# AR TARGET SHEET

The following document was too large to scan as one unit, therefore, it has been broken down into sections.

EDMC#: 0068956
SECTION: 3 OF 4

DOCUMENT #:

TITLE: Modification of RCRA Permit for TSD of Dangerous Waste Rev 008 to Incorporate Final Permit Conditions for IDF

# PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

## OPERATING UNIT 11

## Integrated Disposal Facility

**Appendix 4A – Section 2** **Critical Systems**

### Critical Systems Tables and Data Sheets

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## SECTION 02315--FILL AND BACKFILL

## PART 1--GENERAL

### WORK INCLUDED:

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

### REFERENCES:

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

ASTM INTERNATIONAL (ASTM)

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

### DEFINITIONS:

Relative Compaction:

Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM D698.

Apply corrections for oversize material to maximum dry density.

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

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

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

Lift: Loose (uncompacted) layer of material.

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

Well-Graded:

A mixture of particle sizes with no specific concentration or lack thereof of one or more sizes.

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

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

Influence Area: Area within planes sloped downward and outward at 60-degree angle from horizontal measured from:

1-foot outside outermost edge at base of foundations or slabs.
1-foot outside outermost edge at surface of roadways or shoulder.
0.5-foot outside exterior at spring line of pipes or culverts.

Imported Material: Materials obtained from sources offsite, suitable for specified use.

Standard Specifications: When referenced in this section, shall mean Standard Specifications for Road, Bridge and Municipal Construction, as published by the Washington State Department of Transportation, 2002 edition, English units.

SLDS: Secondary Leak Detection System.

Permanent Stockpile: Stockpile of material that remains at the completion of construction.

SUBMITTALS--APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Submit gradation test results for all imported materials from independent testing laboratory as specified in paragraph SOURCE QUALITY CONTROL in Part 2.

Stockpile Plan: Prior to any excavation activities associated with construction of the IDF, Construction General Contractor shall submit a Stockpile Plan for approval. The plan shall include the following information:

Scale drawing, using the project plans as a base, which shows the proposed location for stockpiles on the project site. Show all access roads around stockpiles. Address stockpile locations during construction of the IDF and permanent stockpiles which will remain upon completion of construction activities for this project.

Stockpile layout drawings which show the estimated location of toe of slope and top of slope for each stockpile. Drawings shall show plan and typical sections and shall be fully dimensioned.

Plan shall show how differing materials encountered during the excavation will be segregated for future use. This includes material for use as topsoil, admix base soil, and operations layer. Also show a stockpile area for material to be used in the future as clean backfill during landfill operations by the Tank Farm Contractor.

Method by which stockpile compaction will be achieved.

Dust control for the stockpiles during active use and until grass is established.

Placing of topsoil, seeding, fertilizing, and mulching each stockpile after active use of stockpile is finished in accordance with Section 02920, RECLAMATION AND REVEGETATION.

SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR):

Qualifications of independent testing laboratory.

Qualifications of construction quality control personnel.

SEQUENCING AND SCHEDULING:

Complete applicable Work specified in Sections 02316, EXCAVATION, and 02319, SUBGRADE PREPARATION, prior to placing fill or backfill.

PERMIT REQUIREMENTS:

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

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CONSTRUCTION QUALITY ASSURANCE:

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

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

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

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

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

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

Earthfill: One per 5,000 square feet ($ft^2$) per lift.

Structural Fill: One per 2,500 $ft^2$ per lift.

Subgrade Preparation: Four per acre.

Operations Layer (Outside Edge of Liner): One per 5,000 $ft^2$ per lift.

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

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

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

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PART 2--PRODUCTS

EARTHFILL:

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

STRUCTURAL FILL:

Conform to the requirements of Section 9-03.9(3) Crushed Surfacing-Base Course in the Standard Specifications, except for structural fill beneath leachate storage tank. At this location, utilize crushed surfacing-top course conforming to the requirements of Section 9-03.9(3).

Material selected from excavation meeting the requirements of Section 9-03.9(3) Crushed Surface-Base Course may be used for structural fill.

OPERATIONS LAYER:

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

DRAIN GRAVEL:

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

CRUSHED SURFACING:

Material for crushed surfacing-base course and top course shall conform to the requirements in Section 9-03.9(3) of the Standard Specifications.

QUARRY SPALLS:

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

Maximum Size: 8 inches.

50 percent by weight shall be larger than 3 inches.

Minimum Size: 3/4 inch.

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SOURCE QUALITY CONTROL:

Gradation tests performed in accordance with ASTM D422 by a qualified independent testing laboratory shall be made for imported materials on samples taken at place of production prior to shipment. Imported materials shall not be shipped without submittal approval. Samples of the finished product for gradation testing shall be taken from each 2,000 tons of prepared materials in accordance with ASTM D75. Test results shall be submitted to Construction Manager within 48 hours after sampling.

BASE SOIL:

As specified in Section 02666, ADMIX LINER.

WATER FOR MOISTURE CONDITIONING:

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

PART 3--EXECUTION

GENERAL:

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

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

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

Tolerances:

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

Grade to establish and maintain slopes and drainage as shown. Reverse slopes are not permitted.

Settlement: Correct and repair any subsequent damage to structures, pavements, curbs, slabs, piping, and other facilities, caused by settlement of fill or backfill material.

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BACKFILL UNDER AND AROUND STRUCTURES:

Under Facilities: Backfill with earthfill or structural fill, as shown on the Drawings, for each structure or facility. Place earthfill or structural fill in lifts of 6-inch maximum compacted thickness and compact each lift to minimum of 95 percent relative compaction as determined in accordance with ASTM D698.

FILL:

Outside Influence Areas Beneath Structures, Slabs, Piping, and Other Facilities: Unless otherwise shown, place earthfill as follows:

Allow for 6-inch thickness of topsoil where required.

Maximum 8-inch thick lifts.

Place and compact fill across full width of embankment.

Compact to minimum 95 percent relative compaction.

REPLACING OVEREXCAVATED MATERIAL:

Replace excavation carried below grade lines shown as follows:

Beneath IDF Cell: Earthfill as specified herein.

Beneath Fill or Backfill: Same material as specified for overlying fill or backfill.

Beneath Structures and Roadways: Structural fill or earthfill as shown on the Drawings and specified herein.

TOPSOIL:

Place topsoil on areas disturbed by construction and on permanent stockpile slopes in accordance with Section 02920, RECLAMATION AND REVEGETATION.

STOCKPILING:

Material shall be placed in permanent stockpiles as follows:

Place material in maximum 2-foot lifts and compact with a minimum four passes with earth-moving equipment.

Maximum slopes shall be 3H:1V. Minimum slopes shall be 3 percent to promote drainage.

Upper 2 feet of stockpile surface shall be placed in maximum 12-inch thick lifts and compacted to minimum 90 percent relative compaction as determined in accordance with ASTM D698.

Place 6-inch thick layer of topsoil on completed slopes in accordance with Section 02920, RECLAMATION AND REVEGETATION.

Permanent stockpiles shall be seeded, fertilized, and mulched when each stockpile is completed and as directed by the Engineer in accordance with Section 02920, RECLAMATION AND REVEGETATION.

PLACING CRUSHED SURFACING:

Place crushed surfacing base course and top course at locations shown on the Drawings. Placement shall conform to Section 4-04.3 of the Standard Specifications.

PLACING DRAIN GRAVEL AND OPERATIONS LAYER OVER GEOSYNTHETICS:

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

Compaction requirements for drain gravel around pipes and the sumps are specified in Section 02320, TRENCH BACKFILL.

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

Place material to the lines and grades shown and compact by tracking a minimum two passes with spreading equipment.

QUARRY SPALLS PLACEMENT:

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

damaged during the placement of quarry spalls shall be repaired at Construction General Contractor's sole expense.

CONSTRUCTION QUALITY CONTROL:

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

Material Placed by Stockpile (Upper 2 Feet): One per 10,000 $ft^2$ per lift.

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

END OF SECTION 02315

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## SECTION 02319--SUBGRADE PREPARATION

### PART 1--GENERAL

#### WORK INCLUDED:

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

#### REFERENCES:

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

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D698 | Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft$^3$ (600 kN-m/m$^3$)) |

#### DEFINITIONS:

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

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

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

SLDS: Secondary Leak Detection System.

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

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

#### SEQUENCING AND SCHEDULING:

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

#### CONSTRUCTION QUALITY ASSURANCE:

The CQA Certifying Engineer shall determine in-place density and moisture for subgrade preparation as specified in Section 02315, FILL AND BACKFILL.

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

PART 2--PRODUCTS (NOT USED)

PART 3--EXECUTION

GENERAL:

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

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

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

PREPARED SUBGRADE FOR ROADWAY, EMBANKMENT, AND STRUCTURES:

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

PREPARED SUBGRADE FOR ADMIX LINER:

Prior to admix liner placement, subgrade shall be backbladed to remove loose soil. Low spots or erosion rills shall be backfilled with structural fill as specified herein. Compact prepared subgrade to 95 percent relative compaction. Scarify and moisture condition subgrade soil as required to achieve specified compaction. If soft or loose zones are found, correct as specified herein. Proof-roll subgrade with a vibratory drum roller or equal to detect soft or loose subgrade or unsuitable material. After compaction and proof-rolling, scarify subgrade surface of 3H:1V side slopes to a minimum depth of 1/2 inch prior to admix liner placement.

PREPARED SUBGRADE FOR ~~SECONDARY~~ GEOMEMBRANE (SECONDARY AND SLDS) AND SECONDARY GCL:

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

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CORRECTION:

Soft or Loose Subgrade:

Adjust moisture content and compact to meet density requirements, or

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

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

END OF SECTION 02319

# 02371 – Table 1 – Required Geotextile Properties

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Document Type: Construction Specifications (C-1)
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Table 1. REQUIRED GEOTEXTILE PROPERTIES

| Property | Unit | Value[a] Type 1 | Value[a] Type 2 | Test Method |
|---|---|---|---|---|
| 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<br>100 min opening | — | ASTM D4751 |
| Grab Strength | lb | 140 | 300 | ASTM D4632 |
| Trapezoidal Tear Strength | lb | 70 | 110 | ASTM D4533 |
| Puncture Strength | lb | 65 | 135 | ASTM D4833 |
| Permittivity | $sec^{-1}$ | 1.2 | — | ASTM D4491 |
| UV Resistance (500 hours) | % strength retained | 70 | 70 | ASTM D4355 |

Notes:
[a]All values are minimum average values, except as noted.
[b]Nominal values.

# 02373 – Table 1 - Required Geonet Properties
# 02373 – Table 2 - Required CDN Properties

Project Title: Integrated Disposal Facility
Document Type: Construction Specifications (C-1)
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Table 1. REQUIRED GEONET PROPERTIES

| Property | Qualifier | Unit | Value | Test |
|---|---|---|---|---|
| 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 | $3 \times 10^{-3}$ | ASTM D4716 |

Table 2. REQUIRED CDN PROPERTIES

| Property | Qualifier | Unit | Value | Test |
|---|---|---|---|---|
| Ply Adhesion | ARV | lb/in | 1.0 | ASTM D413 or GRI-GC7 |
| Transmissivity[1] | MARV | $m^2$/sec | $5 \times 10^{-4}$ | ASTM D4716 |

Notes:

MARV = Minimum Average Roll Value.
ARV = Average Roll Value.

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

# 02661 – Table 1 – Required Geomembrane Properties

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Document Type: Construction Specifications (C-1)
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Table 1. REQUIRED GEOMEMBRANE PROPERTIES
60-MIL TEXTURED HDPE

| Property | Qualifier | Unit | Specified Value | Test Method |
|---|---|---|---|---|
| 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 | 0.1-1.1 | ASTM D1238 condition 190/2.16 |
| Asperity | min avg. value[1] | mils | 10 | GRI-GM12 |
| Mechanical Properties | | | | |
| Tensile Properties (each direction) | | | | ASTM D638 (Type IV) |
| 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 8 of 10 | category | 1 or 2 | ASTM D5596 |
| Environmental Stress Crack | minimum[3] | hrs | 200 | ASTM D5397 |

[1]Of 10 readings, 8 out of 10 must be greater or equal to 7 mils, and lowest individual reading must be greater or equal to 5 mils. Provide data for both sides of textured geomembrane.
[2]Yield elongation is calculated using a gauge length of 1.3 inches.
[3]Minimum = mean minus 3 standard deviations from documented manufacturer's quality control (MQC) testing.

## 02661 – Table 2 – Required Seam Properties

Project Title: Integrated Disposal Facility
Document Type: Construction Specifications (C-1)
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Table 2. REQUIRED SEAM PROPERTIES
HDPE GEOMEMBRANES

| Property | Qualifier | Unit | Specified Value | Test Method |
|---|---|---|---|---|
| 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 |

[1]Also called "Bonded Seam Strength."
[2]FTB = Film Tear Bond (failure occurs through intact geomembrane, not through seam).

# 11305-01 Sump Pump Data Sheet – 1 of 2

Project Title: Integrated Disposal Facility
Document Type: Construction Specifications (C-1)
RPP-18489, Rev. 0

SUMP PUMP DATA SHEET, 11305-01

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

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

Manufacturer and Model Number: (1) Hydromatic Pump Co.; Model SB3S
(2) Barnes
(3) Or approved equal

SERVICE CONDITIONS:

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

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

Specific Gravity at 60 Degrees F: 1.0 Viscosity Range: NA pH: 5-9

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

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

Largest diameter solid pump can pass (inches) 0.5

PERFORMANCE REQUIREMENTS:

Capacity (US gpm): Rated: 250

Total Dynamic Head (Ft): Rated: 19

Maximum Shutoff Pressure (Ft): 50

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

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

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

# 11305-01 Sump Pump Data Sheet – 2 of 2

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DESIGN AND MATERIALS:

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

Volute Material: Cast Iron ASTM A48

Pump Casing Material: Cast Iron ASTM A48

Motor Housing Material: Cast Iron ASTM A48

INDUCTION DRIVE MOTOR:

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

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

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

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

# 11305-02 Sump Pump Data Sheet – 1 of 2

Project Title: Integrated Disposal Facility
Document Type: Construction Specifications (C-1)
RPP-18489, Rev. 0

SUMP PUMP DATA SHEET, 11305-02

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

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

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

SERVICE CONDITIONS:

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

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

Specific Gravity at 60 Degrees F: 1.0 Viscosity Range: NA pH: 5-9

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

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

Largest diameter solid pump can pass (inches) 0.5

PERFORMANCE REQUIREMENTS:

Capacity (US gpm): Rated: 28

Total Dynamic Head (Ft): Rated: 14

Maximum Shutoff Pressure (Ft): 30

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

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

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

# 11305-02 Sump Pump Data Sheet – 2 of 2

Project Title: Integrated Disposal Facility
Document Type: Construction Specifications (C-1)
RPP-18489, Rev. 0

DESIGN AND MATERIALS:

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

Volute Material: Cast Iron ASTM A48

Pump Casing Material: Cast Iron ASTM A48

Motor Housing Material: Cast Iron ASTM A48

INDUCTION DRIVE MOTOR:

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

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

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

Enclosure: Submersible

# 11306 01 Leachate Pump Data Sheet – 1 of 2

Project Title: Integrated Disposal Facility
Document Type: Construction Specifications (C-1)
RPP-18489, Rev. 0A

LEACHATE PUMP DATA SHEET, 11306-01:

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

Pump Locations and I.D.: Cell 1 LCRS Sump, Low Flow
Cell 2 LCRS Sump, Low Flow

Manufacturer and Model Number: (1) EPG Companies; Model WSD 3-3
(2) Or equal

SERVICE CONDITIONS:

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

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

Specific Gravity at 60 Degrees F: 1.0 Viscosity Range: NA pH: 5-9

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

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

PERFORMANCE REQUIREMENTS AT PRIMARY DESIGN POINT:

Capacity (US gpm): Rated: 13

Total Dynamic Head (Ft): Rated: 66

Min. Hydraulic Efficiency (%): 60

Maximum Shutoff Pressure (Ft): 90

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

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

# 11306-01 Leachate Pump Data Sheet – 2 of 2

Project Title: Integrated Disposal Facility
Document Type: Construction Specifications (C-1)
RPP-18489, Rev. 0A

DESIGN AND MATERIALS:

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

Discharge Orientation: Center

Casing Materials: Type 304 SST

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

Impeller: Type: Closed  Material: Type 304 SST

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

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

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

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

Drive Type: Direct Coupled

INDUCTION DRIVE MOTOR:

Horsepower: 0.5  Voltage: 460  Phase: 3

Speed (rpm): 3,450

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

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

Enclosure: Submersible

# PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

## OPERATING UNIT 11

## Integrated Disposal Facility

**Appendix 4A - Section 3** **Contents**

### Critical Systems Design Drawings

H-2- 830828A
H-2- 830832
H-2- 830836
H-2- 830837
H-2- 830838
H-2- 830839
H-2- 830840
H-2- 830845
H-2- 830846
H-2- 830848
H-2- 830850
H-2- 830854 sh1
H-2- 830854 sh3
H-2- 830869

**Drawings redacted in electronic version.** These documents may be viewed by appointment (509-372-7920) at the Washington State Department of Ecology Richland Office Library, 3100 Port of Benton Boulevard, Richland, Washington.

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NOTES:

1. CONTRACTOR TO ESTABLISH CONSTRUCTION HAUL ROAD ALIGNMENTS BETWEEN CONSTRUCTION AND STOCKPILE AREAS ON SITE.
2. CONTOURS SHOWN FOR INTERIOR SURFACES OF CELLS 1 AND 2 ARE TOP OF OPERATIONS LAYER.
3. SEE SPECIFICATIONS FOR STOCKPILE AND BORROW AREA GRADING REQUIREMENTS.
4. MAINTAIN ACCESS AND DO NOT BLOCK ROAD TO PUREX FACILITY, TYPICAL FULL LENGTH.
5. MAINTAIN A MINIMUM 50 FOOT BUFFER SPACE BETWEEN PROJECT BOUNDARY AND STOCKPILE/CONSTRUCTION ACTIVITIES.
6. POTENTIAL STOCKPILE AREAS. APPROX. TOE OF SLOPE SHOWN. CONTRACTOR TO PROVIDE DETAILED STOCKPILE PLAN AS SPECIFIED.
7. CLEAR, GRUB, AND STRIP ONLY THE MINIMUM AREAS NECESSARY. CLEARED AREAS SHOULD NOT EXTEND MORE THAN 10' BEYOND CATCHLINES FOR STOCKPILES, BORROW AREAS, ROADS, EXCAVATIONS, AND FILLS.
8. SEED, FERTILIZE, AND MULCH AS SPECIFIED, AREAS OUTSIDE OF THE EXCAVATION AREAS THAT ARE DISTURBED BY CONSTRUCTION AND THAT ARE NOT OTHERWISE STABILIZED. PLACE A 6" THICK LAYER OF TOPSOIL PRIOR TO SEEDING IN ALL AREAS TO BE SEEDED.
9. BOUNDARY BETWEEN CELLS 1 AND 2.
10. CONTRACTOR TO LIMIT BORROW ACTIVITIES TO AREA SHOWN.
11. VALVE FOR GENERAL CONSTRUCTION CONTRACTOR PROVIDED WATER FILL STATION. SEE DETAIL 1 ON DWG H-2-830845.
12. VALVE FOR GENERAL CONSTRUCTION CONTRACTOR PROVIDED PUG MILL. SEE DETAIL 1 ON DWG H-2-830845.
13. CONSTRUCT POWER LINE ACCESS WITH TURNAROUND ON NORTH END. CENTER ACCESS ALIGNMENT ON IDF LANDFILL CENTERLINE (SEE CONTROL POINTS 305 AND 311 ON DWG H-2-830831). CLEAR, STRIP AND GRUB ACCESS ROUTE PRIOR TO PLACING CSTC. CONSTRUCT ACCESS SECTION 20 FT WIDE USING COMPACTED CSTC RESULTING IN A 6-INCH THICK CROSS-SECTION. FINISHED GRADE TO MATCH ADJACENT GROUND SURFACE. CROSS SECTION SURFACE SHOULD BE SLOPED TO DRAIN SIMILAR TO TYPICAL ROAD SECTION SHOWN ON DETAIL 1 ON DWG H-2-830835 SHT 2.
14. AFTER CONSTRUCTION OF IDF CELLS 1 AND 2 IS COMPLETE, CONSTRUCT A 1520 FT LONG, 30 FT WIDE ACCESS ROUTE USING COMPACTED CSBC MATERIAL RESULTING IN AN 8-INCH THICK CROSS SECTION. PRELIMINARY ALIGNMENT CENTERLINE IS SHOWN, COORDINATE FINAL ALIGNMENT WITH CONSTRUCTION MANAGER. CONSTRUCT THIS ACCESS ROUTE FOLLOWING SITE PREPARATION, GRADING AND CROSS SECTION SLOPE AS DESCRIBED IN NOTE 13 FOR POWER LINE ACCESS.

D C B A

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CH2MHILL

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INDEX NO.

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| NAME | DATE | COMPANY |
|---|---|---|
| DRAWN BY G. ALMSTRONG | 2/9/04 | CH2MHILL |
| DSGN APPROVED J. WINTERS | 2/9/04 | CH2MHILL |

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Office of River Protection

TITLE
IDF
CELLS 1 AND 2
SITE AND ACCESS PLAN

DESIGN AUTHORITY E. GIRDIS 2/9/04

| SIZE | BLDG NO | INDEX NO | DWG NO | REV |
|---|---|---|---|---|
| D | 200E | 0110 | H-2-830828 | A |

SCALE 1"=200' EDT 634144 SHEET 1 OF 3

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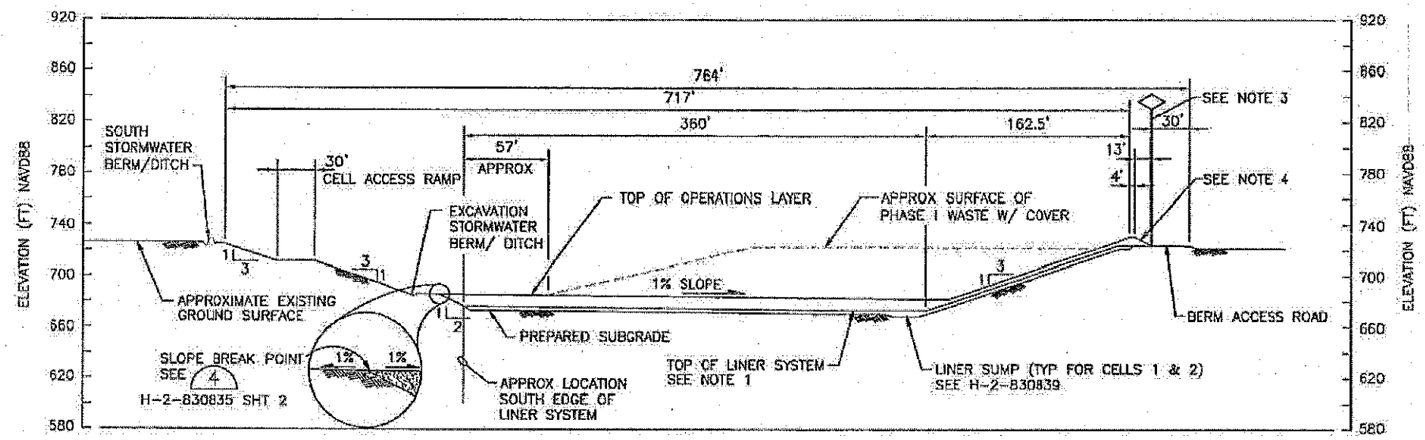
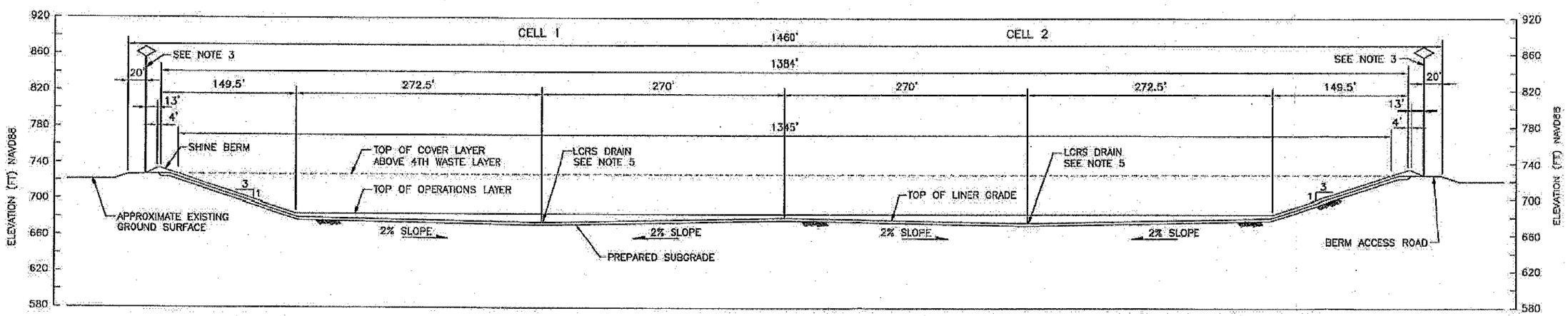



SECTION (A)
1" = 60' H-2-830830

NOTES:

1. FOR LINER SYSTEM, SEE H-2-830836 AND H-2-830838.
2. FOR SUBGRADE LAYER AND OPERATIONS LAYER DETAILED SECTIONS, SEE H-2-830833 AND H-2-830834.
3. SURVEY CONTROL LINE, SEE H-2-830829, H-2-830833 AND H-2-830834.
4. CREST PAD BLDG NOT SHOWN. SEE H-2-830846 FOR DETAILS.
5. SEE H-2-830845 FOR LCRS PIPING PLAN.




SECTION (B)
1" = 60' H-2-830830

0 60 120 180
1"=60'

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|---|---|---|---|
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|---|---|
| DRAWN BY B.A. Martin | 2/6/01 |
| CHKD BY S. MATTSON | 2/6/01 |
| DES APPROVED J. WINTERS | 2/7/01 |
| DESIGN AUTHORITY E. GREGG | 2/7/01 |

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TITLE: IDF GRADING AND DRAINAGE SECTIONS

| SIZE | BLDG NO | INDEX NO | DWG NO | REV |
|---|---|---|---|---|
| D | 200E | 0111 | H-2-830832 | A |

SCALE 1"=60' | CDI 634144 | SHEET 1 OF 1

## GENERAL NOTES

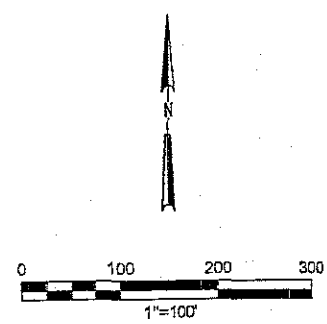
1. GRADES WITHIN LINER LIMITS ARE PRIMARY LINER GRADES. PRIMARY LINER GRADES ARE DEFINED AS TOP OF ADMIX LINER EXCEPT FOR LCRS SUMP TROUGH AND LDS SUMP AREAS. SEE LDS SUMP PARTIAL PLAN (DWG H-2-830837) FOR TOP OF ADMIX GRADES IN THIS AREA. GRADES OUTSIDE LINER SYSTEM LIMITS ARE FINAL GRADES.

2. FOR SIDE SLOPE LINER SEE DETAIL 2 H-2-830838 FOR BOTTOM LINER SEE DETAIL 1 H-2-830838

3. BORROW AREA FOR ADMIX BASE SOIL IS SHOWN ON DWG H-2-830827. ADMIX SOIL MAY BE OBTAINED FROM BORROW AREA OR PHASE 1 EXCAVATION. SEE SPECIFICATION SECTION 02666 FOR BASE SOIL REQUIREMENTS.

4. SHADED AREA INDICATES LIMITS OF PONDED LIQUID WITH MAXIMUM 1 FT LEACHATE HEAD IN LCRS SUMP.

5. SEE DETAIL 3 ON DWG H-2-830838 FOR NORTH, EAST AND WEST EDGE OF LINER DISTANCE FROM CONTROL LINE FOR CIVIL GRADING. SEE DETAIL 2 ON DWG H-2-830840 FOR SOUTH EDGE OF LINER CONTROL POINTS.

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| DFG APPROVED H. REIMBOLD | 2/6/04 | CH2MHILL |
| DESIGN AUTHORITY E. GIRGIS | 2/9/04 | CH2MHILL |

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TITLE
IDF
CELLS 1 AND 2
PRIMARY LINER PLAN

| SIZE | BLDG NO | INDEX NO | DWG NO | REV |
|---|---|---|---|---|
| D | 200E | 0110 | H-2-830836 | A |

SCALE 1"=100' | EDT 634144 | SHEET 1 OF 1

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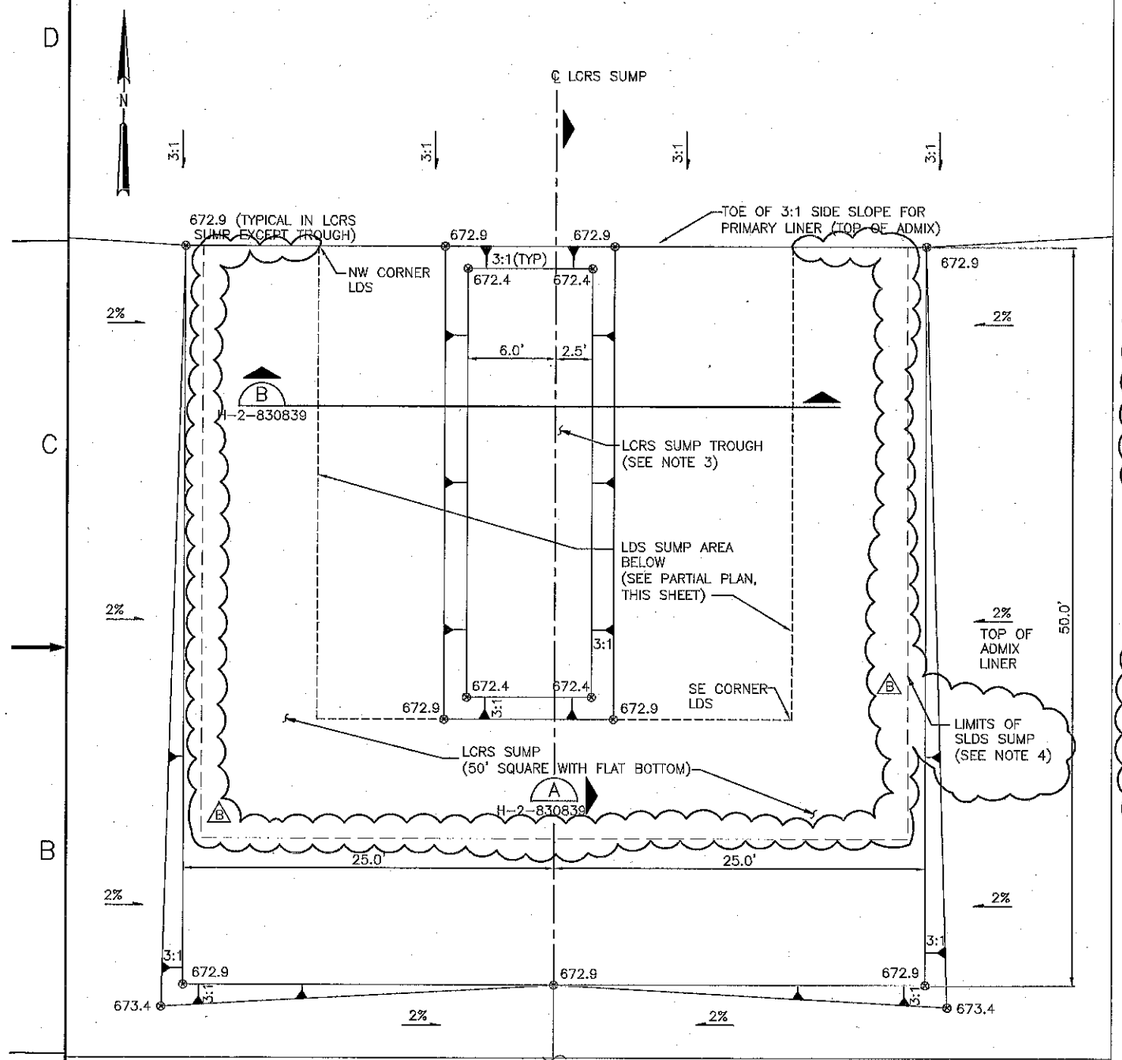
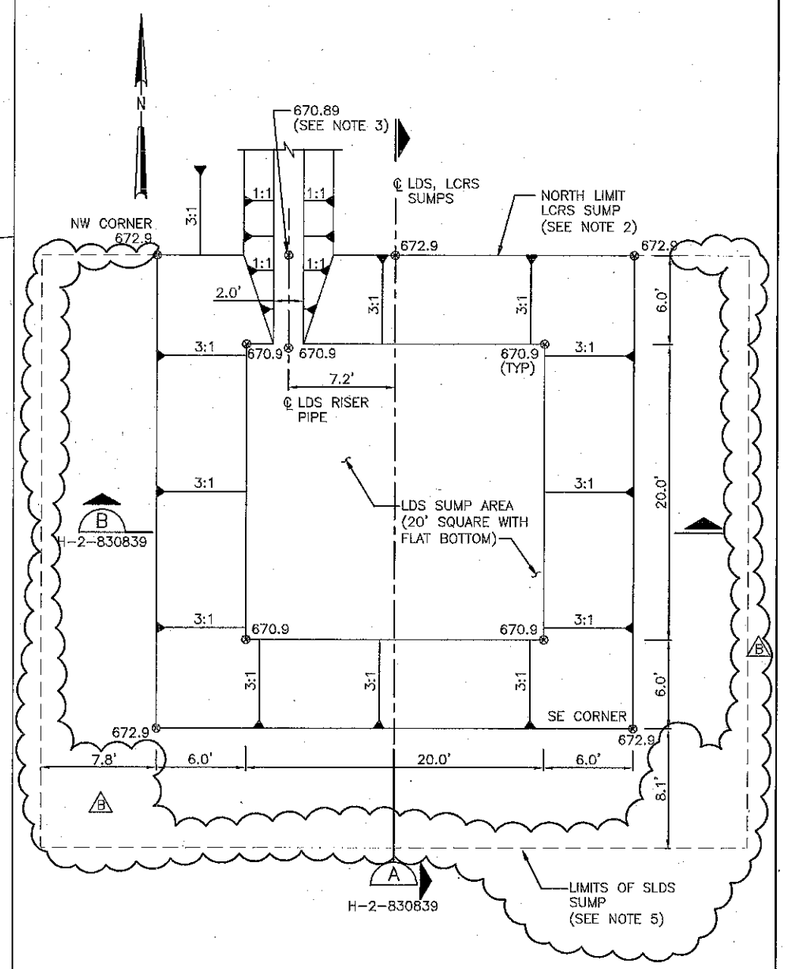



LCRS SUMP PARTIAL PLAN
1" = 5'-0" H-2-830836




LDS SUMP PARTIAL PLAN
1" = 5'-0"

## LCRS SUMP PARTIAL PLAN NOTES:

1. GRADES SHOWN ARE TOP OF ADMIX LINER EXCEPT WITHIN LCRS SUMP TROUGH AND LDS SUMP AREAS. WITHIN LCRS SUMP TROUGH AND LDS SUMP AREAS GRADES SHOWN ARE TOP OF PRIMARY GEOMEMBRANE. SEE LDS SUMP PARTIAL PLAN FOR TOP OF ADMIX GRADES IN THIS AREA.
2. FOR SUBGRADE CONTROL LINE BELOW LCRS SUMP, SEE CELL 1 AND 2 SUMP SUBGRADE TABLES ON DWG. H-2-830829, SHEET 2 OF 2. B
3. SEE SPECIFICATION SECTION 02661 FOR GEOMEMBRANE PANEL LAYOUT REQUIREMENTS FOR LCRS SUMP TROUGH.
4. SEE DWG H-2-830849 SHEET 2 FOR SLDS PARTIAL PLAN. B

## LDS SUMP PARTIAL PLAN NOTES:

1. GRADES SHOWN ARE TOP OF ADMIX LINER.
2. PRIMARY AND SECONDARY GEOMEMBRANE GRADES MATCH AT EL 672.89 (TYP ALL SIDES OF LDS SUMP). CONTINUE 3:1 SLOPE TO ANCHOR TRENCH AT PERIMETER DIKE.
3. START 3:1 SLOPE AT TRENCH BOTTOM. BEGIN TRANSITION TO MAINTAIN 2'-0" DEPTH BELOW PRIMARY LINER GRADES SHOWN ON H-2-830836
4. FOR SUBGRADE CONTROL LINES BELOW LDS SUMP, SEE CELL 1 AND 2 SUMP SUBGRADE TABLES ON DWG. H-2-830829, SHEET 2 OF 2. B
5. SEE DWG H-2-830849 SHEET 2 FOR SLDS PARTIAL PLAN.

