section 1.4 of this specification.

END OF SECTION 02601

# SECTION 02676

# CELL LEACHATE COLLECTION SYSTEM

## PART 1 – GENERAL

Work covered shall consist of all activities including labor, materials, tools, equipment, incidentals, and services necessary for the procurement and installation of all required material for the construction of the leachate collection and removal system and associated appurtenances to the limits and locations indicated in the plans and specifications or as directed by the engineer.

This section details the materials and methods to be used by the Contractor for installing leachate collection pipe and other components of the leachate collection system.

### 1.1 SECTION INCLUDES

A. Construction quality control

B. Construction quality assurance

C. Delivery storage and handling

D. Qualifications

E. Products and materials

F. Geotextile cushion/bedding layer

G. Granular leachate drainage layer

H. Geotextile filter layer

I. Piping system materials

J. Surface acceptance and placement location

K. Equipment

L. Cushion geotextile

M. Drainage layer placement

N. HDPE pipe placement

O. Pipe acceptance

P. Installation of drainage layer

Q. Geotextile filter fabric

R. Tolerances

S. Warranty

1.2 RELATED SECTIONS

A. Section 01320 – Submittals

B. Section 01410 – Testing and Testing Laboratory Services

C. Section 02715 – HDPE Collection and Transport Pipe

D. Section 02245 – Geotextile

1.3 REFERENCES

A. ASTM D 638 - Test Method for Tensile Properties of Plastics

B. ASTM D 792 - Specific Gravity (Relative Density) and Density of Plastics by Displacement

C. ASTM D 1004 - Initial Tear Resistance of Plastic Film and Sheeting

D. ASTM D 1238 - Flow Rates of Thermoplastics by Extrusion Plastometer

E. ASTM D 1505 - Density of Plastics by the Density-Gradient Technique

F. ASTM D 1603 - Carbon Black in Olefin Plastics

G. ASTM D 2837 - HDPE Pipe

H. ASTM D 3261 - HDPE Fittings

I. ASTM D 4437 - Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembrane

J. ASTM D 4833 - Index Puncture Resistance of Geotextiles, Geomembrane, and Related Products

K. ASTM D 5199 - Measuring Nominal Thickness of Geotextiles and Geomembrane.

L. ASTM D 5397 (Appendix A) - Environmental Stress Crack Resistance of Polyolefin Geomembrane Using Single-Point Notched Constant Tensile Load Test

M. ASTM D 5994 - Measuring the Core Thickness of Textured Geomembrane

N. GRI GM6 - Standard Practice for Pressurized Air Channel Test for Dual Seamed Geomembrane

O. GRI GM12 - Asperity Measurement of Textured Geomembrane using a Depth Gage

## 1.4 SUBMITTALS

A. The Contractor shall submit information, reports, and documentation in accordance with Section-01320.

B. The Contractor shall submit to the Engineer, shop drawings of the following items:

1. Leachate collection pipe perforations
2. Sump pipe perforations
3. Sideslope riser pipe

C. The Contractor shall submit testing reports as required for geotextile, pipe, stone, and drainage material.

D. Pre-Construction Submittals: The Contractor shall submit the following to the Engineer within five (5) days of the shipment date:

1. Written list of the lot numbers and specific pipe to be shipped to the project site.
2. Manufacturer's Quality Control test results for pipe to be shipped to the project site indicating compliance with requirements.
3. Manufacturer's data for raw materials:
    a. Copy of quality control certificates issued by resin suppliers
    b. Production date(s) and batch numbers of resin
    c. Results of manufacturer's quality control tests indicating the quality of resin used to manufacture HDPE pipe assigned to the site conforms with Permit requirements
    d. Submit testing reports as required

E. Construction Submittals: The Contractor shall submit the following to the Engineer for review no later than two (2) days following placement:

1. Quality Control documentation by Contractor/Installer and CQA Consultant
2. Any revisions to the piping layout drawings
3. Updated Installation Schedules as construction progresses
4. Conformance test results, upon receipt

F. Post-Construction Submittals: The Contractor shall submit the following to the Engineer within seven (7) days of completion of each of the relevant components:

1. HDPE pipe installation certification

2. HDPE pipe warranty

3. Quality control test results

G. Upon project completion, the Contractor shall submit all warranties, instructions, installation information, operations and maintenance instructions, etc. as provide by the manufacturers of various equipment.

1.5 CONSTRUCTION QUALITY CONTROL

A. Construction Quality Control Program (CQC): Manufacturer/Contractor/Installer shall agree to participate in and conform to all items and requirements of quality assurance program as outlined herein and Section 02232 – Leachate Collection System Granular Drainage Layer, Section 02243 – Bedding/Cushion Geotextile Layer, Section 02245 – Geotextile Filter Fabric, and Section 02715 – HDPE Collection and Transport Piping.

B. Construction Quality Control monitoring shall be the responsibility of the Contractor and shall be conducted in accordance with the specifications. Quality control testing shall be in compliance with Section 01410. Field inspection and testing shall be performed by the Contractor and witnessed by CQA Consultant.

1.6 CONSTRUCTION QUALITY ASSURANCE

A. The Contractor shall submit a fifty-pound sample to the CQA Consultant of the gravel and sand to be used in the leachate drainage layer of the Cell for testing a minimum of thirty days prior to use to confirm the source meets the minimum specifications for use.

B. The Contractor shall submit the information required by Section 02243 – Bedding/Cushion Geotextile and Section 02245 – Geotextile Filter Fabric.

C. HDPE Pipe installation inspection by the CQA Consultant shall include:

1. Visual inspection for installation damage and conformance with the specifications

2. Observation/documentation of seals and/or welds

3. Observation/documentation of field seaming/welding, including:

a. Date and time of field seal connection fabrication

b. Seam/seal number, pipe numbers, and length of pipe

c. Identity of seamer/welder and equipment

d. Seaming/welding method

e. Weather conditions at the time of seaming/welding and any mitigate measures taken to address heat, cold, moisture, or wind

f. Complete description of field sampling procedure, number of test specimens, size of test specimens

g. Observation/documentation of non-destructive testing, including type of non-destructive test, results, identification of failures and subsequent repairs, and date(s) of retesting

D. HDPE Pipe conformance testing by the CQA Consultant shall include:

1. The Engineer may, at any time during the Contract, request additional testing of HDPE Pipe delivered to the site to ensure conformance with the required properties. The Manufacturer shall bear the costs of any failing tests.

1.7 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping:

1. HDPE pipes shall be packaged and shipped by appropriate means to prevent damage to the material and to facilitate off-loading.

2. The Contractor shall meet all requirements for shipping, handling, and storage of HDPE piping as specified in Section 02715 – HDPE Collection and Transport Piping.

1.8 QUALIFICATIONS

A. The manufacturer of the HDPE pipe shall meet the requirements listed in Section 02715 – HDPE Collection and Transport Piping.

B. Contractor/Installer:

1. The Contractor/Installer shall have at least 5 years continuous experience in installation of HDPE Pipe or similar products. The Contractor/Installer must demonstrate his acuity, by submitting a list of previous projects involving the utilization of similar construction practices.

