

1
2
3
4

**APPENDIX 4A – SECTION 2
CRITICAL SYSTEMS TABLES & DATA SHEETS**

1
2
3
4

This page intentionally left blank.

APPENDIX 4A – SECTION 2
CRITICAL SYSTEMS TABLES & DATA SHEETS

CONTENTS

1
2
3
4 02315 – Specification for Fill and Backfill..... 5
5 02319 – Specification for Subgrade Preparation 11
6 02371 – Table 1. Required Geotextile Properties 13
7 02373 – Table 1. Required Geonet Properties 14
8 02373 – Table 2. Required CDN Properties 14
9 02661 – Table 1. Required Geomembrane Properties 60-Mil Textured HDPE 15
10 02661 – Table 2. Required Seam Properties HDPE Geomembranes 16
11 11305-01 – Sump Pump Data Sheet 18
12 11305-02 – Sump Pump Data Sheet 19
13 11306-01 – Leachate Pump Data Sheet 20
14 11306-02 – Leachate Pump Data Sheet 22
15 11306-03 – Leachate Pump Data Sheet 24
16 11312-01 – Horizontal End Suction Centrifugal Pump Data Sheet..... 25

17
18

1
2
3
4

This page intentionally left blank.

1 **02315 – Specification for Fill and Backfill**

2 Part 1 – General

3 Work Included:

4 This section describes placement and testing of fill and backfill in general areas of the site (including
5 stockpiles).

6 References:

7 The following is a list of standards, which may be referenced in this section:

8 **ASTM INTERNATIONAL (ASTM)**

| | | |
|----|------------|--|
| 9 | ASTM D75 | Standard Practice for Sampling Aggregates |
| 10 | ASTM D422 | Standard Test Method for Particle-Size Analysis of Soils |
| 11 | ASTM D698 | Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³ (600 kN-m/m ³)) |
| 12 | | |
| 13 | ASTM D1140 | Standard Test Method for Amount of Material in Soils Finer than the No. 200 (75 micrometer) Sieve |
| 14 | | |
| 15 | ASTM D1556 | Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method |
| 16 | | |
| 17 | ASTM D2216 | Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass. |
| 18 | | |
| 19 | ASTM D2922 | Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth) |
| 20 | | |
| 21 | ASTM D3017 | Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth) |
| 22 | | |

23 Definitions:

24 **Relative Compaction:** Ratio, in percent, of as-compacted field dry density to laboratory maximum dry
25 density as determined in accordance with ASTM D698.

26 Apply corrections for oversize material to maximum dry density.

27 **Optimum Moisture Content:** Determined in accordance with ASTM D698 specified to determine
28 maximum dry density for relative compaction.

29 **Prepared Ground Surface:** Ground surface after completion of required demolition, clearing and
30 grubbing, scalping of sod, stripping of topsoil, excavation to grade, and subgrade preparation.

31 **Completed Course:** A course or layer that is ready for next layer or next phase of Work.

32 **Lift:** Loose (uncompacted) layer of material.

33 **Geosynthetics:** Geotextiles, geocomposites, geosynthetic clay liner, or geomembranes.

34 **Well-Graded:** A mixture of particle sizes with no specific concentration or lack thereof of one or more
35 sizes.

36 Does not define numerical value that must be placed on coefficient of uniformity, coefficient of curvature,
37 or other specific grain size distribution parameters.

38 Used to define material type that, when compacted, produces a strong and relatively incompressible soil
39 mass free from detrimental voids.

- 1 **Influence Area:** Area within planes sloped downward and outward at 60-degree angle from horizontal
2 measured from:
- 3 1-foot outside outermost edge at base of foundations or slabs.
4 1-foot outside outermost edge at surface of roadways or shoulder.
5 0.5-foot outside exterior at spring line of pipes or culverts.
- 6 **Imported Material:** Materials obtained from sources offsite, suitable for specified use.
- 7 **Standard Specifications:** When referenced in this section, shall mean Standard Specifications for Road,
8 Bridge, and Municipal Construction, as published by the Washington State Department of Transportation,
9 2002 edition, English units.
- 10 **SLDS:** Secondary Leak Detection System.
- 11 **Permanent Stockpile:** Stockpile of material that remains at the completion of construction.
- 12 Submittals–Approval Required:
- 13 See Section 01300, SUBMITTALS, for submittal procedures.
- 14 Submit gradation test results for all imported materials from independent testing laboratory as specified in
15 paragraph SOURCE QUALITY CONTROL in Part 2.
- 16 **Stockpile Plan:** Prior to any excavation activities associated with construction of the IDF, Construction
17 General Contractor shall submit a Stockpile Plan for approval. The plan shall include the following
18 information:
- 19 Scale drawing, using the project plans as a base, which shows the proposed location for stockpiles on the
20 project site. Show all access roads around stockpiles. Address stockpile locations during construction of
21 the IDF and permanent stockpiles, which will remain upon completion of construction activities for this
22 project.
- 23 Stockpile layout drawings, which show the estimated location of toe of slope and top of slope for each
24 stockpile. Drawings shall show plan and typical sections and shall be fully dimensioned.
- 25 Plan shall show how differing materials encountered during the excavation will be segregated for future
26 use. This includes material for use as topsoil, admix base soil, and operations layer. Also, show a
27 stockpile area for material to be used in the future as clean backfill during landfill operations by the Tank
28 Farm Contractor.
- 29 Method by which stockpile compaction will be achieved.
- 30 Dust control for the stockpiles during active use and until grass is established.
- 31 Placing of topsoil, seeding, fertilizing, and mulching each stockpile after active use of stockpile is
32 finished in accordance with Section 02920, RECLAMATION AND REVEGETATION.
- 33 Submittals–Approval Not Required:
- 34 **Information/Record (IR):**
- 35 Qualifications of independent testing laboratory.
36 Qualifications of construction quality control personnel.
37 Construction quality control test reports
- 38 Sequencing and Scheduling:
- 39 Complete applicable Work specified in Sections 02316, EXCAVATION, and 02319, SUBGRADE
40 PREPARATION, prior to placing fill or backfill.