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| | | NEXT USED ON | |

| REV NO | DESCRIPTION | REV BY DATE | ENGR | COMPANY |
|---|---|---|---|---|
| B | ADDITION OF SLDS | 4/19/04 | M. REIMBOLD | CH2MHILL |

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| DRAWN BY R. LATTA | | CH2MHILL |
| DPTG APPROVED M. REIMBOLD | | CH2MHILL |
| DESIGN AUTHORITY E. GIROS | | |

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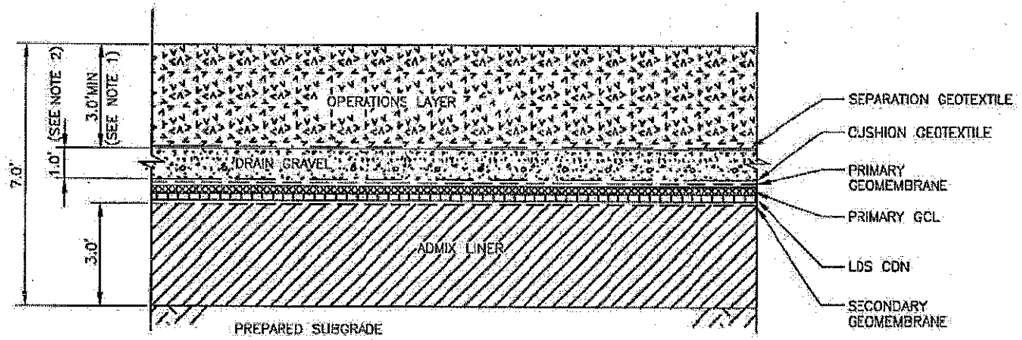
TITLE: IDF CELLS 1 AND 2 SUMP PARTIAL PLANS

| SIZE | BLDG NO | INDEX NO | DWG NO | REV |
|---|---|---|---|---|
| D | 200E | 0111 | H-2-830837 | B |

SCALE 1"=100' EDT 634144 SHEET 1 OF 1

XXXX PLOTID XXXX



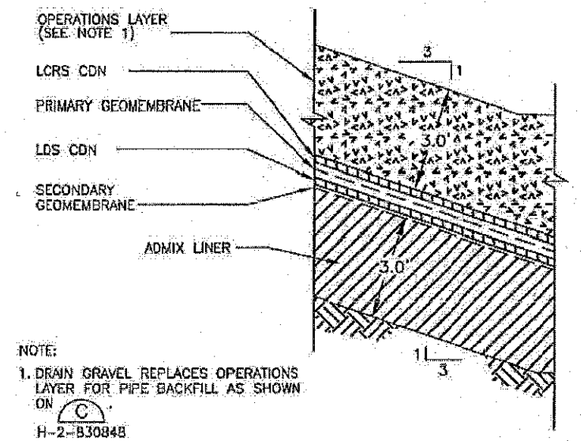

NOTES:

1. OPERATIONS LAYER THICKNESS VARIES ACROSS CELL BOTTOM WITH A 3-FOOT MIN. THICKNESS.
2. INCREASE DRAIN GRAVEL THICKNESS IN VICINITY OF LEACHATE COLLECTION AND RISER PIPES IN LCRS SUMP AS SHOWN ON (B) AND (D) H-2-830848 H-2-830845

## BOTTOM LINER DETAIL (1)

NTS

H-2-830836, H-2-830839, H-2-830840, H-2-830848, H-2-830845




NOTE:

1. DRAIN GRAVEL REPLACES OPERATIONS LAYER FOR PIPE BACKFILL AS SHOWN ON (C) H-2-830848

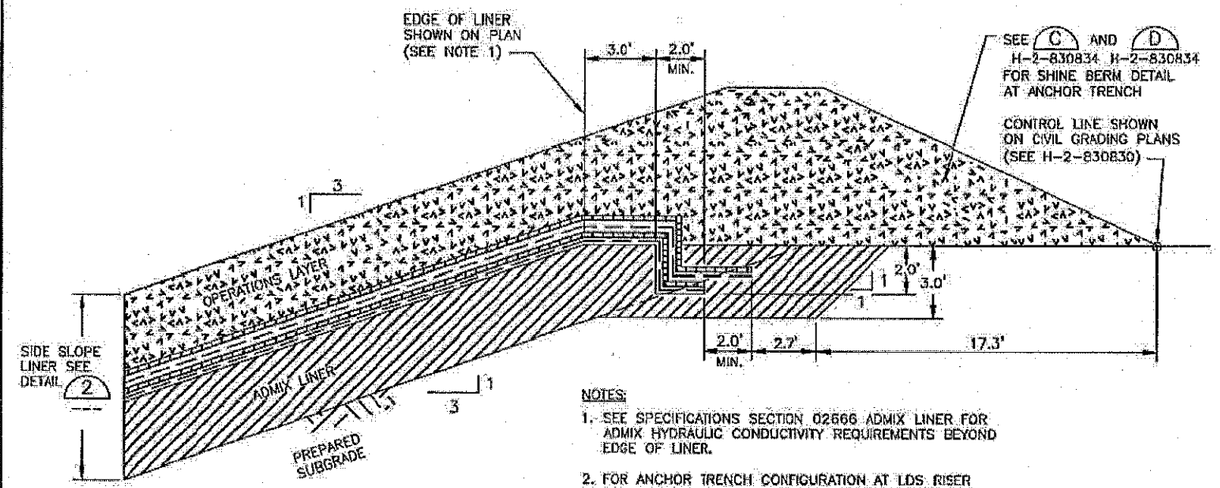
GENERAL NOTE (H-2-830838 THROUGH 830840)

SPACING BETWEEN GEOSYNTHETIC LAYERS IS EXAGGERATED FOR CLARITY.

## SIDE SLOPE LINER DETAIL (2)

NTS

H-2-830836, H-2-830839, H-2-830840, H-2-830848, H-2-830849



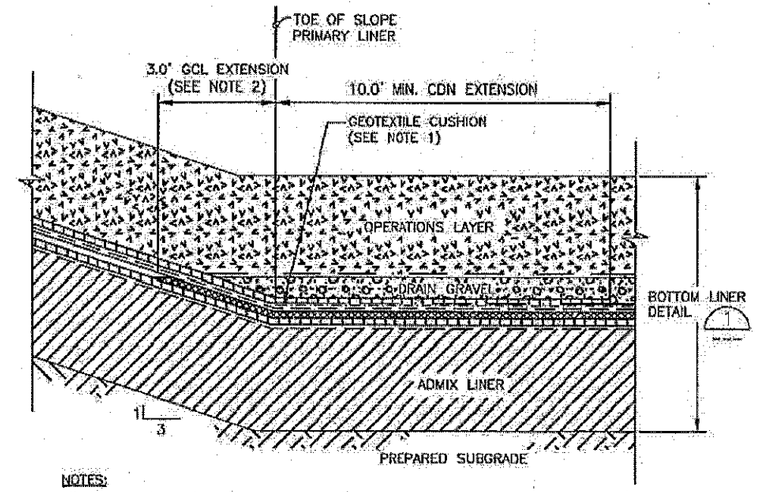

NOTES:

1. SEE SPECIFICATIONS SECTION 02666 ADMIX LINER FOR ADMIX HYDRAULIC CONDUCTIVITY REQUIREMENTS BEYOND EDGE OF LINER.
2. FOR ANCHOR TRENCH CONFIGURATION AT LDS RISER PIPE TRENCH SEE SECTION C ON DWG. H-2-830847.

## LINER ANCHOR TRENCH DETAIL (3)

NTS

H-2-830834, H-2-830836




NOTES:

1. GEOTEXTILE CUSHION ENDS AT TOE OF SLOPE
2. EXTEND GCL 3.0' UP SLOPE (HORIZONTAL LENGTH) TO TOP OF DRAIN GRAVEL.

## TOE OF SLOPE LINER DETAIL (4)

NTS

H-2-830836, H-2-830839

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|---|---|
| DRAWN BY R. LATTA | 2/6/03 |
| CHKD BY J. CARTER | 2/6/03 |
| APPROVED M. ROMOLO | 2/6/03 |
| DESIGN AUTHORITY E. GRIGG | 2/9/04 |

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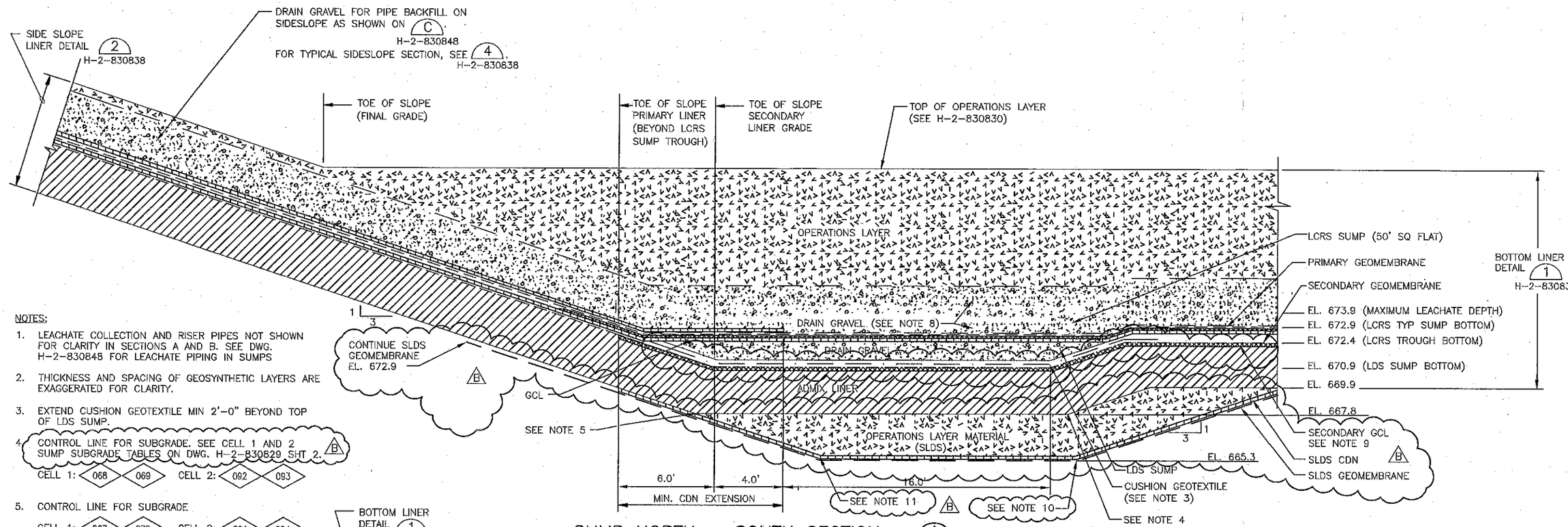
IDF GEOSYNTHETICS SECTIONS AND DETAILS

| SIZE | BLDG NO | INDEX NO | DWG NO | REV |
|---|---|---|---|---|
| D | 200E | 0111 | H-2-830838 | A |

SCALE AS SHOWN KEY 634144 SHEET 1 OF 1

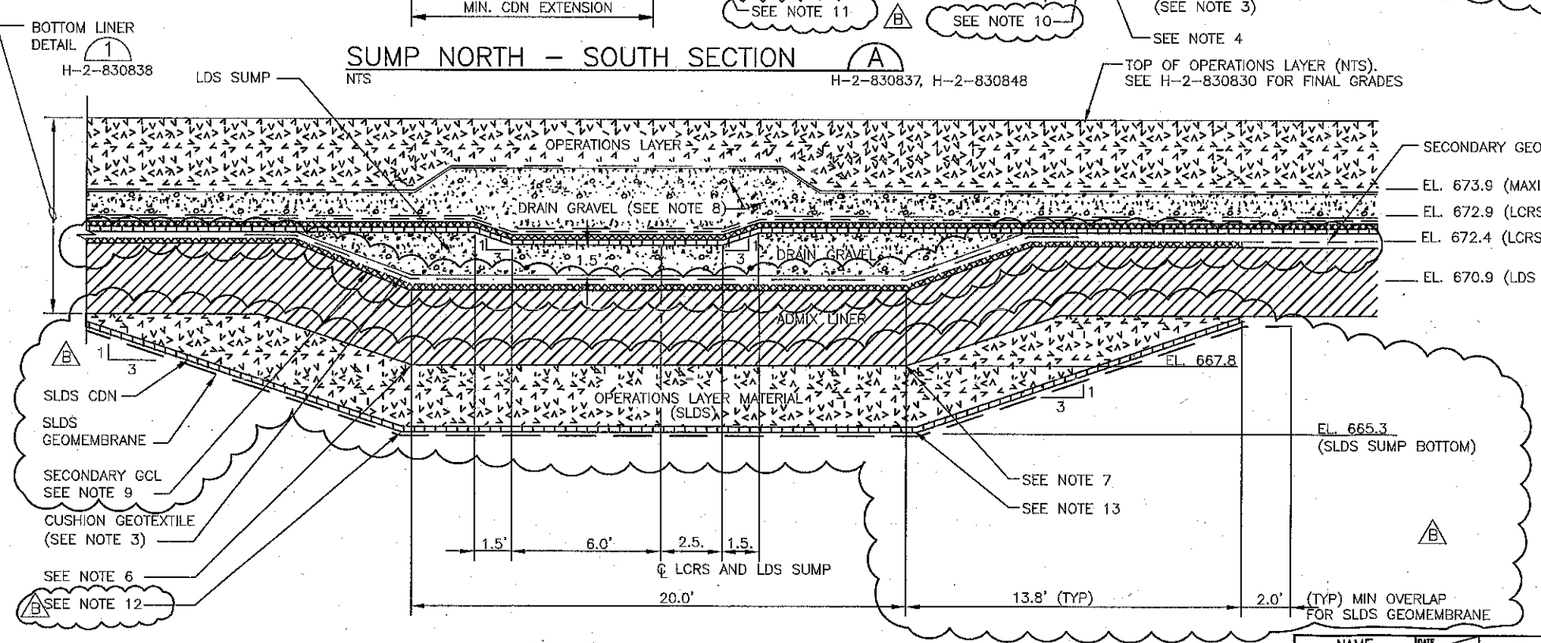
XXXX PLOTD XXXX




SUMP NORTH – SOUTH SECTION A
NTS H-2-830837, H-2-830848

NOTES:

1. LEACHATE COLLECTION AND RISER PIPES NOT SHOWN FOR CLARITY IN SECTIONS A AND B. SEE DWG. H-2-830848 FOR LEACHATE PIPING IN SUMPS
2. THICKNESS AND SPACING OF GEOSYNTHETIC LAYERS ARE EXAGGERATED FOR CLARITY.
3. EXTEND CUSHION GEOTEXTILE MIN 2'-0" BEYOND TOP OF LDS SUMP.
4. CONTROL LINE FOR SUBGRADE. SEE CELL 1 AND 2 SUMP SUBGRADE TABLES ON DWG. H-2-830829 SHT 2. B
   CELL 1: 068 069 CELL 2: 092 093
5. CONTROL LINE FOR SUBGRADE
   CELL 1: 067 070 CELL 2: 091 094
6. CONTROL LINE FOR SUBGRADE
   CELL 1: 067 068 CELL 2: 091 092
7. CONTROL LINE FOR SUBGRADE
   CELL 1: 069 070 CELL 2: 093 094
8. INCREASE GRAVEL THICKNESS IN VICINITY OF LEACHATE COLLECTION AND RISER PIPES IN LCRS SUMP AS SHOWN IN B AND D
   H-2-830848 H-2-830845
9. PROVIDE GCL BENEATH SECONDARY GEOMEMBRANE WITHIN LIMITS OF SLDS SUMP SHOWN ON DWGS. H-2-830837 AND H-2-830849 SHT 2.
10. CONTROL LINE FOR SLDS SUMP SUBGRADE, SEE DETAILS 1 AND 2 ON DWG. H-2-830829 SHT 1.
    CELL 1: 065 066 CELL 2: 088 089
11. CONTROL LINE FOR SUBGRADE
    CELL 1: 056 072 CELL 2: 080 096
12. CONTROL LINE FOR SUBGRADE
    CELL 1: 056 066 CELL 2: 080 089
13. CONTROL LINE FOR SUBGRADE
    CELL 1: 065 072 CELL 2: 088 096
B




SUMP EAST – WEST SECTION B
NTS H-2-830837

| DWG NO | TITLE | REF NUMBER | TITLE |
|---|---|---|---|
| DRAWING TRACEABILITY LIST | | NEXT USED ON | REFERENCES |

| REV NO | DESCRIPTION | REV DATE | ENGR | COMPANY |
|---|---|---|---|---|
| A | ADDITION OF SLDS | 4/19/04 | M REIMBOLD | CH2MHill |

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|---|---|---|
| DRAWN BY R LATTA | | CH2MHill |
| DFTG APPROVED M REIMBOLD | | CH2MHill |
| DESIGN AUTHORITY E GRIGG | | |

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IDF GEOSYNTHETICS SECTIONS AND DETAILS

| SIZE | BLDG NO | INDEX NO | DWG NO | REV |
|---|---|---|---|---|
| D | 200E | 0111 | H-2-830839 | B |

SCALE AS SHOWN EDT 634144 SHEET 1 OF 1

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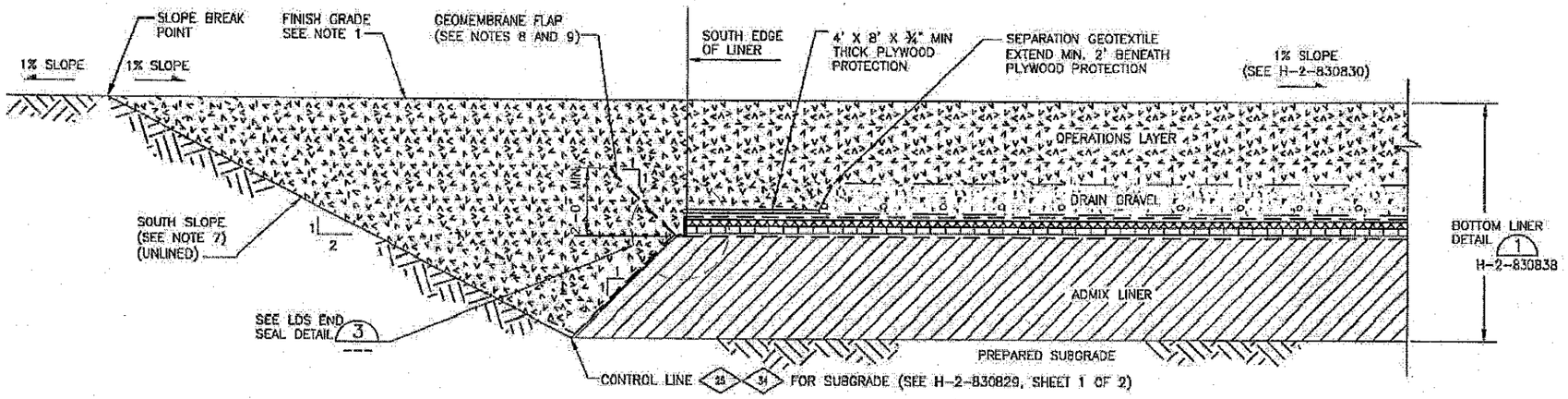
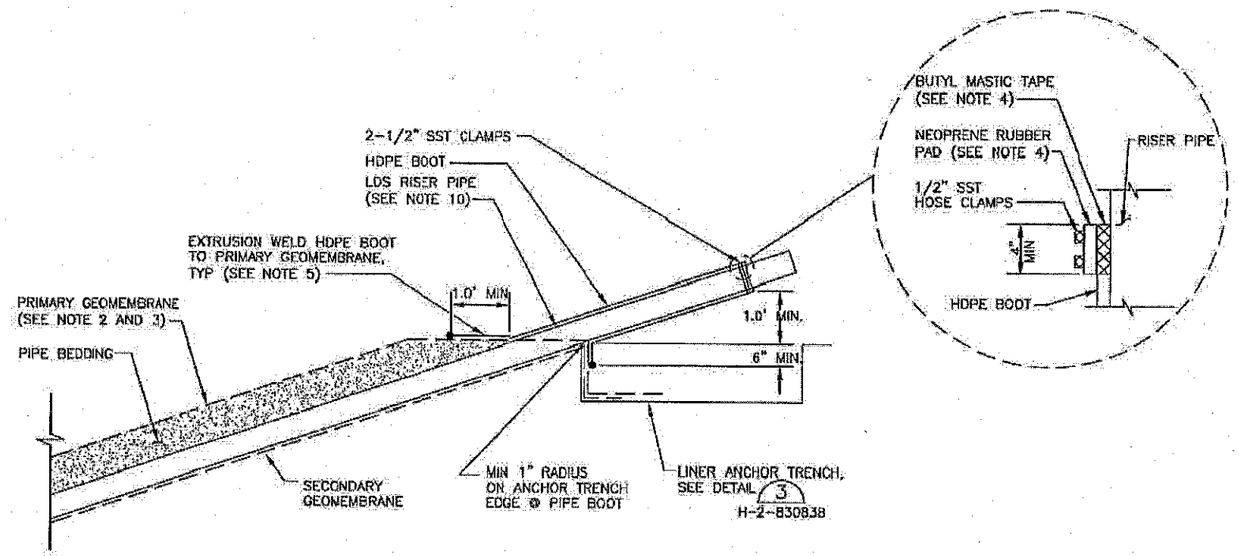



## PHASE 1 SOUTH LINER EDGE TERMINATION DETAIL 1

NTS H-2-830836

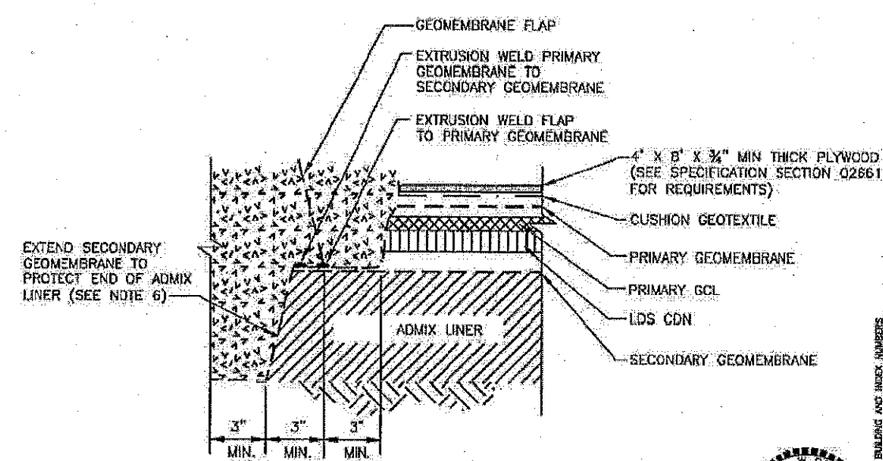
NOTE FOR DETAILS ON H-2-830840:

1. SEE DWG H-2-830830 FOR FINAL GRADING AND DRAINAGE PLAN ABOVE OPERATIONS LAYER AT SOUTH LINER EDGE.
2. OVERLYING LINING SYSTEM COMPONENTS NOT SHOWN FOR CLARITY. SEE SIDE SLOPE LINER DETAIL 3 H-2-830838
3. ONLY PRIMARY GEOMEMBRANE REQUIRES CONNECTION TO BOOT. FOR OTHER GEOSYNTHETICS, CUT OPENING 1/2" LESS THAN PIPE OD.
4. BUTYL MASTIC TAPE AND NEOPRENE RUBBER PAD APPLIED CONTINUOUSLY AROUND PIPE.
5. FORM BOOT WITH SUFFICIENT MATERIAL TO PREVENT OVERSTRESSING DURING BACKFILLING, BUT WITHOUT FOLDS OR WRINKLES.
6. PROTECT LEADING EDGE OF GEOMEMBRANE AGAINST WIND UPLIFT PRIOR TO PLACEMENT OF OPERATIONS LAYER. CONTRACTOR SHALL SELECT BEST METHOD AVAILABLE SUCH AS SAND BAGS OR TEMPORARY SOIL BERM.
7. CONTRACTOR MAY MODIFY SUBGRADE AT SOUTH SLOPE AS NEEDED FOR GEOSYNTHETICS INSTALLATION ACCESS. BACKFILL TO FINISH GRADE AS SHOWN.
8. PROVIDE GEOMEMBRANE FLAP AS SHOWN ACROSS LANDFILL FLOOR FOR CELL 1 AND 2. EXTEND MINIMUM 6 FEET UP 3:1 SIDE SLOPE FROM TOE OF SLOPE.
9. PROVIDE GEOMEMBRANE PIPE BOOT SIMILAR TO 2 FOR LCRS CLEANOUT IN CELLS 1 AND 2 SHOWN ON H-2-830845.
10. SEE SECTION C ON DWG H-2-830847 FOR LDS RISER PIPE DETAIL.