2. Personnel performing seaming/connection seals (butt fusion and electro fusion) operations shall be qualified by experience.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MATERIALS

A. Material used for bedding gravel and pipe envelope in the leachate collection system shall be as specified in this specification.

B. Material used for geotextile bedding and filter layers shall be as specified in this specification.

2.2 GEOTEXTILE CUSHION/BEDDING LAYER

A. A geotextile bedding/cushion layer shall be placed between the geomembrane and the gravel leachate collection layer as shown in the Construction Drawings.

2.3 The geotextile bedding/cushion layer shall conform to the requirements contained in Section 02243 – Bedding/Cushion Layer.

A. A granular leachate collection and drainage layer shall be placed above the geomembrane that is a minimum of one (1) foot thick. The granular leachate collection layer shall consist of gravel as depicted in the Construction Drawings. Drainage layer material shall be compatible to municipal landfill leachate which is typically acidic and contain no more than five (5) percent carbonate material as determined by ASTM D 3042, modified for a pH of 4.0. An alternate material and/or thickness may be used if it is demonstrated to the satisfaction of the Owner that the material meets the requirements of the drainage layer characteristics of this section.

B. Gravel

1. Gravel drainage layer material shall be a non-carbonate, clean gravel conforming to the grain size distribution of ODOT #9 stone specifications Section 703, Table 703-1.

2. The permeability shall be a minimum of 3.0 cm/s and conform to requirements of Section 02232 – LCS Granular Drainage Layer.

2.4 GEOTEXTILE CUSHION LAYER

A. A geotextile cushion layer shall be placed between the geomembrane and the gravel leachate collection layer as shown in the Construction Drawings.

B. The geotextile bedding/cushion layer shall conform to the requirements contained in Section 02245 – Geotextile Filter Fabric.

2.5 PIPING SYSTEM MATERIALS

A. HDPE pipe shall be manufactured from high density PG 3408 polyethylene resin conforming to ASTM D 2837 and shall have the following diameter ratios or as depicted in the Construction Drawings:

1. 6-inch diameter perforated collection pipe SDR = 15.5

B. HDPE pipe shall meet the requirements Section 02715 – HDPE Collection and Transport Piping.

C. All fittings shall conform to ASTM D 3261 for HDPE fittings and Section 02715 – HDPE Collection and Transport Piping.

D. Pipes shall be joined by butt fusion into continuous lengths at the job site. The joints shall be sealed in such a way to prevent separation and meet the requirements of Section 02715 – HDPE Collection and Transport Piping.

E. The pipe shall be physically and chemically resistant to attack by the solid waste, leachate, or other materials that the pipe may come into contact with. Sealing materials shall also be physically and chemically resistant to the attack by the solid waste, leachate, or other materials the pipe may come into contact with.

## PART 3 – EXECUTION

### 3.1 SURFACE ACCEPTANCE AND PLACEMENT LOCATION

A. The Contractor/Installer shall remove debris, stones, etc. from the surface of the Geomembrane Liner prior to installation of the geotextile cushion layer and HDPE Pipe

B. Perforated pipe in accordance with Section 02715 – HDPE Collection and Transport Piping shall be used on the bottom portion of the leachate collection pipe placed right above the cell base, prior to installation of the drainage layer as depicted in the Construction Drawings.

### 3.2 EQUIPMENT

A. Equipment used for deployment shall not be operated on the cell liner.

B. Pipe deployment shall utilize hand and manual type equipment that shall not damage the cell liner.

C. Equipment used shall not damage the cell geomembrane by handling, trafficking, and leakage of hydrocarbons (such as gasoline or oil) or other means. Defects in material installation arising from the use of equipment shall be repaired by the Contractor at no cost to the Owner.

D. Direct equipment contact with components of the geosynthetic liner system shall be minimized. Pipe in traffic areas shall be protected by geotextiles, geomembrane, or other suitable materials.

### 3.3 CUSHION GEOTEXTILE

A. The cushion geotextile shall be placed by the Contractor above the geomembrane liner in all areas that will receive gravel for the leachate collection layer.

B. The cushion geotextile shall be placed in accordance with Section 02243 – Bedding/Cushion Geotextile and the manufacturer's recommendations.

### 3.4 DRAINAGE LAYER PLACEMENT

A. The drainage layer shall be placed by the Contractor on the landfill base geomembrane liner to maximize the effectiveness of the leachate collection system and provide a protective layer over the geomembrane layer.

B. The Contractor shall notify the Engineer twenty four (24) hours prior to the placement of the granular drainage layer to ensure that the CQA Consultant is present, as required, during placement of the granular drainage layer to document that the Contractor uses appropriate methods to make sure that no damage to the underlying geosynthetic material occurs, no excessive wrinkles in the underlying geosynthetic form, and that no unacceptable materials are placed.

C. The drainage layer shall be placed as promptly as work permits, but not until the underlying layers being covered have been properly constructed, tested, and documented as completed. Drainage materials shall be placed in accordance with Section 02232 – Leachate Collection System Granular Drainage Layer.

D. The Contractor shall verify that the top of the granular drainage layer conforms to the minimum thickness and slopes of the Contract Documents prior to notifying the CQA Consultant that the area is ready for certification surveying.

## 3.5 HDPE PIPE PLACEMENT

A. General Requirements

1. The Contractor shall notify CQA Consultant and the Engineer the day before the initiation of activities.

2. Personnel working on pipe shall not smoke, wear damaging shoes, or engage in other activities that could damage geomembrane.

3. Methods used to handle the HDPE pipe shall not cause scratches, dents or crimps in pipe.

B. Pipe Installation

1. The Contractor shall follow instructions from the manufacturer of the HDPE Pipe to ensure pipes are properly placed and prepared for making pipe connections. Pipes shall be installed in accordance with Section 02715 – HDPE Collection and Transport Pipe and manufacturer's recommendations.

2. Perforated collection lines shall be installed by the Contractor as depicted on the drawings. The pipe shall be bedded in gravel, as specified as detailed in the Construction Drawings. The completed collection line shall be protected with a geotextile wrap to prevent fine migration as depicted in the Construction Drawings.

3. All collection lines shall be laid to proper line and grade by the Contractor as depicted on the Drawing. All joints shall be tight and true. The pipe shall be carefully bedded and backfilled so as not to disturb the pipe alignment.

4. At all times, the Contractor shall prevent soil and other foreign material from entering the pipe. Whenever work progress is interrupted, suitable fittings shall be attached to pipe ends.

C. Weather Conditions

1. The Contractor shall not make connection at ambient temperatures below or above the manufacturer's suggested ambient temperature range for making connections.

2. The Contractor shall not make connections during precipitation, in presence of excessive moisture (e.g., fog, dew), or during excessive winds/dust.

D. Damage, Defects, and Repairs

1. The Contractor shall inspect each piece of pipe to ensure that undamaged pipe only shall be installed.

2. The Contractor shall broom or wash pipe if amount of dust or mud inhibits inspection of potentially damaged pipe.

3. Any pipe which, in judgment of the Engineer, becomes damaged (such as bent, dented, crimped or twisted) or suffers from other defects shall be replaced by the Contractor at no cost to the Owner.