1 Permit Requirements:

2 A backfill and fill permit is required for each backfill and fill work element. Construction General
3 Contractor shall obtain from Tank Farm Contractor and post before starting backfill and fill work, as
4 specified in Division 1, General Requirements.

5 Construction Quality Assurance:

6 The Construction General Contractor shall accommodate all CQA activities described herein and in the
7 CPA Plan for this project. The CQA Plan is made part of these Specifications by reference.

8 The CQA Certifying Engineer shall determine in-place density and moisture content by any one or
9 combination of the following methods: ASTM D2922, ASTM D3017, ASTM D1556, ASTM D2216, or
10 other methods approved by the Construction Manager.

11 Testing requirements and locations will be determined by the CQA Certifying Engineer. Construction
12 General Contractor shall cooperate with the CQA Certifying Engineer and testing work by leveling small
13 test areas designated by the CQA Certifying Engineer. Backfill test areas at Construction General
14 Contractor's sole expense. The CQA Certifying Engineer may have any material tested at any time,
15 location, or elevation.

16 After Construction General Contractor makes repairs to any areas failing a test, the Construction General
17 Contractor shall rerun appropriate tests, subject to the approval of the CQA Certifying Engineer, to
18 demonstrate the area meets specifications, at the Construction General Contractor's sole expense.

19 The following minimum test schedule shall be assumed. Additional tests may be required as directed by
20 CQA Certifying Engineer.

21 In-place density tests shall be made on the following minimum schedule:

22 **Earth fill:** One per 5,000 square feet (ft²) per lift.

23 **Structural Fill:** One per 2,500 ft² per lift.

24 Subgrade Preparation: Four per acre.

25 Operations Layer (Outside Edge of Liner): One per 5,000 ft² per lift.

26 Operations Layer Material (SLDS): Two (2) per lift.

27 Standard Proctor (ASTM D698) laboratory density curves (five-point minimum) shall be performed for
28 each material by the CQA Certifying Engineer. Samples of native materials used for embankment and
29 backfill and samples of imported materials shall be taken at locations as specified by CQA Certifying
30 Engineer.

31 Gradation tests (sieve analysis) shall be performed in accordance with ASTM D422 on operations layer
32 material obtained from required excavations to demonstrate the materials meet the Specifications.
33 Samples of operations layer material shall be taken from each 10,000 cubic yards of placed material in
34 accordance with ASTM D75.

35 Part 2 – Products:

36 Earthfill:

37 Excavated material from required excavations and designated borrow sites, free from rocks larger than
38 4 inches in the greatest dimension, from roots and other organic matter, ashes, cinders, trash, debris, and
39 other deleterious materials.

40 Structural Fill:

41 Structural fill adjacent to concrete structures shall be as specified in Section 02320, TRENCH
42 BACKFILL, for Pipe Bedding. Structural fill beneath concrete structures and beneath leachate storage
43 tank shall conform to the requirements of Section 9-03 9(3) Crushed Surfacing-Top Course in the
44 Standard Specifications.

1 **Operations Layer:**

2 Meeting the requirements of earthfill above and having a maximum of 25 percent by weight passing the
3 No. 200 U.S. sieve and a maximum particle size of 2 inches.

4 **Drain Gravel:**

5 Material for drain gravel shall conform to the requirements of Section 9-03.12(4) of the Standard
6 Specifications except material shall be subrounded to rounded gravel. Crushed rock and angular gravel
7 shall not be allowed.

8 **Crushed Surfacing:**

9 Material for crushed surfacing-base course and top course shall conform to the requirements in Section 9-
10 03 9(3) of the Standard Specifications.

11 **Quarry Spalls:**

12 Quarry spalls shall consist of broken stone free from segregation, seams, cracks, and other defects tending
13 to destroy its resistance to weather and shall meet the following requirements for grading:

14 Maximum Size: 8 inches

15 50 percent by weight shall be larger than 3 inches

16 Minimum Size: 3/4 inch

17 **Source Quality Control:**

18 Gradation tests performed in accordance with ASTM D422 by a qualified independent testing laboratory
19 shall be made for imported materials on samples taken at place of production prior to shipment. Imported
20 materials shall not be shipped without submittal approval. Samples of the finished product for gradation
21 testing shall be taken from each 2,000 tons of prepared materials in accordance with ASTM D75. Test
22 results shall be submitted to Construction Manager within 48 hours after sampling. Size distribution for
23 imported quarry spalls material shall be determined in accordance with one of the methods described in
24 ASTM D5519.