## TYPICAL GEOMEMBRANE BOOT DETAIL 2

NTS H-2-830847, H-2-830849




## LDS END SEAL DETAIL 3

NTS

BLDG. NO. 200E

INDEX NO. 0111

THIS SPACE RESERVED FOR BUILDING AND INDEX NUMBERS

EXPIRES 12/24/09

CH2MHILL

| DWG NO | TITLE | REF NUMBER | TITLE |
|---|---|---|---|
| DRAWING TRACEABILITY LIST | | NEXT USED ON | REFERENCES |

| REV NO | DESCRIPTION | REV BY DATE | CHKR COMPANY |
|---|---|---|---|
| REVISIONS | | | |

| NAME | DATE | COMPANY |
|---|---|---|
| DRAWN BY | | |
| CHKD APPROVED | | CH2MHILL |
| | | CH2MHILL |

DESIGN AUTHORITY

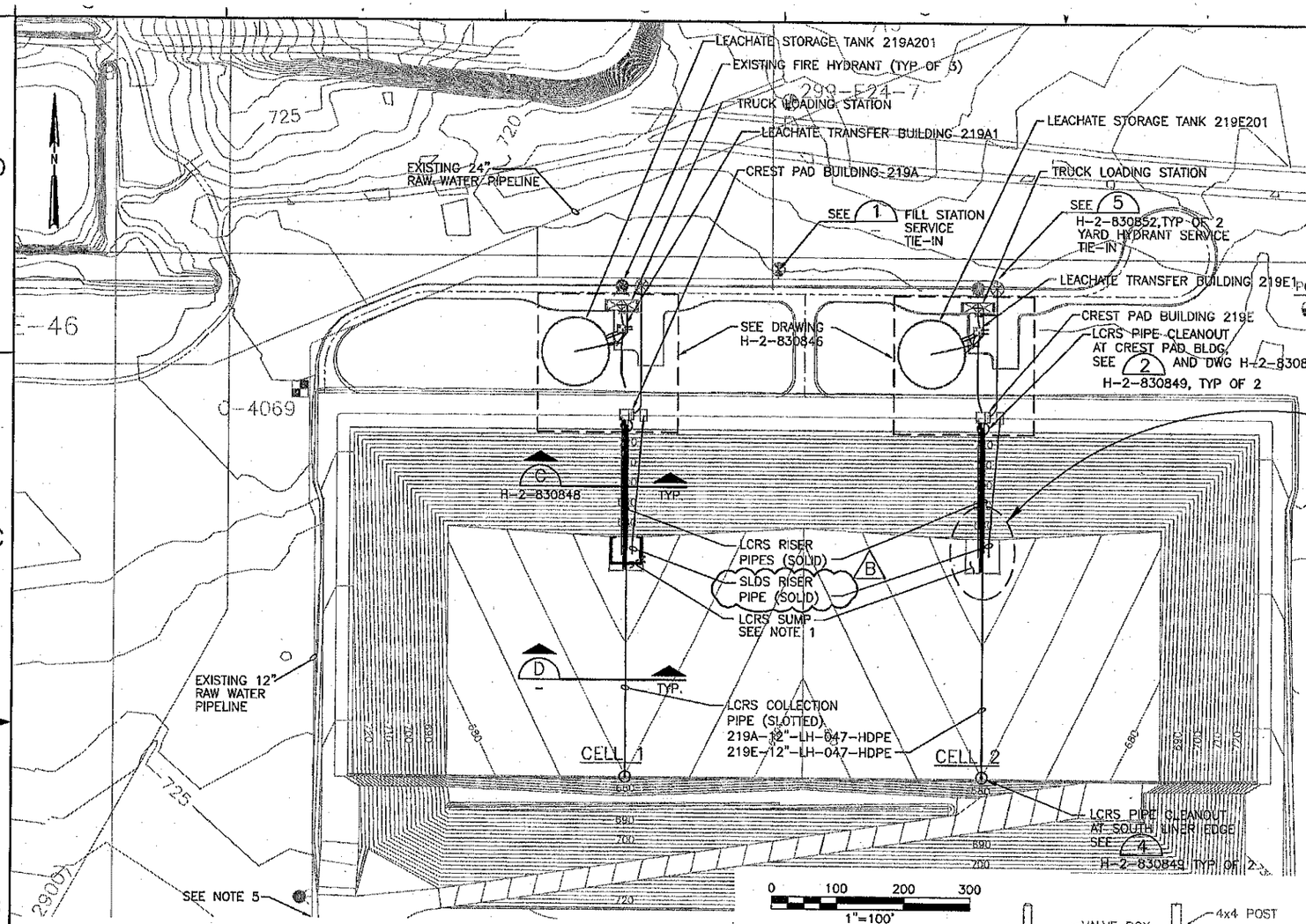
U.S. DEPARTMENT OF ENERGY
Office of River Protection

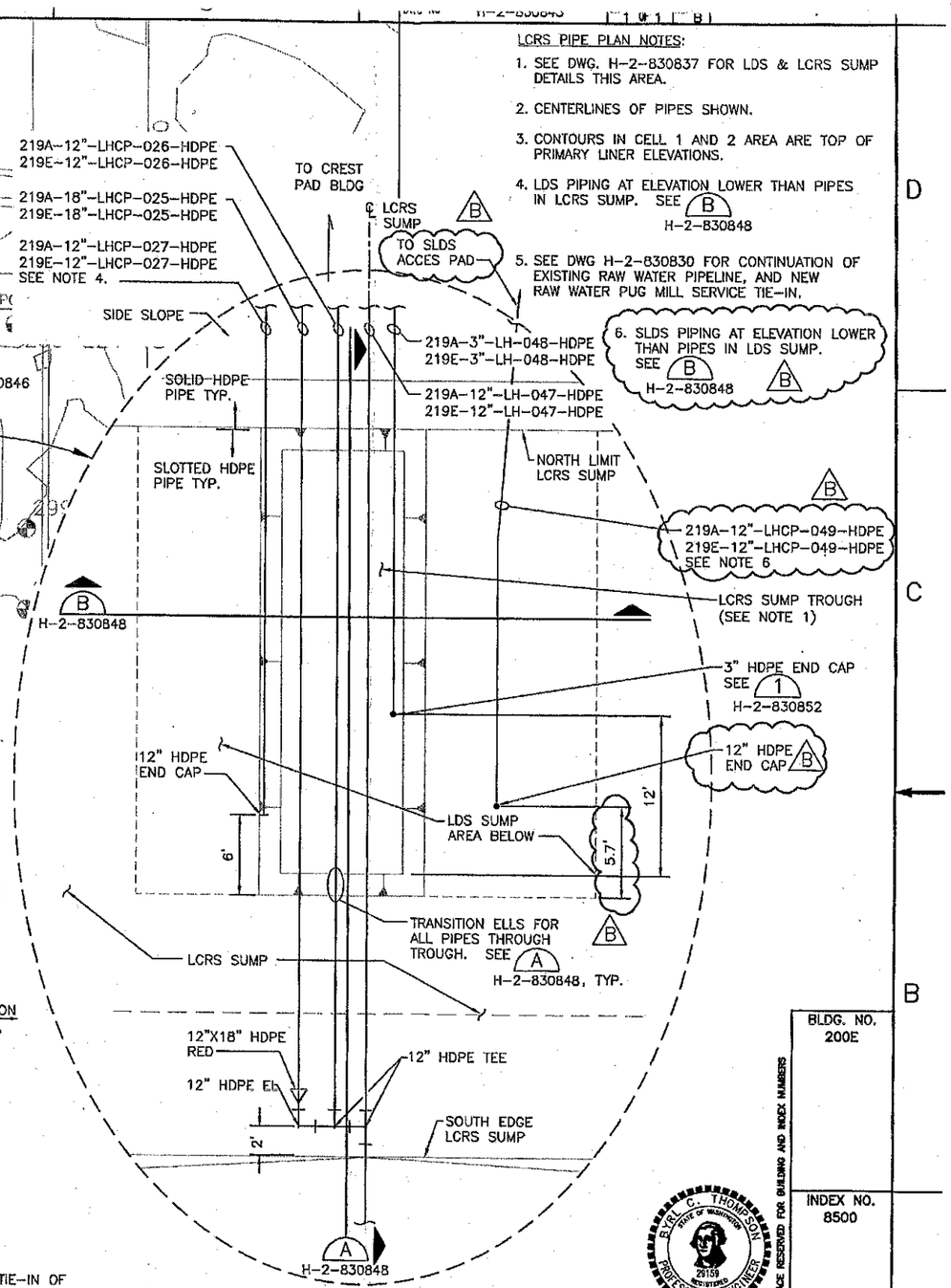
TITLE: IDF GEOSYNTHETICS SECTIONS AND DETAILS

| SIZE | BLDG NO | INDEX NO | DWG NO | REV |
|---|---|---|---|---|
| D | 200E | 0111 | H-2-830840 | A |

SCALE AS SHOWN REF 634144 SHEET 1 OF 1

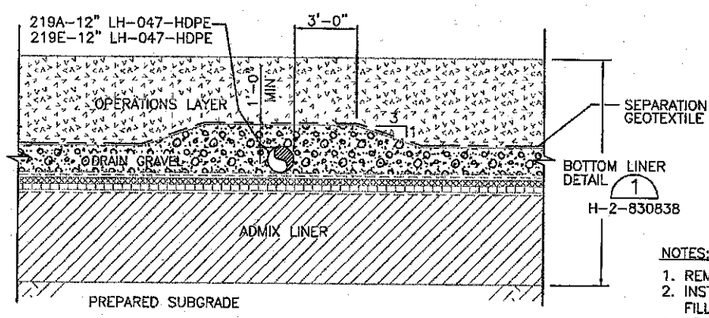
XXXX PLOTID XXXX




LCRS PIPE PLAN NOTES:

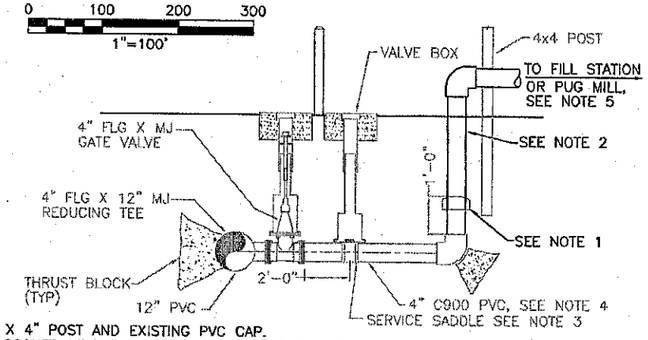
1. SEE DWG. H-2-830837 FOR LDS & LCRS SUMP DETAILS THIS AREA.
2. CENTERLINES OF PIPES SHOWN.
3. CONTOURS IN CELL 1 AND 2 AREA ARE TOP OF PRIMARY LINER ELEVATIONS.
4. LDS PIPING AT ELEVATION LOWER THAN PIPES IN LCRS SUMP. SEE B H-2-830848
5. SEE DWG H-2-830830 FOR CONTINUATION OF EXISTING RAW WATER PIPELINE, AND NEW RAW WATER PUG MILL SERVICE TIE-IN.
6. SLDS PIPING AT ELEVATION LOWER THAN PIPES IN LDS SUMP. SEE B H-2-830848




NOTES;

1. OPERATIONS LAYER THICKNESS VARIES ACROSS CELL BOTTOM WITH A 3-FOOT MIN. THICKNESS.

LCRS COLLECTION PIPE D
NTS H-2-830849




NOTES:

1. REMOVE 4" X 4" POST AND EXISTING PVC CAP.
2. INSTALL 4" SOCKET WELD PIPING AND FITTINGS AS REQUIRED FOR BELOW AND ABOVE GROUND TIE-IN OF FILL STATION AND PUG MILL.
3. 1" DRAIN VALVE, 1" DIA X 12" LONG GSP, AND 2 CUBIC FEET OF DRAIN GRAVEL NOT SHOWN FOR CLARITY.
4. EXISTING 4" C900 PVC IS APPROXIMATELY 200' LONG FOR PUG MILL SERVICE AND APPROXIMATELY 10' LONG FOR FILL STATION SERVICE.
5. COORDINATE WITH CONSTRUCTION MANAGER FOR REQD DEMOLITION OF ABOVE GROUND PIPING AND RE-CAPPING OF BURIED PIPING AFTER PROJECT COMPLETION.

FILL STATION/PUG MILL TIE-IN 1
NTS H-2-830830

TYPICAL LCRS/LDS SUMP PIPING SCHEMATIC CELLS 1 & 2
NTS

BLDG. NO. 200E

INDEX NO. 8500

THIS SPACE RESERVED FOR BUILDING AND INDEX NUMBERS

BURL C. THOMPSON, STATE OF WASHINGTON, 29159, REGISTERED PROFESSIONAL ENGINEER
EXPIRES 4/20/

CH2MHILL

| DWG NO | TITLE | REF NUMBER | TITLE |
|---|---|---|---|
| DRAWING TRACEABILITY LIST | | REFERENCES | NEXT USED ON |

| REV NO | DESCRIPTION | REV BY DATE | |
|---|---|---|---|
| A | ADDITION OF SLDS | 4/23/04 | E THOMAS CH2MHILL |
| REVISIONS | | | |

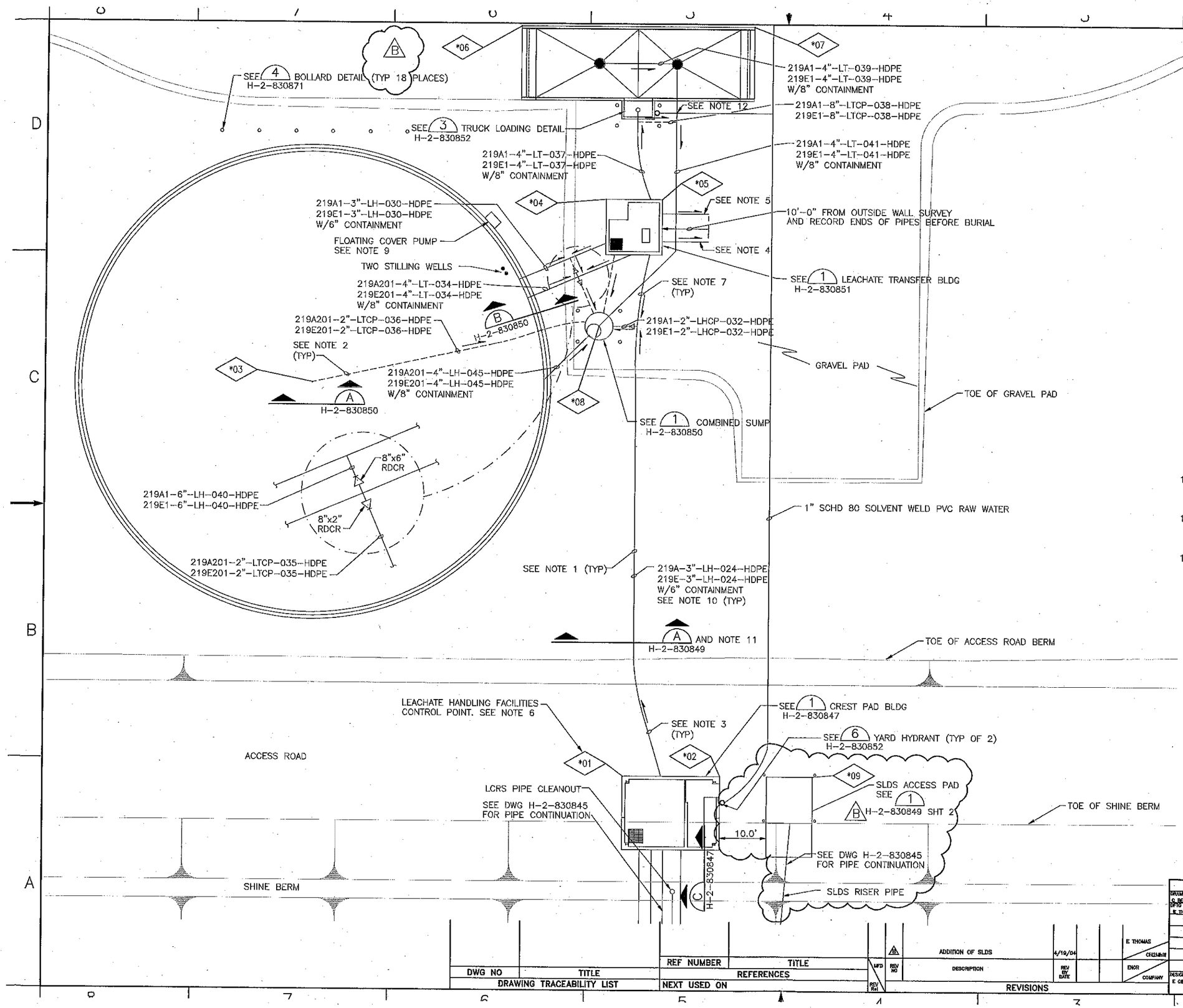
| NAME | DATE | COMPANY |
|---|---|---|
| DRAWN BY T. SUH | | CH2MHILL |
| DSIGN APPROVED B. THOMPSON | | CH2MHILL |
| DRAWN AUTHORITY E. GIBBS | | |

U.S. DEPARTMENT OF ENERGY
Office of River Protection

TITLE
IDF
LEACHATE COLLECTION PIPING PLAN

| SIZE | BLDG NO | INDEX NO | DWG NO | REV |
|---|---|---|---|---|
| D | 200E | 8500 | H-2-830845 | B |

SCALE AS SHOWN | EDT 634144 | SHEET 1 OF 1




NOTES:

1. PIPES SHOWN AS SOLID LINES NORTH OF CREST PAD BLDG. INDICATE BURIED DOUBLE CONTAINED LEACHATE PIPING OR RAW WATER PIPING.
2. DASHED LINE INDICATES BURIED SINGLE WALL PIPING FOR SECONDARY CONTAINMENT SYSTEMS.
3. SLOPE ALL PIPING IN DIRECTION INDICATED AT 1% SLOPE MINIMUM. FOR PRIMARY PIPE FLOW DIRECTIONS, SEE P&ID'S ON H-2-830854, SHEETS 1 THROUGH 4.
4. INSTALL HDPE CAP ON CARRIER PIPE AND FIXED END SEAL FOR SECONDARY CONTAINMENT PIPE. THIS PIPE IS PROVIDED FOR FUTURE PUMP SUCTION CONNECTION TO FUTURE LEACHATE STORAGE TANK.
5. INSTALL HDPE CAP ON CARRIER PIPE AND FIXED END SEAL FOR SECONDARY CONTAINMENT PIPE. THIS PIPE IS PROVIDED FOR FUTURE LEACHATE TRANSFER BUILDING DISCHARGE CONNECTION TO FUTURE LEACHATE STORAGE TANK.
6. SEE DWG H-2-830829, SHT 2 FOR LEACHATE HANDLING FACILITIES SURVEY CONTROL POINTS. FOR CELL 1 FACILITIES CONTROL POINTS, REPLACE "*" WITH 4; FOR CELL 2 FACILITIES CONTROL POINTS, REPLACE "*" WITH 5.

   EXAMPLE: CELL 2 <*02> IS <502>
7. BEND RADIUS SHALL NOT BE LESS THAN ALLOWED BY PIPE MANUFACTURER.
8. STILLING WELLS SHALL BE INSTALLED PER TANK MANUFACTURER REQUIREMENTS AT THE LOCATION SHOWN FOR ANALOG AND DISCRETE LEVEL INSTRUMENTATION.
9. FLOATING COVER PUMP AND ASSOCIATED BASEPLATE/BRACKET SHALL BE INSTALLED PER TANK MANUFACTURER REQUIREMENTS AT THE LOCATION SHOWN. THIS PUMP SHALL BE OPERATED AS REQD TO MINIMIZE DEPTH OF RAIN/SNOWMELT ACCUMULATION ON TOP OF FLOATING COVER.
10. PIPING DESIGNATIONS ARE IDENTIFIED FOR CELL 1 AND CELL 2 LEACHATE PIPELINES. THE "219A" PREFIX IS FOR CELL 1 AND THE "219E" PREFIX IS FOR CELL 2.
11. APPLIES TO ALL PIPING NORTH OF CREST PAD BUILDING INCLUDING RAW WATER PIPING EXCEPT RAW WATER PIPIING SHALL HAVE MINIMUM 3'-6" OF COVER.
12. INSTALL 1" RAW WATER PIPE A MINIMUM OF 6" BELOW 8" HDPE PIPE.

N

0 10 20 30
1"=10'

| BLDG. NO. |
|---|
| 219A<br>219A1<br>219A201<br>219E<br>219E1<br>219E201 |

| INDEX NO. |
|---|
| 8500 |

THIS SPACE RESERVED FOR BUILDING AND INDEX NUMBERS

EDWARD JOHN THOMAS STATE OF WASHINGTON 38007 REGISTERED PROFESSIONAL ENGINEER
EXPIRES 8/4/

CH2MHILL

| DWG NO | TITLE |
|---|---|
| DRAWING TRACEABILITY LIST | |

| REF NUMBER | TITLE |
|---|---|
| REFERENCES | |
| NEXT USED ON | |

| REV NO | DESCRIPTION | REV BY DATE | ENGR | COMPANY |
|---|---|---|---|---|
| B | ADDITION OF SLDS | 4/19/04 | E THOMAS | CH2MHill |

REVISIONS

| | NAME | DATE | COMPANY |
|---|---|---|---|
| DRAWN BY | G. BENTZ | | CH2MHill |
| DFTG APPROVED | E. THOMAS | | CH2MHill |
| DESIGN AUTHORITY | E. GROSS | | |

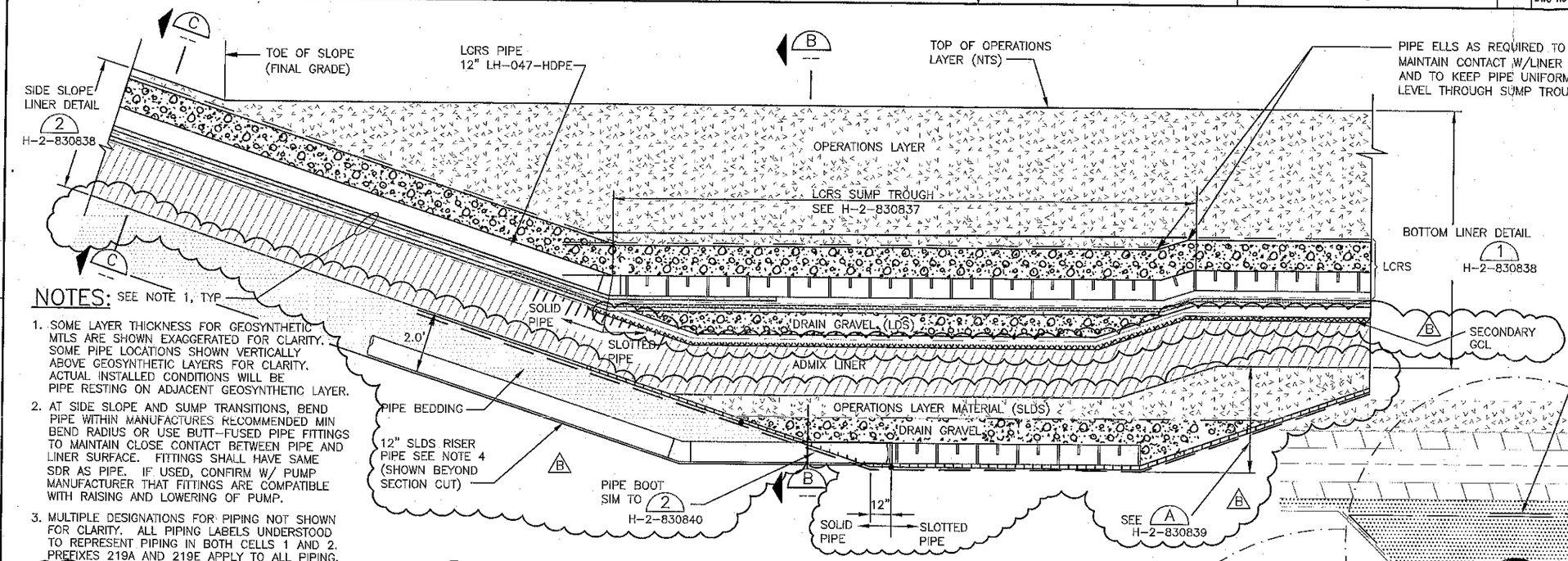
U.S. DEPARTMENT OF ENERGY
Office of River Protection

TITLE
# IDF LEACHATE TRANSFER PIPING PLAN

| SIZE | BLDG NO | INDEX NO | DWG NO | REV |
|---|---|---|---|---|
| D | 219A 219A1 | 8500 | H-2-830846 | B |

SCALE AS SHOWN EDT 634144 SHEET 1 OF 1

XXXX PLOTID XXXX



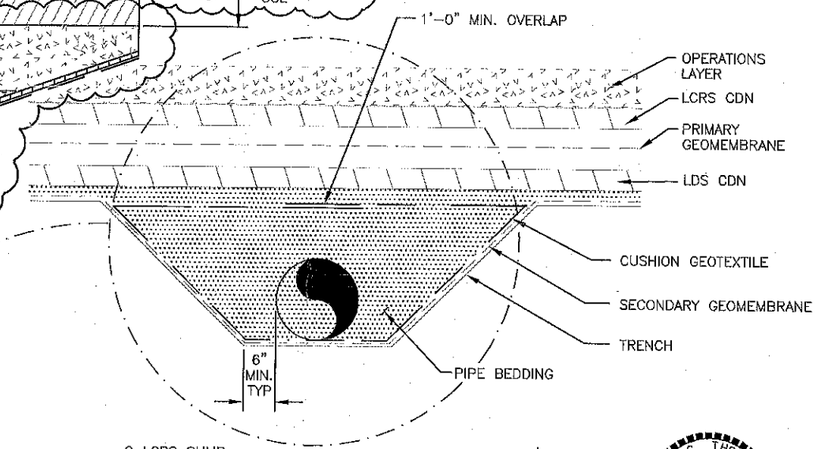

## NOTES:

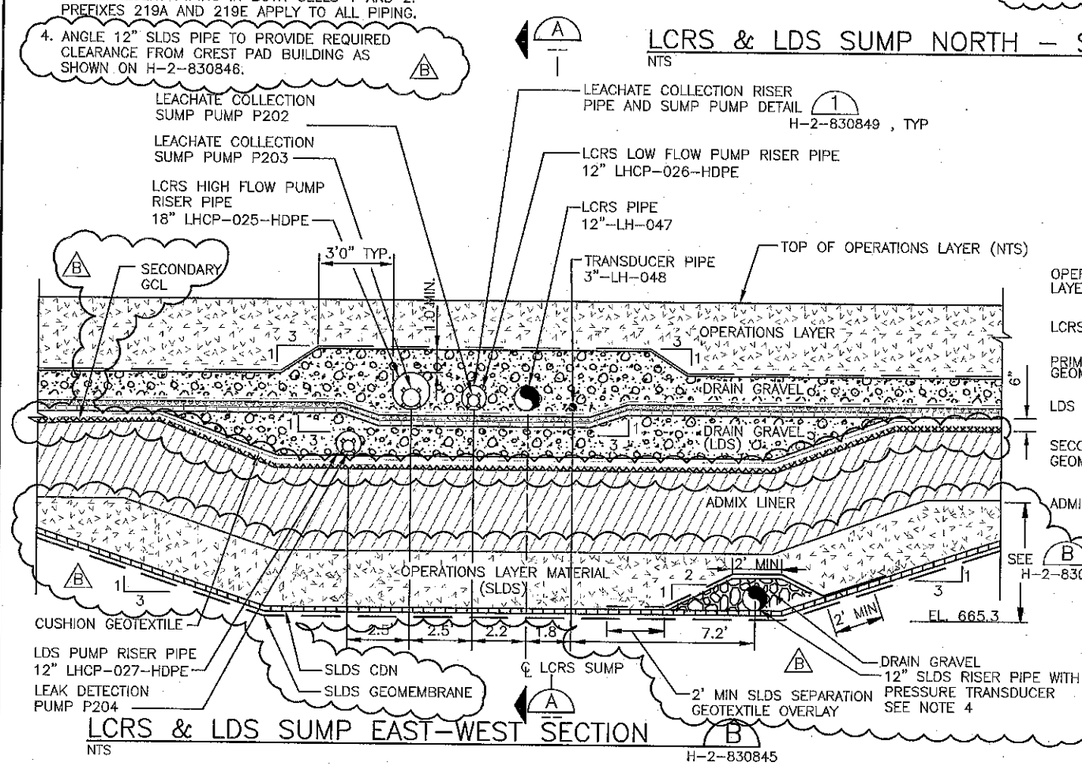
1. SOME LAYER THICKNESS FOR GEOSYNTHETIC MTLS ARE SHOWN EXAGGERATED FOR CLARITY. SOME PIPE LOCATIONS SHOWN VERTICALLY ABOVE GEOSYNTHETIC LAYERS FOR CLARITY. ACTUAL INSTALLED CONDITIONS WILL BE PIPE RESTING ON ADJACENT GEOSYNTHETIC LAYER.
2. AT SIDE SLOPE AND SUMP TRANSITIONS, BEND PIPE WITHIN MANUFACTURES RECOMMENDED MIN BEND RADIUS OR USE BUTT-FUSED PIPE FITTINGS TO MAINTAIN CLOSE CONTACT BETWEEN PIPE AND LINER SURFACE. FITTINGS SHALL HAVE SAME SDR AS PIPE. IF USED, CONFIRM W/ PUMP MANUFACTURER THAT FITTINGS ARE COMPATIBLE WITH RAISING AND LOWERING OF PUMP.
3. MULTIPLE DESIGNATIONS FOR PIPING NOT SHOWN FOR CLARITY. ALL PIPING LABELS UNDERSTOOD TO REPRESENT PIPING IN BOTH CELLS 1 AND 2. PREFIXES 219A AND 219E APPLY TO ALL PIPING.
4. ANGLE 12" SLDS PIPE TO PROVIDE REQUIRED CLEARANCE FROM CREST PAD BUILDING AS SHOWN ON H-2-830846.

## LCRS & LDS SUMP NORTH – SOUTH SECTION A

NTS

H-2-830845
H-2-830849

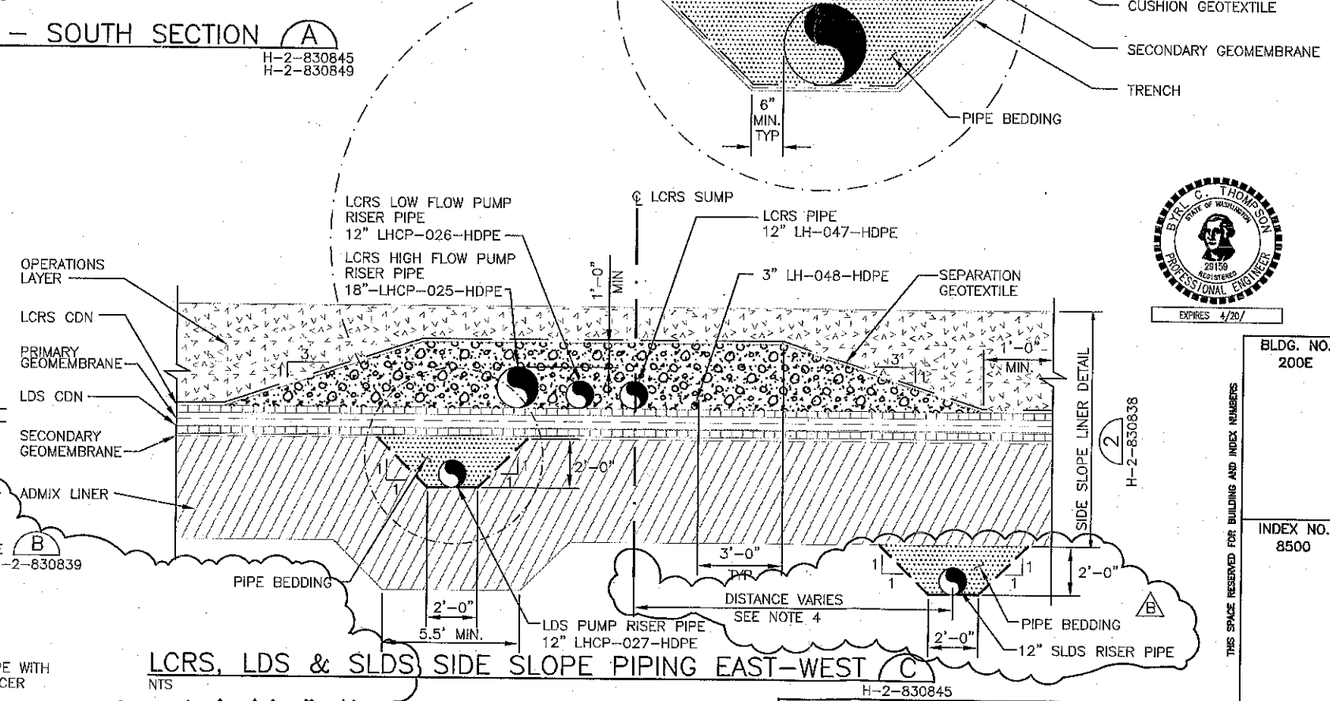



## LCRS & LDS SUMP EAST-WEST SECTION B

NTS

H-2-830845




## LCRS, LDS & SLDS SIDE SLOPE PIPING EAST-WEST C

NTS

H-2-830845

BYRON C. THOMPSON STATE OF WASHINGTON 29159 Registered PROFESSIONAL ENGINEER
EXPIRES 4/20/

BLDG. NO. 200E

INDEX NO. 8500

THIS SPACE RESERVED FOR BUILDING AND INDEX NUMBERS

| DWG NO | TITLE |
|---|---|
| DRAWING TRACEABILITY LIST | |

| REF NUMBER | TITLE |
|---|---|
| REFERENCES | |
| NEXT USED ON | |

| REV NO | DESCRIPTION | REV BY DATE | ENGR COMPANY |
|---|---|---|---|
| B | ADDITION OF SLDS | 4/19/04 | N REIMBOLD CH2MHILL |
| REVISIONS | | | |

| NAME | DATE | COMPANY |
|---|---|---|
| DRAWN BY R LATTA | | CH2MHILL |
| DFTG APPROVED B THOMPSON | | CH2MHILL |
| DESIGN AUTHORITY E GROIS | | CH2MHILL |

U.S. DEPARTMENT OF ENERGY
Office of River Protection

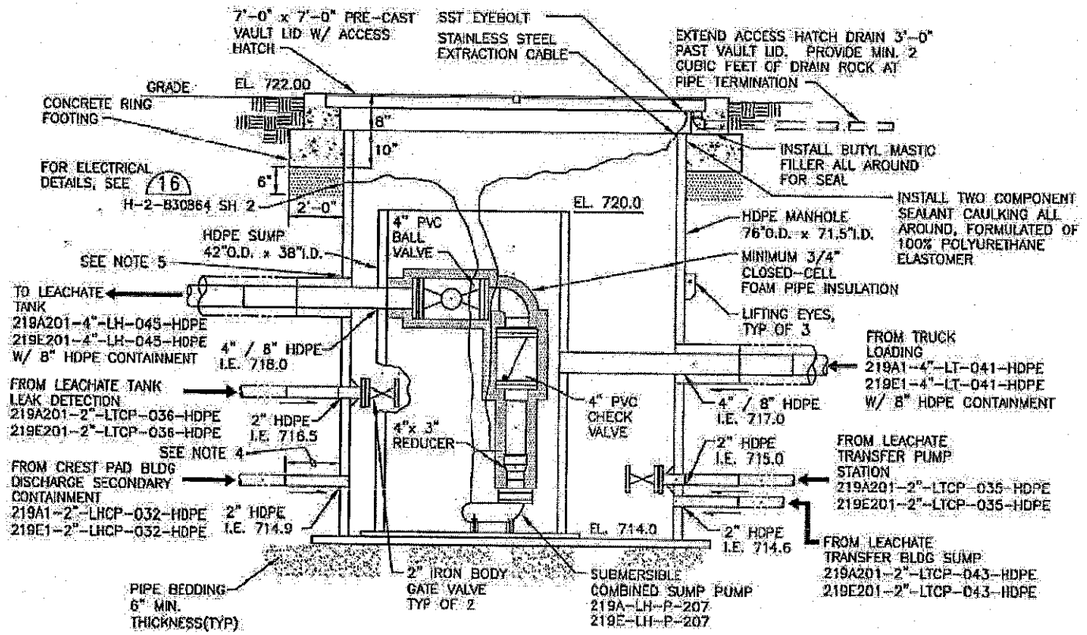
TITLE: IDF LCRS/LDS/SLDS SECTIONS AND DETAILS

| SIZE | BLDG NO | INDEX NO | DWG NO | REV |
|---|---|---|---|---|
| D | 200E | 8500 | H-2-830848 | B |

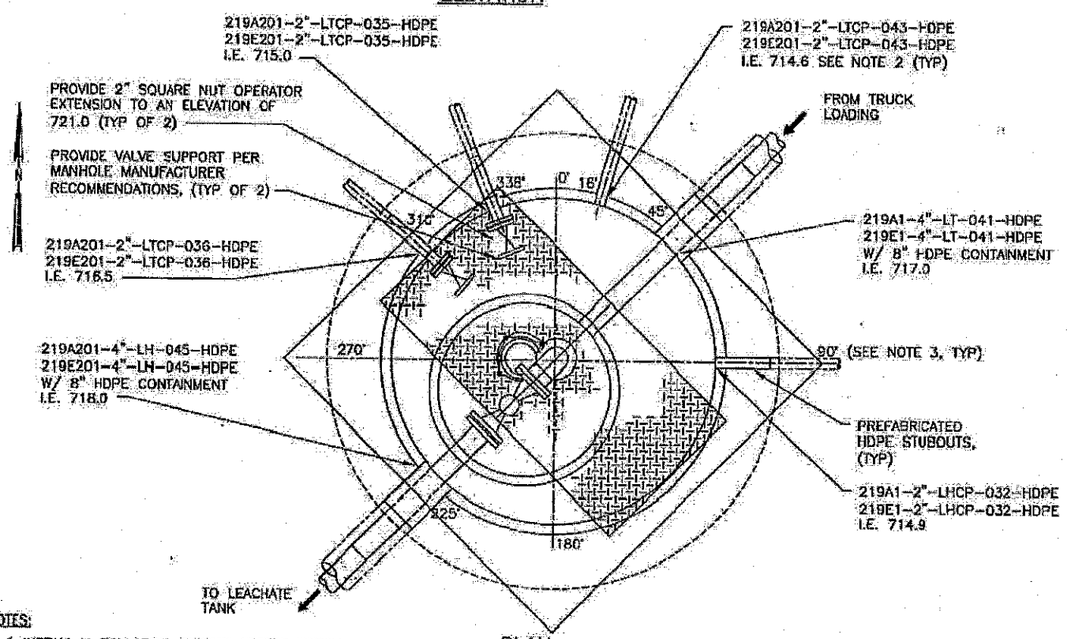
SCALE AS SHOWN | CDF 634144 | SHEET 1 OF 1

XXXX PLOTID XXXX

DRP_TB_D (12-02).DWG




ELEVATION



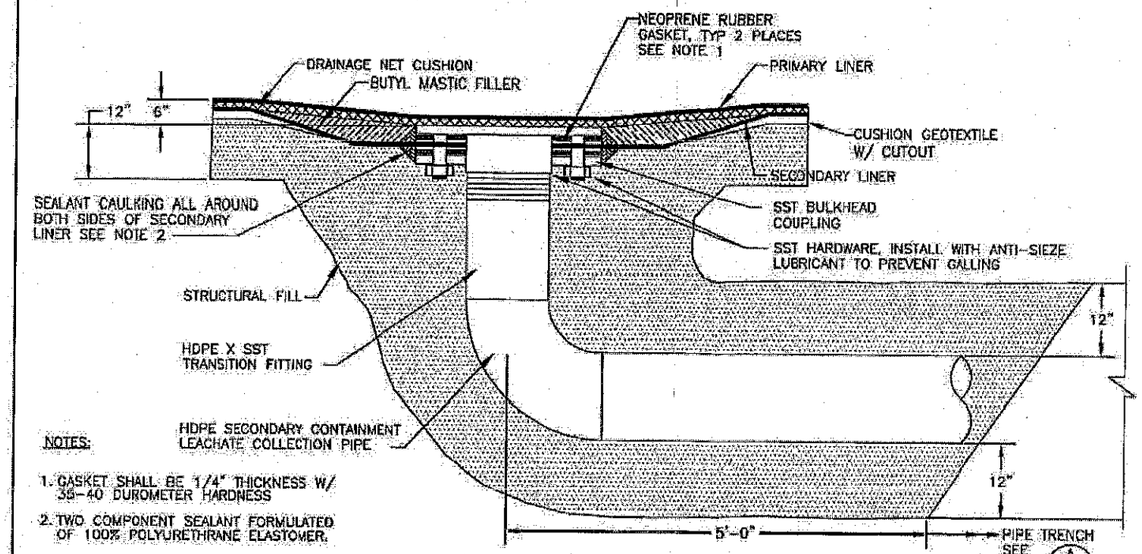

PLAN

## COMBINED SUMP MANHOLE (1)

NTS H-2-830846

NOTES:

1. INSTALL 4 BOLLARDS AROUND ACCESS HATCH.
2. PIPING AND EQUIPMENT DESIGNATIONS ARE IDENTIFIED FOR CELL 1 AND CELL 2. THE "219A" PREFIX IS FOR CELL 1 AND THE "219E" PREFIX IS FOR CELL 2.
3. MANHOLE STUBOUT ANGLES AND INVERT ELEVATIONS SHALL BE FIELD VERIFIED PRIOR TO FABRICATION OF MANHOLE.
4. PROVIDE DISTANCE AS REQD TO BUTT FUSE IN FIELD, TYP.
5. PROVIDE FUSION WELDED GUSSETED, SHOP FABRICATED PENETRATION CONNECTIONS. NO FIELD WELDS, TYP.