4. The Contractor shall remove rejected damaged pipes from work area.

E. Materials in Contact with Pipe

1. The Contractor shall carefully install materials in contact with pipe surfaces to minimize damage potential. Geotextile wrap on the pipe must be intact after installation as protection for pipe

## 3.6 PIPE ACCEPTANCE

A. The Contractor/Installer shall retain ownership and responsibility for pipe until acceptance by the Owner. The Owner shall accept pipe installation when:

1. Installation is finished

2. Documentation of installation is completed, including Engineer's Report and reporting of all pipe test results

3. Confirmation of adequacy of pipe connections, including associated testing, is complete

## 3.7 INSTALLATION OF DRAINAGE LAYER

A. HPDE pipe shall be wrapped with Geotextile fabric and placed as depicted in the drawings. The drainage layer materials shall be placed around the pipe so that the geotextile fabric wrap on the pipe and the pipe are not damaged. Damaged geotextile wrap and pipe shall be removed and replaced by the Contractor at no cost to the Owner.

B. No equipment shall be used over the geomembrane liner or the pipe(s) that may cause any damage to the pipes. No dozers or similar equipment, including wheeled vehicles or track units shall be used in contact with the geomembrane liner or pipes.

C. The granular drainage layer shall be protected from the intrusion of material fines (less than #200 sieve material) through appropriate sedimentation control measures. In-place granular drainage material, which exhibits evidence of excessive material fines, shall be removed and replaced with appropriate material.

## 3.8 GEOTEXTILE FILTER FABRIC

A. The geotextile filter layer shall be placed by the Contractor above the granular leachate collection layer liner to protect it from clogging with material fines that migrate downward from the refuse and daily cover.

B. The geotextile filter layer shall be placed in accordance with Section 02245 – Geotextile Filter Fabric and the manufacturer's recommendations.

## 3.9 TOLERANCES

A. The Contractor shall complete leachate collection system construction within the following tolerances:

1. Elevations:

a. Leachate collection pipe, ±0.05 feet

2. Locations:

a. Leachate collection pipe, ±0.05 feet

## 3.10 WARRANTY

A. The Contractor shall provide to the Owner a guarantee that the system shall function as demonstrated for a period of at least one year after substantial completion. Performance bonds shall remain in effect for this period.

END OF SECTION 02676

# SECTION 02715

# HDPE COLLECTION AND TRANSPORT PIPE

## PART 1 – GENERAL

Work covered shall consist of all activities including labor, materials, tools, equipment, incidentals, and services necessary for the procurement and installation of all required collection and transport piping and associated appurtenances at locations and limits indicated in the plans and specifications or as directed by the engineer.

This section details the methods and materials for use by the Contractor furnishing pipes, fittings, and joining methods for the HDPE cell leachate collection pipe.

### 1.1 SECTION INCLUDES

A. Construction quality control

B. Delivery, storage, and handling

C. Contractor's work plan for HDPE installation

D. Materials

E. Pipe material schedule

F. Leachate collection piping

G. Fittings

H. General requirements

I. Pipe cutting and cleaning

J. Jointing method

K. Installation

L. Connections

M. Cleanouts

N. Repair of damaged sections

O. Cleanup

P. Warranty

### 1.2 RELATED SECTIONS

A. Section 01030 – Contractor's Safety and Health

B. Section 01320 – Submittals

C. Section 02218 – Landfill Materials Handling

D. Section 02225 – Trenching and Backfilling

E. Section 02676 – Leachate Collection System

1.3 REFERENCES

A. ASTM A 193 - Alloy Steel and Stainless Steel Bolting Materials for High Temperature Services

B. ASTM D 638 - Tensile Properties of Plastics

C. ASTM D 1248 - Polyethylene Plastics Molding and Extrusion Materials

D. ASTM D 3261 - Butt Heat Fusion Polyethylene (PE) Plastic Pipe Fittings for Polyethylene (PE) Plastic Pipe and Tubing

E. ASTM D 3035 - Polyethylene (PE) Plastic Pipe (SDR-PR) Based On Outside Diameter

F. ASTM D 3350 - Polyethylene Plastics Pipe and Fitting Materials

1.4 SUBMITTALS

A. The Contractor shall submit all information, reports, and documentation in accordance with Section 01320.

B. The Contractor shall submit to the Engineer in writing that the pipe furnished under this specification is in conformance with the material and mechanical requirements specified herein.

C. The Contractor shall submit product certification for pipes, fittings, and related components including material, grade, and class data.

D. The Contractor shall submit the manufacturer's specifications and shop drawings for all products.

E. The Contractor shall submit the current pipe welding certification for personnel performing this function. Welding certification shall be in conformance with pipe manufacturer's recommendations for installation of the pipe.

F. The Contractor shall submit as-built drawings indicating the actual location of all piping, valves, etc.

G. The Contractor shall provide a certificate from the pipe manufacturer(s) that the piping system is properly installed.

H. The Contractor shall submit the warranty.

## 1.5 CONSTRUCTION QUALITY CONTROL

A. The Contractor shall comply with the manufacturer's installation procedures, methods and recommendations, including Quality Control, for each specific piping material or product.

B. Each HDPE pipe length shall be clearly marked with the following:

1. Manufacturer's Name

2. Pipe Size

3. SDR or Ring Stiffness Constant Classification

4. Production Code Designating Plant Location, Machine, and Date of Manufacture

C. The CQA Consultant shall observe and review all in-place pipes before backfilling as to the lines, grades, bedding, proper joint construction, and temperature.

D. The CQA Consultant shall observe and review pipe and fittings before they are installed and shall reject any pipe that is damaged by handling or which is defective to a degree which shall materially affect the function and service of the pipe. Engineer's review of materials and workmanship does not relieve Contractor of full responsibility for a complete installation free of defects and leakage.

## 1.6 DELIVERY, STORAGE AND HANDLING

A. The Contractor shall provide on-site storage area(s) for HDPE Pipe from time of delivery until installation. Unloading, on-site handling, and storage of the pipes are the responsibility of the Contractor/Installer.

B. The Contractor shall exercise care in handling, placing the pipes, loading and unloading of all materials to avoid shock and surface abrasions. Lift pipes and fittings by hoists or lower on skid ways. Pipes and fittings shall not be dropped or dumped, or damaged.

C. All materials shall be suitably packed and properly protected by the Contractor for outdoor storage. Pipe shall be stored on wood supports placed on level ground, free of sharp objects that could damage the pipe. Contractor shall protect HDPE pipe from sunlight or temperature exposure (unless restrained in racks) by covering with a tarpaulin or other material as recommended by the manufacturer. The Contractor shall preserve integrity and readability of pipe labels.

D. Stacking of the polyethylene pipe shall follow the manufacturer's written instruction and shall be limited to a height that shall not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions. The pipe shall be spaced suitably, and of such widths as not to allow deformation of the pipe at the point of contact with the supports.

E. The handling of the joined pipeline by the Contractor shall be in such a manner that the pipe is not damaged by dragging over sharp and cutting objects. Ropes, fabric, or rubber-protected slings and straps shall be used when handling pipes. Chains, cables, or hooks inserted into the pipe ends shall not be used. Pipe or fittings shall not be dropped or damaged. Slings for handling the pipeline shall not be positioned at butt-fused joints. Sections of the pipes with cuts and gouges exceeding 10

percent of the pipe wall thickness or kinked sections shall be removed and the ends of the pipe rejoined.