25 **Base Soil:**

26 As specified in Section 02666, ADMIX LINER.

27 **WATER FOR MOISTURE CONDITIONING:**

28 See Section 02200, SITE PREPARATION, for raw water supply availability and requirements for proper
29 compaction.

30 **Part 3 – Execution**

31 **General:**

32 Keep placement surfaces free of water, debris, and foreign material during placement and compaction of
33 fill and backfill materials.

34 Place and spread fill and backfill materials in horizontal lifts of uniform thickness as specified in
35 paragraphs BACKFILL UNDER AND AROUND STRUCTURES and FILL, in a manner that avoids
36 segregation, and compact each lift to specified densities prior to placing succeeding lifts. Slope lifts only
37 where necessary to conform to final grades or as necessary to keep placement surfaces drained of water.

38 Do not place fill or backfill, if fill or backfill material is frozen, or if surface upon which fill or backfill is
39 to be placed is frozen.

40 **Tolerances:**

41 **Final Lines and Grades:** Within a tolerance of 0.1-foot unless dimensions or grades are shown or
42 specified otherwise.

- 1 Grade to establish and maintain slopes and drainage as shown. Reverse slopes are not permitted.
- 2 **Settlement:** Correct and repair any subsequent damage to structures, pavements, curbs, slabs, piping, and
3 other facilities, caused by settlement of fill or backfill material.
- 4 **Backfill Under and Around Structures:**
- 5 **Under Facilities:** Backfill with earthfill or structural fill, as shown on the Drawings, for each structure or
6 facility. Place earthfill or structural fill in lifts of 6-inch maximum compacted thickness and compact
7 each lift to minimum of 95 percent relative compaction as determined in accordance with ASTM D698.
- 8 **Fill:**
- 9 **Outside Influence Areas Beneath Structures, Slabs, Piping, and Other Facilities:** Unless otherwise
10 shown, place earthfill as follows:
- 11 Allow for 6-inch thickness of topsoil where required.
12 Maximum 8-inch thick lifts.
13 Place and compact fill across full width of embankment.
14 Compact to minimum 95 percent relative compaction.
- 15 **Replacing Overexcavated Material:**
- 16 Replace excavation carried below grade lines shown as follows:
- 17 **Beneath IDF Cell:** Earthfill as specified herein.
- 18 **Beneath Fill or Backfill:** Same material as specified for overlying fill or backfill.
- 19 **Beneath Structures and Roadways:** Structural fill or earthfill as shown on the Drawings and specified
20 herein.
- 21 **Topsoil:**
- 22 Place topsoil on areas disturbed by construction and on permanent stockpile slopes in accordance with
23 Section 02920, RECLAMATION AND REVEGETATION.
- 24 **Stockpiling:**
- 25 Material shall be placed in permanent stockpiles as follows:
- 26 Place material in maximum 3-foot lifts and compact with a minimum four passes with earth-moving
27 equipment. Uniformly route hauls truck traffic across the surface of each lift to aid in lift compaction.
28 Maximum slopes shall be 3H:1V. Minimum slopes shall be 3 percent to promote drainage.
- 29 Upper 2 feet of stockpile surface shall be placed in maximum 12-inch thick lifts and compacted to
30 minimum 90 percent relative compaction as determined in accordance with ASTM D698.
- 31 Place 6-inch thick layer of topsoil on completed slopes in accordance with Section 02920,
32 RECLAMATION AND REVEGETATION.
- 33 Permanent stockpiles shall be seeded, fertilized, and mulched when each stockpile is completed and as
34 directed by the Engineer in accordance with Section 02920, RECLAMATION AND REVEGETATION.
- 35 **Placing Crushed Surfacing:**
- 36 Place crushed surfacing base course and top course at locations shown on the Drawings. Placement shall
37 conform to Section 4-04.3 of the Standard Specifications.
- 38 Thickness of the drain gravel on the cell floor shall be a minimum of 1.0 foot (increase drain gravel
39 thickness in vicinity of LCRS collection and riser pipes as shown on drawings) and tolerances for the top
40 of the drain gravel shall be grade to plus 0.2 foot.
- 41 **pLacing DRAIN GRAVEL and operations layer over geosynthetics:**

1 Place material over geosynthetics as specified in Sections 02371, GEOTEXTILES; 02661,
2 GEOMEMBRANES; and 02667, GEOSYNTHETIC CLAY LINER (GCL).

3 Compaction requirements for drain gravel on the cell floor, around pipes, and the sumps are specified in
4 Section 02320, TRENCH BACKFILL.

5 Operations layer within lining system limits, except as specified for SLDS sump area, shall be placed in
6 12-inch thick lifts and track-walked into place with a minimum two passes with a Caterpillar D6M-LGP
7 or equal. Operations layer material within SLDS sump area shall be placed in 12-inch thick lifts and
8 compacted to 90 percent relative compaction. Operations layer placed outside edge of liner, such as for
9 shine berm, shall be placed in maximum 8-inch thick lifts and compacted to 95 percent relative
10 compaction.