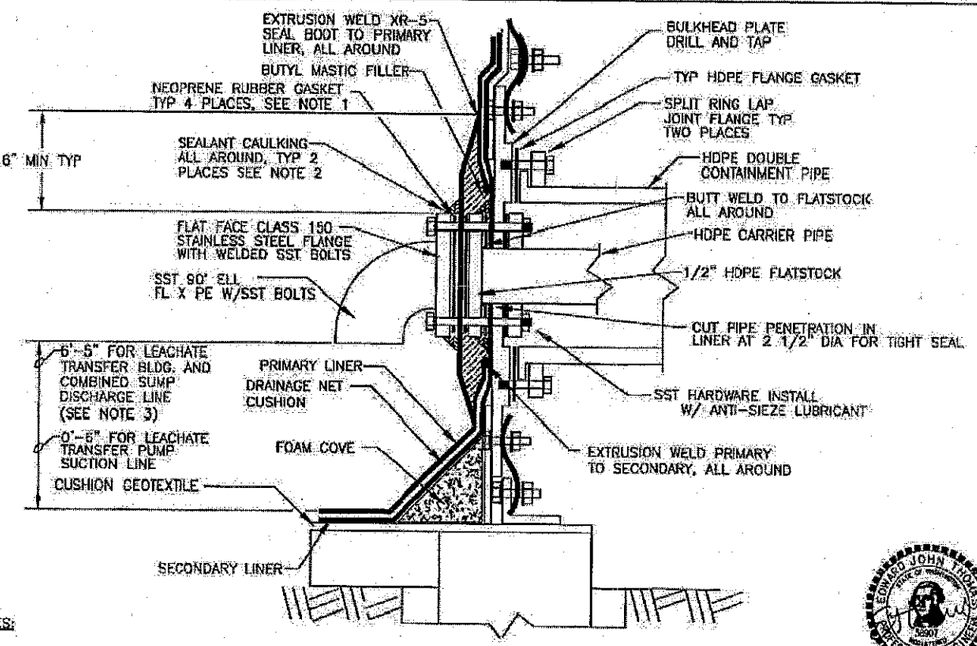



NOTES:

1. GASKET SHALL BE 1/4" THICKNESS W/ 35-40 DUROMETER HARDNESS
2. TWO COMPONENT SEALANT FORMULATED OF 100% POLYURETHRANE ELASTOMER.

## LEACHATE TANK LEAK DETECTION PENETRATION (A)

NTS H-2-830846




NOTES:

1. GASKET SHALL BE 1/4" THICKNESS W/ 35-40 DUROMETER HARDNESS.
2. TWO COMPONENT SEALANT FORMULATED OF 100% POLYURETHRANE ELASTOMER.
3. PROVIDE MIN. OF 2 PIPE SUPPORTS PER DISCHARGE LINE. PIPE SUPPORTS SHALL CONNECT TO TANK WALL PER TANK MANUFACTURER'S REQUIREMENTS.

## LEACHATE TANK WALL PENETRATION (B)

NTS H-2-830846

BLDG. NO. 200E

INDEX NO. 8500

THIS SPACE RESERVED FOR BUILDING AND INDEX NUMBERS

EDWARD JOHN THOMAS STATE OF WASHINGTON 36307 REGISTERED PROFESSIONAL ENGINEER

2/19/14 DATE 8/4/06

CH2MHILL

| DWG NO | TITLE |
|---|---|
| DRAWING TRACEABILITY LIST | |

| REF NUMBER | TITLE |
|---|---|
| REFERENCES | |
| NEXT USED ON | |

| REV NO | DESCRIPTION | REV BY DATE | CHKD | COMPANY |
|---|---|---|---|---|
| REVISIONS | | | | |

| NAME | DATE | COMPANY |
|---|---|---|
| DRAWN BY E. BOYD | 2/19/14 | CH2M |
| QA/QC APPROVAL E. THOMAS | 2/19/14 | CH2M |
| DESIGN AUTHORITY E. DAVIS | 2/19/14 | CH2M |

U.S. DEPARTMENT OF ENERGY
Office of River Protection

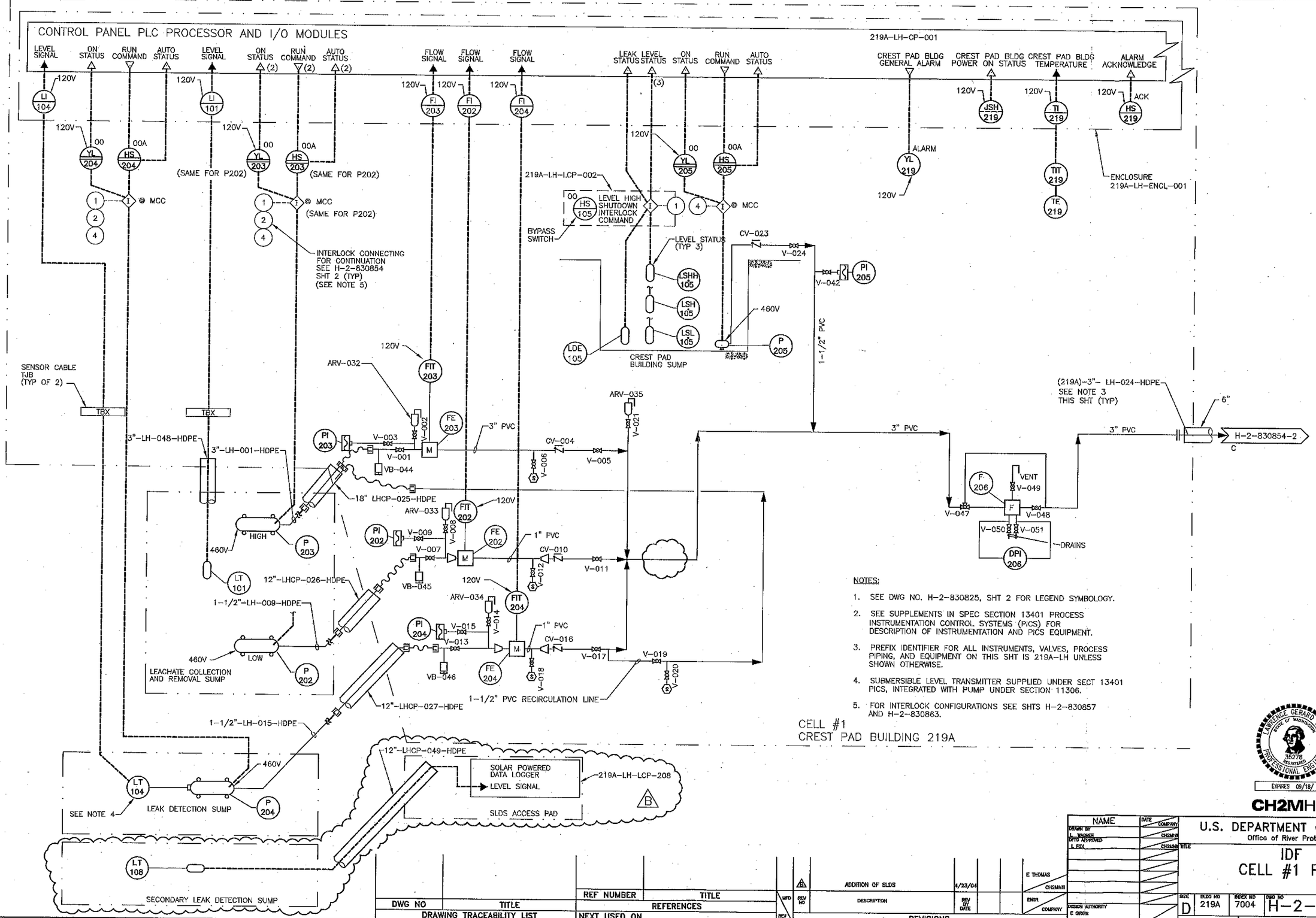
TITLE: IDF LCRS / LDS SECTIONS AND DETAILS

| SIZE | BLDG NO | INDEX NO | DWG NO | REV |
|---|---|---|---|---|
| D | 200E | 8500 | H-2-830850 | A |

SCALE AS SHOWN | CAT 634144 | SHEET 1 OF 1

XXXX PLOTID XXXX

DWP_TLD (12-02) DWG




NOTES:

1. SEE DWG NO. H-2-830825, SHT 2 FOR LEGEND SYMBOLOGY.
2. SEE SUPPLEMENTS IN SPEC SECTION 13401 PROCESS INSTRUMENTATION CONTROL SYSTEMS (PICS) FOR DESCRIPTION OF INSTRUMENTATION AND PICS EQUIPMENT.
3. PREFIX IDENTIFIER FOR ALL INSTRUMENTS, VALVES, PROCESS PIPING, AND EQUIPMENT ON THIS SHT IS 219A-LH UNLESS SHOWN OTHERWISE.
4. SUBMERSIBLE LEVEL TRANSMITTER SUPPLIED UNDER SECT 13401 PICS, INTEGRATED WITH PUMP UNDER SECTION 11306.
5. FOR INTERLOCK CONFIGURATIONS SEE SHTS H-2-830857 AND H-2-830863.

BLDG. NO.
219A
219A1
219A201
219E
219E1
219E201

INDEX NO.

THIS SPACE RESERVED FOR BUILDING AND INDEX NUMBERS

LAWRENCE GERARD FOX STATE OF WASHINGTON 35278 REGISTERED PROFESSIONAL ENGINEER
EXPIRES 09/18/

CH2MHILL

| DWG NO | TITLE | REF NUMBER | TITLE |
|---|---|---|---|
| DRAWING TRACEABILITY LIST | | REFERENCES | NEXT USED ON |

| REV NO | DESCRIPTION | REV BY DATE | ENGR | COMPANY |
|---|---|---|---|---|
| B | ADDITION OF SLDS | 4/23/04 | E THOMAS | CH2MHill |

REVISIONS

| NAME | DATE | COMPANY |
|---|---|---|
| DRAWN BY L. WAGNER | | CH2MHill |
| DFTG APPROVED L. FOX | | CH2MHill |
| DESIGN AUTHORITY E GROS | | |

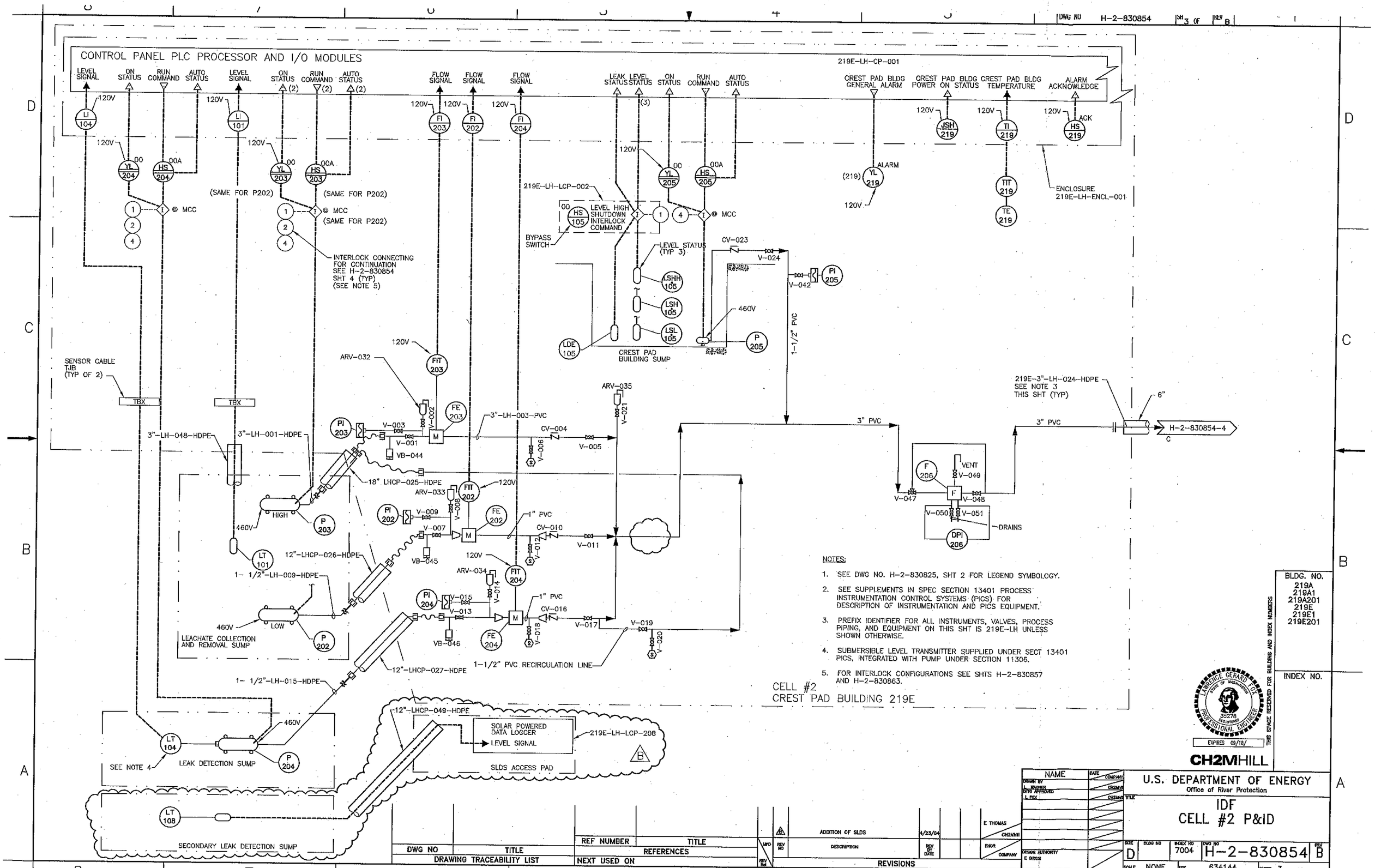
U.S. DEPARTMENT OF ENERGY
Office of River Protection

TITLE
IDF
CELL #1 P&ID

| SIZE | BLDG NO | INDEX NO | DWG NO | REV |
|---|---|---|---|---|
| D | 219A | 7004 | H-2-830854 | B |

SCALE NONE EDT 634144 SHEET 1 OF 4

XXXX PLOTID XXXX




NOTES:

1. SEE DWG NO. H-2-830825, SHT 2 FOR LEGEND SYMBOLOGY.
2. SEE SUPPLEMENTS IN SPEC SECTION 13401 PROCESS INSTRUMENTATION CONTROL SYSTEMS (PICS) FOR DESCRIPTION OF INSTRUMENTATION AND PICS EQUIPMENT.
3. PREFIX IDENTIFIER FOR ALL INSTRUMENTS, VALVES, PROCESS PIPING, AND EQUIPMENT ON THIS SHT IS 219E-LH UNLESS SHOWN OTHERWISE.
4. SUBMERSIBLE LEVEL TRANSMITTER SUPPLIED UNDER SECT 13401 PICS, INTEGRATED WITH PUMP UNDER SECTION 11306.
5. FOR INTERLOCK CONFIGURATIONS SEE SHTS H-2-830857 AND H-2-830863.

BLDG. NO.
219A
219A1
219A201
219E
219E1
219E201

INDEX NO.

THIS SPACE RESERVED FOR BUILDING AND INDEX NUMBERS

LAWRENCE GERARD FOX STATE OF WASHINGTON 38278 REGISTERED PROFESSIONAL ENGINEER
EXPIRES 09/18/

CH2MHILL

| DWG NO | TITLE | REF NUMBER | TITLE |
|---|---|---|---|
| DRAWING TRACEABILITY LIST | | REFERENCES | |
| | | NEXT USED ON | |

| REV NO | DESCRIPTION | REV BY DATE | ENGR | COMPANY |
|---|---|---|---|---|
| B | ADDITION OF SLDS | 4/23/04 | E THOMAS | CH2MHill |

REVISIONS

| NAME | DATE | COMPANY |
|---|---|---|
| DRAWN BY L. WAGNER | | CH2MHill |
| DPTD APPROVED L. FOX | | CH2MHill |
| DESIGN AUTHORITY E GROS | | |

U.S. DEPARTMENT OF ENERGY
Office of River Protection

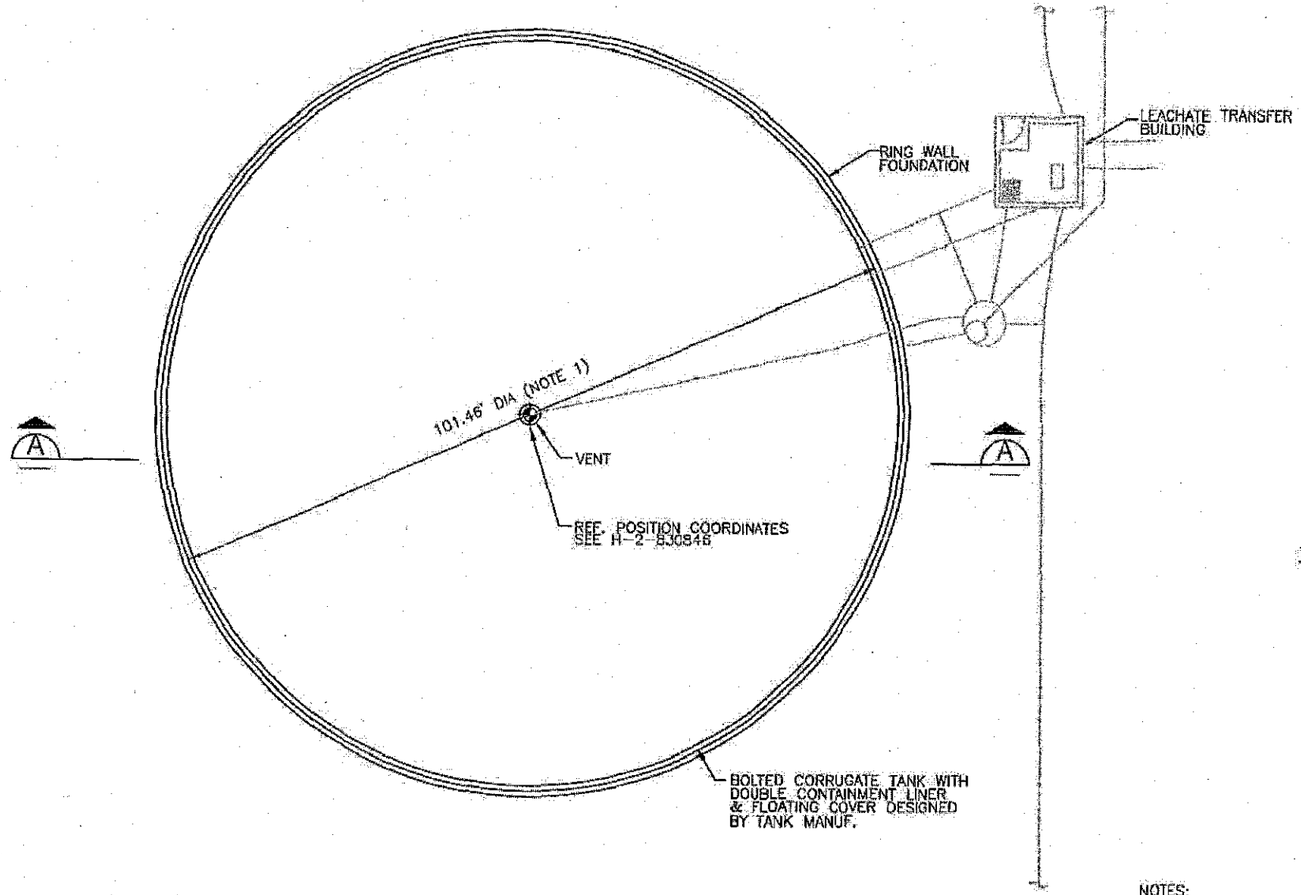
TITLE
IDF
CELL #2 P&ID

| SIZE | BLDG NO | INDEX NO | DWG NO | REV |
|---|---|---|---|---|
| D | | 7004 | H-2-830854 | B |

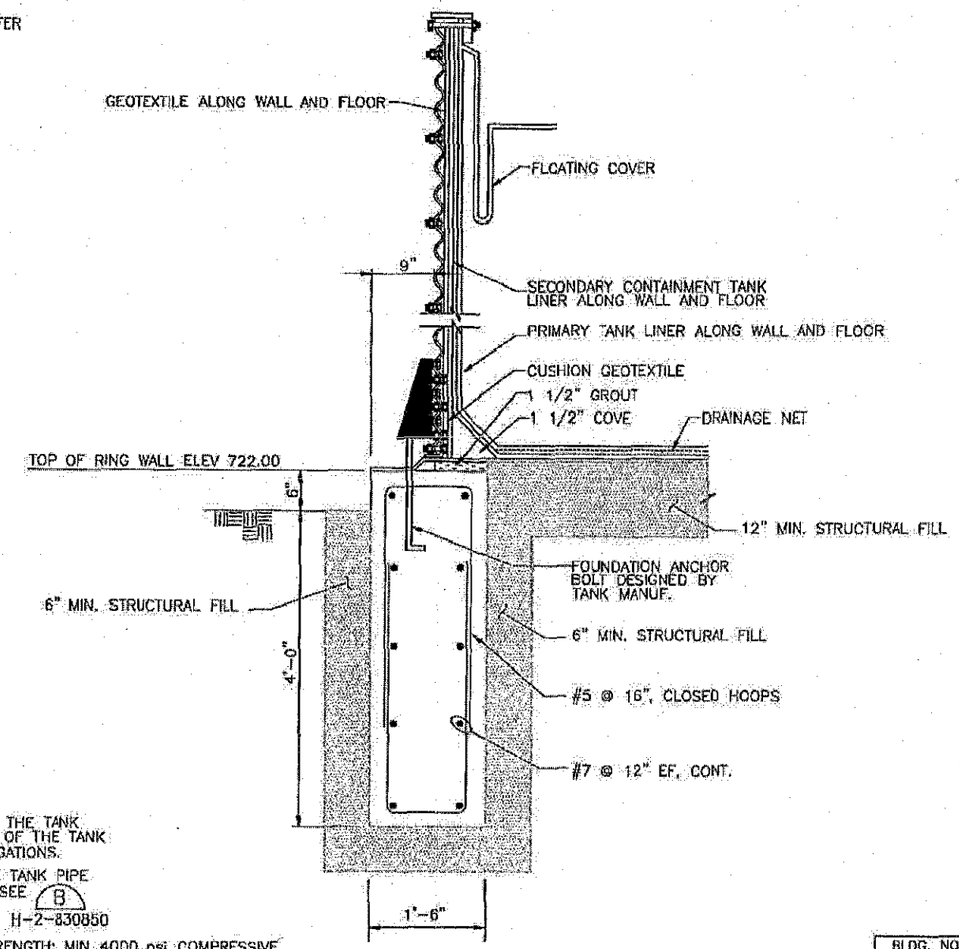
SCALE NONE | EDT 634144 | SHEET 3 OF

XXXX PLOTID XXXX

CRP_TB_D [12-02].DWG



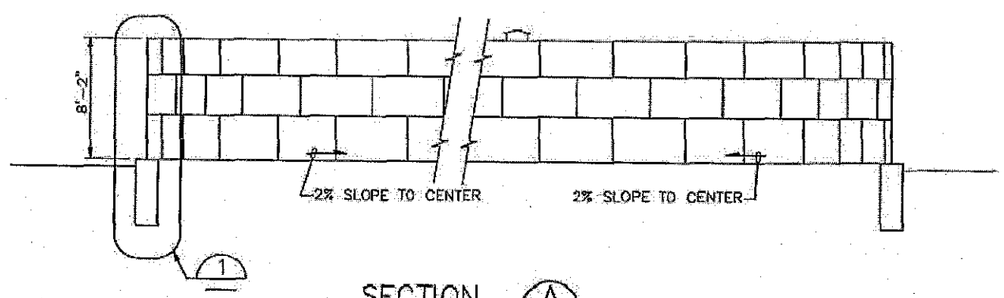

## FLOOR AND ROOF PLAN
3/32"=1'-0" TYP FOR 219A201 & 219E201




NOTES:
1. DIAMETER FOR THE TANK REFERS TO ℄ OF THE TANK SHELL CORRUGATIONS.
2. FOR LEACHATE TANK PIPE PENETRATION, SEE (B) H-2-830850
3. CONCRETE STRENGTH: MIN 4000 psi COMPRESSIVE (CLASS 40) @ 28 DAYS

REINFORCING STEEL: ASTM 615, GRADE 60

## DETAIL (1)
1"=1'-0"

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Office of River Protection

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# PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

## OPERATING UNIT 11

## Integrated Disposal Facility

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1 **Acronyms**

| | |
|---|---|
| ASTM | American Society for Testing and Materials |
| CDN | Composite drainage net |
| CM | Construction Manager |
| CQA | Construction Quality Assurance |
| CQC | Construction Quality Control |
| DOE | U.S. Department of Energy |
| EPA | U.S. Environmental Protection Agency |
| GCL | Geosynthetic clay liner |
| GRI | Geosynthetic Research Institute |
| IDF | Integrated Disposal Facility |
| LCRS | Leachate collection and removal system |
| LDS | Leak detection system |
| NCR | Non-Conformance Report |
| ORP | Office of River Protection |
| OSHA | Occupational Safety and Health Administration |
| PM | Project Manager |
| QA | Quality assurance |
| QC | Quality control |
| RFI | Request for Information |
| SBL | Soil bentonite admix liner |
| SLDS | Secondary leak detection system |
| UCL | Upper control limit |
| WAC | Washington Administrative Code |

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# SECTION I–GENERAL

## 1.1 INTRODUCTION

This Construction Quality Assurance (CQA) Plan describes the quality assurance (QA) activities for constructing Phase I of the Integrated Disposal Facility (IDF) at the Hanford facility in Richland, Washington.

### 1.1.1 Applicable Units

QA activities will be required during construction of Cell 1 of Phase I to certify that the following construction activities are performed in accordance with the construction documents:

- Construction/preparation of foundation systems for liners
- Construction of dikes or embankments
- Construction of low-permeability soil liners
- Construction of geomembranes
- Construction of leachate collection and removal systems and leak detection systems

This CQA Plan has been prepared to describe the activities that will be performed during construction of the lining system, leachate collection and leak detection systems, and operation layer of Cell 1. This CQA Plan is intended to satisfy the regulatory requirements and guidance established in 40 CFR 264.19, the U.S. Environmental Protection Agency's (EPA) technical guidance document, *Quality Assurance and Quality Control for Waste Containment Facilities* (EPA 1993), and Washington Administrative Code (WAC) 173-303-335.

This CQA Plan will be implemented by a CQA Officer (herein referred to as the CQA certifying engineer), a person familiar with EPA's technical guidance document, *Quality Assurance and Quality Control for Waste Containment Facilities* and this CQA Plan. The CQA certifying engineer will be supported by the number of CQA representatives necessary to implement the requirements in this CQA Plan and to document the work.

### 1.1.2 Scope

This CQA Plan establishes general administrative and documentation procedures that will be applicable for selected activities of construction. With respect to responsibilities, personnel qualifications, and specific inspection and testing activities, this CQA Plan addresses only those activities associated with the soils, geosynthetics, and related liner and leachate collection system piping components for the IDF.

The CQA requirements are divided into the following sections to provide quick access to CQA requirements for individual liner components:

- Soils CQA
- Geosynthetic Clay Liner CQA
- Geomembrane CQA
- Geotextile CQA
- Composite Drainage Net CQA
- Polyethylene Pipe and Fittings CQA
- CQA Documentation and Certification
- CQA Documentation and Certification

## 1.2 PROJECT ORGANIZATION

This section describes the anticipated project organization for the IDF construction activities. The following subsections address the organizations involved in the construction, their respective roles in construction activities, and the methods of interactions between organizations.

### 1.2.1 Responsibility and Authority

The organization chart for the IDF construction is shown in Figure 1-1. These personnel will be associated with two main entities that include the Tank Farm operating contractor and his agents and the

construction general contractor and his personnel and/or subcontractors. The project team consists of both full-time field personnel and part-time management personnel. The part-time management personnel will be onsite during the IDF construction periodically to monitor progress, attend meetings, resolve disputes, and ensure that the work is implemented in accordance with the construction drawings, technical specifications, CQA Plan, and the RCRA permit. The field personnel will consist of the key personnel onsite during construction. The solid lines on the organization chart represent project responsibilities such as scope, cost, and schedule. The dashed lines represent the functional responsibilities of staff for QA, design, and management. The responsibilities and reporting requirements for each project team member are described in the following sections.