F. Pipe that is cut, kinked, or otherwise damaged shall be removed from the Site by the Contractor. The Engineer shall have the authority to reject pipe, pipe fittings, pipe supports and anchors, and nuts and bolts for non-conformity to any of the provisions of these specifications.

G. The Contractor shall report any observed damage to the CQA Consultant or the Engineer.

1.7 CONTRACTOR'S WORK PLAN FOR HDPE PIPE INSTALLATION

A. The Contractor shall prepare a force main installation plan that shall contain the following information:

1. A schedule for the trench excavation and pipe installation work

2. A sequencing plan which limits the amount of work within the confines of the trench (i.e., welding sections of the pipe between manholes into individual pipe units on the surface and installing the pipe units in the trench)

3. Methods of restricting access to the pipe trench

4. Equipment and methods of excavating waste/residue in accordance to Section 02218 - Landfill Materials Handling

5. Equipment and methods for backfilling the trench in accordance to Section 02225 - Trenching and Backfilling, include provisions for temperature adjustment to HDPE piping

6. Materials and procedures for installing manholes and making pipe connections

7. Procedure for managing groundwater encountered in trench excavation

8. Identification of trees or other obstacles that need to be removed.

9. Other pertinent information for successfully completing the work

PART 2 – PRODUCTS

2.1 MATERIALS

A. The pipe manufacturer shall be listed with the Plastic Pipe Institute as meeting the recipe and mixing requirements of the resin manufacturer for the resin used to manufacture the pipe for this project. Pre-approved manufacturers include Phillips - Driscopipe, Inc. of Watsonville, California and Chevron - Plexco® of Bensenville, Illinois.

B. HDPE solid wall pipe and fittings shall be made from extra-high molecular weight, high-density polyethylene meeting the requirements of thermoplastics materials designation code PE 4710 or higher in accordance with ASTM D-3350. Resin used in the manufacturing of the pipe shall be new, first-quality, polyethylene resin. The addition of recycled polymer (from the manufacturing process) to resin shall be permitted if it does not exceed 2% by weight and is performed with appropriate cleanliness. The addition of reclaimed/recycled polymer to resin shall not be permitted. The polyethylene compound shall

be suitably protected against degradation by ultraviolet light by means of carbon black, well dispersed by pre-compounding in a concentration of not less than 2 percent. The fittings shall be HDPE, molded or fabricated by same manufacturer as the pipe.

C. Solid wall pipe and fittings shall be homogenous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density, and other physical properties.

D. HDPE pipe and fittings shall be manufactured in accordance with the requirements of ASTM F 894-85 for profile pipe and ASTM F 714 for solid wall DR pipe.

2.2 PIPE MATERIAL SCHEDULE

A. HDPE Cell leachate collection pipe shall have a diameter as indicated on the drawings with a numerical Standard Dimension Ratio (SDR) of 15.5 or less.

B. HDPE fittings shall be molded or fabricated from material which is compatible with the pipe for the purpose of fusion welding, have the same or numerically smaller SDR than pipe connecting to the fitting, and be free from cracks, holes, foreign intrusions, voids, or other defects.

C. Mechanical connections shall utilize ANSI Class 150, convoluted, 316 stainless steel back-up rings with standard dimensions meeting ANSI B16.5. Flanges shall be complete with one-piece, HDPE molded flange adapters. Flanged connections shall have the same or greater pressure rating as the pipe.

D. The bolts and nuts used for mechanical joining shall be 304-stainless steel for above grades service and 316-stainless steel below grade. For stainless 316 bolts, apply anti-seize compound and torque as recommended by the Manufacturer.

E. The Contractor shall provide all other materials not specifically described herein but that are required for complete and proper installation.

2.3 LEACHATE COLLECTION PIPING (Perforated Pipe)

A. Pipe supplied under this specification shall have IPS (Iron Pipe Size) OD unless otherwise specified.

B. The perforated piping shall have an OD of 6.625” and SDR 15.5, unless otherwise specified on the plans. Hole’s size shall be 3/8”. Four holes, at 90 degrees, on six-inch centers will be drilled in the pipe. To maintain accuracy and uniformity, the pipe is to be drilled by a machine designed for perforating HDPE pipe. No drilling by hand will be allowed.

2.4 FITTINGS

A. All molded fittings and fabricated fittings shall be fully pressure rated to match the pipe SDR pressure rating to which they are made. All fittings shall be molded or fabricated by the manufacturer. No Contractor fabricated fittings shall be used unless approved by the Engineer.

B. The manufacturer of the HDPE pipe shall supply all HDPE fittings and accessories as well as any adapters and/or specials required to perform the work as shown on the Drawings and specified herein.

C. All fittings shall be installed using butt-fused fittings, thermo-fused fittings/couplings, or flanged adapters and must be approved by the Engineer. No size on size wet taps shall be permitted.

D. All transitions from HDPE pipe to stainless steel or PVC shall be made per the approval of the Engineer and per the HDPE pipe manufacturer's recommendations and specifications. 316 stainless steel back-up rings shall mate with 316 stainless steel flanges per ANSI B16.1.

1. Transition from HDPE to stainless steel fittings and valves shall be approved by the Engineer before installation.

2. Fittings and transitions shall be as manufactured by Phillips Driscopipe, Inc., 1000 Series Pressure Pipe, Chevron Chemical Company Plexco/Spiralite pipe, or equal.

3. The pipe supplier must certify compliance with the above requirements.

## PART 3 – INSTALLATION

### 3.1 GENERAL REQUIREMENTS

A. All HDPE pipe shall be cut, fabricated, and installed in strict conformance with pipe manufacturer's recommendations. Joining, laying, and pulling of HDPE pipe shall be accomplished by personnel experienced in working with HDPE pipe.

B. The pipe manufacturer shall certify in writing that the Contractor is qualified to join, lay, and pull the pipe, or a representative of the pipe manufacturer shall be on-site to oversee the pipe joining.

C. The Contractor shall verify all pipe dimensions, alignments, and the locations of associated facilities prior to fabrication or installation.

D. The Contractor shall prepare proposed alignment changes for review and approval by the Engineer, in the event obstructions not depicted on the Construction drawings or conflicts with other improvements are encountered during the progress of the work. The Contractor shall not proceed until the proposed realignment is reviewed and written notice is received from the Engineer to continue installation of the pipe.

### 3.2 PIPE CUTTING AND CLEANING

A. Pipe cutting shall be done only with mechanical cutters and cuttings shall be removed from the pipe prior to final acceptance.

B. The Contractor shall take precautions to prevent debris from pipe cutting or fusing, stones, dirt, or any other material from entering the pipe.

C. Pipe shall be cleaned in sections not exceeding 120 feet before connecting it to the remainder of the piping system. The Contractor shall demonstrate to the Engineer that the cleaning method is sufficient to remove cuttings and debris from the pipe over the entire section being cleaned.

D. The Contractor shall clean out the inlet and outlet portions of the piping system at the completion of the work.

## 3.3 JOINTING METHOD

A. The pipe shall be joined by the Contractor with butt, heat fusion joints as outlined in ASTM D2657. All joints shall be made in strict compliance with the manufacturer's recommendations. A factory qualified joining technician as designated by pipe manufacturer or experienced, trained technician shall perform all heat fusion joints in the presence of the CQA Consultant. No pipe shall be installed prior to submittal of the verification of qualifications.