11 Place material to the lines and grades shown and compact by tracking a minimum two passes with
12 spreading equipment. Thickness of the operations layer shall be a minimum 3 feet and tolerances for top
13 of operations layer shall be grade to plus 0.3 foot.

14 Quarry Spalls Placement:

15 Quarry spalls shall be placed around the ends of stormwater pipes to provide erosion protection in
16 accordance with the Plans and as directed by the Engineer. Quarry spalls shall be placed in such a
17 manner that all relatively large stones are essentially in contact with each other and voids are filled with
18 the finer materials to provide a well graded compact mass. Finished surface shall be free from
19 irregularities. The stone shall be dumped on the ground in a manner that will ensure the stone attains its
20 specified thickness in one operation. When dumping or placing, care shall be used to avoid damaging the
21 underlying material. Stone shall not be dumped from height greater than 12 inches above surface.
22 Material placement shall be started from the bottom of the installation, working toward edges. Geotextile
23 damaged during the placement of quarry spalls shall be repaired at Construction General Contractor's sole
24 expense.

25 Construction Quality Control:

26 The Construction General Contractor shall perform in-place density and moisture content tests with own
27 qualified personnel or with a qualified independent testing laboratory as specified in paragraph
28 CONSTRUCTION QUALITY ASSURANCE, to be observed by the Construction Manager, on the
29 following minimum schedule:

30 Material Placed by Stockpile (Upper 2 Feet): One per 10,000 ft² per lift.

31 Construction General Contractor shall submit qualifications of personnel or independent testing
32 laboratory that will perform construction quality control.

33 END OF SECTION 0231

1 **02319 – Specification for Subgrade Preparation**

2 Part 1 – General

3 work included:

4 This section describes requirements for preparation of subgrades in areas to receive fill.

5 References:

6 The following is a list of standards, which may be referenced in this section:

7 **ASTM INTERNATIONAL (ASTM)**

8 ASTM D698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard
9 Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))

10 Definitions:

11 **Optimum Moisture Content:** As defined in Section 02315, FILL AND BACKFILL.

12 **Prepared Ground Surface:** Ground surface after completion of clearing and grubbing, scalping of sod,
13 stripping of topsoil, excavation to grade, and scarification and compaction of subgrade.

14 **Relative Compaction:** As defined in Section 02315, FILL AND BACKFILL.

15 **SLDS:** Secondary Leak Detection System.

16 **Subgrade:** Layer of existing soil after completion of excavation to grade prior to placement of fill,
17 roadway structure, or base for floor slab.

18 **Proof Rolling:** Testing of subgrade as specified herein to identify soft or loose zones requiring correction.

19 Sequencing and Scheduling:

20 Complete applicable Work specified in Section 02316, EXCAVATION, prior to subgrade preparation.

21 Construction Quality Assurance:

22 The CQA Certifying Engineer shall determine in-place density and moisture for subgrade preparation as
23 specified in Section 02315, FILL AND BACKFILL, except for prepared subgrade for admix on
24 sideslopes.

25 CQA requirements for geomembrane subgrade preparation are specified in Section 02661,
26 GEOMEMBRANES.

27 Part 2 – Products (Not Used)

28 Part 3 – Execution

29 General:

30 Keep subgrade free of water, debris, and foreign matter during compaction or proof rolling.

31 Bring subgrade to proper grade and cross-section as shown on the Drawings, and uniformly compact
32 surface.

33 Maintain prepared ground surface in finished condition until next course is placed.

34 Prepared Subgrade for Roadway, Embankment, and Structures:

35 After completion of excavation and prior to foundation, road fill, structural fill, or embankment
36 construction, compact prepared subgrade to 95 percent relative compaction. Scarify and moisture
37 condition subgrade soil as required to achieve specified compaction. If soft or loose zones are found,
38 correct as specified herein. Proof-roll subgrade with a fully loaded dump truck or equal to detect soft or
39 loose subgrade or unsuitable material.

1 Landfill Bottom Floor Prepared Subgrade For Admix Liner:

2 Prior to admix liner placement, subgrade shall be back bladed to remove loose soil. Low spots or erosion
3 rills shall be backfilled with structural fill as specified herein. Compact prepared subgrade to 95 percent
4 relative compaction. Scarify and moisture condition subgrade soil as required to achieve specified
5 compaction. If soft or loose zones are found, correct as specified herein. Proof-roll subgrade with a
6 vibratory drum roller or equal to detect soft or loose subgrade or unsuitable material.

7 Landfill Sideslope (3H: 1V) Prepared Subgrade For Admix Liner:

8 Prior to admix placement, the subgrade shall be back bladed to remove all loose material produced by
9 trimming operations. Low spots or erosion rills shall be backfilled with structural fill as specified herein.
10 The trimmed surface shall be watered so that moisture penetrates a minimum of 3 inches into the
11 subgrade. The trimmed and watered surface shall be track-walked by D6-LGP dozer or equivalent with a
12 minimum 4 passes to produce a firm and stable subgrade. Visual monitoring (no in-place density testing
13 is required) of the subgrade preparation on sideslopes will be performed by the CQA Certifying Engineer.