#### 1.2.1.1 Project Team

When the individuals identified below are designated to perform specific functions described in this CQA Plan, the reference to these individuals includes their designee or an alternate who can function on their behalf. The Department of Energy – Office of River Protection (DOE-ORP) Manager is the owner's representative and is responsible for project funding and overall project scope. The DOE-ORP manager and IDF project manager keep the regulatory agencies informed of IDF construction activities and progress.

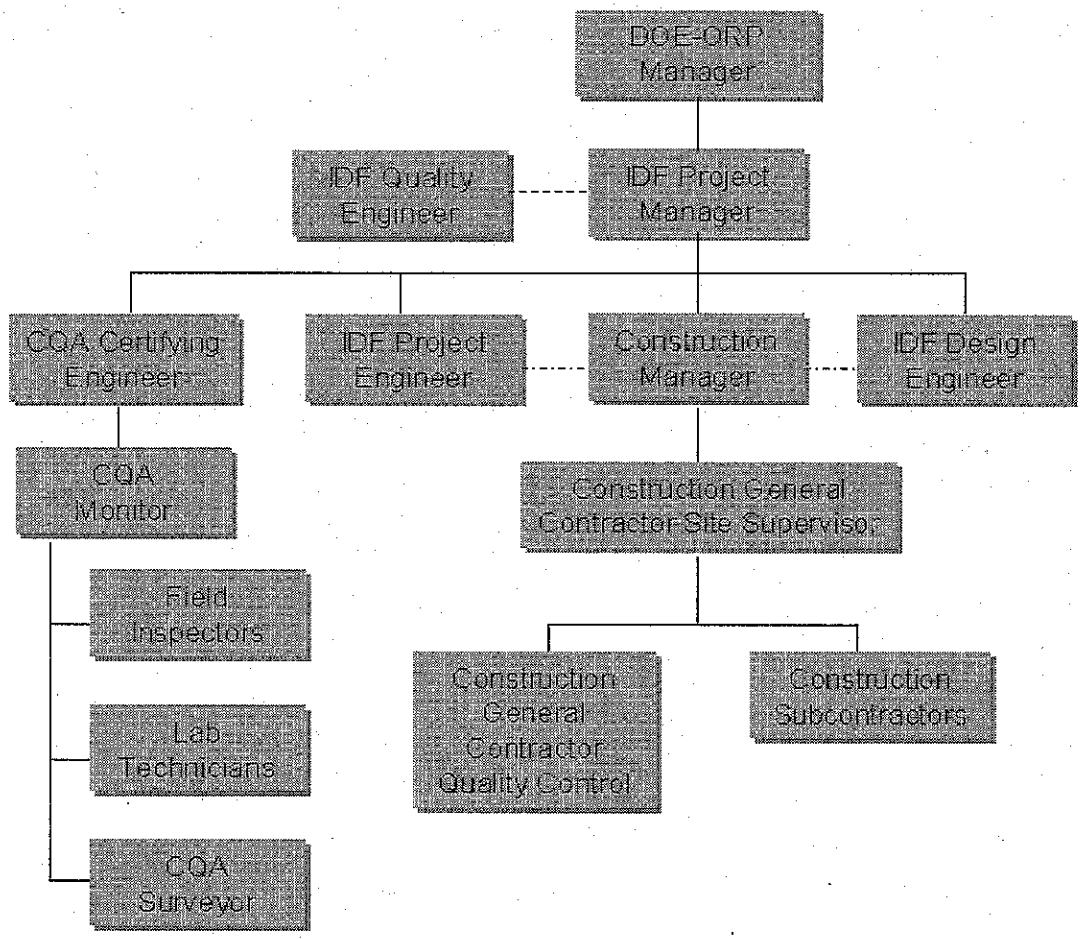
**IDF Project Manager (PM)**

The IDF PM is an employee or agent of the Tank Farm operating contractor, has overall responsibility for the IDF construction, and interfaces with the DOE-ORP manager. The IDF PM directs the activities of the IDF project and field team staff, including the CM, design engineer, and the project engineer. Additionally, the IDF PM has overall responsibility for the achievement of quality. Functionally, the IDF PM reviews and approves quality assurance reports submitted by the IDF CQA certifying engineer.

**IDF Project Engineer**

The IDF project engineer is an employee or agent of the Tank Farm operating contractor and is responsible for providing technical support to the IDF project team. The IDF project engineer is supported by the design engineer for reviewing and/or preparing technical documents related to engineering design and analyses.

**Figure 1-1. QA Organization Chart**




**IDF Quality Engineer**

The IDF quality engineer is an employee or agent of the Tank Farm operating contractor and is independent from line management on the project. The IDF quality engineer provides overview and

assessment of QA on the project. The IDF quality engineer provides feedback and assessment results to the IDF PM.

**IDF Design Engineer**

The IDF design engineer is an employee or agent of the Tank Farm operating contractor is responsible for reviewing and/or preparing technical documents related to the IDF design and construction. The design engineer prepares the construction drawings, technical specifications, and the CQA Plan. The IDF design engineer reports to the IDF PM and supports the IDF project engineer.

#### 1.2.1.2 Field Team

**IDF Construction Manager**

The IDF CM is an employee or agent of the Tank Farm operating contractor and serves as the point of contact between the IDF construction general contractor and the IDF project team. All construction general contractor correspondence and direction flows through the CM. The CM oversees the daily construction field activities and is the onsite representative for the IDF PM.

**CQA Certifying Engineer**

The CQA certifying engineer is an employee or agent of the Tank Farm operating contractor who has the overall responsibility of implementing this CQA Plan and directly supervises the CQA monitor, field inspection team, and laboratory technicians. The CQA certifying engineer is responsible for preparation of an implementation plan that addresses how the CQA Plan is to be implemented, and how CQA work is to be performed, tracked, and coordinated, as well as how procedures outlined in this CQA Plan are to be followed. The implementation plan will be submitted to IDF project manager and CM for approval.

Functionally, the CQA certifying engineer submits certified CQA reports to the IDF CM for review and approval by the IDF PM. The CQA certifying engineer is a registered professional engineer in Washington and has the authority to provide a certification letter that the IDF is constructed in accordance with the approved CQA Plan, the approved plans and specifications, and any approved changes. The CQA certifying engineer also has the authority and responsibility to stop work and recommend remedial actions to the IDF PM.

**Field Inspector**

Field inspectors are employees or agents of the Tank Farm operating contractor and report to the CQA certifying engineer. The field inspector's function is to perform testing and observations, in accordance with this CQA Plan and under the direction of the CQA monitor and CQA certifying engineer.

**Soils Laboratory Technicians**

Laboratory technicians are employees or agents of the Tank Farm operating contractor and report to the CQA certifying engineer and provide the QA laboratory testing, required by this CQA Plan and as requested by the CQA monitor and CQA certifying engineer.

**CQA Surveyor**

The CQA surveyor will be an employee or agent of the Tank Farm operating contractor and will be a registered land surveyor in the State of Washington.

**CQA Monitor**

The CQA monitor is an employee or agent of the Tank Farm operating contractor, reports directly to the CQA certifying engineer, and is a CQA representative, supported by the field inspection team and laboratory technician. The CQA monitor ensures that all CQA tests are performed in accordance with this CQA Plan and accepted procedures.

**Construction General Contractor**

The IDF construction general contractor is responsible for implementing the approved design by providing the necessary labor, equipment, materials, and all other resources necessary to construct the IDF.

**Construction General Contractor Site Supervisor**

The site supervisor is an employee or agent of the construction general contractor and is responsible for implementing the IDF construction activities. The site supervisor has overall responsibility for all construction activities related to the IDF, controls day-to-day construction tasks, and is the point of contact for construction general contractor field personnel. The site supervisor ensures the work is progressing in accordance with approved construction contract documents and the approved schedule.

**Construction Subcontractors**

Construction subcontractors include specialty companies, retained by the IDF construction general contractor, to perform specific work activities at the IDF such as earth moving, geosynthetic lining installation, piping, and building/tank installation. The construction subcontractors report directly to the construction general contractor site supervisor.

**Construction General Contractor Quality Control**

The construction general contractor provides a construction QC engineer who supports the site supervisor. The primary responsibility of the construction QC engineer is to ensure that the work is performed in accordance with the technical specifications and construction drawings. Specific duties of the construction QC engineer include activities such as preparing construction submittals, field documentation, and interfacing with the CQA certifying engineer.

### 1.2.2 Project Meetings

The various progress and status meetings that are anticipated to be held throughout the IDF construction are described below. The purpose of the meetings is to discuss work progress, planning, and other issues related to construction. A portion of these meetings can be dedicated to CQA issues, as necessary, to provide an opportunity for the CQA team to express concerns regarding quality, relay test results, and ensure good communication between all organizations involved in the construction of the IDF.

#### 1.2.2.1 Pre-Construction Meeting

A pre-construction meeting will be scheduled prior to beginning construction activities for the IDF. At a minimum, the meeting will be attended by IDF staff including the PM, CM, project engineer, design engineer, as well as the construction general contractor site supervisor, and the CQA certifying engineer. A portion of the meeting will be dedicated to the discussion of QA issues. Suggested CQA topics will include, but not be limited to:

- Reviewing the responsibilities of each organization
- Discussing the authority of agencies and project and field team members to order work stoppages
- Reviewing lines of authority and communication for each organization
- Providing each organization with all relevant CQA documents and supporting information
- Familiarizing each organization with the CQA Plan and its role, relative to the design criteria, plans, and specifications
- Discussing the established procedures or protocol for observations and tests, including sampling strategies
- Discussing the established procedures or protocol for handling construction deficiencies, repairs, and re-testing, including "stop work" conditions
- Reviewing methods for documenting and reporting inspection data
- Reviewing methods for distributing and storing documents and reports
- Reviewing work area security and safety protocol
- Reviewing the proposed project schedule
- Discussing procedures for the location and protection of construction materials and for the prevention of damage of the materials from inclement weather or other adverse events
- Determining action items, assigning actionees, and recording minutes to be transmitted to meeting attendees
- Discussing document control requirements and control of CQA records
- Discussing control and protection of samples

#### 1.2.2.2 Daily Pre-Job Briefing

The construction general contractor will conduct daily pre-job briefings at the work area. The participants will include the construction field personnel, including lower tiered subcontractors and CQA representatives. The primary purpose of these meetings will be to address the day's planned activities. The CQA monitor will discuss CQA activities planned for that day and interface needs with the construction personnel. Suggested CQA topics are:

- Review the work location and activities for the day
- Discuss the construction general contractor's personnel and equipment assignments for the day
- Address scheduling of resources for upcoming work
- Review any new test data
- Discuss any potential construction problems, including unexpected subsurface conditions

- Discuss CQA-planned activities and interface needs

This meeting will be documented and the documentation will be retained on file by the CQA monitor.

#### 1.2.2.3 Construction Progress Meetings

Weekly progress meetings will be held at the site to discuss construction progress. At a minimum, the weekly progress meetings will be attended by the IDF PM, CM, the site supervisor, and the CQA certifying engineer or CQA monitor. The purposes of the meeting are to:

- Review previous activities and accomplishments
- Review claims, change orders, delays, and similar items
- Review planned activities for the upcoming 2-week period
- Finalize resolution of problems from previous meetings
- Discuss potential problems with the work planned for the upcoming 2-week period

Minutes will be recorded and transmitted to meeting attendees and other interested parties.

#### 1.2.2.4 Non-Conformance Meetings

Meetings will be convened as necessary to address non-conformances discovered during inspection. Deficiencies observed during construction by the CQA representatives will be brought to the attention of the IDF CM and CQA certifying engineer and documented using the non-conformance reporting (NCR) procedures outlined in Section 8.1.4. These deficiencies also will be tracked in the CQA representative's field log book until resolution and included in the daily summary report. These documents will include the description of the deficiency and actions taken or to be taken to resolve.

### 1.2.3 Hold Points

Mandatory hold points will be established for certain key activities. At these points, the IDF construction general contractor will notify the CQA monitor or CQA certifying engineer that the layer or portion of a layer is ready for review. The hold points anticipated for the IDF would be at completion or partial completion of each of the following components:

- Prepared subgrade
- SLDS geomembrane and composite drainage net (CDN)
- SLDS riser pipe
- Soil bentonite admix soil liner
- Secondary GCL
- Secondary geomembrane
- LDS CDN
- LDS piping
- Primary geosynthetic clay liner (GCL)
- Primary geomembrane
- Cushion geotextile
- LCRS piping
- Drain gravel
- Separation geotextile
- Operations layer

On side slopes, a LCRS CDN would substitute for the cushion geotextile, drain gravel, and separation geotextile.

## 1.3 PERSONNEL QUALIFICATIONS AND TRAINING

This section describes the qualifications and training required for CQA personnel. All documentation relating to qualifications will be maintained with the project CQA records.

### 1.3.1 CQA Certifying Engineer

The CQA certifying engineer will have landfill construction certification experience. The CQA certifying engineer will, at a minimum, be a registered civil professional engineer in good standing in the State of Washington, possess a bachelor's degree in civil or construction engineering, geotechnical engineering, engineering geology, or a closely related discipline, and have sufficient practical, technical, and managerial experience to successfully direct the CQA activities discussed in this CQA Plan. The CQA certifying engineer's qualifications will be documented by training records and a professional resume showing significant field experience in landfill construction and low permeability soil-bentonite admix liner construction, having directed CQA activities at a minimum of three landfill construction projects or a minimum of 100 acres of combined landfill area certifying experience. The CQA certifying engineer will be familiar with the EPA technical guidance document, *Quality Assurance and Quality Control for Waste Containment Facilities* (EPA 1993). Qualification documentation will be reviewed by the IDF PM and IDF project engineer.

### 1.3.2 CQA Monitor

At a minimum, the CQA monitor will have a high school diploma and at least five years of construction-related experience, including at least three years of experience conducting CQA monitoring for earthwork construction (including a minimum of three landfill construction projects or a minimum of 50 acres of combined landfill area experience), or a bachelor of science degree from a four-year college or university and at least two years of experience conducting CQA monitoring for earthworks construction (including a minimum of three landfill construction projects). The CQA monitor must be capable of performing work with little or no daily supervision. The CQA monitor will be familiar with the EPA technical guidance document, *Quality Assurance and Quality Control for Waste Containment Facilities* (EPA 1993).

Qualifications of the CQA monitor will be documented by training records and a professional resume, reviewed by the IDF PM and CQA certifying engineer.

### 1.3.3 Field Inspector

At a minimum, the field inspector will have a high school diploma and at least two years of construction-related experience, including at least one year of experience conducting CQA monitoring for earthwork construction, or will have a bachelor of science degree from a four-year college or university and at least six months of experience conducting field inspection for earthworks construction. The field inspector must be capable of routine engineering technician work, under general daily supervision. The field inspector will be familiar with the EPA technical guidance document, *Quality Assurance and Quality Control for Waste Containment Facilities* (EPA 1993). Qualifications of the field inspector will be documented by training records and a professional resume, reviewed by the IDF PM and CQA certifying engineer.

### 1.3.4 Soils Laboratory Technicians

Laboratory technicians will have at a minimum a high school diploma and at least five years of construction materials laboratory testing related experience, including at least three years of experience performing geotechnical laboratory tests for earthwork construction, including compacted low permeability soil-bentonite admix, or will have a bachelor of science degree from a four-year college or university and at least two years of experience performing geotechnical laboratory tests for earthwork construction, including low permeability soil-bentonite admix. The laboratory technician must be capable of routine laboratory tech work, under general daily supervision. Qualifications of laboratory technicians, including training records and professional resumes, will be reviewed by the IDF PM and CQA certifying engineer.

### 1.3.5 Geosynthetic Laboratory

The geosynthetic laboratory will be selected by the CQA certifying engineer and will provide the geosynthetic QA conformance testing required by this CQA Plan, as requested by the CQA monitor and/or CQA certifying engineer. The geosynthetics CQA laboratory will be unaffiliated with the materials supplier or manufacturer, or construction general contractor. The geosynthetics CQA laboratory will have at least five years of experience in testing geosynthetics and other relevant liner system components, and will be familiar with American Society for Testing and Materials (ASTM) and other applicable test standards.

## 1.4 DEFINITIONS RELATING TO CONSTRUCTION QUALITY ASSURANCE

### 1.4.1 Construction Quality Assurance and Construction Quality Control

**Construction Quality Assurance**—A planned and systematic pattern of the means and actions designed to provide adequate confidence that items or services meet contractual and regulatory requirements, and will perform satisfactorily in service.

**Construction Quality Control (CQC)**—Those actions that provide a means to measure and control the characteristics of an item or service to meet contractual and regulatory requirements.

### 1.4.2 Use of the Terms in This Plan

The definitions used in the context of this CQA Plan are as follows:

- CQA refers to means and actions employed by the CQA representatives to assure conformity of liner system, LCRS, LDS, SLDS, and pipe preparation, production, and installation with this CQA Plan, the technical specifications, and the construction drawings. CQA will be provided by a third party, acting independently from the product manufacturer and construction general contractor.
- CQC refers to those actions taken by manufacturers, suppliers, or construction general contractor, including their designated representatives, to ensure that the materials and the workmanship meet the requirements of the technical specifications and the construction drawings.

## 1.5 REFERENCES

### 1.5.1 Applicable Organizations

Organizations whose standards are referenced in the CQA Plan include:

- ASTM—American Society for Testing and Materials
- DOE—Department of Energy
- GRI—Geosynthetic Research Institute
- OSHA—Occupational Safety and Health Administration
- EPA—U.S. Environmental Protection Agency

### 1.5.2 Applicable Standards

Any reference to standards of any society, institute, association, or governmental agency will pertain to the edition in effect as of the date of this CQA Plan, unless stated otherwise.

Specific test standards for tests cited in the CQA Plan are provided in the technical specifications. These standards may be modified due to technological advances since compilation of the technical specifications. All such modifications are to be approved in accordance with change order procedures described in Section 8.1.5.

## 1.6 CONSTRUCTION ACTIVITIES AND SUBMITTAL REQUIREMENTS

### 1.6.1 Construction Activities

This section describes the construction activities and submittal requirements that will be performed by the construction general contractor during the IDF construction. This CQA Plan only addresses selected activities of the Phase I construction.

In general, construction activities will consist of preparing the subgrade, installing the liner system, the leak detection systems (LDS and SLDS), the leachate collection and removal system (LCRS), and operations layer and necessary equipment to complete the landfill for waste acceptance. Construction will consist of these activities:

- Mobilizing construction equipment and personnel
- Vendor data submittals
- Installing sediment and erosion control
- Preparing soil bentonite material
- Excavation, embankment, fine grading of landfill subgrade, and sump construction
- Constructing the secondary leak detection system (SLDS) sump
- Constructing the soil bentonite admix liner (SBL)
- Dust control activities during construction
- Placing the geosynthetics for the secondary liner
- Constructing the leak detection system (LDS)
- Placing the geosynthetics for the primary liner
- Constructing the leachate collection and removal system
- Constructing the operations layer
- Site restoration
- Demobilization

Prior to the start of construction activities, the CQA representatives will review and become familiar with all construction drawings, technical specifications, the CQA Plan, and RCRA permit. The CQA certifying engineer also will be familiar with the most recent construction schedule, so that adequate resources (i.e., laboratory, field testing equipment, staff, and CQA forms), including contingencies (e.g., backup equipment, alternate laboratory, and alternate CQA staff) for CQA activities, will be commensurate with the anticipated construction productivity and work schedule.

### 1.6.2 Submittal Requirements

The construction general contractor will provide the submittals required (listed in Table 1-1 in this section) to the IDF PM. Submittals will be provided far enough in advance of scheduled installation dates to allow time for reviews, possible revisions and resubmittals, placing orders, and securing delivery. The construction general contractor will identify, track, and disposition all required vendor data. The IDF PM will respond to each required submittal as stated in the technical specifications.

The submittals presented in Table 1-1 will be required as a minimum. A master submittal list will be provided as part of the contract documents.

### 1.6.3 Receipt Inspection Procedures

Inventory of manufactured materials used in lining system construction is detailed in Sections 3.1.4 (GCL), 4.1.4 (geomembrane), 5.1.4 (geotextiles), 6.1.4 (CDN) and 7.1.4 (polyethylene piping). The purpose of this section is to provide a general summary of the minimum requirements and procedures for receiving and controlling purchased materials, equipment, or services as required by the contract documents.

Procurement, receipt, and inspection of construction materials and equipment are the responsibilities of the construction general contractor, with verification by the CQA certifying engineer and IDF CM.

Procedures specific to the IDF Phase I construction project will be prepared as part of the construction quality control (QC) plan, to be submitted by the construction general contractor.

Procedures to control receipt inspection will include the following, at a minimum:

- The contract documents will provide a master submittal list that identifies the materials, equipment, or services requiring receipt inspection. Upon delivery to the project site, the general construction contractor will attach secure and visible "Quality Hold for Inspection" tags to each item.
- All items, materials, and equipment that have been tagged will be stored in segregated areas, as identified in the contract documents. Items will be restricted from further use until all construction general contractor and CQA certifying engineer inspections are completed.
- Upon inspection if items, materials, or equipment held for inspection, the "Quality Hold for Inspection" tag will be removed and replaced with one of the following, as appropriate:

  a) Acceptance tag
  b) Non-conformance (red) tag
  c) Conditional use tag

- The construction general contractor may utilize only those items tagged as "Accepted" or "Conditional Use."
- Red tagged materials will not be used in construction and will be moved to a segregated area or removed from the site.
- Conditional use tagged materials are restricted to use for specific conditions identified on the tag.
- Documentation of receipt inspection will be completed, maintained, and stored in a single location, in a secure and protected environment for the full performance period of the construction contract.

1 **Table 1-1. Required Submittals**

| Submittal | Description | Requirement |
|---|---|---|
| Source Quality Control for Imported Materials (structural fill, drain gravel and crushed surfacing) | Gradation tests performed in accordance with ASTM D422 by a qualified independent test laboratory for imported materials on samples taken at place of production prior to shipment. Samples will be taken for gradation testing from every 2,000 tons of prepared materials, in accordance with ASTM D75. | Submitted by the construction general contractor and approved by the IDF PM prior to the shipment of material to the project site. |
| Geomembrane Installation Plan | Proposed layout drawings for each layer of geomembrane material. Geomembrane layout will show panel configuration, general dimensions, and seam locations. | Submitted by the construction general contractor and approved by the IDF PM prior to the installation of the respective geomembrane liner. |
| Subgrade surface acceptance | Certification in writing that the surface on which the geomembrane will be installed is acceptable to the installer. A certificate of acceptance will be provided by the construction general contractor to the CQA representative, who will then verify to the CQA certifying engineer that the deployment surface has been accepted immediately prior to commencement of geomembrane installation in the area under consideration. | Certificate signed by the installer and construction general contractor prior to installation of geomembrane over the subgrade. |
| GCL quality control certifications, test data and properties guarantee | Provide manufacturer's quality control (QC) test data for GCL material to be installed, including:<br>Bentonite – suppliers' name and location, brand name, lot number, dated quality control information from supplier, manufacturer's test data verifying that bentonite meets manufacturer's specifications.<br>GCL – written guarantee that GCL conforms to the technical specification requirements and test certificates for each production lot or 50,000 square feet of GCL material including roll numbers, test methods, and test results verifying compliance with the technical specification requirements for GCL. | Submitted by the construction general contractor prior to installation of the GCL material and approved by the IDF PM. |

| Submittal | Description | Requirement |
|---|---|---|
| Geomembrane quality control certifications, test data and properties guarantee | QC Testing shall be performed by manufacturer to demonstrate the geomembrane conforms to technical specification requirements. Prior to delivery of any geomembrane material, the manufacturer shall submit all required information listed in the technical specifications (Section 02661).<br><br>QC Certification: Prior to shipment, the geomembrane manufacturer shall provide a quality control certificate for each roll of geomembrane. The quality control certificate shall be signed by a responsible party employed by the geomembrane manufacturer, such as the production manager. The quality control certificate shall include:<br>1. Roll numbers and identification, resin lot, and batch numbers.<br>2. Sampling procedures and results of quality control tests. As a minimum, results shall be given for thickness, asperity, tensile strength, and tear resistance in accordance with methods indicated in the technical specifications. Tests shall be conducted on each production lot of geomembrane or every 50,000 square feet, whichever results in the greater number of tests. | Submitted by the construction general contractor prior to installation of the geomembrane material and approved by the IDF PM. |
| Geotextile material certifications and test data | Provide manufacturer's QC test data for geotextile material to be installed, including:<br><br>Geotextile – written guarantee that geotextile conforms to specification requirements, certification that manufacturer continuously inspected geotextile for presence of needles and found it to be needle-free, and test certificates for geotextile material including roll numbers, test methods, and test results verifying compliance with the technical specifications physical properties for geotextile. Frequency of manufacturer's QC testing shall be at the standard rate stated in the manufacturer's QC plan for each required property in the technical specifications. | Submitted by the construction general contractor prior to installation of the geotextile material and approved by the IDF PM. |
| Composite drainage net material certifications and test data | Provide manufacturer's QC test data for composite drainage net material to be installed, including:<br><br>Composite drainage net – manufacturer's specification measured using appropriate test methods, written guarantee that composite drainage net conforms to specification requirements, manufacturer's QC test data for the geotextile component as specified above for geotextile, and test certificates for composite drainage net material and geonet component including roll numbers, test methods, and test results verifying compliance with the technical specification requirements for composite drainage net and geonet. Frequency of manufacturer's QC testing shall be at the standard rate stated in the manufacturer's QC plan for each required property in the technical specifications | Submitted by the construction general contractor prior to installation of the composite drainage net material and approved by the IDF PM. |

| Submittal | Description | Requirement |
|---|---|---|
| Interface Shear Strength test data | Provide data prior to material shipment for the interface friction angle between the textured geomembrane and other materials (including CDN, GCL, and Admix Liner) directly in contact with the geomembrane as specified in Section 02661; and between the CDN and the operations layer as specified in Section 02373 of the technical specifications.<br>Friction angle shall be determined by direct shear testing under fully saturated conditions (ASTM D5321 or D6243 for GCL interface) at low nominal normal loads of both 100, 250, and 500 pounds per square foot (psf), and high nominal normal loads of 2,000, 8,000, and 15,000 psf, except for the CDN/Operations Layer interface which shall be reported at low normal load only. Report results for both peak and large displacement (minimum 2 inches) strength. Perform two interface shear strength tests on each interface under each set of normal loads. | Submitted by the construction general contractor prior to geosynthetic material shipment and reviewed and approved by the IDF PM for conformance with project strength requirements. Allow IDF PM a minimum 20 working days for this evaluation upon receipt of data. |
| Admix Liner Preparation and Placement Plan | Provide a detailed plan for preparation of the admix material, including a description of the equipment and procedures to be used, personnel qualifications, equipment calibration certificates and methods for monitoring bentonite additions and moisture conditioning.<br>Also provide an admix liner placement plan to specify lift thickness control and to allow for required testing, described in the CQA Plan and technical specifications on the admix liner during placement operations. | Submitted by the construction general contractor prior to start of admix production for approval by IDF PM. |
| Bentonite QC certificates and test data | Provide bentonite supplier's descriptive data, specification sheets, literature, and other data as necessary to fully demonstrate that the bentonite proposed for use in the admix complies with the requirements of the technical specifications. The manufacturer shall certify that the bentonite furnished complies with these Specifications. A certificate shall be submitted to the CQA Engineer for each railcar or every three truckloads of bentonite delivered. | Submitted by the construction general contractor prior to start of admix production for approval by IDF PM. |
| Polyethylene Pipe and Fittings | Provide manufacturer's QC test data for piping and fittings that will be installed on the landfill floors and slopes. | Submitted by the construction general contractor prior to installation of the pipe for approval by the IDF PM. |

# SECTION II–SOILS CONSTRUCTION QUALITY ASSURANCE

This section discusses the CQA requirements for soil layers including fill placement, subgrade preparation, admix liner, drain gravel, and operations layer.

## 2.1 FILL PLACEMENT AND SUBGRADE PREPARATION

This section of the CQA Plan addresses the soils components necessary to provide a prepared subgrade for the liner systems and specifies the soils CQA program to be implemented with regard to materials selection and evaluation, laboratory test requirements, field test requirements, and corrective action requirements.

### 2.1.1 Fill Placement and Compaction

The technical specifications will be followed for the stockpiling, placement, and compaction of earthfill and structural fill. The CQA monitor will monitor the fill placement and compaction to verify and document the following:

- The soil being placed meets the technical specifications requirements for earthfill and structural fill as determined by the test methods and frequencies specified within this CQA Plan and the source quality control submittals.
- The placement surface has been prepared as specified in the technical specifications.
- The compacted lift thickness is in accordance with the requirements of the technical specifications.
- The dry unit weight of the earthfill and structural fill meets specifications as determined by the test methods and frequencies described in Table 2-1 for earthfill and Table 2-2 for structural fill.
- Material placed in permanent stockpiles meets the appropriate specifications for earthfill or structural fill.

### 2.1.2 Construction Quality Assurance Evaluation

The frequency of soils testing for CQA purposes will conform to the minimum frequencies presented in Table 2-1 for earthfill and Table 2-2 for structural fill. Material properties will be determined from samples collected either immediately after placement or from stockpiles.

Nuclear density meter test methods will be used for the field testing of the in situ dry unit weight of the in-place, compacted fill. Any settlement or other defects in the fill will be backfilled and compacted in accordance with the technical specifications.

Standard count calibrations will be conducted to monitor the aging of the nuclear density gauge sources in accordance with ASTM standards. Sand cone or drive sleeve tests will be conducted periodically to verify densities using the nuclear density gauge. Oven moisture content tests will be conducted and compared to field moisture content results to determine a field correction factor for moisture. Sand cone or drive sleeve tests and in situ moisture content tests will be performed at the frequencies specified in Tables 2-1 and 2-2.

If an in-place density test result fails to meet specifications, a confirmatory test will be performed immediately adjacent to the failed test. If the confirmatory test meets or exceeds specifications, a second confirmatory test will be performed at a second location immediately next to the failed test. If the second confirmatory test also meets or exceeds specifications, the area will be declared as meeting project specifications and the confirmatory tests will be reported. In the event that either confirmatory test fails to meet specifications, a CQA representative will determine the extent and nature of the defect by observations and/or additional testing, as necessary, to identify the limits of the area that does not meet project specifications.

If a defective area is discovered in the fill, a CQA representative will determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA representative will determine the extent of the defective area by additional tests, observations, a review of records, or other means that the CQA representative deems appropriate. If the defect is related to adverse site conditions, such as excessively wet soils or surface desiccation, the CQA representative will define the limits and nature of the defect by testing or observation. After the extent and nature of a defect is determined and remedied by the construction general contractor, the CQA representative will verify that the deficiency has been corrected by re-testing repaired areas before any additional work is performed by the construction general contractor in the area of the deficiency. All confirmatory tests, failing tests, and re-tests will be recorded in the CQA representative's field book or compaction testing form. The approximate location and elevation of each test will be recorded.

The CQA representative will document fill placement and compaction as determined by the test methods and frequency prescribed by this CQA Plan and will report any non-conformance in accordance with the non-conformance reporting procedures outlined in Section 8.1.4.

## 2.2 PREPARED SUBGRADE

The CQA representative will verify and document that the prepared subgrade is constructed to the elevations and grades shown in the construction drawings, with subgrade meeting the requirements of the technical specifications as determined by the test methods and frequencies specified within this CQA Plan.

Upon completion of the excavation of the landfill, the CQA monitor will perform the following tasks:

- Inspect the subgrade on the side slopes and base of the landfill and note areas of weak or excessively weathered subgrade materials
- Observe completion of excavation and subgrade compaction prior to foundation, fill, or liner placement
- Observe the proof rolling of the base of the landfill and note areas that exhibit excessive rutting, heaving, or softening
- Observe that the surface of the subgrade is free of debris, wet and soft areas, standing water, vegetation, mud, ice, or frozen material
- Observe any excavation and backfilling operations associated with unsuitable material found in the prepared subgrade
- Verify that a survey has been conducted to further verify that the subgrade grades and elevations conform to the construction drawings
- Verify that the prepared subgrade material meets the requirements of the technical specifications as determined by the CQA testing methods and frequency in Table 2-3
- Verify that sampling points in the prepared subgrade are plugged or backfilled so that the prepared subgrade meets the technical specifications
- Document the location and volume of any unsuitable material removed from the prepared subgrade and report any non-conformance with the technical specifications in accordance with the non-conformance reporting procedures in Section 8.1.4

### 2.2.1 Layer Completion Certification

The construction general contractor will be required to notify the CQA representative when an area of prepared subgrade is complete prior to constructing the overlying layer. The construction general contractor can proceed with the overlying layer upon acceptance of the area of prepared subgrade by the

CQA representative. The CQA certifying engineer will provide a certificate of layer completion to the construction general contractor and the IDF project engineer, certifying that the area is complete.

## 2.3 SOIL BENTONITE ADMIX LINER AND TEST PADS

The soil bentonite admix liner (SBL) is composed of a mixture of base soil and bentonite material. Two SBL test pads will include both a horizontal and a sloped test pad. The horizontal test pad will be constructed by using the same compaction methods as that used for the production SBL, to ensure the SBL is constructed to meet the minimum hydraulic conductivity requirements. The sloped test pad will be constructed on a sloping surface to verify that compaction methods (determined during the horizontal test pad) will be adequate for the side slopes of the landfill. If necessary, the technical specifications and/or CQA Plan may be modified, based on the results of the test pads.