B. Lengths of pipe shall be assembled into suitable installation lengths by the Contractor by the butt fusion process. All pipes so joined shall be made from the same class and type of raw material made by the same raw material supplier. Pipe shall be furnished in standard laying lengths not to exceed 50 feet and no shorter than 20 feet.

C. On days butt fusions are to be made, the first fusion by the Contractor shall be a trial fusion in the presence of the CQA Consultant The following shall apply:

1. Heating plates shall be inspected for cuts and scrapes. The plate temperature shall be measured at various locations to ensure proper heating/melting per manufacturer's recommendations and approval by the CQA Consultant.

2. The fusion or test section shall be cut out after cooling completely for inspection.

3. The test section shall be 12" or 30 times (minimum) the wall thickness in length and 1" or 1.5 times the wall thickness in width (minimum).

4. The joint shall be visually inspected as to continuity of "beads" from the melted material, and for assurance of "cold joint" prevention (i.e. – joint shall have visible molded material between walls of pipe). Joint spacing between the walls of the two ends shall be a minimum of 1/16" to a maximum 3/16".

D. The Contractor shall provide cover over the fusion machine during pipe welding operations during precipitation to ensure that moisture does not come into contact with the piping while welding. Costs for working during precipitation events shall be incidental to the project.

E. Verify correct alignment when making joints. Friction or lever pullers or other approved means of insuring alignment shall be used.

F. Pipe and fittings shall be jointed with as small a deviation as possible at the joints so that inverts present a smooth surface. Pipes and fittings that do not form a tight fitting joint shall be rejected.

G. The polyethylene flange adapters at pipe material transitions shall be backed up by stainless steel flanges conforming to ANSI B16.1 and shaped as necessary to suit the outside dimensions of the pipe. The flange adapter assemblies shall be connected with corrosion resisting bolts and nuts of Type 316 Stainless Steel as specified in ASTM A726 and ASTM A307. All bolts shall be tightened to the manufacturer's specified torques. Bolts shall be tightened alternatively and evenly. After installation apply a bitumastic coating to bolts and nuts.

## 3.4 INSTALLATION

A. Trenching, bedding, and backfilling shall conform to Section 02225- Trenching and Backfilling.

B. Any waste materials encountered during excavation of the trench shall be handled in accordance with 02218 - Landfill Materials Handling

C. Before the pipe is placed in position in the trench, the bottom and sides of the trench shall be carefully prepared, the required bedding placed, and bracing and sheeting installed. The trench shall be excavated to the dimensions shown on the Construction drawings. Each pipe shall be accurately placed to the line and grade called for on the drawings. Grade shall be controlled by a laser beam or batter boards and a Mason's line. All equipment for maintaining grade shall be furnished by the Contractor.

D. All pipe and fittings shall be inspected before they are installed.

E. Pipe lying shall proceed upgrade, starting at the lower end of the grade with the bells uphill.

F. If the trench bottom does not provide a firm and stable working platform, sufficient material shall be removed and replaced with approved compacted materials to provide a firm foundation for the pipe.

G. Pipe trenches shall be kept free from water during pipe laying, jointing and until sufficient backfill has been placed to prevent flotation of the pipe. The minimum height of backfill to prevent flotation may be obtained from the Engineer. The Contractor may use sump pumps, well points, or other devices to remove water from the trench bottom. Small puddles that are no closer than 4" from the bottom of the pipe are acceptable. The Contractor shall provide ample means and devices to promptly remove and dispose of all water from any source entering the trench.

H. No connection shall be made where joint surfaces and joint materials have been soiled by earth in handling until such surfaces are thoroughly cleaned by washing and wiping.

I. As the work progresses, the interior of all pipes shall be kept clean. After each line of pipe has been laid, it shall be carefully inspected and all earth, debris, trash, rags, and other foreign matter removed from the interior.

J. Pipe bedding shall be placed in accordance with the Construction Drawings and as recommended by the pipe manufacturer.

K. Backfilling of trenches shall be started immediately after the pipe is placed in the trench in accordance with the Construction Drawings and as recommended by the manufacturer.

L. If necessary shoring, sheeting, or trench shields shall be utilized in such a manner as to minimize disturbance of the backfill material beneath the pipe crown. Trench sheeting that extends below the crown should either be left permanently in place or consist of adequately supported steel sheets 1" (one inch) thick or less which can be extracted with minimal disturbance to the pipe embedment. Where moveable trench shields are used, the following steps shall be followed unless an alternate technique that does not disturb the pipe embedment can be demonstrated:

1. Excavation of the trench below the elevation of the pipe crown shall be done from inside of the trench shield to prevent the accumulation of loose or sloughed material along the outside of the shield. Excavation of the trench ahead of the shield at an elevation below the pipe crown is not permitted unless approved by the Engineer.

2. After laying the pipe in the trench, bedding and pipe embedment shall be placed in lifts and the shield must be lifted in steps. As the shield is lifted, embedment material shall be shoveled under the shield so as to fill all voids left by the removal of the shield.

M. Bedding Material. Bedding material to be selected by Engineer. (Note to Engineer: Bedding material to be selected by evaluating depth of cover and E' required to control deflection and buckling.)

N. Backfill material placed under the pipe haunches shall be thoroughly shovel sliced along the length of the pipe.

O. Where compaction of backfill materials is required, compact by mechanical means. Suitable mechanical means includes vibratory sleds, gasoline driven impact tampers, and air driven impact tampers or other approved means. Compact to a minimum of 95 percent Standard Proctor or as required by the Engineer.

P. Pipe embedment soil shall be placed in lifts as follows:

1. Lift thickness shall not exceed 6 inches

Q. After completing backfill in the pipe zone the trench shall be backfilled to grade with native soil.

R. HDPE pipe shall not be subject to a roller or wheel loads until a minimum of one diameter or 24" (whichever is larger) of backfill has been placed over the top of the pipe.

## 3.5 CONNECTIONS

A. Connections to existing lines shall be made by coupling a piece of smooth O.D. HDPE pipe to the existing line. The coupling shall be a flexible elastomeric boot with stainless steel clamps. The coupling is to be encased in cement stabilized sand, grout, or concrete.

B. Connections to concrete manholes shall be made using smooth O.D. pipe and water stops, solid wall pipe cast into the concrete, or via elastomeric sleeves or gaskets precast in the manhole. Since the particular technique used is highly dependent on the construction method these connections cannot be guaranteed by the manufacturer to be leak free.

C. Connections to HDPE manholes shall be made using closure pieces with shoulder gaskets. After completion of any section of the line, the grades, joints, and alignment shall be true to line and grade. There shall be no visual leakage and the pipeline shall be completely free from any cracks and from protruding joint materials, deposits of sand, mortar or other materials on the inside to the satisfaction of the Engineer.