14 Prepared Subgrade For Geomembrane (Secondary And SLDS) And Secondary GCI:

15 At completion of SLDS excavation and grading (SLDS geomembrane) or admix liner placement
16 (secondary geomembrane and GCL), prepare the subgrade surface for geomembrane or GCL placement.
17 The surface shall not have holes, depressions more than 1 inch in a 12-inch width, nor protrusions
18 extending above the surface more than 1/2 inch. Roll surface with smooth-drum roller to form a firm
19 stable base. Allow for leachate piping and sumps or features as shown on the Drawings.

20 Correction:

21 **Soft or Loose Subgrade:**

22 Adjust moisture content and compact to meet density requirements, or

23 Over excavate and replace with suitable material from the excavation, as specified in Section 02315,
24 FILL AND BACKFILL.

25 **Unsuitable Material:** Over excavate and replace with suitable material from the excavation, as specified
26 in Section 02315, FILL AND BACKFILL. Dispose of unsuitable material excavation in accordance with
27 Article DISPOSAL OF SPOIL in Section 02316, EXCAVATION.

28 END OF SECTION 02319

29

30

1 **02371 – Table 1. Required Geotextile Properties**

2 Value^(a)

| <u>Property</u> | <u>Unit</u> | <u>Type 1</u> | <u>Type 2</u> | <u>Test Method</u> |
|---|--------------------|-----------------------------------|---------------------|---------------------|
| Mass/Unit Area | oz/yd ² | 6.0 ^(b) | 12.0 ^(b) | ASTM D5261 or D3776 |
| Apparent Opening Size ^(b) | U.S. Sieve | 70 max opening 100 min opening | — | ASTM D4751 |
| Grab Strength | lb | 140 | 300 | ASTM D4632 |
| Trapezoidal Tear Strength ASTM D4533 | lb | 70 | | 110 |
| Puncture Strength | lb | 65 | 135 | ASTM D4833 |
| Permittivity | sec ⁻¹ | 1.2 | — | ASTM D4491 |
| UV Resistance % strength | (500 hours) | retained 70 | 70 | ASTM D4355 |

3 Notes:

4 ^(a)All values are minimum average values, except as noted. ^(b)Nominal values.

1 **02373 – Table 1. Required Geonet Properties**

| <u>Property</u> | <u>Qualifier</u> | <u>Unit</u> | <u>Value</u> | <u>Test</u> |
|---------------------------------------|------------------|---------------------|----------------------|---------------------|
| Polymer Composition | Minimum | % polyethylene | 95 | --- |
| Resin Specific Gravity | Minimum | N/A | 0.92 | ASTM D1505 |
| Carbon Black Content | Range | % | 2 - 3 | ASTM D1603 or D4218 |
| Nominal Thickness | MARV | mils | 250 | ASTM D1777 or D5199 |
| Nominal Transmissivity ⁽¹⁾ | MARV | m ² /sec | 3 x 10 ⁻³ | ASTM D4716 |

2

3 **02373 – Table 2. Required CDN Properties**

| <u>Property</u> | <u>Qualifier</u> | <u>Unit</u> | <u>Value</u> | <u>Test</u> |
|-------------------------------|------------------|---------------------|----------------------|----------------------|
| Ply Adhesion | ARV | lb/in | 1.0 | ASTM D413 or GRI-GC7 |
| Transmissivity ⁽¹⁾ | MARV | m ² /sec | 5 x 10 ⁻⁴ | ASTM D4716 |

4 Notes:

5 MARV = Minimum Average Roll Value.

6 ARV = Average Roll Value.

7 ⁽¹⁾The design transmissivity is the hydraulic transmissivity of the CDN measured using water at
8 70 degrees F ±3 degrees F with a hydraulic gradient of 0.1, under the compressive stress of 10,000 psf.
9 Transmissivity value shall be measured between two steel plates 15 minutes after application of the
10 confining stress in the machine direction.

11

1 **02661 – Table 1. Required Geomembrane Properties 60-Mil Textured HDPE**

| <u>Specified Property</u> | <u>Qualifier</u> | <u>Unit</u> | <u>Value</u> | <u>Test Method</u> |
|----------------------------------|------------------------------|-------------|--------------|-------------------------------|
| Physical Properties | | | | |
| Thickness | min. avg. value | mils | 60 | ASTM D5994 |
| | minimum | | 54 | ASTM D5994 |
| Specific Gravity | minimum | N/A | 0.932 | ASTM D1505 |
| Melt Index | range | g/10 min | <1.1 | ASTM D1238 condition 190/2.16 |
| Asperity | min avg. value ¹ | mils | 10 | GRI-GM12 |
| Mechanical Properties | | | | |
| Tensile Properties | (each direction) | | (Type IV) | ASTM D638 |
| Strength at yield | min. avg. value | lb/in | 120 | |
| Elongation at yield ² | min. avg. value | % | | 12 |
| Tear Resistance | min. avg. value | lb | 42 | ASTM D1004 |
| Puncture Resistance | min. avg. value | lb | 80 | ASTM D4833 |
| Carbon Black Content | Range | % | 2-3 | ASTM D1603 or D4218 |
| Carbon Black Dispersion | Minimum ¹ 8 of 10 | category | 1 or 2 | ASTM D5596 |
| Environmental Stress | | | | |
| Crack | minimum ³ | hrs | 200 | ASTM D5397 |

2 ¹ Of 10 readings, 8 out of 10 must be greater or equal to 7 mils, and lowest individual reading must be
 3 greater or equal to 5 mils. Provide data for both sides of textured geomembrane.