### 2.3.1 Test Pads

Test pads will be constructed by the construction general contractor to determine acceptable placement and compaction methods to produce a low permeable SBL on a horizontal surface and on a 3H:1V side slope that satisfies the performance requirements of the technical specifications.

In addition, the mixing of the base soil and bentonite admixture using the pugmill will be tested to ensure adequate control of the ratio of admixture components as well as the homogeneity of the completed SBL mixture.

#### 2.3.1.1 Construction Quality Assurance Evaluation

During test pad construction, the CQA representative will continuously observe and document the construction of the test pad. These guidelines will be followed to ensure that the test pad accurately represents the performance of the full-scale facility:

- Construction of the test pad will use the same soil material, design specifications, equipment, and procedures as proposed for the full-scale facility.
- The test pad length, width, and depth will be as required by the technical specifications and for the in-situ hydraulic conductivity test spacing.
- The number of lifts used to construct the test pad will be as required by the technical specifications.

The test pad will be constructed to allow determination of the relationship among density, moisture content, and method of compaction. Field variables can affect this relationship and must be carefully measured and controlled, both in the test pad and during construction of the full-scale liner. At a minimum, the following will be observed and documented:

- Track weight of base soil and bentonite during mixing operations
- Mixing operation homogeneity
- Test pad configuration and dimensions
- Compaction equipment type, configuration, and weight
- Number of passes and speed of the compaction equipment
- Uncompacted and compacted lift thickness
- Weather conditions, including ambient temperature, humidity, wind speed and direction, and precipitation

The CQA representative will provide the necessary surveying and/or reference grid points for adequately and expeditiously determining the elevation and dimensions of the test pad, including each lift.

The CQA representative will be responsible for all testing, surveying, and documentation necessary to verify that the test pad performs in accordance with the technical specifications, and that the methods, equipment, and materials used can achieve the same results or better during full-scale construction.

Testing methods and frequencies will be as indicated in Table 2-4. Additional tests may be conducted at the direction of the CQA certifying engineer. All tests will be conducted in accordance with the methods and procedures specified in Table 2-4. Tests are separately identified in Table 2-4 which are intended to provide the following:

- Information Only, for use in evaluating overall methods , materials, or equipment
- Pass/Fail, that have criteria established in the technical specifications which must be met
- Calibration and Check, for use in calibrating instruments

The CQA certifying engineer will compare the results of the test pad constructed on the level surface with the results of the test pad on the side slopes. The CQA certifying engineer will recommend changes to compaction methods, if necessary, to the IDF project engineer. The CQA certifying engineer will prepare an interim report which summarizes the construction and testing of the test pads.

It is important to note that an acceptable zone has been established in the technical specifications for the allowable moisture content and density ranges that are applicable for the SBL admix to meet minimum permeability requirements. This zone may be adjusted as a result of the test pad data obtained during construction to reflect specific conditions observed based on the construction general contractor's proposed blending, placement, and compaction methods. With the range of placement moisture content and density allowed with this approach, minimum compaction effort (i.e., the number of passes a piece of compaction equipment needs to bring the admix into the allowable moisture/density zone) will vary based on material conditions and placement location. Minimum compaction effort recommendations will be developed by the CQA certifying engineer for application to both bottom slope and side-slope admix construction based on test pad results. However, these minimums should be considered as guidelines only and may need to be adjusted based on changes to admix properties (primarily moisture content), site conditions, and compaction location as needed to bring the admix into the required acceptable zone for compaction.

### 2.3.2 Soil Bentonite Admix Liner

The CQA team will verify and document that the SBL is placed to the elevations, grades, and thicknesses shown in the construction drawings, with bentonite-amended material meeting the requirements of the technical specifications as determined by the test methods and frequencies specified within this CQA Plan.

#### 2.3.2.1 Construction Quality Assurance Evaluation

CQA testing will be performed during processing and placement of the SBL. The CQA team will conduct the processing and placement tests for the SBL as specified in Table 2-5. The maximum allowable percentage of failing tests is specified in Table 2-6.

***Processing***

The construction general contractor shall process and condition admix material using a central type pugmill plant as described in the technical specifications. Prior to amending the base soil with bentonite, a CQA representative will verify and document the following:

- Equipment and methods are the same or equivalent as determined from the test pad studies.
- All submittals have been reviewed and approved.
- The base soil source area (either onsite excavation or borrow area) has been approved by the design engineer, IDF PM, or IDF project engineer.
- The mixing equipment is suitable for amending base soils with bentonite.
- The base soil does not contain rocks with dimensions in excess of those required by the technical specifications.

During processing, the CQA representative will verify and document the following:

- The bentonite is in conformance with the technical specifications.
- Close observation of the base soil excavation and processing is performed by the field inspector.
- The processed SBL material meets the requirements of the technical specifications as determined by the CQA testing methods and frequency in Table 2-5.
- The moisture content and consistency of base soil allow bentonite to be mixed uniformly.
- Bentonite amendments are mixed uniformly with the base soil.
- The processed SBL material is stored, protected, and allowed to cure in accordance with the conditions and minimum requirements of the technical specifications.
- Calibration of the pugmill operation feed rate controls for bentonite, base soil and water.
- The bentonite is mixed at the required application rate, established by the technical specifications as determined by the CQA testing methods and frequency in Table 2-5.

The CQA representative will document the properties of the processed soil bentonite material, as determined by the test methods and frequency prescribed by this CQA Plan, and will report any non-conformance with the technical specifications, following procedures outlined in Section 8.1.4.

The CQA representative will observe processing activities including base soil excavation, bentonite blending, and moisture conditioning.

The CQA representative will monitor the excavation of base soil from the approved borrow source or onsite excavations. Deleterious base soil or base soil not meeting the technical specifications will be identified and reported to the CQA certifying engineer and not allowed in the processing area.

CQA tests will be performed on the raw bentonite used in the SBL to verify conformance to the technical specifications. The CQA representative will collect samples of raw bentonite delivered to the site for testing. The CQA laboratory technician will conduct free swell, and grain size tests of the bentonite in accordance with Table 2-5. If the test results of a sample fail to meet specifications, a confirmatory test will be performed immediately subsequent to the failed test. If the confirmatory test meets or exceeds specifications, a second confirmatory test will be performed. If the second confirmatory test also meets or exceeds specifications, the bentonite will be declared as meeting project specifications and the confirmatory tests will be reported. In the event that either confirmatory test fails to meet specifications, the bentonite will be rejected and removed from the site.

The CQA representative will observe mixing and test the bentonite-amended soil, prior to placing it in the landfill.

***Placement***

Prior to the placement of the SBL, the CQA representative will verify and document the following:

- The test pads have been constructed with the approved liner material and production scale equipment to confirm placement and compaction procedures produce the required low-permeability admix for both on a horizontal surface and on a 3H:1V side slope.
- All or an approved portion of the prepared subgrade meets specifications as determined by the test requirements of this CQA Plan and the CQA certifying engineer has issued the completion certificate.
- The SBL material is free of roots, stumps, vegetation, or any other type of deleterious material that may impact the performance of the placed SBL.

- The SBL material does not contain stones with dimensions in excess of those required by the technical specifications.
- The SBL material meets or exceeds the requirements of the technical specifications as determined by the CQA testing methods and frequency in Table 2-5.
- The moisture content of the SBL material is uniform.

During placement and compaction of the SBL, the CQA Team will verify and document the following:

- Close observation of the placement and compaction of SBL material with earthmoving equipment is performed by the field inspectors. Inspectors to verify that means and methods are the same as those approved in the test pad process.
- The SBL material meets the requirements of the technical specifications as determined by the CQA testing methods and frequency in Table 2-5 and is within the maximum allowable failure rates in Table 2-6.
- The SBL is placed in accordance with the conditions and minimum requirements of the technical specifications.
- Each lift is compacted to the required thickness and minimum dry unit weight within the range of moisture contents established by the technical specifications as determined by the CQA testing methods and frequency in Table 2-5.
- Shelby tube samples are collected for laboratory permeability testing at the frequency specified in Table 2-5.
- Penetrations in the SBL at testing and sampling locations are repaired in accordance with the technical specifications.
- The SBL is maintained until it is covered by the geomembrane liner in accordance with the technical specifications.
- In areas of inaccessibility by the compactor, in areas of nonstandard SBL placement, and/or in areas of different compaction methods, more frequent testing will be performed due to thinner lift thicknesses to achieve equivalent compactive effort. Each lift, no matter how thin, will be tested for density and moisture in accordance with Table 2-5.

The CQA representative will document the properties of the SBL as determined by the test methods and frequency prescribed by this CQA Plan and will report any non-conformance in accordance with the non-conformance reporting, as outlined in Section 8.1.4.

The CQA representatives will collect samples immediately after a loose lift of SBL materials has been placed for property tests, prior to compaction. Once compacted, nuclear density gauge test methods will be used for testing the in situ compacted dry unit weight and moisture content of the SBL. Standard count calibration and moisture content tests will be used to calibrate the reading of the nuclear density gauge. Standard count calibration and in situ moisture content tests, using the oven dry method, will be performed at the frequencies specified in Table 2-5. The results of the oven dry moisture content tests will be compared with the field moisture content results to determine a field moisture correction factor. The CQA representative will adjust the field moisture correction factor as test data is collected (i.e., moving average). The CQA representative will collect Shelby tube samples of the SBL for laboratory permeability tests as specified in Table 2-5.

If in-place density test results fail to meet specifications, a confirmatory test will be performed immediately adjacent to (within 3 ft of) the failed test. If the confirmatory test meets or exceeds specifications, a second confirmatory test will be performed at a second location immediately next to

(within 3 ft of) the failed test. If the second confirmatory test also meets or exceeds specifications, the area will be declared as meeting project specifications and the confirmatory tests will be reported. In the event that either confirmatory test fails to meet specifications, additional testing will be performed to identify the limits of the area that does not meet project specifications. All confirmatory tests, failing tests, and re-tests will be recorded in the CQA representative's field book or compaction testing form. The approximate location and elevation of each test will be recorded.

Rapid laboratory permeability tests, such as the constant volume tests, will be used when possible to determine permeability. Once the sample has achieved the specified permeability, the test result will be reported immediately to the CQA certifying engineer. The number of failing tests will be less than the maximum percentage of failing tests specified in Table 2-6. The maximum percentage of failing tests are anticipated to cover laboratory or field recording mistakes, math errors, or other unknown circumstances that are not discovered until after the layer is covered with the succeeding layer(s). Otherwise, all failed tests will be corrected in the field as they are observed.

If a defective area is discovered in the SBL other than a failed in-place density test, the CQA representative will determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA representative will determine the extent of the defective area by additional tests, observations, a review of records, or other means that the CQA representative deems appropriate. If the defect is related to adverse site conditions, such as excessively wet soils or surface desiccation, the CQA representative will define the limits and nature of the defect by testing or observation. After the extent and nature of a defect is determined and remedied by the construction general contractor, the CQA representative will verify that the deficiency has been corrected by re-testing repaired areas before any additional work is performed by the construction general contractor in the area of the deficiency.

The testing frequency during the SBL construction may be increased or modified at the discretion of the CQA certifying engineer, when visual observations of construction performance indicate potential problems or when field experience with the proposed SBL material have been obtained.

During construction, the frequency of testing may be increased by the CQA representative during adverse weather conditions, if equipment breaks down, at the start and finish of grading, if the material fails to meet the requirements of the technical specifications, or if the extent of the work area is reduced.

The construction general contractor will repair all penetrations in the SBL resulting from sampling and other CQA activities, in accordance with the technical specifications. These perforations will be identified to the construction general contractor by the CQA representative. All repairs will be inspected by the CQA representative.

The construction general contractor will be required to use all means necessary to protect all prior work as well as all materials and completed work of other sections. In the event of damage, the construction general contractor will be required to immediately make all repairs and replacements necessary. The CQA representative will verify and document that all damages are repaired.

#### 2.3.2.2 Layer Completion Certification

The construction general contractor will be required to notify the CQA representative when an area of SBL is complete, prior to constructing the overlying layer. The construction general contractor may begin placement of the overlying layer after acceptance of the SBL by the CQA certifying engineer. The CQA certifying engineer will provide a certificate of layer completion to the construction general contractor and the IDF project engineer, certifying that the area is complete.

The CQA certifying engineer will ensure all CQA tests are complete and that all defective areas have been repaired and re-tested in accordance with this CQA Plan and the technical specifications. The certificate of layer completion will indicate that the SBL meets the low permeability requirement, based

on laboratory tests and the thickness of the SBL meeting the minimum requirement specified in the technical specifications.

## 2.4 DRAIN GRAVEL

### 2.4.1 Conformance Evaluation

No CQA conformance material testing is planned for the drain gravel. Construction general contractor is required to submit gradation test results demonstrating conformance with required material properties as part of source quality control, in accordance with the technical specifications.

### 2.4.2 Placement and Compaction

The CQA representative will verify and document that the drain gravel is constructed to the elevations, grades, and thicknesses shown in the construction drawings, with material meeting the requirements of the technical specifications as determined by the test methods and frequencies specified within this CQA Plan.

Prior to the placement of the drain gravel, the CQA representative will verify and document that:

- The underlying geosynthetic layers are free of holes, tears, excessive wrinkles, or foreign objects.
- All work on underlying layers is complete and accepted by the CQA certifying engineer.

During placement and compaction of the drain gravel, the CQA representative will verify and document the following:

- Drain gravel material satisfies the requirements of the technical specifications as determined by the source quality control submittals.
- Drain gravel material is non-angular and free of material that could damage the underlying liner materials.
- Drain gravel material is spread during cooler portions of the day, unless otherwise approved by the CQA certifying engineer.
- Spreading and hauling equipment and operations are in compliance with material thickness and operations requirements, given in the technical specifications.
- If excessive wrinkles begin to develop in the underlying geosynthetics during gravel or sand placement or spreading, the wrinkles are worked out prior to continued placement operations.
- The drain gravel is placed in a manner that will not damage underlying geosynthetics, will minimize slippage of geosynthetic layers, and will not provide excess tensile stress on the geosynthetics, in accordance with the technical specifications.
- Close observation of the placement and compaction of drain gravel with earth moving equipment is performed.

### 2.4.3 Construction Quality Assurance Evaluation

No density tests will be conducted on the drain gravel. If the CQA representative suspects damage to pipes or underlying geosynthetic, the construction general contractor will be required to expose the potentially damaged materials and repair any observed damage.

### 2.4.4 Layer Completion Certification

The construction general contractor will be required to notify the CQA representative when an area of the LCRS or LDS drain gravel is complete, prior to constructing the overlying layer. The construction general contractor may begin placing the overlying layer when the drain gravel is accepted by the CQA certifying engineer. The CQA certifying engineer will provide a certificate of layer completion to the construction general contractor and the IDF project engineer, certifying that the area is complete.

## 2.5 OPERATIONS LAYER

The CQA representative will verify and document that the operations layer, including the operations layer material placed in the SLDS sump area, is constructed to the elevations, grades, and thicknesses shown in the construction drawings, with material meeting the requirements of the technical specifications as determined by the test methods and frequencies specified within this CQA Plan.

Prior to the placement of the operations layer, the CQA representative will verify and document the following:

- The underlying geosynthetic layer is free of holes, tears, excessive wrinkles, or foreign objects.
- All work on underlying layers is complete and accepted by the CQA certifying engineer.

During placement of the operations layer, the CQA representative will verify and document that:

- The soil is suitable and satisfies the requirements of the technical specifications as determined by the test methods and frequencies prescribed in Table 2-7.
- The operations soil is placed in accordance with the technical specifications and construction drawings.
- The lift thicknesses and total thickness of the operations layer agree with the requirements of the construction drawings.
- If excessive wrinkles begin to develop in the underlying geosynthetics during material placement or spreading, the wrinkles are worked out prior to continued placement operations.
- The operations layer is placed in a manner that will not damage underlying geosynthetics, will minimize slippage of geosynthetic layers, and will not provide excess tensile stress on the geosynthetics, in accordance with the technical specifications.
- Spreading and hauling equipment and operations are in compliance with material thickness and operations requirements given in the technical specifications.
- The operations layer is placed on the side slopes to the limits shown in the construction drawings.
- No operations layer material is placed or compacted during periods of unfavorable weather conditions, such as after heavy rains or snow, in accordance with requirements given in the technical specifications.

### 2.5.1 Conformance Evaluation

The test methods and frequencies for CQA conformance testing for the operations layer are specified in Table 2-7.

If damage to underlying geosynthetics is suspected, the CQA representative will require that the overlying operations layer material be removed to expose the geosynthetics.

The construction general contractor will be required to use all means necessary to protect all prior work, as well as all materials and completed work of other sections. In the event of damage, the construction general contractor will be required to immediately make all repairs and replacements necessary. The CQA representative will verify and document that all damages are repaired.

### 2.5.2 Layer Completion Certification

The construction general contractor will be required to notify the CQA representative when an area of the operations layer is complete. The CQA certifying engineer will provide a certificate of layer completion to the construction general contractor and the IDF project engineer, certifying that the area is complete.

## 2.6 SOIL SURVEYING

A survey will be performed by or under the direction of a professional land surveyor registered in the State of Washington. The surveyor will independently survey the elevations and grades of the soil layers including, but not limited to:

- Top of prepared subgrade
- Top of SBL
- Top of LCRS drain gravel
- Top of operations layer

Surveys will be performed on the base and side slopes of the landfill, to confirm that the grades and elevations in the field agree with those shown in the construction drawings and with the minimum acceptable tolerances required in the technical specifications. The results of the survey, conducted by the surveyor, will be compiled in a report signed by the surveyor and the CQA certifying engineer.

The surveyor will be required to survey each soil layer of the liner system for the IDF landfill, in accordance with the requirements of this CQA Plan. A record drawing or tabular listing of surveyed points will be submitted to the CQA certifying engineer by the surveyor before the placement of the next liner system layer. The surveys will be conducted at a 50-ft grid across the entire area of the survey. The survey will include, but not be limited to, the following features of the landfill:

- Toe of slope
- Crest of slope
- Grade breaks
- Anchor trench
- SLDS, LDS and LCRS sumps

**Table 2-1. Minimum Frequency of Testing for CQA Evaluation of Earthfill**

| Test | Frequency | Standard Test Method |
|---|---|---|
| **Material Properties** | | |
| Standard proctor or maximum index density for free-draining soil | 1 per 20,000 $yd^3$ (minimum 1 per source or soil type) | ASTM D698 or ASTM D4253 |
| **Placement** | | |
| In-place wet unit weight | 1 per 5,000 $ft^2$ per lift | ASTM D2922, D1556 |
| In-place moisture content | 1 per 5,000 $ft^2$ per lift | ASTM D3017, D2216 |
| Standard count calibration | 1 per day of fill placement | ASTM D3017/D2922 |
| Oven moisture contents (in situ moisture content) | 1 per day of fill placement | ASTM D2216 |

**Table 2-2. Minimum Frequency of Testing for CQA Evaluation of Structural Fill**

| Test | Frequency | Standard Test Method |
|---|---|---|
| **Material Properties** | | |
| Standard proctor or maximum index density for free-draining soil | 1 per 2,000 tons (minimum 1 per source or soil type) | ASTM 698 or ASTM 4253 |
| **Placement** | | |
| In place moisture content | 1 per 2,500 $ft^2$ per lift | ASTM D3017, D2216 |
| In place dry unit weight | 1 per 2,500 $ft^2$ per lift | ASTM D2922, D1556 |
| Standard count calibration | 1 per day of fill placement | ASTM D3017/D2922 |
| Oven moisture contents (in situ moisture content) | 1 per day of fill placement | ASTM D2216 |

**Table 2-3. Minimum Frequency of Testing for CQA Evaluation of Prepared Subgrade**

| Test | Frequency | Standard Test Method |
|---|---|---|
| **Material Properties**[a] | | |
| Standard proctor or maximum index density for free-draining soil | 1 per 250,000 $ft^2$ (minimum 1 per source or soil type) | ASTM 698 or ASTM 4253 |
| **In Place**[b] | | |
| In-place wet unit weight | 4 per acre (approx. 1 per 10,000 $ft^2$) | ASTM D2922, D1556 |
| In-place moisture content | 4 per acre (approx. 1 per 10,000 $ft^2$) | ASTM D3017, D2216 |
| Standard count calibration | 1 per day when in place tests are performed | ASTM D3017/D2922 |
| Concrete block calibration | 1 per day when in place tests are performed | ASTM D3017/D2922 |
| Over moisture content (in situ moisture content) | 1 per day when in place tests are performed | ASTM D2216 |

a. Prior to subgrade excavation.
b. After reaching subgrade elevation.

1 **Table 2-4. Test Pad Testing Methods and Minimum Frequency**

| Test | Frequency | Standard Test Method |
|---|---|---|
| **Material Property** | | |
| Natural moisture content [a] | 4 per each Base Soil type per test pad | ASTM D2216 |
| Particle size distribution [b] | 4 per each Base Soil type per test pad | ASTM D422 |
| Standard proctor [a] | 4 per each Base Soil type per test pad | ASTM D698 |
| Bentonite dry fineness [b] | 1 per test pad | Technical specification |
| Bentonite high swelling [b] | 1 per test pad | Technical specification |
| **Processing [b]** | | |
| Bentonite/Base Soil application rate | 1 per working day of admix processing during test pad construction | Measure weight of base soil and bentonite entering pugmill during a given period of time |
| Maximum clod size | Periodic monitoring | Observation |
| Curing | 1 per 12 hours | Observation |
| **Pre Compaction [a]** | | |
| Lift thickness | 1 per lift | Field measurement |
| Percent fines | 1 per lift | ASTM D1140 |
| Percent gravel | 1 per lift | ASTM D422 |
| Atterberg limits | 1 per lift | ASTM D4318 |
| Placement | Periodic monitoring | Observation |
| Post Compaction | | |
| Lift thickness [b] | 4 per lift | Field measurement |
| In-place moisture content [b] | 4 per lift | ASTM D3017 |
| In-place dry unit weight [b] | 4 per lift | ASTM D2922 |
| Shelby tube samples [b] (laboratory permeability) | 1 per lift | ASTM D1587/ASTM D5084[c,d] |
| Number of passes [a] | Monitor each lift | Observation |
| Boutwell permeameter test [b] | 5 for the horizontal test pad only | ASTM D6391, first stage only |
| **Calibration and Check [e]** | | |
| Standard count calibration | 1 per day of fill placement | ASTM D3017/D2922 |
| Oven moisture contents (in situ moisture content) | 1 per lift | ASTM D2216 |
| In-place dry unit weight | 1 per lift | ASTM D1556, D2167, or D2937 |

Notes:
a. Tests for information only
b. Pass/fail tests
c. The average effective confining stress will be 5 psi.
d. Rapid turnaround tests (Method F–Constant Volume) will be used when possible.
e. Calibration check tests

1 **Table 2-5. Minimum Frequency of Testing for CQA Evaluation of SBL**

| Test | Frequency | Standard Test Method |
|---|---|---|
| **Bentonite** | | |
| Dry fineness | 1 per lot | Technical specification [a] |
| High swelling | 1 per lot | Technical specification |
| **Processing** | | |
| Base soil excavation | Periodic monitoring | Observation |
| Base soil natural moisture content | 1 per working day of hauling base material or per material color/consistency change | ASTM D2216 |
| Base soil grain size | 1 per working day of hauling base material or per material color/consistency change | ASTM D422 |
| Bentonite/Base Soil application rate | 1 per working day of admix processing | Measure weight of base soil and bentonite entering pugmill during a given period of time |
| Maximum clod size | Periodic monitoring | Observation |
| Curing [c] | 1 per 12 hours | Observation |
| **Pre-Compaction** | | |
| Lift thickness [d] | 1 per 2,500 $ft^2$ per lift | Field measurement |
| Percent fines | 1 per 1,000 $yd^3$ (minimum of 1 per day of placement) | ASTM D1140 |
| Percent gravel | 1 per 1,000 $yd^3$ (minimum of 1 per day of placement) | ASTM D422 |
| Atterberg limits | 1 per 1,000 $yd^3$ (minimum of 1 per day of placement) | ASTM D4318 |
| Placement | Periodic monitoring | Observation |
| **Post Compaction** | | |
| Lift thickness | 5 per acre per lift | Full measurement |
| In place moisture content | 5 per acre per lift | ASTM D3017 |
| In place dry unit weight | 5 per acre per lift | ASTM D2922 |
| Shelby tube samples (laboratory permeability) | 1 per acre per lift | ASTM D1587/ ASTM D5084 [e, f] |
| Number of passes [g] | Observe 1 per acre per lift | Observation |
| Construction oversight | Periodic monitoring | Observation |
| **Calibration and Check** | | |
| Oven moisture content (per each nuclear gauge) | 1 per 10 nuclear gauge moisture contents | ASTM D2216 |

| Test | Frequency | Standard Test Method |
|---|---|---|
| Standard count calibration (per each nuclear gauge) | 1 per day of placement | ASTM D2922/ASTM D3017 |

a. The test method is described in the technical specification.
b. Not used.
c. Curing is stockpiling the SBL material for 12 hours to allow the bentonite to hydrate.
d. A loose lift thickness is such that the compacted thickness is 6 inches or less.
e. The average effective confining stress will be 5 psi.
f. Rapid turnaround tests (Method F – Constant Volume) will be used when possible.
g. A single pass is defined as forward and back.

**Table 2-6. Maximum Allowable Percentage of Failed Tests for CQA Evaluation of SBL**

| Test | Maximum percentage |
|---|---|
| Percent gravel | 5 percent not concentrated in one lift or one area |
| Clod size | 10 percent not concentrated in one lift or one area |
| In place moisture content | 3 percent not concentrated in one lift or one area, and no water content less than 2 percent or more than 3 percent of the specified value |
| In place dry unit weight | 3 percent not concentrated in one lift or one area, and no dry unit weight less than 5 pounds per cubic foot (pcf) below the specified value |
| Shelby tube samples (laboratory permeability) | 5 percent not concentrated in one lift or one area |

**Table 2-7. Minimum Frequency of Testing for CQA Evaluation of Operations Layer**

| Test | Frequency | Standard Test Method |
|---|---|---|
| **Material Properties** | | |
| Standard proctor or maximum index density for free-draining soil | 1 per 20,000 $yd^3$ (minimum 1 per source or soil type) | ASTM D698 or ASTM D4253 |
| Sieve analysis | 1 per 10,000 $yd^3$ placed (minimum 1 per source) | ASTM D422 |
| **In-Place (Outside edge of liner only)** | | |
| In-place wet unit weight | 1 per 5,000 $ft^2$ per lift | ASTM D2922, D1556 |
| In-place moisture content | 1 per 5,000 $ft^2$ per lift | ASTM D3017, D2216 |
| **In-Place (SLDS sump)** | | |
| In-place wet unit weight | 2 per lift | ASTM D2922, D1556 |
| In-place moisture content | 2 per lift | ASTM D3017, D2216 |

# SECTION III–GEOSYNTHETIC CLAY LINER CONSTRUCTION QUALITY ASSURANCE

## 3.1 GEOSYNTHETIC CLAY LINER MANUFACTURE AND DELIVERY

### 3.1.1 Labeling

The CQA representative will verify and document that the GCL manufacturer has labeled each roll of GCL and includes the information required by the technical specifications. The CQA representative will examine GCL rolls upon delivery and deviation from the above requirements will be reported to the CQA certifying engineer prior to installation of the GCL.

### 3.1.2 Transportation and Handling

The CQA representative will observe and document that the type of GCL handling equipment used by the installer minimizes damage to the material. Upon delivery at the site, the CQA representative will conduct a visual inspection of all rolls for defects and for damage. This examination will be conducted without unrolling rolls unless visible defects or damages are found. The CQA representative will indicate to the CQA certifying engineer:

- Any rolls that need to be unrolled to allow for their inspection
- Any rolls, or portions thereof, that need to be rejected and removed from the site because they have severe flaws
- Any rolls that include minor repairable flaws

### 3.1.3 Storage

The CQA representative will verify and document that storage of the GCL is in accordance with the technical specifications.

### 3.1.4 Inventory

All geosynthetic materials that arrive onsite will be inventoried. The inventory will include the specific roll numbers delivered with each shipment. The inventory will be compared to the QC testing information, supplied by the manufacturer to ensure that the material tested is the same material that was delivered to the site. Material for which QC testing data has been supplied will be sampled for conformance testing. Conformance samples may be obtained by the CQA representative at the manufacturing plant or taken upon delivery of the material to the site by a CQA representative. As shipments arrive at the site, a CQA representative will monitor the unloading operations and will inventory the material. Rolls selected for conformance testing will be set aside for sampling as soon as possible.

The CQA representative will record the following information, at a minimum, for each roll:

- **Manufacturer**–Indicate the manufacturer of the material that is being inventoried, that may not be the same as the installer
- **Date of Inventory**–Date that the material was inventoried
- **Date of Delivery**–Enter date when the truck arrived onsite, if known
- **Truck Type**–Indicate type of truck used for shipping geosynthetics (covered or uncovered flatbed, box trailer)
- **Bill of Lading Number**–If the bill-of-lading is available, indicate number and date (also attach copy to inventory form)
- **CQA Representative**–Indicate name of CQA representative performing inventory
- **Unloading Equipment**–Indicate the type and model number of the equipment unloading the geosynthetic material; also note any special attachments that are used to unload the material (stinger, straps, forks)
- **Weather Conditions**–Describe the weather conditions, including temperature, wind, cloud cover, and precipitation during unloading and conformance sampling operation
- **Material Type**–Indicate type of geosynthetic material
- **Roll Number**–Indicate each roll number that is written on the roll (The roll numbers contain a variety of information regarding the material and the manufacturing process.)
- **Lot Number**–Lot number
- **Roll (L × W)**–Indicate the roll width as written on the roll label; if two materials are bonded together (i.e., geonet/geotextile), obtain measurements for both materials
- **Area (square feet)**–Indicate the total square footage of the roll
- **Damage Remarks**–Document any visible damage to the roll; if possible, indicate if damage was present prior to unloading or if it occurred during unloading

The CQA representative will immediately notify the IDF CM if a nonconforming or conditional use tag is attached to any of the inventoried items.

Items that are restricted from further use until the inspections have been completed will be clearly delineated by the CQA representative. Accepted materials will be kept separate or clearly delineated from inventoried and approved items, to the extent possible. The CQA representative will be responsible for coordinating with the construction general contractor during material delivery, so that the material is not moved more than necessary after it is unloaded and damage due to handling is minimized.

The CQA representative will perform the inventory immediately after the material arrives on the site to avoid delaying construction. The CQA representative will be responsible for verifying that only accepted material is installed at the IDF landfill and that all inventories and inspections are documented and maintained.

### 3.1.5 Quality Assurance Conformance Testing

Either at the manufacturer's plant or upon delivery of the rolls of GCL, the CQA representative will ensure that samples are removed at the specified frequency and forwarded to the Geosynthetics CQA Laboratory for testing, to verify and document conformance with the technical specifications.

Conformance samples will be taken across the entire width of the roll and will not include the first 3 feet along the length of the roll. Unless otherwise specified, samples will be 1.5 feet (minimum) long by the roll width. The CQA representative will mark the machine direction on the samples with an arrow.

Unless otherwise specified, samples will be taken at a rate of one per lot or one per 50,000 square feet, whichever is greater. These samples will be tested for:

- Index Flux (ASTM D5887)
- Bentonite Mass per Unit Area (ASTM D5993)
- Bentonite Swell Index Test (ASTM D5890)

The test will be conducted in accordance with the test procedure presented in the technical specifications.

The CQA representative will examine all results from laboratory conformance testing and compare the results to the specifications presented in the technical specifications. In addition, the CQA representative will report any non-conformance to the CQA certifying engineer as soon as practical after the test results become available.

The following procedure will apply whenever a sample fails a conformance test that is conducted by the Geosynthetics CQA Laboratory:

- The construction general contractor will be required to replace the roll (or rolls) of GCL not in conformance with the specifications with a roll that meets the requirements of the technical specifications.

- The CQA representative will ensure that conformance samples are removed for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the roll from which the failing sample was obtained. These two samples must pass the above conformance tests. If either of these samples fails to meet the requirements, samples will be collected from the five numerically closest untested rolls on both sides of the failed samples and tested by the Geosynthetics CQA Laboratory. These ten samples must pass the above conformance tests. If any of these samples fail, a sample from every roll of GCL onsite and a sample from every roll that is subsequently delivered from the same manufacturer must be conformance tested by the Geosynthetics CQA Laboratory until the manufacturer has thoroughly demonstrated compliance with the above requirements to the sole satisfaction of the CQA certifying engineer. The costs of all such tests are to be borne by the construction general contractor.

- The CQA representative will document actions taken in conjunction with conformance test failures as outlined in Section 8.1.4 and report all actions to the CQA certifying officer.

## 3.2 GEOSYNTHETIC CLAY LINER INSTALLATION

### 3.2.1 Surface Preparation

For fill surfaces that will underlay a GCL layer, the CQA representative will verify and document the following:

- The surface of the fill does not contain holes, ruts, protrusions, or other surface irregularities in excess of those dimensions specified by the technical specifications.