D. At the Engineer's request, a deflection test shall be performed by the Contractor. The deflection can be measured mechanically by a mandrel or manually using an extension ruler. The final deflection test shall not be made on a section of pipe until all the backfill on that section has been in-place for 30 days. However, the Contractor shall deflection test the first 300-400 feet of pipe after it has been backfilled in order to verify that the installation procedures are adequate to meet the requirements of the contract. No additional pipe shall be laid until this test has been successfully completed. Pipe deflection may be determined by direct vertical measurement of no less than 4 equally spaced points in each pipe section or by pulling a mandrel.

E. For solid wall PE pipe deflection shall not exceed 5 percent of the I.D. For profile pipe, deflection shall not exceed 5 percent of base I.D. All excess deflections shall be corrected. The Contractor shall correct the deficiency and retest the pipe.

F. The Contractor shall conduct leak testing in general accordance with ASTM F1417-92 Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air. Testing shall be conducted in accordance with all applicable safety standards.

Testing Procedure:

- Follow ASTM F 1417-92 Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air.
- Disconnect any equipment that may be damaged from pneumatic pressure testing.
- Verify that the ends of the secondary containment pipe are sealed, seal ends if necessary and block any pipes/equipment that may move under pressure.
- Drill holes in the secondary containment pipe at both ends at the end caps installed or at existing end caps in structures, if extending an existing section.
- Install a pressure gauge at one end of the section to be tested and apply pressure at the opposite end (can be altered to avoid unnecessary equipment re-location).
- Verify containment pipe continuity by observing a pressure reading at the gauge during application of pressure. Verify that the inner conveyance pipe is not a source of pressure loss at either end the of the test section before proceeding to apply the full test pressure.
- Apply 10 PSI to the sections, or a pressure equal to the pressure rating of the lowest pressure rated component in the section, whichever is less.
- Allow pressure on the section according to ASTM 1417-92 time requirements as shown:

| Pipe Diameter (inches) | Minimum Test Duration (minutes) | | | |
|---|---|---|---|---|
| | Less than 500 ft. | 500 ft. to 1000 ft. | 1000 ft. to 2000 ft. | 2000 ft. to 4000 ft. |
| <4 | 3.25 | 6.5 | 13 | 25.5 |
| 4 | 3.25 | 6.5 | 13 | 25.5 |
| 6 | 7.5 | 15 | 30 | 60 |

- Pass/fail criteria – if no leakage is detected through the inner conveyance pipe, and the pressure loss during the test period does not exceed 1 PSIG, then a passing test is indicated for the section.
- Slowly relieve the pressure in the section.
- Remove the pressure gauge.
- Remove the end cap or thread a cap screw into the hole drilled for the test gauge; if at an existing structure.
- Remove the supply line.
- Remove the end cap or thread a cap screw into the hole drilled for the supply line if at an existing structure.
- Reconnect any disconnected equipment in the existing structures.
- Open/close and operate the existing system according to the site's standard operational procedures.

General Repair Methods:
When a section of the dual contained forcemain pipe is determined to be leaking according to the pneumatic test, then the following general method shall be employed to repair the section.

- After sufficient pneumatic testing has been performed to isolate a leaking section and no visual damage/leak is observed, then the leaking section of force main shall be removed.
- If a leak is located along a section of forcemain, then a new section of dual contained forcemain shall be spliced into the existing system. Spacers should be installed in the ends of the dual contained forcemain to line up the replacement piping.
- If a leak is located in a fitting, the damaged fitting shall be removed and replaced by splicing a new one into the system. Spacers shall be used to line up the piping.
- If a leak is located at a structure, a section of pipe maybe removed and replaced using spacers to line up the new piping.
- No fusion couplings shall be used in any of the repairs to the forcemain or splicing sections back together.
- Leaks regarding unique circumstances will be repaired according to whatever method is deemed most effective in the field.
- All repaired sections of forcemain shall be pneumatically tested after repairs to verify the adequateness of the repairs.

3.6 CLEANOUTS

A. Cleanouts for leachate piping are shown in the Construction Drawings.

2.5 REPAIR OF DAMAGED SECTIONS

A. Segments of pipe having cuts or gouges in excess of 10% of the wall thickness of the pipe shall be cut out and removed. The undamaged portion of pipe can be rejoined after a new piece has been welded to the pipe

2.6 CLEANUP

A. After completing each section of the leachate collection line, the Contractor shall remove all debris, construction materials, and equipment from the site of the work, grade, and smooth over the surface on both sides of the line and leave the area in a clean, neat, and serviceable condition.

2.7 WARRANTY

A. The Contractor shall warranty the piping systems supplied to the Owner against defects in workmanship and material for a period of 1 year from the date of acceptance of the project by the Owner and Engineer. The warranty shall be in printed form and apply to all products specified in this Section.

END OF SECTION 02715

# SECTION 02920

# VEGETATIVE COVER FOR POST-CONSTRUCTION

## PART 1 – GENERAL

Work covered shall consist of all activities including labor, materials, tools, equipment, incidentals, and services necessary for the installation of a vegetative cover for final and/or temporary stabilization as required and associated items at locations and limits indicated in the plans and specifications or as directed by the engineer.

This section details the methods and materials used by the Contractor to prepare the soil layer for vegetative cover, for placement of amendments, and finishing of the emended surface soil layer.

### 1.1 SECTION INCLUDES

A. Amendment certification testing

B. Construction quality control

C. Amendments

D. Amended soil

E. Preparation of surface soil layer

F. Placement of amendments

G. Finishing of amended surface soil

### 1.2 RELATED WORK

A. Section 01050 – Field Engineering

B. Section 01320 – Submittals

C. Section 01410 – Testing and Testing Laboratory Services

D. Section 02270 – Construction Erosion and Sediment Control

E. Section 02936 – Seeding

### 1.3 REFERENCES

A. ASTM D 420 - Site Characterization for Engineering, Design, and Construction Purposes

B. ASTM D 422 - Particle Size Analysis of Soils

C. ASTM D 2216 - Laboratory Determination of Water (Moisture) Content of Soil and Rock

D. ASTM D 2974 - Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

E. ASTM D 4972 - pH of Soils

F. State of Ohio, Department of Transportation, Construction and Material Specifications, 1997

G. Predicting Rainfall Erosion Losses, Agriculture Handbook No. 537, U.S. Department of Agriculture, 1978

1.4 SUBMITTALS

A. The Contractor shall submit all information, reports, and documentation in accordance with Section 01320.

B. Information on amendments and their sources shall be submitted to the Engineer. At a minimum, this information shall include:

1. The type and estimated quantity of material to be provided

2. The results of previous index property and/or chemical analysis tests representative of the proposed amendments

3. A copy of required U.S. Army Corps of Engineers permits for dredging or the destruction of wetlands, if necessary and available.

1.5 AMENDMENT CERTIFICATION TESTING (Optional)

A. The Contractor shall arrange sampling and testing of potential amendments. Amendment sampling and subsequent analysis (physical and chemical) shall be performed by a qualified testing laboratory in accordance with Section 01410 – Testing and Testing Laboratory Services. Pre-certification submittals described in Paragraph 1.4 shall be provided to the Engineer at least 5 working days in advance of the sampling event.