4 ² Yield elongation is calculated using a gauge length of 1.3 inches.

5 ³ Minimum = mean minus 3 standard deviations from documented manufacturer's quality control (MQC)
 6 testing.

7

1 **02661 – Table 2. Required Seam Properties HDPE Geomembranes**

| <u>Property</u> | <u>Qualifier</u> | <u>Unit</u> | <u>Specified Value</u> | <u>Test Method</u> |
|-----------------------------|------------------|-------------|---|--------------------|
| Shear Strength ¹ | minimum | lb/in width | 90% of tensile strength at yield as listed in tables in this section | ASTM D6392 |
| Peel Adhesion | minimum | lb/in width | 60% of tensile strength at yield as listed in tables in this section and FTB ² | ASTM D6392 |

2 ¹Also called “Bonded Seam Strength”.

3 ²FTB = Film Tear Bond (failure occurs through intact geomembrane, not through seam).

4

1 **Geomembrane Installer's Certification of Subsurface Acceptability**

2 The geomembrane installer, _____
3 for the Integrated Disposal Facility (IDF), hereby certifies that the supporting prepared subgrade surfaces
4 are acceptable for installation of the HDPE geomembrane lining system, the undersigned having
5 personally inspected the condition of the constructed surfaces. This certification is for the areas shown on
6 Attachment or defined as follows:

7 The condition of the supporting surfaces in the defined area meets or exceeds the minimum requirements
8 for installation of the geomembrane.