- The surface of the fill has been compacted to form a firm, stable base.

- The surface of the fill is free of any type of deleterious material that may cause damage to GCL, including debris, organic material, frozen soil, ice, and rocks.

- The surface of the fill is free of standing water or excessive moisture.

- The construction general contractor has certified in writing that the surface on which the GCL will be installed is acceptable.

The subgrade surface will be inspected immediately prior to commencement of GCL installation. If any change in the surface requires repair work, in accordance with the technical specifications, the construction general contractor will be responsible for repairing the fill surface.

A certificate of subgrade surface acceptance will be required from the construction general contractor. The CQA representative will verify that the subgrade is accepted by the GCL installer, immediately prior to commencement of GCL installation.

After the surface on which the GCL is to be installed has been accepted by the construction general contractor, it will be the CQA representative's responsibility to indicate to the CQA certifying engineer any change in the underlying layer that may, in accordance with the technical specifications, require repair work. If the CQA certifying engineer requires that repair work be done, it will be the responsibility of the construction general contractor to repair the underlying layer.

### 3.2.2 Anchor Trenches and Sumps

Prior to placement of geosynthetics in the anchor trenches or sumps, the CQA representative will verify and document the following:

- The sumps and anchor trenches are excavated to the grades and dimensions shown in the construction drawings. Any anomalies in the soil encountered during excavation will be brought to the attention of the IDF project engineer and removed as directed.
- The anchor trench excavation surface is prepared for installation of geosynthetics, with rounded corners, and free of loose soil or deleterious material.

After geosynthetics deployment into the anchor trench is complete, the CQA representative will verify and document that the backfill for the geosynthetic anchor trenches is placed and compacted in accordance with the technical specifications.

### 3.2.3 Geosynthetic Clay Liner Deployment

#### 3.2.3.1 Field Panel Identification

A field panel is the unit area of GCL that is to be placed in the field (i.e., a field panel is a roll or a portion of roll cut in the field).

The CQA representative will track the placement location of each GCL panel by assigning an identification code (number or letter-number) or by an equivalent tracking method. The identification method will be agreed upon by the CQA certifying engineer and the construction general contractor. This field panel identification scheme will be as simple and logical as possible. (Note: manufacturing plant roll numbers are usually cumbersome and are not related to location in the field.) It will be the responsibility of the construction general contractor to ensure that each field panel placed is marked with the manufacturing plant roll number. The roll number will be marked in the center of the panel in a color to allow for easy inspection.

The CQA representative will establish a table or chart showing correspondence between manufacturing plant roll numbers and field panel identification codes. The field panel identification code will be used for all CQA records.

#### 3.2.3.2 Field Panel Placement

***Installation Schedule***

The CQA representative will evaluate significant changes in the schedule, proposed by the construction general contractor, and will advise the CQA certifying engineer on the acceptability of that change. The CQA representative will verify and document that the condition of the underlying layer has not changed

detrimentally during installation. Any damage to the surface of the underlying layer will be repaired by the construction general contractor, in accordance with the technical specifications.

***Weather Conditions***
The CQA representative will verify and document that GCL is not placed during inclement weather conditions, as specified in the technical specifications. Additionally, the CQA monitor will verify and document that the existing underlying layer has not been damaged by weather conditions.

***Damage***
The CQA representative will visually observe each panel, after placement, for damage. The CQA representative will inform the construction general contractor which panels, or portions of panels, are rejected, repaired, or accepted. Damaged panels or portions of damaged panels that have been rejected by the CQA representative will be marked, and their removal from the work area will be documented by the CQA representative.

***Seam Overlap and Bentonite Seal***
The construction general contractor will observe and document that the seam overlaps and bentonite material placed between panels, if required, along the seams meets specification guidelines. The CQA representative will verify overlap width and will observe bentonite seal placement.

#### 3.2.3.3 Field Panel Protection

The CQA representative will observe and document that the GCL is completely covered with geomembrane or protective plastic cover at the end of each workday and protected from damage and hydration due to weather. The CQA representative will verify and document that equipment does not operate directly on the GCL and that a smooth rub sheet is used to maneuver textured geomembrane over the GCL to prevent damage to the GCL.

### 3.2.4 Defects and Repairs

Any defects and subsequent repairs will be documented, using NCR procedures outlined in Section 8.1.4.

#### 3.2.4.1 Identification

All seams and non-seam areas of the GCL will be inspected by the CQA representative for evidence of defects, holes, contamination of geotextiles, displaced panels, premature hydration, and any sign of contamination by foreign matter. The CQA representative will observe and document repair procedures described below.

#### 3.2.4.2 Repair Procedures

Prior to cover material placement, damage to the GCL will be identified and repaired by the installer.

***Rip and Tear Repair (Flat Surfaces)***
Rips or tears may be repaired by completely exposing the affected area, removing all foreign objects or soil, and by then placing a patch cut from unused GCL over the damage (damaged material may be left in place), with a minimum overlap of 12 inches on all edges.

Accessory bentonite will be placed between the patch edges and the repaired material at a rate of a quarter pound per lineal foot of edge, spread in a continuous 6 inch fillet.

***Rip and Tear Repair (Slopes)***
Damaged GCL material on slopes will be repaired by the same procedures as described above, however, the overlapped edges of the patch need to be wide enough to ensure the patch will keep its position during backfill or cover operations.

***Displaced Panels***

Displaced panels will be adjusted to the correct position and orientation. The adjusted panel will then be inspected for any geotextile damage or bentonite loss. Damage will be repaired by the above described procedure.

***Premature Hydration***

If the GCL is subjected to premature hydration, the construction general contractor will notify the CQA certifying engineer for a site-specific determination as to whether the material is acceptable or if alternative measures must be taken to ensure the quality of the design dependent upon the degree of damage.

# SECTION IV–GEOMEMBRANE CONSTRUCTION QUALITY ASSURANCE

## 4.1 GEOMEMBRANE MATERIAL

### 4.1.1 Labeling

The CQA representative will verify and document that the geomembrane manufacturer has labeled each roll of geomembrane and includes the information required by the technical specifications. The CQA representative will examine geomembrane rolls upon delivery and deviation from the requirements will be reported to the CQA certifying engineer, prior to installation of the geomembrane.

### 4.1.2 Transportation and Handling

Upon delivery at the site, the CQA representative will conduct a visual inspection of all rolls for defects and damage. This examination will be conducted without unrolling rolls unless visible defects or damage are found. The CQA representative will indicate the following to the CQA certifying engineer:

- Any rolls that need to be unrolled to allow for their inspection
- Any rolls, or portions thereof, that need to be rejected and removed from the site because they have severe flaws
- Any rolls that include minor repairable flaws

### 4.1.3 Storage

The CQA representative will verify and document that storage of the geomembrane is in accordance with the technical specifications.

### 4.1.4 Inventory

All geosynthetic materials that arrive onsite will be inventoried in accordance with the technical specifications. The inventory will include the specific roll numbers delivered with each shipment. The inventory will be compared to the QC testing information supplied by the manufacturer to ensure that the material tested is the same material that was delivered to the site. Material for which QC testing data has been supplied will be sampled for conformance testing. Conformance samples may be obtained by the CQA representative at the manufacturing plant or taken upon delivery of the material to the site by a CQA representative. As shipments arrive at the site, a CQA representative will monitor the unloading operations and will inventory the material. Rolls selected for conformance testing will be set aside for sampling as soon as possible.

The CQA representative will record the following information, at a minimum, for each roll:

- **Manufacturer**–indicate the manufacturer of the material that is being inventoried, that may not be the same as the installer
- **Date of Inventory**–Date that the material was inventoried
- **Date of Delivery**–Enter date when the truck arrived onsite, if known
- **Truck Type**–Indicate type of truck used for shipping geosynthetics (covered or uncovered flatbed, box trailer)
- **Bill-of-Lading Number**–If the bill-of-lading is available, indicate number and date (also attach copy to inventory form)
- **CQA Representative**–Indicate name of CQA representative performing inventory

- **Unloading Equipment**–Indicate the type and model number of the equipment unloading the geosynthetic material; also note any special attachments that are used to unload the material (stinger, straps, forks)
- **Weather Conditions**–Describe the weather conditions, including temperature, wind, cloud cover, and precipitation during unloading and conformance sampling operation
- **Material Type**–Indicate type of geosynthetic material (HDPE, geotextile, or geonet)
- **Roll Number**–Indicate each roll number that is indicated on the roll (The roll numbers contain a variety of information regarding the material and the manufacture process.)
- **Lot Number**–Lot number as indicated
- **Roll (L × W)**–Indicate the roll width as indicated on the roll label; if two materials are bonded together (i.e., geonet/geotextile), obtain measurements for both materials
- **Area (square feet)**–Indicate the total square footage of the roll
- **Damage Remarks**–Document any visible damage to the roll; if possible, indicate if damage was present prior to unloading or if it occurred during unloading

Items that are restricted from further use until the inspections have been completed will be clearly delineated by the CQA representative. Accepted materials will be kept separate or clearly delineated from inventoried and approved items to the extent possible. The CQA representative will be responsible for coordinating with the construction general contractor during material delivery, so that the material is not moved more than necessary after it is unloaded and damage due to handling is minimized.

The CQA representative will perform the inventory immediately after the material arrives onsite to avoid delaying construction. The CQA representative will be responsible for verifying that only accepted material is installed at the IDF landfill, and that all inventories and inspections are documented and maintained.

### 4.1.5 Quality Assurance Conformance Testing

Either at the manufacturer's plant or upon delivery of the rolls of geomembrane, the CQA representative will ensure that samples are removed at the specified frequency and forwarded to the Geosynthetics CQA Laboratory for testing to verify and document conformance with the technical specifications.

Conformance samples will be taken by the CQA representative across the entire width of the roll and will not include the first 3 feet. Unless otherwise specified, samples will be 3 feet (minimum) long by the roll width. The CQA representative will mark the direction of the machine used to cut the samples with an arrow.

Unless otherwise specified, samples will be taken at a rate of one per lot or one per 50,000 square feet, whichever is greater. These samples will be tested for:

- Thickness (ASTM D5199 or D5994)
- Tensile characteristics (yield strength and elongation at yield, ASTM D638)
- Asperity (GRI GM-12)
- Puncture resistance (ASTM D4833)

Test will be conducted in accordance with the test procedure presented in the technical specifications. The CQA representative will examine all results from laboratory conformance testing and will report any non-conformance after the test results become available. The following procedure will apply whenever a sample fails a conformance test that is conducted by the CQA representative:

- The construction general contractor will be required to replace the roll (or rolls) of geomembrane in non-conformance with the technical specifications with a roll that meets the technical specifications.

- The CQA certifying engineer will ensure that conformance samples are removed for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the failed roll. These two samples must pass the above conformance tests. If either of these samples fail, samples will be collected from the five numerically closest untested rolls on both sides of the failed sample and tested by the Geosynthetics CQA Laboratory. These ten samples must pass the above conformance tests. If any of these samples fail, a sample from every roll of geomembrane onsite and every roll subsequently delivered from the same manufacturer must be conformance tested by the Geosynthetics CQA Laboratory, until the manufacturer has thoroughly demonstrated compliance with the above requirements to the sole satisfaction of the CQA certifying engineer. The costs of all such tests are to be borne by the construction general contractor.

#### 4.1.6 Manufacturing Plant Site Visit

The manufacturer shall allow the CQA certifying engineer or his designated representative to visit the manufacturing plant, if the CQA certifying engineer so chooses. If possible, the visit shall be prior to or during the manufacturing of the geomembrane rolls for the specific project. The CQA Engineer or his designated representative shall review the manufacturing process, quality control, laboratory facilities, and testing procedures as described in the technical specifications (see Section 02661).

### 4.2 GEOMEMBRANE INSTALLATION

#### 4.2.1 Surface Preparation

For SBL surfaces that will underlay a geomembrane layer, the CQA representative will verify and document the following:

- The surface of the subgrade or SBL does not contain holes, depressions, or protrusions in excess of those dimensions specified by the technical specifications.
- The surface of the subgrade or SBL has been rolled with a smooth-drum roller to form a firm stable base without ridges, wheel ruts, and surface irregularities.
- The surface of the subgrade or SBL is free of any type of deleterious material that may cause damage to geomembrane.
- The construction general contractor has certified in writing that the surface on which the geomembrane will be installed is acceptable.

The subgrade and SBL surface will be inspected immediately prior to commencement of geomembrane installation. If any change in the surface requires repair work, in accordance with the technical specifications, the construction general contractor will be responsible for repairing the surface. A certificate of subgrade surface acceptance will be required from the construction general contractor. The CQA representative will verify that the subgrade is accepted by the geomembrane installer immediately prior to commencement of geomembrane installation.

After the surface on which the geomembrane is to be installed has been accepted by the construction general contractor, it will be the CQA representative's responsibility to indicate to the CQA certifying engineer any change in the underlying layer that may, in accordance with the technical specifications, require repair work. If the CQA certifying engineer requires that repair work be done, it will be the responsibility of the construction general contractor to repair the underlying layer.

#### 4.2.2 Anchor Trenches and Sumps

Prior to placement of geosynthetics in the anchor trenches or sumps, the CQA representative will verify and document the following:

- The excavation of the sumps and anchor trenches is performed in accordance with the technical specifications. Any anomalies in the soil encountered during excavation will be brought to the attention of the IDF project engineer and removed as directed.
- The anchor trench excavation surface is prepared for installation of geosynthetics with rounded corners and is free of loose soil or deleterious material.

After geosynthetics deployment into the anchor trench is complete, the CQA representative will verify and document that the backfill for the geosynthetic anchor trenches is placed and compacted in accordance with the technical specifications and construction drawings.

### 4.2.3 Geomembrane Deployment

#### 4.2.3.1 Layout Drawing

The construction general contractor will be required to produce layout drawings that show the geomembrane panel configuration, dimensions, details, and seam locations. The layout drawings must be approved by the CQA certifying engineer, prior to the installation of the geomembrane.

#### 4.2.3.2 Field Panel Identification

A field panel is the unit area of geomembrane that is to be seamed in the field (i.e., a field panel is a roll or a portion of roll cut in the field).

The CQA representative will verify that each field panel is given an identification code (number or letter-number) consistent with the layout plan. This identification code will be agreed upon by the CQA representative and the construction general contractor. This field panel identification code will be as simple and logical as possible. (Note: manufacturing plant roll numbers are usually cumbersome and are not related to location in the field.) It will be the responsibility of the construction general contractor to ensure that each field panel placed is marked with the manufacturing plant roll number. The roll number will be marked in the center of the panel in a color to allow for easy inspection.

The CQA representative will establish a table or chart showing correspondence between manufacturing plant roll numbers and field panel identification codes. The field panel identification code will be used for all CQA records.

#### 4.2.3.3 Field Panel Placement

***Location***

The CQA representative will verify and document that field panels are installed at the locations and positions indicated in the construction general contractor's layout plan, as approved or modified by the CQA certifying engineer.

***Installation Schedule***

The CQA representative will evaluate significant changes in the schedule, proposed by the construction general contractor, and will advise the CQA certifying engineer on the acceptability of that change. The CQA representative will verify and document that the condition of the underlying layer has not changed detrimentally during installation. Any damage to the surface of the underlying layer will be repaired by the construction general contractor in accordance with the technical specifications.

The CQA representative will record the identification code, location, and date of installation of each field panel.

***Weather Conditions***

The CQA representative will verify and document that geomembrane is not placed during inclement weather conditions, as specified in the technical specifications. Additionally, the CQA representative will verify and document that the underlying layer has not been damaged by weather conditions.

***Damage***

The CQA representatives will visually observe each panel, after placement and prior to seaming, for damage (e.g., holes, blisters, and creases). The CQA representative will inform the construction general contractor which panels, or portions of panels, need to be rejected, repaired, or accepted. Damaged panels or portions of damaged panels that have been rejected by the CQA certifying engineer will be marked, and their removal from the work area will be documented by the CQA representative, using the NCR procedures outlined in Section 8.1.4.

### 4.2.4 Field Seaming

#### 4.2.4.1 Seam Layout

The CQA certifying engineer will verify and document that the seam layout shown in the panel layout drawing is consistent with the technical specifications. A seam numbering system compatible with the panel numbering system will be agreed upon by the construction general contractor and CQA certifying engineer.

#### 4.2.4.2 Seaming Equipment and Products

Processes approved by the technical specifications for field seaming are extrusion seaming; and fusion seaming. Proposed alternate processes will be required to be documented and submitted to the CQA certifying engineer for approval. The construction general contractor will be required to use a pyrometer to ensure that accurate temperatures of the extrudate and seamer nozzle are being achieved.

The extrusion seaming apparatus will be equipped with gauges, indicating the temperatures of the extrudate and nozzle. The construction general contractor will be required to provide to the CQA certifying engineer the manufacturer's certification that the extrudate is compatible with the geomembrane material and is comprised of the same resin as the geomembrane.

The CQA representative will log ambient temperatures, seaming apparatus temperatures, and extrudate temperatures or fusion seaming apparatus speeds. Ambient temperatures will be measured to verify compliance with the technical specifications.

#### 4.2.4.3 Seam Preparation

The CQA certifying engineer will verify and document the following:

- Prior to seaming, the seam area is clean and free of moisture, dust, dirt, debris, and foreign material.
- Preparation of seams is in accordance with the technical specifications.

#### 4.2.4.4 Weather Conditions for Seaming

The CQA representative will verify and document that weather conditions for seaming are within the limits specified in the technical specifications.

#### 4.2.4.5 Trial Seams

The construction general contractor will be required to make trial seams on fragment pieces of geomembrane liner to verify that seaming conditions are adequate. The construction general contractor will be required to make and test trial seams at the frequency and in accordance with the methods specified in the technical specifications.

The CQA representative will observe all trial seam procedures. The trial seam samples will be assigned a number and marked accordingly by the CQA representative, along with the date, hour, ambient temperature, number of seaming unit, name of seamer, and pass or fail description. A sample of the trial seam will be retained by the CQA team until the construction of the liner is complete and the liner has been accepted by the CQA certifying engineer.

#### 4.2.4.6 Nondestructive Seam Continuity Testing

Except as otherwise noted in the technical specifications, the construction general contractor will nondestructively test all field seams over their full length, in accordance with the technical specifications. The purpose of nondestructive tests is to check the continuity of seams. Continuity testing will be carried out as the seaming work progresses, not at the completion of all field seaming. Nondestructive testing will not be permitted before sunrise or after sunset unless the construction general contractor demonstrates to the CQA certifying engineer that the construction general contractor has the capabilities to perform continuity testing under reduced light conditions. The CQA representative will perform the following tasks:

- Observe the continuity testing
- Record location, date, test unit number, name of tester, and outcome of all testing
- Document and inform the construction general contractor of any required repairs

The construction general contractor will be required to complete any required repairs, in accordance with the technical specifications. The CQA representative will perform the following tasks:

- Observe the repair and re-testing of the repair
- Mark on the geomembrane that the repair has been made
- Document the results

The CQA representative will verify and document the procedures specified in the technical specifications where seams cannot be nondestructively tested. The location, date of visual observation, name of tester, and outcome of the test or observation will be recorded by the CQA representative and reported to the CQA certifying engineer.

#### 4.2.4.7 Destructive Seam Testing

***Concept***

Destructive seam tests will be performed at selected locations. The purpose of these tests is to evaluate seam strength and integrity. Seam strength testing will be done as the seaming work progresses, not at the completion of all field seaming.

***Location and Frequency***

The CQA representative will select locations where seam samples will be cut out for laboratory testing at the frequency specified in the technical specifications (see Section 02661). In general, destructive tests will be located in non-critical areas, such as seam run-out areas or near three-panel intersections or other areas that will require a patch anyway. In addition, because extrusion welding may be limited on a daily basis, extrusion destructive samples may be welded after passing a trial seam on scrap material not used for construction. However, when significant lengths (greater than 100 feet) of seams or caps are extrusion welded, a destructive test of the weld will be taken.

Control charts will be used to track the performance of each welding machine and technician to allow for biased sampling, according to performance. An upper control limit (UCL) will be established to statistically identify the sources of test failures. Machines and technicians whose failure rates exceed the UCL will then be identified and destructively tested at twice the original frequency (one per 250 feet of seam length) to better monitor their performance. Once the failure rate drops back into compliance with the UCL, the original testing frequency will be reinstated. Machines and technicians whose failure notes are below the UCL will be identified to decrease the original frequency, as approved by the CQA certifying engineer.

The UCL is established based on the failure rate for all destructive tests plus three standard deviations with a ceiling of 3.5 percent. The ceiling is the maximum failure rate determined to be acceptable, as agreed upon jointly by the construction general contractor and CQA certifying engineer. The initial UCL will be calculated once a single machine or technician fails two destructive tests and will typically be

updated daily with the most recent destructive testing results. Destructive tests tracking a failed destructive will not be included in the calculation of the failure rates.

Additional destructive test locations may be required during seaming operations. The necessity for such additional sampling and testing will be determined by CQA representatives and will be implemented when there is cause to suspect the presence of excess crystallinity, contamination, offset welds, or any other reason to suspect potentially defective seams. The location selection of the additional testing will be based on the CQA representative's judgment and observation of a suspected problem.

The construction general contractor will not be informed in advance of the locations where the seam samples will be taken.

***Sampling Procedure***

The construction general contractor will be required to cut samples, as directed by the CQA representative as the seaming progresses, in order to have laboratory test results before the geomembrane is covered by another material. The CQA representative will perform the following tasks:

- Observe sample cutting
- Assign a number to each sample and mark it accordingly
- Record the sample number and location on the panel layout drawing
- Record the reason for taking the sample at this location (e.g., routine testing, suspicious feature of the geomembrane)

All holes in the geomembrane resulting from destructive seam sampling will be covered by the construction general contractor immediately after sampling and will be repaired in accordance with the repair procedures described in the technical specifications. The continuity of the new seams in the repaired area will be nondestructively tested, according to the technical specifications.

***Size of Samples***

At a given sampling location, two types of samples will be taken by the construction general contractor. First, two specimens for field testing will be taken. Each of these specimens will be 1 inch wide by 6 to 12 inches long, with the seam centered parallel to the width. The distance between these two specimens will be approximately 42 inches. If both specimens pass the field test described in the technical specifications, a sample for laboratory testing will be taken.

The sample for laboratory testing will be required to be taken between the two specimens for field testing. The destructive sample will be 12 inches wide by 42 inches long, with the seam centered lengthwise. The sample will be cut into three parts and distributed as follows:

- One portion to the construction general contractor, 12 inches long
- One portion to the IDF CM for archive storage, 12 inches long
- One portion to the CQA certifying engineer for CQA Laboratory testing, 18 inches long

Final determination of the sample sizes will be made at the preconstruction meeting.

***Field Testing***

The two 1-inch-wide specimens, as specified above, will be required to be tested in the field by the CQA representative by tensiometer for peel and shear and need to not fail in the seam. If any field test sample fails to pass, the procedures outlined in the technical specifications will be followed.

The CQA representative will mark all samples and portions with their number, date, and time.

***Geosynthetic Construction Quality Assurance Laboratory Testing***

Laboratory destructive test samples will be packaged and shipped to the Geosynthetics CQA Laboratory by the CQA representative in a manner that will not damage the test sample. The CQA representative will store the archive samples until the completion of the project.

Testing will include "Shear Strength" and "Peel Strength" (ASTM D6392) with 1-inch-wide strip, tested at 2 inches per minute. The minimum acceptable values to be obtained in these tests are those indicated in the technical specifications. At least five specimens will be tested for each test method. Specimens will be selected alternately by test from the samples (i.e., peel, shear, peel, shear). At least four out of five of the specimens for each test must pass.

The laboratory will provide test results verbally to the CQA certifying engineer in a timely manner after they receive and test the samples. The CQA certifying engineer will review laboratory test results as soon as they become available and will inform the CQA certifying engineer of the test results.

***Procedures for Destructive Test Failure***

The procedures specified in the technical specifications will be required whenever a sample fails a destructive test, whether that test is conducted by the Geosynthetics CQA Laboratory or by field tensiometer. The CQA certifying engineer will verify and document that one of the options specified in the technical specifications is followed. The CQA representative will document all actions taken in conjunction with destructive test failures, including preparation of NCRs, as outlined in Section 8.1.4.

### 4.2.5 Defects and Repairs

#### 4.2.5.1 Identification

All seams and non-seam areas of the geomembrane will be inspected by the CQA representative for evidence of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane will be required to be clean at the time of examination. The geomembrane surface will be required to be swept or washed by the construction general contractor if the amount of dust or mud inhibits examination.

#### 4.2.5.2 Evaluation

Each suspect location both in seam and non-seam areas will be required to be either non-destructively tested using the methods described in the technical specifications, or repaired as appropriate as determined by the CQA certifying engineer. Each location that fails the non-destructive testing will be marked by the CQA representative and will be required to be repaired by the construction general contractor. Materials will not be placed over geomembrane locations that have been repaired until the CQA representative has approved the repair.

#### 4.2.5.3 Large Wrinkles

When seaming of the geomembrane is completed (or when seaming of a large area of the geomembrane is completed) and prior to placing overlying materials, the CQA representative will visually inspect the geomembrane for wrinkles. Based on the requirements of the technical specifications, the CQA representative will indicate to the construction general contractor which wrinkles, if any, are to be cut, overlapped, and seamed to remove the wrinkle. The seam thus produced will be tested like any other seam.

#### 4.2.5.4 Repair Procedures

Any portion of the geomembrane either exhibiting a flaw or failing a destructive or nondestructive test will be repaired by the construction general contractor in accordance with the applicable method specified in the technical specifications. An NCR will be prepared to document all flaws and failed tests, as outlined in Section 8.1.4. Each repair will be located and logged by the CQA representative.

#### 4.2.5.5 Testing of Repairs

Each repair will be non-destructively tested, using the methods described in the technical specifications as appropriate. Repairs that pass the non-destructive test will be considered adequate. Large caps may be of sufficient extent to require destructive testing, at the discretion of the CQA certifying engineer. Failed tests will require the repair to be redone and re-tested until passing test results are obtained. The CQA

representative will observe the non-destructive testing of repairs and will document the date of the repair and test outcome.

#### 4.2.6 Appurtenances

The CQA representative will verify and document the following:

- Installation of the geomembrane around, and connection of geomembrane to, appurtenances have been made according to the technical specifications or manufacturer's recommendations.
- Extreme care is taken while seaming around appurtenances, since neither non-destructive nor destructive testing may be feasible in these areas.
- The geomembrane has not been visibly damaged while being connected to appurtenances.

The CQA representative will inform the CQA certifying engineer if the above conditions are not fulfilled.

## 4.3 GEOMEMBRANE PANEL LAYOUT SURVEY

A survey will be performed by or under the direction of a professional land surveyor registered in the State of Washington. The surveyor will independently survey the elevations and location of each panel intersection and destructive sample. The results of the survey conducted by the surveyor will be compiled in a report signed by the surveyor and the CQA certifying engineer.

The surveyor will be required to survey each geomembrane panel intersection and destructive sample location for the IDF landfill, in accordance with the requirements of this CQA Plan. A record drawing will be submitted to the CQA certifying engineer by the surveyor. The survey will include enough information to confirm that the geomembrane layout is in accordance with the panel layout and include, but not be limited to, the following information:

Geomembrane panel intersections

- Destructive sample location and identification
- Edge of geomembrane liner
- Panel identification numbers

Each geomembrane layer will be surveyed including, but not be limited to:

- Secondary leak detection system geomembrane
- Secondary geomembrane
- Primary geomembrane

## 4.4 LAYER COMPLETION CERTIFICATION

The construction general contractor will be required to notify the CQA representative when an area of geomembrane is complete, prior to constructing the overlying layer. The construction general contractor may place overlying layer after acceptance of geomembrane layer by the CQA Certifying Engineer. The CQA certifying engineer will provide a certificate of layer completion to the construction general contractor and the IDF project engineer, certifying that all CQA tests are complete and all defects have been repaired and tested.

# SECTION V–GEOTEXTILE CONSTRUCTION QUALITY ASSURANCE

## 5.1 GEOTEXTILE MATERIAL AND INSTALLATION

### 5.1.1 Labeling

The CQA representative will verify and document that the geotextile manufacturer has labeled all rolls of geotextile with the information specified in the technical specifications. The CQA representative will examine rolls upon delivery, and any deviation from the requirements will be reported to the CQA certifying engineer. Geotextile rolls that are not labeled or that have illegible labels will be removed and disposed by the construction general contractor.

### 5.1.2 Transportation and Handling

The CQA representative will observe rolls of geotextile upon delivery at the site, and any deviation from the transportation and handling requirements specified in the technical specifications will be reported to the CQA certifying engineer. Any damaged rolls will be rejected by the CQA certifying engineer and required to be repaired or replaced by the construction general contractor.

### 5.1.3 Storage

The CQA representative will verify and document that storage of the geotextile is in accordance with the technical specifications.

### 5.1.4 Inventory

All geotextile materials that arrive onsite will be inventoried. The inventory will include the specific roll numbers delivered with each shipment. The inventory will be compared to the QC testing information, supplied by the manufacturer to ensure that the material tested is the same material that was delivered to the site. Material for which QC testing data has been supplied will be sampled for conformance testing. Conformance samples may be obtained by the CQA representative at the manufacturing plant or taken upon delivery of the material to the site by a CQA representative.

As shipments arrive at the site, a CQA representative will monitor the unloading operations and will inventory the material. Rolls selected for conformance testing will be set aside for sampling as soon as possible.

The CQA representative will record the following information, at a minimum, for each roll:

- **Manufacturer**–Indicate the manufacturer of the material that is being inventoried, that may not be the same as the installer
- **Date of Inventory**–Date that the material was inventoried
- **Date of Delivery**–Enter date when the truck arrived onsite, if known
- **Truck Type**–Indicate type of truck used for shipping geosynthetics (covered or uncovered flatbed, box trailer)
- **Bill-of-Lading Number**–If the bill-of-lading is available, indicate number and date (also attach copy to inventory form)
- **CQA Representative**–Indicate name of CQA representative performing inventory
- **Unloading Equipment**–Indicate the type and model number of the equipment unloading the geosynthetic material; also note any special attachments that are used to unload the material (stinger, straps, forks)
- **Weather Conditions**–Describe the weather conditions, including temperature, wind, cloud cover, and precipitation during unloading and conformance sampling operation

- **Material Type**–Indicate type of geosynthetic material
- **Roll Number**–Indicate each roll number that is indicated on the roll
- **Lot Number**–Lot number
- **Roll (L × W)**–Indicate the roll width as indicated on the roll label; if two materials are bonded together (i.e., geonet/geotextile), obtain measurements for both materials
- **Area (square feet)**–Indicate the total square footage of the roll
- **Damage Remarks**–Document any visible damage to the roll; if possible, indicate if damage was present prior to unloading or if it occurred during unloading

Items that are restricted from further use until the inspections have been completed will be clearly delineated by the CQA representative. Accepted materials will be kept separate or clearly delineated from inventoried and approved items to the extent possible. The CQA representative will coordinate with the construction general contractor during material delivery so that the material is not moved more than necessary after it is unloaded and damage due to handling is minimized.

The CQA representative will perform the inventory immediately after the material arrives onsite to avoid delaying construction. The CQA representative will be responsible for verifying that only accepted material is installed at the IDF landfill and that all inventories and inspections are documented and maintained.

### 5.1.5 Conformance Testing

Either at the manufacturer's factory or upon delivery of the geotextile rolls, the CQA representative will ensure that samples are removed and forwarded to the Geosynthetics CQA Laboratory for testing to verify and document conformance with the requirements of the technical specifications. Conformance samples will be taken across the entire width of the roll and will not include the first 3 feet along the edge of the roll. Unless otherwise specified, samples will be 3 feet (minimum) long by the roll width. The CQA representative will mark the machine direction on the samples with an arrow.

Samples will be taken at a rate of one per material lot or one per 50,000 square foot, whichever is greater. These samples will be tested for the following:

- Permittivity (ASTM D4491, Type 1 only)
- Grab strength (ASTM D4632)
- Tear strength (ASTM D4533)
- Puncture strength (ASTM D4833)

The CQA representative will examine all results of laboratory conformance testing and report any non-conformance to the CQA certifying engineer as soon as results become available. The following procedure will apply whenever a sample fails a conformance test that is conducted by the Geosynthetics CQA Laboratory:

- The construction general contractor will replace the roll (or rolls) of geotextile not in conformance with the specifications with a roll that meets the requirements of the technical specifications.
- The CQA representative will ensure that conformance samples are removed for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the roll from which the failing sample was obtained. These two samples must pass the above conformance tests. If either of these samples fail to meet the requirements, samples will be collected from the five numerically closest untested rolls on both sides of the failed sample and tested by the Geosynthetics CQA Laboratory. These ten samples must pass the above conformance tests. If any of these samples fail, a sample from every roll of geotextile onsite and a sample from every roll that is subsequently

delivered from the same manufacturer must be conformance tested by the Geosynthetics CQA Laboratory, until the manufacturer has thoroughly demonstrated compliance with the above requirements to the sole satisfaction of the CQA certifying engineer. The cost of all such tests are to be borne by the construction general contractor.