B. A minimum of five (5) discrete samples shall be taken for each amendment.

C. The following index tests shall be performed on each discrete sample:

| Property | Standard | Minimal Frequency |
|---|---|---|
| Moisture Content | ASTM D22161 | 1 test |
| Organic Content | ASTM D29741 | 1 test |

1.6 CONSTRUCTION QUALITY CONTROL

A. Field inspection and testing shall be performed under provisions of this Specification and Section 01410 – Testing and Laboratory Testing Services.

B. Field measurements by means accepted as industry standard shall be performed by the CQA Contractor to verify proper layer thicknesses. Thickness measurements for each layer placed shall be collected at the node points of a uniform 100-ft by 100-ft grid established for layout purposes (See Section 01050 – Field Engineering).

C. Visual inspections not limited to the following shall be performed by the Contractor and documented in Daily Field Reports noting:

1. The character and condition of the placement surface

2. Pertinent methods of placement and physical properties of amendments

3. Amendment mixing and disking procedures

4. Effects of equipment on the construction surface

5. Obtain conformance samples of in-place amended soils and perform the following testing:

| Property | Standard | Minimal Frequency |
|---|---|---|
| Organic Content | ASTM D 29741 | 1 per 250,000 $ft^2$ |
| Soil pH | ASTM D 49721 | 1 per 250,000 $ft^2$ |
| Nitrogen/Phosphorous/Soluble Potash | Industry Standard | 1 per 250,000 $ft^2$ |

## PART 2 – PRODUCTS

### 2.1 AMENDMENTS

A. The Contractor shall provide compost containing natural organic matter or material of a generally humus nature capable of sustaining plant growth, free of stones, lumps of soil or other inorganic material greater than two inches. Composts derived from organic wastes such as food and agricultural residues, animal manure, or leaves shall be approved by the Owner's representative before application.

Compost derived from mulched and chipped vegetation from site clearing shall be considered as an alternative. It is the Contractor's responsibility to demonstrate the equivalency of such an alternative product.

B. The Contractor shall provide pulverized agricultural limestone meeting the requirements of ODOT 659.02.

C. Other amendments may be used contingent upon approval from the Owner's representative.

### 2.2 AMENDED SOIL

A. The Contractor shall add amendments to the upper 6-inches of soil to achieve an organic content of not less than 4 percent or more than 10 percent, maintaining a minimum soil pH of 6.0 and a maximum soil pH of 8.0.

B. The upper 6-inches of amended soil shall have a Soil Erodability Factor less than 0.3, as established for use with the Universal Soil Loss Equation.

PART 3 – EXECUTION

3.1 PREPARATION OF SURFACE SOIL LAYER

A. The Contractor shall prepare the surface of the soil to eliminate uneven areas and low spots and maintain lines, levels, profiles, and contours as designed. Changes in grade shall be gradual. The Contractor shall blend slopes into level areas.

B. The Contractor shall remove: stones over 2 inches in any dimension, foreign materials, weeds, plants, and roots.

C. The Contractor shall scarify the surface soil to a depth of 6 inches throughout. Repeat in areas where equipment used for hauling or spreading has compacted the underlying soils.

3.2 PLACEMENT OF AMENDMENTS

A. The Contractor shall place agricultural limestone and/or compost as needed to provide a vegetative layer meeting the specified criteria.

B. The Contractor shall base proportions of amendments to vegetative cover on recommendations of Ohio State Agricultural Laboratory, or approved equal.

3.3 FINISHING OF AMENDED SURFACE SOIL

A. The Contractor shall scarify the surface to a depth of 6-inches, thoroughly blending surface soil and amendments. Repeat in areas where equipment used for hauling or spreading has compacted the upper 6 inches.

B. The Contractor shall prepare the surface of the soil to eliminate uneven areas and low spots and maintain lines, levels, profiles, and contours as designed. Changes in grade shall be gradual. The Contractor shall blend slopes into level areas.

C. The Contractor shall remove stones over 2-inches in any dimension, foreign materials, weeds, and undesirable plants and their roots.

END OF SECTION 02920

# SECTION 02936

# SEEDING

## PART 1 – GENERAL

Work covered shall consist of all activities including labor, materials, tools, equipment, incidentals, and services necessary for seeding (final and/or temporary stabilization) operations and associated items at locations and limits indicated in the plans and specifications or as directed by the engineer.

This section details the methods and materials used by the Contractor to conduct inspections, fertilization, seeding, mulching, and maintenance of the work.

### 1.1 SECTION INCLUDES

A. Substitutions

B. Acceptance

C. Delivery, storage, and handling

D. Warranty

E. Seed mixture

F. Soil materials

G. Accessories

H. Inspection

I. Fertilization and seeding

J. Mulching

K. Maintenance

### 1.2 RELATED WORK

A. Section 02270 – Construction Erosion and Sediment Control

B. Section 02272 – Erosion Control Fabric

C. Section 02920 – Vegetative Cover for Post Construction

### 1.3 REFERENCES

A. State of Ohio, Department of Transportation, Construction and Material Specifications, 1997.

1.4 SUBMITTALS

A. The Contractor shall submit all information, reports, and documentation in accordance with Section 01320.

1.5 SUBSTITUTIONS

A. Substitution of an alternate species may be accepted upon written approval from the Engineer, and without any increase in unit cost.

1.6 ACCEPTANCE

A. There shall be no partial acceptance of vegetative cover.

B. Final acceptance of grasses shall be given when the following conditions are met:

1. There are no bare spots larger than 1 (one) square foot. A bare area is defined as one square foot with a population of seeded grasses less than 120 live grass plants.

2. The total area of bare spots within a given acre does not exceed 5 percent.

3. Upon Contractor's request, final acceptance shall be made within fifteen (15) working days of date of notice to the Owner if contracted work has been satisfactorily completed at the end of the warranty period.

1.7 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall properly store products to prevent damage.

B. The Contractor shall deliver fertilizer in waterproof bags showing weight, chemical analysis and name of manufacturer.

C. The Contractor shall deliver seeds in separate varieties, separately packaged or bagged, and clearly labeled, tagged, and marked.

1.8 WARRANTY

A. The Contractor shall provide at least 1-year warranty on all vegetative cover. The warranty period commences after substantial completion of the seeding and mulching work.

B. The Contractor shall replace vegetative cover that fails during the warranty period according to the specifications.

C. The Contractor shall periodically inspect and water areas of vegetative cover for proper watering and spraying, during warranty period.

D. Vegetative cover which dies due to insects, diseases, drought, or flood is included in the warranty.

PART 2 – PRODUCTS

2.1 SEED MIXTURE

A. All seed shall be approved by the State of Ohio, Department of Agriculture, and Division of Plant Industry; and shall meet current ODOT specifications as to percentage purity, weed seed, and germination.

B. The Contractor shall select the appropriate standard seed mixtures based on the application (cover or slopes) for planting when the forecasted daily high temperature is above 55° F:

| Species | Typical Cover (<10%) | Side Slopes (>10H:1V) |
|---|---|---|
| Improved Perennial Ryegrass | 50% | 60% |
| Turf Type Tall Fescue | 25% | 30% |
| Improved Kentucky Bluegrass | 25% | 10% |

Alternatively, the Contractor may select a seed mixture that conforms with ODOT 659 Class 2 Roadside Mixture

C. The Contractor shall use the following grass varieties and seed counts for the above mixtures (Pennington®, or equal):

1. Improved Perennial Ryegrass (250,000 seeds per lb.)

2. Turf Type Tall Fescue (200,000 seeds per lb.)

3. Improved Kentucky Bluegrass (1,250,000 seeds per lb.)

D. For dormant seeding, when the forecasted daily high temperature is below 40° F, the Contractor shall add wheat or oats at a rate of 4 lb. per 1,000 sq. ft. to the standard seed mix.