9 Signed: _____
10 Geomembrane Installer

Signed: _____
Construction General Contractor

11 _____
12 _____
13 Date Signed

Date Signed

14

1 **11305-01 – Sump Pump Data Sheet**

2 Tag Numbers: 219A-LH-P-207, 219E-LH-P-207

3 Pump Locations and I.D.: Buildings 219A and 219E, Combined Sump Pump

4 Manufacturer and Model Number: (1) Hydromatic Pump Co., Model SB3S

5 (2) Barnes

6 (3) Or approved equal

7 **Service Conditions:**

8 Liquid Pumped (Material and Percent): Leachate from low-level radioactive waste disposal facility and
9 rain/snow melt

10 Pumping Temperature (Fahrenheit): Normal: 55 Max 130 Min 27

11 Specific Gravity at 60 Degrees F: 1.0 Viscosity Range: N/A pH: 5.0-9.3

12 Abrasive (Y/N) (fine/coarse soil particles) Possible Scale Buildup (Y/N): Y

13 Total suspended solids (mg/L) 200 (estimated)

14 Largest diameter solid pump can pass (inches) 0.5

15 **Performance Requirements:**

16 Capacity (US gpm): Rated: 250

17 Total Dynamic Head (Ft): Rated: 19

18 Maximum Shutoff Pressure (Ft): 50

19 Min. Rated Pump Hydraulic Efficiency at Rated Capacity (%): 50

20 Max. Pump Speed at Rated Capacity (rpm): 1,750

21 Constant (Y/N): Y Adjustable (Y/N): N

22 **Design and Materials:**

23 Pump Type: Heavy-Duty Nonclog (Y/N) Y

24 Volute Material: Cast Iron ASTM A48

25 Pump Casing Material: Cast Iron ASTM A48

26 Motor Housing Material: Cast Iron ASTM A48

27 **Induction Drive Motor:**

28 Horsepower: 0.30 Voltage: 460 Phase: 3 Speed (rpm): 1,750

29 Service Factor: 1.15 Inverter Duty (Y/N): N

30 Motor nameplate horsepower shall not be exceeded at any head-capacity point on the pump curve.

31 Enclosure: Explosion-proof, submersible, Class 1, Div. 1 or Div. 2, Groups C and D

32

1 **11305-02 – Sump Pump Data Sheet**

2 Tag Numbers: 219A-LH-P-205, 219E-LH-P-205

3 Pump Locations and I.D.: Buildings 219A and 219E, Floor Sump

4 Manufacturer and Model Number: (1) Hydromatic Pump Co.

5 (2) Barnes

6 Service Conditions:

7 Liquid Pumped: Leachate from low-level radioactive waste disposal facility

8 Pumping Temperature (Fahrenheit): Normal: 55 Max 130 Min 27

9 Specific Gravity at 60 Degrees F: 1.0 Viscosity Range: N/A pH: 5-9.3

10 Abrasive (Y/N) Y (fine/coarse soil particles) Possible Scale Buildup (Y/N): Y

11 Total suspended solids (mg/L) 200 (estimated)

12 Largest diameter solid pump can pass (inches) 0.5

13 Performance Requirements:

14 Capacity (US gpm): Rated: 28

15 Total Dynamic Head (Ft): Rated: 14

16 Maximum Shutoff Pressure (Ft): 30

17 Min. Rated Pump Hydraulic Efficiency at Rated Capacity (%): 45

18 Max. Pump Speed at Rated Capacity (rpm): 1,750

19 Constant (Y/N): _____ (Y/N): _____

20 Design and Materials:

21 Pump Type: Heavy-Duty Nonclog (Y/N) Y

22 Volute Material: Cast Iron ASTM A48

23 Pump Casing Material: Cast Iron ASTM A48

24 Motor Housing Material: Cast Iron ASTM A48

25 Induction Drive Motor:

26 Horsepower: 0.30 Voltage: 460 Phase: 3 Speed (rpm): 1,750

27 Service Factor: 1.15 Inverter Duty (Y/N): N

28 Motor nameplate horsepower shall not be exceeded at any head-capacity point on the pump curve.

29 Enclosure: Submersible

1 **11306-01 – Leachate Pump Data Sheet**

2 Tag Numbers: 219A-LH-P-202, 219E-LH-P-202

3 Pump Locations and I.D.: Cell 1 LCRS Sump, Low Flow

4 Cell 2 LCRS Sump, Low Flow

5 Manufacturer and Model Number: (1) EPG Companies; Model WSD 3-3

6 (2) Or equal

7 Service Conditions:

8 Liquid Pumped (Material and Percent): Leachate from low-level radioactive waste landfill

9 Pumping Temperature (Fahrenheit): Normal: 55 F Max: 130 F Min: 27 F

10 Specific Gravity at 60 Degrees F: 1.0 Viscosity Range: NA pH: 5.0-9.3

11 Abrasive (Y/N) Y (infrequent fine soil particles) Possible Scale Buildup (Y/N): Y

12 Total Suspended Solids (mg/l): 200 (estimated)

13 Performance Requirements at Primary Design Point:

14 Capacity (US gpm): Rated: 13

15 Total Dynamic Head (Ft): Rated: 66

16 Min. Hydraulic Efficiency (%): 60

17 Maximum Shutoff Pressure (Ft): 90

18 Max. Pump Speed at Design Point (rpm): 3,450

19 Constant (Y/N): Y Adjustable (Y/N): N

20

21

1 Design and Materials:

2 Design: Wheeled enclosure frame Back Pullout (Y/N) Y

3 Discharge Orientation: Center

4 Casing Materials: Type 304 SST

5 Case Wear Ring (Y/N) NA Material: NA

6 Impeller: Type: Closed Material: Type 304 SST

7 Impeller Wear Ring (Y/N): Y Material: E-Glide (engineered plastic) or equal

8 Shaft Material: Type 304 SST Shaft Sleeve Material: E-Glide or equal

9 Shaft Seal: Y Ring Material: E-Glide or equal Lubrication: Fluid

10 AFBMA B-10 Bearing Life (Hrs): NA Lubrication: NA

11 Drive Type: Direct Coupled

12 Induction Drive Motor:

13 Horsepower: 0.5 Voltage: 460 Phase: 3

14 Speed (rpm): 3,450

15 Service Factor: 1.15 Inverter Duty (Y/N) N

16 Motor nameplate horsepower shall not be exceeded at any head-capacity point on the pump curve.

17 Enclosure: Submersible

18

19

1 **11306-02 – Leachate Pump Data Sheet**

2 Tag Numbers: 219A-LH-P-203, 219E-LH-P-203

3 Pump Location and I.D.: Cell 1 LCRS Sump, High Flow

4 Cell 2 LCRS Sump, High Flow

5 Manufacturer and Model Number: (1) EPG Companies; Model WSD 30-4

6 (2) Or equal

7 Service Conditions:

8 Liquid Pumped (Material and Percent): Leachate from low-level radioactive waste landfill

9 Pumping Temperature (Fahrenheit): Normal: 55 F Max: 130 F Min: 27 F

10 Specific Gravity at 60 Degrees F: 1.0 Viscosity Range: NA pH: 5.0-9.3

11 Abrasive (Y/N) Y (infrequent fine soil particles) Possible Scale Buildup (Y/N): Y

12 Total Suspended Solids (mg/l): 200 (estimated)

13 Performance Requirements at Primary Design Point:

14 Capacity (US gpm): Rated: 155

15 Total Dynamic Head (Ft): Rated: 118

16 Min. Hydraulic Efficiency (%): 60

17 Maximum Shutoff Pressure (Ft): 208

18 Max. Pump Speed at Design Point (rpm): 3,450

19 Constant (Y/N): Y Adjustable (Y/N): N

20

- 1 Design and Materials:
- 2 Design: Wheeled enclosure frame (Y/N) Y
- 3 Discharge Orientation: Center
- 4 Casing Materials: Type 304 SST
- 5 Case Wear Ring (Y/N) NA Material: NA
- 6 Impeller: Type: Closed Material: Type 304 SST
- 7 Impeller Wear Ring (Y/N): Y Material: E-Glide (engineered plastic), or equal
- 8 Shaft Material: Type 304 SST Shaft Sleeve Material: E-Glide (engineered plastic), or
- 9 equal
- 10 Shaft Seal: Y Ring Material: E-Glide or equal Lubrication: Fluid
- 11 AFBMA B-10 Bearing Life (Hrs): NA Lubrication: NA
- 12 Drive Type: Direct Coupled
- 13 Induction Drive Motor:
- 14 Horsepower: 7.5 Voltage: 460 Phase: 3
- 15 Speed (rpm): 3,450
- 16 Service Factor: 1.15 Inverter Duty (Y/N) N
- 17 Motor nameplate horsepower shall not be exceeded at any head-capacity point on the pump curve.
- 18 Enclosure: Submersible
- 19
- 20

1 **11306-03 – Leachate Pump Data Sheet**

2 Tag Numbers: 219A-LH-P-204, 219E-LH-P-204

3 Pump Locations and I.D.: Cell 1 LDS Sump

4 Cell 2 LDS Sump

5 Manufacturer and Model Number: (1) EPG Companies; Model WSD 1.5-3

6 (2) Or equal

7 Service Conditions:

8 Liquid Pumped (Material and Percent): Leachate from low-level radioactive waste landfill

9 Pumping Temperature (Fahrenheit): Normal: 55 F Max: 130 F Min: 27 F

10 Specific Gravity at 60 Degrees F: 1.0 Viscosity Range: NA pH: 5.0-9.3

11 Abrasive (Y/N) Y (infrequent fine soil particles) Possible Scale Buildup (Y/N): Y

12 Total Suspended Solids (mg/l): 200 (estimated)

13 Performance Requirements at Primary Design Point:

14 Capacity (US gpm): Rated: 4

15 Total Dynamic Head (Ft): Rated: 65

16 Min. Hydraulic Efficiency (%): 60

17 Maximum Shutoff Pressure (Ft): 80

18 Max. Pump Speed at Design Point (rpm): 3,450

19 Constant (Y/N): Y

Adjustable (Y/N): N

20 Design and Materials:

21 Design: Wheeled enclosure frame Back Pullout (Y/N) Y

22 Discharge Orientation: Center

23 Casing Materials: Type 304 SST

24 Case Wear Ring (Y/N) NA Material: NA

25 Impeller: Type: Closed Material: Type 304 SST

26 Impeller Wear Ring (Y/N): Y Material: E-Glide (engineered plastic) or equal

27 Shaft Material: Type 304 SST Shaft Sleeve Material: E-Glide or equal

28 Shaft Seal: Y Ring Material: E-Glide or equal Lubrication: Fluid

29 AFBMA B-10 Bearing Life (Hrs): NA Lubrication: NA

30 Drive Type: Direct Coupled

31 Induction Drive Motor:

32 Horsepower: 0.5 Voltage: 460 Phase: 3

33 Speed (rpm): 3,450

34 Service Factor: 1.15 Inverter Duty (Y/N) N

35 Motor nameplate horsepower shall not be exceeded at any head-capacity point on the pump curve.

36 Enclosure: Submersible

1 **11312-01 – Horizontal End Suction Centrifugal Pump Data Sheet**

2 Tag Numbers: _____

3 Pump Name: _____

4 Manufacturer and Model Number: (1) _____

5 (2) _____

6 Service Conditions:

7 Liquid Pumped (Material and Percent): _____

8 Pumping Temperature (Fahrenheit): Normal: 55 Max 130 Min 27

9 Specific Gravity at 60 Degrees F: 1.0 Viscosity Range: N/A pH: 5.0-9.3

10 Abrasive (Y/N) Y (fine soil particles) Possible Scale Buildup (Y/N): Y

11 Total suspended solids (mg/L) 200 (estimated)

12 Largest diameter solid pump can pass (inches) .25

13 Performance Requirements at Primary Design Point:

14 Capacity (US gpm): Rated: 250

15 Total Dynamic Head (Ft): Rated: 25

16 Min. Hydraulic Efficiency (%): 75

17 Maximum Shutoff Pressure (Ft): 40

18 Max. Pump Speed at Design Point (rpm): 1,750

19 Constant (Y/N): Y Adjustable (Y/N): N

20 Design and Materials:

21 ANSI (Y/N) Y Standard (Y/N) Y Design: Frame-mounted (Y/N) Y

22 Close-Coupled Casing (Y/N) N Back Pullout (Y/N) Y

23 Discharge Orientation: 12:00 Rotation (view from end coupling): CW

24 Shaft Seal: Packing (Y/N) N

25 Mechanical (Y/N) _____

26 Lubrication: Process Water

27 Drive Type: Direct-Coupled: _____ Belt _____ Adjustable Speed _____

28 Induction Drive Motor:

29 Horsepower: _____ Voltage: _____ Phase: _____ Speed (rpm): 1,750

30 Service Factor: 1.15 Inverter Duty (Y/N) _____

31 Motor nameplate horsepower shall not be exceeded at any head-capacity point on the pump curve.

32 Enclosure: Totally enclosed fan cooled

33 Mounting Type: Horizontal _____ Nonreverse Ratchet (Y/N) _____

34 Testing:

35 Pump Tests: Factory Functional (Y/N) _____ Field Performance (Y/N) N

36 Factory Hydrostatic Casing Pressure Test (Y/N) _____

1 Field Functional (Y/N) _____

Field Performance (Y/N) _____

2 Field Vibration (Y/N) N

3

4