2.2 SOIL MATERIALS

A. Vegetative Cover for Post Construction: See Section 02920 for material specifications.

2.3 ACCESSORIES

A. Fertilizer: The Contractor shall use a commercial fertilizer obtained from a dealer or manufacturer registered or licensed by the State of Ohio, Department of Agriculture. Fertilizer may be dry or liquid.

B. Straw Mulch: The Contractor shall provide dry stalks from oats, wheat, rye, barley, or rice that are free from weeds, mold, or foreign matter detrimental to plant life.

C. Cellulose Fiber Mulch: The Contractor shall provide specially prepared cellulose fiber for use with hydraulically applied seed and fertilizer, dyed dark green or brown to facilitate visual metering of the application, a pH range from 4.5 to 7.0, and contain no growth or germination-inhibiting factors.

D. Water: The Contractor shall use clean, fresh water free of substances or matter that could inhibit vigorous growth of grass. The Contractor shall identify the water source at least two weeks prior to use. The use of river water is prohibited.

E. Binding agent: The Contractor shall use natural, gum based tacking agent (Terra-Tack™, or equal).

F. Erosion Control Fabric: The Contractor shall use fabric meeting the requirements of Section 02272.

PART 3 - EXECUTION

3.1 INSPECTION

A. The Contractor shall verify that the surface soil is prepared and is ready to receive the work of this Section.

B. Beginning of installation means acceptance of existing site conditions by the Contractor.

3.2 FERTILIZING AND SEEDING (DRY SOWN)

A. The Contractor shall apply fertilizer, with a composition of 10% nitrogen, 20% phosphoric acid, and 10% soluble potash, at a rate of 20 lb. per 1,000 sq. ft. Distribute in an even pattern over the specified area. Alternate ratios and rates may be used based on the results of agronomy testing, as approved.

B. The Contractor shall use a disk, harrow, or rake the vegetative cover soil to a depth of at least 2 inches, thoroughly incorporating the fertilizer. Lightly water to aid the dissipation of fertilizer.

C. The Contractor shall not apply fertilizer at same time or with same machine as shall be used to apply seed.

D. The Contractor shall not sow immediately following rain, when ground is too dry, or during windy periods. If the seedbed becomes compacted prior to seeding, it shall be re-disked or loosened to a friable condition before seeding.

E. The Contractor shall apply seed with a rotary or drop type distributor at a minimum rate of 2.5 lb. per 1,000 sq. ft. evenly in 2 intersecting directions for a total of 5 lb. per 1,000 sq. ft. On side slopes, 10H:1V or steeper, apply seed at a minimum rate of 6 lb. per 1,000 sq. ft. Do not seed area in excess of that which can be mulched on same day.

F. After seeding, the Contractor shall rake or drag surface of soil lightly to incorporate seed into top 1/4-inch of soil.

3.3 FERTILIZING AND SEEDING (HYDRAULICALLY)

A. The Contractor shall apply seed, fertilizer, and cellulose fiber mulch, spraying them on the previously prepared seed bed in the form of an aqueous mixture at a rate not less than 1,000 gallons per acre.

1. The rate of seed application shall be a minimum of 5 lb. per 1,000 sq. ft. on all areas with slopes less than 10%. The rate of seed application shall be a minimum of 6 lb. per 1,000 sq. ft. on side slopes 10H:1V or steeper.

2. The rate of fertilizer application shall be 20 lb. per 1,000 sq. ft., with a composition of 10% nitrogen, 20% phosphoric acid, and 10% soluble potash.

B. Mixtures shall be constantly agitated by the Contractor from the time they are mixed until they are applied to the seedbed. Mixtures shall be used within 8 hours of the time at which they were mixed, or after 8 hours they shall be disposed at approved locations.

C. The Contractor shall apply the mixture by means of a high-pressure spray which shall be directed upward into the air so that the mixture shall fall to the ground like rain in a uniform spray. Nozzles or sprays shall not be directed toward the ground in such a manner as might produce erosion or runoff.

D. The Contractor shall exercise particular care to ensure uniform application at the prescribed rate, guarding against misses and overlapped areas. Use proper, predetermined quantities of the mixture to cover known areas. Checks on the uniformity and rate of application shall be made by distributing test sheets of paper or dishes over the area and observing the quantity of material deposited thereon.

## 3.4 MULCHING

A. Straw Mulch

1. Within 24 hours of seeding, the Contractor shall uniformly spread straw mulch over seeded areas. A mechanical blower may be used. Apply straw mulch at the specified rate for the following seeded areas:

| | Dry Sown Seed | Hydro-Seed |
|---|---|---|
| Typical Cover (<10%) | 2.0 tons/acre | 1.5 tons/acre |
| Side Slopes (>10H:1V) | 2.5 tons/acre | 2.0 tons/acre |

Note: Do not apply straw mulch were erosion control fabric is specified. Install erosion control fabric in accordance with Section 02272 – Erosion Control Fabric and the drawings.

2. The Contractor shall anchor straw mulch as follows:

a. In-line disking parallel to surface contours. Disking should crimp straw into the surface of the vegetative soil cover. Disks should be spaced a maximum of 1 ft. apart.

b. Binding agent: Natural, gum-based tacking agent (Terra-Tack™, or equal) applied per the manufacturer's recommendations.

B. Cellulose Fiber Mulch

1. The Contractor shall apply cellulose fiber mulch with hydraulically applied seed and fertilizer. After addition and agitation in slurry tanks, the fibers shall be uniformly suspended to form homogeneous slurry.

2. The Contractor shall apply cellulose fiber mulch at a rate of 46 lb. per 1,000 sq. ft.; and provide cellulose fiber containing not more than 2 percent moisture on an air-dry weight basis.

3. The cellulose fiber mulch shall form a blotter-like cover uniformly impregnated with seed when hydraulically sprayed on the ground. The cover shall allow the absorption of moisture to the underlying soil.

## 3.5 MAINTENANCE

A. Monthly inspections by Owner shall be conducted to monitor the performance of the established vegetation. Additional inspections may be warranted subsequent to large storm events. These inspections shall address and/or verify the following:

1. A healthy, self-sustained vegetative cover is present over the entire extent of the cover.

2. Signs of erosion are not present upon visual inspection.

3. Surface drainage systems are in good condition and provide effective drainage.

B. Areas requiring corrective actions by the Contractor as observed during the monthly inspections shall be documented in a report to the Engineer. The Contractor shall perform corrective actions at the earliest possible convenience, but no later than May 15th of the year following seeding work. Examples of corrective actions include:

1. Filling rills and gullies deeper than 2 inches

2. Fertilization and re-seeding of bare spots

3. Restoration of missing or damaged erosion control measures (permanent or temporary)

4. Placement of additional erosion control measures as directed by the Engineer.

END OF SECTION 02936