The CQA representative will document actions taken in conjunction with conformance test failures and report all actions taken to the CQA certifying engineer. Failed tests will be documented using NCR procedures, outlined in Section 8.1.4.

### 5.1.6 Deployment

The construction general contractor will be required to handle all geotextile material in such a manner as to ensure that it is not damaged in any way.

It will be the CQA representative's responsibility to indicate to the CQA certifying engineer any change in the underlying layer that may, in accordance with the technical specifications, require repair work. If the CQA certifying engineer requires that repair work be done, it will be the responsibility of the construction general contractor to repair the underlying layer.

The CQA representative will verify and document compliance with the following:

- Just prior to geotextile placement, the layer that underlies the geotextile, if it is a geosynthetic, is clean and free of excessive amounts of dust, dirt, stones, rocks, or other obstructions that could potentially damage the liner system.
- In the presence of excessive wind, the geotextile is weighted with sandbags (or equivalent weight approved by the CQA representative).
- Geotextile is kept under tension to minimize the presence of wrinkles in the geotextile. If necessary, the geotextile is positioned by hand after being unrolled to minimize wrinkles.
- Geotextile is cut using a geotextile cutter approved by the geotextile manufacturer and the CQA representative. If in place, special care is taken to protect other materials (such as underlying geosynthetics) from damage that could be caused by the cutting of the geotextiles.
- The construction general contractor takes any necessary precautions to prevent damage to the underlying layers during placement of the geotextile.
- During placement of geotextile, care is taken not to entrap stones, excessive dust, or moisture that could damage the underlying layers, generate clogging of drains or filters, or hamper subsequent seaming.
- Geotextile is not left exposed for an excess of 14 days after placement, to prevent damage from exposure to ultraviolet radiation (sunlight). If the geotextile is exposed for more than 14 days, a temporary cover may be deployed for the duration of the delay or samples may be submitted to an independent testing laboratory to ensure that detrimental levels of UV degradation have not occurred. Test results shall be submitted to CQA certifying engineer for review and approval. Detrimental level of UV degradation is defined in the technical specifications (see Section 02371).

The CQA representative will document any non compliance with the above requirements and report them to the CQA certifying engineer.

### 5.1.7 Seams and Overlaps

The CQA representative will verify and document that all geotextile seams are oriented and overlapped, in accordance with the technical specifications. The construction general contractor will be required to pay close attention at seams to ensure that no protective soil layer material could be inadvertently placed beneath the geotextile.

### 5.1.8 Repair

The CQA representative will verify and document that any holes or tears in the geotextile are repaired, in accordance with the requirements of the technical specifications. The CQA representative will document any noncompliance with the above requirements and report it to the CQA certifying engineer.

# SECTION VI–COMPOSITE DRAINAGE NET CONSTRUCTION QUALITY ASSURANCE

## 6.1 COMPOSITE DRAINAGE NET MATERIAL AND INSTALLATION

### 6.1.1 Labeling

The CQA representative will verify and document that the composite drainage net manufacturer has labeled all rolls of composite drainage net as specified in the technical specifications. The CQA representative will examine rolls upon delivery, and any deviation from the above requirements will be reported to the CQA certifying engineer prior to installation of the composite drainage net.

### 6.1.2 Transportation and Handling

The CQA representative will observe rolls of composite drainage net upon delivery at the site, and any deviation from the requirements of the technical specifications will be reported to the CQA certifying engineer. Any damaged rolls will be rejected by the CQA representative and be required to be repaired or replaced by the construction general contractor.

### 6.1.3 Storage

The CQA representative will verify and document that the storage of the composite drainage net is in accordance with the technical specifications.

### 6.1.4 Inventory

All CDN that arrive onsite will be inventoried. The inventory will record the specific roll numbers delivered with each shipment. The inventory will be compared to the QC testing information supplied by the manufacturer, to ensure that the material tested is the same material that was delivered to the site. Material for which QC testing data has been supplied will be sampled for conformance testing. Conformance samples may be obtained by the CQA representative at the manufacturing plant or taken upon delivery of the material to the site by a CQA representative.

As shipments arrive at the site, a CQA representative will monitor the unloading operations and will inventory the material. Rolls selected for conformance testing will be set aside for sampling as soon as possible.

The CQA representative will record the following information, at a minimum, for each roll:

- **Manufacturer**–Indicate the manufacturer of the material that is being inventoried, that may not be the same as the installer
- **Date of Inventory**–Date that the material was inventoried
- **Date of Delivery**–Enter date when the truck arrived onsite, if known
- **Truck Type**–Indicate type of truck used for shipping geosynthetics (covered or uncovered flatbed, box trailer)
- **Bill-of-Lading Number**–If the bill-of-lading is available, indicate number and date (also attach copy to inventory form)
- **CQA Representative**–Indicate name of CQA representative performing inventory
- **Unloading Equipment**–Indicate the type and model number of the equipment unloading the geosynthetic material; also note any special attachments that are used to unload the material (stinger, straps, forks)
- **Weather Conditions**–Describe the weather conditions, including temperature, wind, cloud cover, and precipitation during unloading and conformance sampling operation

- **Material Type**–Indicate type of geosynthetic material (high-density polyethylene, geotextile, or geonet)
- **Roll Number**–Indicate each roll number that is written on the roll
- **Lot Number**–Lot number as indicated
- **Roll (L × W)**–Indicate the roll width as indicated on the roll label; if two materials are bonded together (i.e., geonet/geotextile), obtain measurements for both materials
- **Area (square feet)**–Indicate the total square footage of the roll
- **Damage Remarks**–Document any visible damage to the roll; if possible, indicate if damage was present prior to unloading or if it occurred during unloading

Items that are restricted from further use until the inspections have been completed will be clearly delineated by the CQA representative. Accepted materials will be kept separate or clearly delineated from inventoried and approved items to the extent possible. The CQA representative will coordinate with the construction general contractor during material delivery so that the material is not moved more than necessary after it is unloaded and damage due to handling is minimized.

The CQA representative will perform the inventory immediately after the material arrives onsite to avoid delaying construction. The CQA representative will be responsible for verifying that only accepted material is installed at the IDF landfill and that all inventories and inspections are documented and maintained.

### 6.1.5 Conformance Testing

Either at the manufacturer's plant or upon delivery of the composite drainage net rolls, the CQA representative will ensure that samples are removed and forwarded to the Geosynthetics CQA Laboratory for testing, to verify and document conformance with the requirements of the technical specifications.

Conformance samples will be taken across the entire width of the roll and will not include the first 3 feet. Unless otherwise specified, samples will be 3 feet long (minimum) by the roll width. The CQA representative will mark the machine direction on the samples with an arrow.

Samples will be taken at a rate of one per lot or one per 50,000 square feet, except as noted otherwise below, whichever is greater. The geonets will be tested for the following:

- Polymer specific gravity (ASTM D1505)
- Thickness (ASTM D5199)
- Nominal transmissivity (ASTM D4716 – one per production lot)

The composite drainage nets will be tested for the following:

- Adhesion (GRI-GC7 or ASTM D413)
- Transmissivity (ASTM D4716 – one per production lot)

The CQA representative will examine all results from laboratory conformance testing and will report any non-conformance to the CQA certifying engineer as soon as the results become available.

The following procedure will apply whenever a sample fails a conformance test that is conducted by the Geosynthetics CQA Laboratory:

- The construction general contractor will be required to replace the roll (or rolls) of composite drainage net not in conformance with the specifications with a roll that meets the requirements of the technical specifications.

- The CQA representative will ensure that conformance samples are removed for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the failed roll. These two samples must pass the above conformance tests. If either of these samples fail, samples will be collected from the five numerically closest untested rolls on both sides of the failed sample and tested by the Geosynthetics CQA Laboratory. These ten samples must pass the above conformance tests. If any of these samples fail, a sample from every roll of composite drainage net onsite and a sample from every roll that is subsequently delivered from the same manufacturer must be conformance tested by the Geosynthetics CQA Laboratory, until the manufacturer has thoroughly demonstrated compliance with the above requirements to the sole satisfaction of the CQA certifying engineer. The cost of such tests is to be borne by the construction general contractor.

The CQA representative will document actions taken in conjunction with conformance test failures and report all actions to the CQA certifying engineer. Failed tests will be documented using NCR procedures, outlined in Section 8.1.4.

### 6.1.6 Deployment

The construction general contractor will be required to handle all composite drainage net in such a manner as to ensure that it is not damaged.

The construction general contractor (responsible for composite drainage net installation) will be required to certify in writing that the surface on which the composite drainage net will be installed is complete and acceptable. A certificate of partial completion will be given by the construction general contractor to the CQA representative, who will then verify to the CQA certifying engineer that the deployment surface is complete, prior to commencement of composite drainage net installation.

After the surface on which the composite drainage net is to be installed has been accepted by the construction general contractor, the CQA representative will have responsibility to indicate to the CQA certifying engineer any change in the underlying layer that may, in accordance with the technical specifications, require repair work. If the CQA certifying engineer requires that repair work be done, it will be the responsibility of the construction general contractor to repair the underlying layer.

The CQA representative will verify and document compliance with the following:

- Just prior to composite drainage net placement, the layer that will underlie the composite drainage net is clean and free of excessive amounts of dust, dirt, stones, rocks, or other obstructions that could potentially damage the underlying layers or clog the drainage system.
- In the presence of excessive wind, the composite drainage net is weighted with sandbags (or equivalent weight approved by the CQA certifying engineer).
- Composite drainage net is kept under tension to minimize the presence of wrinkles in the composite drainage net. If necessary, the composite drainage net is positioned by hand after being unrolled, to minimize wrinkles.
- Composite drainage net is cut using a composite drainage net cutter, approved by the composite drainage net manufacturer and the CQA representative. If in place, special care is taken to protect other materials from damage that could be caused by the cutting of the composite drainage net.
- The construction general contractor takes all necessary precautions to prevent damage to the underlying layers during placement of the composite drainage net.
- Composite drainage net is not welded to geomembranes.
- During placement of clean composite drainage net, care is taken not to entrap stones, excessive dust, or moisture that could damage the underlying geomembrane, generate clogging of drains or filters, or hamper subsequent seaming.

- A visual examination of the composite drainage net is carried out over the entire surface, after installation, to ensure that no potentially harmful foreign objects, such as needles, are present.
- Composite drainage net is not left exposed for an excess of 14 days after placement, to prevent damage from exposure to ultraviolet radiation (sunlight).

The CQA representative will document any noncompliance with the above requirements and report it to the CQA certifying engineer.

### 6.1.7 Seams and Overlaps

The components of the composite drainage net (e.g., geotextile-geonet-geotextile) are not bonded together at the ends and edges of the rolls. The CQA representative will document that the composite drainage net is overlapped and secured in accordance with the technical specifications.

### 6.1.8 Repair

The CQA representative will verify that any holes or tears in the composite drainage net are repaired, in accordance with the technical specifications. The CQA representative will observe any repair, document any noncompliance with the above requirements, and report the noncompliance to the CQA certifying engineer. Repair areas will be documented using NCR procedures, outlined in Section 8.1.4.

# SECTION VII–POLYETHYLENE PIPE AND FITTINGS CONSTRUCTION QUALITY ASSURANCE

## 7.1 PIPE AND FITTINGS

The CQA representative will monitor the placement of the LCRS, LDS and SLDS pipe, located on the IDF landfill floor and on the landfill slopes.

### 7.1.1 Labeling

The CQA representative will verify that the pipe is labeled with the information specified in the technical specifications. Any deviations from the labeling requirements will be reported to the CQA certifying engineer prior to pipe installation.

### 7.1.2 Transportation and Handling

The CQA representative will verify and document that the pipe and fittings are handled in accordance with the technical specifications. The CQA representative will visually inspect the pipe upon delivery at the site, and any deviations from the requirements of the technical specifications will be reported to the CQA certifying engineer.

### 7.1.3 Storage

The CQA representative will verify and document that storage of the pipe and fittings is in accordance with the technical specifications.

### 7.1.4 Inventory

The CQA representative will inventory the polyethylene piping and fitting, delivered to the site that will be installed at the bottom and on the slopes of the landfill. The CQA representative will perform the following tasks:

- Verify the material for conformance with the technical specifications and construction drawings
- Verify slot dimensions for conformance with the technical specifications
- Check the material for damage, mishandling, and adverse exposure

Items that are restricted from further use until the inspections have been completed will be clearly delineated by the CQA representative. Accepted materials will be kept separate from inventoried and approved items, to the extent possible. The CQA representative will be responsible for coordinating with the construction general contractor during material delivery, to limit the material being moved more than necessary after it is unloaded and thereby minimizing damage due to handling.

The CQA representative will perform the inventory immediately after the material arrives onsite to avoid delaying construction. The CQA representative will be responsible for verifying that only accepted material is installed at the IDF landfill, and that all inventories and inspections are documented and maintained.

### 7.1.5 Conformance Testing

No conformance testing will be conducted on the materials delivered to the site.

### 7.1.6 Handling and Laying

The CQA representative will verify and document that the pipe is installed at the specified locations, grades, and angles, and that placement of backfill around and over the pipe is conducted in accordance with the requirements of the technical specifications and in a manner intended to prevent damage to the pipe.

The pipe and fittings will be carefully examined before installation by the CQA representative. The CQA representative will verify and document that cracks, damage, or defects are not present in the pipe and fittings in excess of that allowed by the technical specifications.

The CQA representative will also note the condition of the interior of pipes and fittings. Foreign material will be removed from the pipe interior before it is moved into final position. No pipe will be permitted to be placed until the CQA representative has observed the condition of the pipe. The CQA representative will document any deviation from the requirements and report it to the CQA certifying engineer.

### 7.1.7 Joints and Connections

Lengths of pipe will be required to be assembled into suitable installation lengths by the butt-fusion process. Butt-fusion refers to the butt-joining of the pipe by softening the aligned faces of the pipe ends in a suitable apparatus and pressing them together under controlled pressure. The CQA representative will spot-monitor butt-fusion welding operations to ensure that the construction general contractor follows the technical specifications for both slotted and solid pipes. The CQA representative will verify that internal weld beads have been removed from the horizontal and side slope sections of the LCRS, LDS, and SLDS riser pipes. The CQA representative will document any noncompliance with the requirements and report it to the CQA certifying engineer.

### 7.1.8 Surveying

A survey will be performed by or under the direction of a professional land surveyor registered in the State of Washington. The surveyor will independently survey the final elevation and alignment of the top of the pipe and fittings. Surveys will be performed on all pipe locations within the footprint of the landfill to confirm that the alignment and elevations in the field agree with those shown in the construction drawings. The results of the survey will be compiled in a report signed by the surveyor and the CQA certifying engineer.

The surveyor will be required to survey each pipe location within the IDF landfill, in accordance with the requirements of this CQA Plan. A record drawing will be submitted to the CQA certifying engineer by the surveyor before placement of the next liner system layer. The surveys will be conducted every 50 feet along the pipe alignment and appurtenances. The survey will include enough information to confirm that the following features of the landfill piping are constructed in accordance with the construction drawings:

- Beginning and end top of pipe elevations
- Connection location
- Grade breaks
- Riser pipes
- Sump extensions

The piping that will be surveyed will include, but not be limited to, the following:

- SLDS piping
- LDS piping
- LCRS piping

The CQA certifying engineer will approve the survey results for each layer before the subsequent component of the lining system is constructed.

# SECTION VIII–CONSTRUCTION QUALITY ASSURANCE DOCUMENTATION AND CERTIFICATION

## 8.1 DOCUMENTATION AND CERTIFICATION

A major function of CQA is to properly and adequately document and certify the work. This section describes the minimum required documentation. The CQA certifying engineer may recommend to the IDF CM additional documentation for performing CQA tasks that are for certification. In addition, the CQA certifying engineer will prepare forms, field data sheets, sample labeling schemes, and chain-of-custody procedures and submit them to the IDF CM and IDF PM for approval, prior to construction.

### 8.1.1 Daily Reports

Daily reports will be completed by the CQA representatives when they are onsite. All CQA personnel will be assigned field books by the CQA certifying engineer that will be labeled with a unique number. The CQA representatives, including the CQA certifying engineer, will record all field observations and the results of field tests in their assigned field book. When not in use, all field books will be left in the field records file. After each book is filled (or at the end of the project), the field book will be returned to the CQA certifying engineer and routed to the project files.

Each page of the field book will be numbered, dated, and initialed by CQA personnel. At the start of a new work shift, CQA personnel will list the following information at the top of the page:

- Job name
- Job number
- Date
- Name
- Weather conditions
- Page number (if pages are not pre-numbered)

The remaining individual entries will be prefaced by an indication of the time at which they occurred. If the results of test data are being recorded on separate sheets, it will be noted in the field book. Entries in the field book will include, but not be limited to, the following information:

- Reports on any meetings held and their results
- Equipment and personnel being used in each location, including construction general contractors
- Descriptions of areas being observed and documented
- Descriptions of materials delivered to the site, including any quality verification (vendor certification) documentation
- Descriptions of materials incorporated into construction
- Calibrations, or recalibrations, of test equipment, including actions taken as a result of recalibration
- Decisions made regarding use of material and/or corrective actions to be taken in instances of substandard quality
- Unique identifying sheet numbers of inspection data sheets and/or problem reporting and corrective measures reports used to substantiate the decisions described in the preceding item

At the end of each day, the field CQA monitor will summarize the day's activities on a daily field monitoring report form. The field report will include a brief summary of the day's activities and highlight any unresolved issues that must be addressed by the CQA certifying engineer or by CQA representatives the following day.

The daily field monitoring report will be filled out in triplicate. The CQA monitor will attach three copies of the field book notes for that day. The three copies will be distributed as follows:

- Original will be filed in field office
- One copy will be transmitted to the CQA certifying engineer
- One copy will be transmitted to the IDF CM

The CQA certifying engineer will review and initial each summary field report before distributing to the project quality records and the IDF CM.

### 8.1.2 Inspection Data Sheets

All observed field and laboratory test data will be recorded on an inspection data sheet. At a minimum, each inspection data sheet will include the following information:

- Unique identifying sheet number for cross-referencing and document control
- Description of the inspection activity
- If appropriate, location of inspection activity or location from which the sample was obtained
- Type of inspection activity and/or procedure used (reference to standard method when appropriate)
- Any recorded observation or test data, with all necessary calculations
- Results of the inspection activity and comparison with specification requirements
- Identification of any personnel involved in the inspection activity
- Signature of the individual(s) performing the CQA representative activity and concurrence by the CQA certifying engineer
- Identification of deficiencies and any required reinspections

Forms used for the data sheets will be prepared and submitted to the IDF CM and IDF PM in accordance with this section. The data sheets will include, but are not limited to, the forms listed below:

- Sample log
- Compaction test result log
- Soil test result summary form
- Equipment calibration log

### 8.1.3 Record Drawing Maintenance

The construction general contractor will maintain a complete set of construction drawings labeled "Red-Line" as-built drawings. At the completion of the project, the as-built drawings pertaining to the work certified under this CQA Plan will be produced in electronic format and submitted to the CQA certifying engineer. The CQA certifying engineer will review the completed set of as-built drawings and certify the drawing set as the record drawings for the IDF.

### 8.1.4 Non-Conformance Reporting

Deficiencies/defects identified by in-process testing may be reworked in accordance with the technical specifications or CQA Plan to correct the deficiency without initiating the NCR process (i.e., failed compaction test or failed geomembrane destructive test), and in-process tests will be tracked by the CQA representative until it is corrected. A non-conformance is considered to be a deficiency in characteristics, documentation, or procedures that renders the quality of an item or activity unacceptable or indeterminate. All deficiencies, defects, damage, or test failures that are not corrected by in-process rework will be considered a non-conformance and will be documented on a Non-Conformance Report (NCR) form. The

non-conformance will be referred to the IDF CM, for disposition and initiation of corrective action processes.

All NCR situations will be brought to the attention of the IDF CM for concurrence, prior to initiating the NCR. Upon issuance of the non-conformance report, the IDF CM will notify the IDF design engineer, IDF quality engineer, and IDF PM that the report has issued. Other individuals, as directed by the IDF PM, will participate in NCR disposition, resolution, and corrective action processes as needed. All documentation relating to NCR situations will be retained in the project quality records.

### 8.1.5 Resolution of Contract Document Questions and Clarifications

Request for Information (RFI) forms will be provided to the CQA certifying engineer for the purpose of submitting written requests to the IDF CM, for assistance in understanding the design intent of the contract documents. The CM will determine whether the IDF design engineer's technical support staff will address the RFI.

RFIs initiated by the construction general contractor will be addressed by the IDF project engineer and CM, not by the CQA certifying engineer, and are not in the scope of the CQA Plan.

Any RFIs that result in contract document changes will be incorporated by the IDF CM and PM, following the procedures outlined in Section 8.1.6.

### 8.1.6 Construction Change Order and Contract Document Changes

Requests for changes to the technical specifications or construction drawings will be referred to the IDF CM and initiated as a change order. All change orders and resulting design changes will be approved by the appropriate project team member prior to implementation, as outlined in procedure HNF-IP-0842, Volume 4., Section 4.29 (Engineering Document Change Control Requirements). Requests for modifications to the CQA Plan will also be made by completing a change order to the IDF CM and procurement agent, with copies to the IDF quality engineer and IDF project engineer.

If, during the course of construction, questions arise regarding interpretation of the plans and/or specifications, the IDF CM will be contacted by the CQA certifying engineer. Any clarification of the construction drawings will be documented by a change order, if necessary, or by telephone conversation records or meeting minutes, and routed to the IDF design engineer, IDF CM, and IDF PM. The change order will also be routed to the project files.

### 8.1.7 Progress Reports

The CQA certifying engineer will prepare a summary progress report each week, or at time intervals established at the pre-construction meeting. At a minimum, this report will include the following information:

- A unique identifying sheet number for cross-referencing and document control
- The date, project name, location, and other information
- A summary of work activities accomplished during the progress reporting period
- Identification of areas or items inspected and/or tested during the reporting period that are addressed by the report
- A summary of the quality characteristics being evaluated, with appropriate cross-references to technical specifications and/or construction drawings
- References to the technical specifications or construction drawings defining the acceptance criteria for each inspected characteristic
- A summary of inspection and test results, failures, and re-tests

- A summary of construction situations, deficiencies, and/or defects occurring during the progress reporting period
- A summary of other problem resolutions and dispositions
- The signature of the CQA certifying engineer

The progress report will be submitted to the IDF PM no more than two days after the last reporting day in the progress report. Copies will also be submitted to the IDF PM, IDF quality engineer, and construction general contractor.

### 8.1.8 Final Documentation and Certification

All daily inspection summary reports, inspection sheets, problem identification and corrective measures reports, acceptance reports, change orders, NCRs, photographic records, progress reports, construction drawings, construction drawing revisions, and other pertinent documentation will be retained as permanent project quality records. At the completion of the project, a final CQA report that incorporates all such information, along with as-built drawings, will be prepared by the CQA certifying engineer and submitted to the IDF PM. The CQA certifying engineer will prepare an interim report for construction and testing of the test pads. A final CQA report and certification letter will be completed at the end of the construction that will fulfill the CQA certification requirements specified in WAC 173-303-335(4).

The CQA certifying engineer will coordinate the completion of the as-built record drawings that will be generated by a land surveyor licensed in the State of Washington. The as-built records will include scale drawings depicting depths, plan dimensions, elevations, fill thicknesses, and geosynthetic panel layouts. The report will include documentation of each construction component monitored by CQA personnel and will be signed, stamped, and certified by the CQA certifying engineer.

### 8.1.9 Storage of Records

During the construction of the IDF, the CQA certifying engineer will be responsible for all CQA documents. This includes the CQA certifying engineer's copy of the design criteria, plans, procedures, and specifications; the CQA Plan; and the originals of all the data sheets and reports. The field records will be kept in lockable, metal cabinets or on metal shelving within a facility, protected by a fire alarm and/or a communication system that provides fire department response and/or fire suppression systems; or, in an Underwriters Laboratory-listed, one-hour fire-rated cabinet. At the completion of the project, all completed documents will be routed to the project quality records.

### 8.1.10 Storage of Archive Construction Material Samples

The CQA certifying engineer will be responsible for storing construction material samples collected during the duration of the project.

The CQA certifying engineer will coordinate with the IDF PM and IDF CM on which samples will be archived at the completion of the project. All samples will be kept in small containers (i.e., 5-gallon plastic buckets). Each container will be labeled with the following information:

- Project name
- Date
- Sample I.D.
- Material type
- Point of contact

Control and protection of samples will be accomplished through the use of an index listing of samples. This index will identify each sample gathered and include the same information required for the sample containers. It will also identify where the sample is stored and person responsible for the sample storage, thus providing a documented record of each sample and methodology for verifying that all samples are available in storage and that no samples have been misplaced.

All samples will be stored neatly in a cool, dry location, approved by the CQA certifying engineer. The CQA certifying engineer will coordinate with the IDF PM and IDF CM to determine which sample will be archived at the project completion.

## SECTION IX–REFERENCES

40 CFR 264.19. *Code of Federal Regulations,* Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, Section 19, "Construction Quality Assurance Program." Office of the Federal Register. July 9, 1999.

ASTM. *1997 Annual Book of ASTM Standards,* Volume 4.08: Soil and Rock (I). American Society for Testing and Materials, Philadelphia, Pennsylvania. 1997.

CH2M HILL. *Drawings for the Integrated Disposal Facility (IDF) Detailed Design.* RPP-19941, Rev. 0. Prepared for CH2M HILL Hanford Group. February 2004.

CH2M HILL. *Specifications for the Integrated Disposal Facility (IDF) Detailed Design.* RPP-18489, Rev. 0. Prepared for CH2M HILL Hanford Group. February 2004.

Geosynthetic Research Institute (GRI). "Standard Test Method for Asperity Measurement of Textured Geomembranes Using a Depth Gage," Test Method GM12. Philadelphia, Pennsylvania. 2000.

U.S. Department of Energy. "Radioactive Waste Management," DOE O 435.1. August 28, 2001.

U.S. Environmental Protection Agency, Office of Research and Development. *Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities*, EPA/600/R-93-182. Cincinnati, Ohio. 1993.

Washington Administrative Code (WAC) 173-303-335, *Construction Quality Assurance Program.*

# PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

## OPERATING UNIT 11

## Integrated Disposal Facility

**Appendix 4C** **Facility Response Action Plan**

LEAKAGE RESPONSE ACTION PLAN ..... Part III.11.4C.1
Action Leakage Rate ..... Part III.11.4C.1

REFERENCES ..... Part III.11.4C.3

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# LEAKAGE RESPONSE ACTION PLAN

WAC 173-303-665(9) regulations require the owner of the operator of a landfill unit to have an approved Response Action Plan (RAP) before receipt of waste. The RAP is a site-specific plan that establishes actions to be taken if leakage through the upper (primary) lining system of a landfill exceeds a certain rate. The intent of the RAP is to assure that any leachate that leaks through the primary lining system will not migrate out of the landfill into the environment.

A key element of the RAP is the Action Leakage Rate (ALR), a threshold value which triggers the responses described in the RAP, but below which no special actions are required. Because landfill liner systems have not yet been perfected, a small amount of leakage through the primary liner generally occurs, despite the use of best available materials, construction techniques, and quality assurance procedures. (This leakage is collected by the LDS system and removed from the landfill.) Hence, the ALR is set at some level higher than normally expected leakage rates to serve as an indicator that the primary lining system is not functioning as expected. Exceeding the ALR may reflect serious failure of the primary lining system and indicates the need for investigation and possibly corrective action while the problem is still manageable.

This RAP has been prepared in accordance with requirements of WAC 173-303-665(9). The requirements for determining the ALR are contained in WAC 173-303-665(8) and EPA guidance document, *Action Leakage Rates for Leak Detection Systems* (EPA 530-R-92-004).

The following sections establish the ALR and discuss response actions to be taken if the ALR is exceeded.

## Action Leakage Rate

Section 5.11 provides a detailed discussion of the analysis to determine the ALR into the LDS for the IDF. Based on this analyses, the ALR for the IDF permitted cell is 206 gallons per acre per day, or approximately 1,800 gallons per day per cell (each cell area is approximately 8.5 acres). This value includes a factor of safety of 2 in accordance with EPA guidelines (57 FR 19). It is also much lower than the LDS pump capacity. Details of the calculation are presented in Appendix C.10.

In accordance with WAC 173-303-665(8)(b), the flow rate used to determine if the ALR has been exceeded will be calculated as the average daily flow rate into the sump, expressed as gallons per acre per day (unless Ecology approves a different calculation). This calculation will be performed on a weekly basis during the active (operational) life of the landfill, and monthly after the landfill has been closed. Post-closure frequency may be reduced if only minimal amounts of leachate accumulate in the leak detection system sump. As outlined in WAC 173-303-665(4)(c)(ii), during post-closure monitoring, if the liquid level in the LDS sump stays below the pump operating level for two consecutive months, monitoring of the amount of liquid in the LDS sumps can be reduced to at least quarterly. If the liquid level in the LDS sump stays below the pump operating level for two consecutive quarters, monitoring of the amount of liquid in the LDS sumps can be reduced to at least semiannually. Pump operating level is defined as a liquid level approved by Ecology, based on pump activation level, sump dimensions, and level that minimizes head in the sump.

## Response Actions

WAC 173-303-665(9) lists several required actions if the ALR is exceeded. In the event that the ALR is exceeded, DOE will:

- Notify Ecology in writing of the exceedance within 7 days of the determination
- Submit a preliminary written assessment to Ecology within 14 days of the determination, as to the amount of liquids, likely sources of liquids, possible location, size, cause of any leaks, and short-term actions taken and planned
- Determine, to the extent practicable, the location, size , and cause of any leak
- Determine whether waste receipt should cease or be curtailed, whether any waste should be removed from the unit for inspection, repairs, or controls, and whether or not the unit should be closed
- Determine any other short-term and longer-term actions to be taken to mitigate or stop any leaks
- Within 30 days after the notification that the action leakage rate has been exceeded, submit to Ecology the results of the analyses specified in bullets 3, 4, and 5 of this section, the results of actions taken, and actions planned. Monthly thereafter, as long as the flow rate in the leak detection system exceeds the action leakage rate, the owner or operator must submit to the regional administrator a report summarizing the results of any remedial actions taken and actions planned.

If the ALR is exceeded, the DOE will submit the required notifications to Ecology, as stated above. The EPA will also receive copies of this confirmation.

The leachate will be analyzed for RCRA constituents. If the analytical results indicate that these constituents are present, and if the constituents can be traced to a particular type of waste stored in a known area of the landfill, then it may be possible to estimate the location of the leak. However, because the waste will meet land disposal restrictions, it will contain no free liquids and will be stabilized or solidified, except as allowed by Appendix 3A, section 1.2. In addition, the canister(s) or other type of waste package(s) may not undergo enough deterioration during the active life of the landfill to permit escape of its contents. For these reasons, it is possible that the leachate may be clean or the composition too general to indicate a specific source location.

If the source location cannot be identified, large-scale removal of the waste and operations layer to find and repair the leaking area of the liner would be one option for remediation. However, this procedure risks damaging the liner. In addition, waste would have to be handled, stored, and replaced in the landfill. Backfill would need to be removed from around the waste packages to accomplish this. If the waste packages are damaged during this process, the risk of accidental release may be high. For these reasons, large scale removal of waste and liner system materials is not considered a desirable option and will not be implemented except as a last resort.

The preferred options for remediation include covers and changes in landfill operating procedures. The preferred alternative will depend on factors such as the amount of waste already in the landfill, the rate of waste receipt, the chemistry of the leachate, the availability of other RCRA-compliant disposal facilities, and similar considerations. Hence, at this time no single approach can be selected. If the ALR is exceeded, potential options will be evaluated prior to selecting a remediation process. If necessary, an interim solution will be implemented while the evaluation and permanent remediation is performed. Examples of potential approaches include the following:

- The surface of the intermediate soil cover over the waste could be graded to direct runoff into a shallow pond. The surface would then be covered with a discardable, temporary geomembrane (e.g., 30-mil PVC or reinforced polypropylene). Precipitation water would be pumped or evaporated from the pond and would not infiltrate the waste already in the landfill. Waste packages would be placed only during periods of dry weather and stored temporarily at other times. This type of approach would also be used, if necessary, to reduce leakage during the time immediately after the ALR was exceeded, while other remediation options were being evaluated.

- If the landfill was nearly full, partial construction of the final closure cover might be an option. This would reduce infiltration into the landfill and possibly the leakage rate, if the cover was constructed over the failed area.
- A layer of low-permeability soil could be placed over the existing waste, perhaps in conjunction with a geomembrane, to create a second "primary" liner higher in the landfill. This new liner would intercept precipitation and allow its removal.
- A rigid-frame or air-supported structure could be constructed over the landfill to ensure that no infiltration occurred. Although costly, this approach might be less expensive than constructing a new landfill.

In general, the selected remediation efforts would be those that are easiest to implement, with more difficult or expensive options to be applied only if earlier approaches were not satisfactory.

**REFERENCES**

EPA 530-R-92-004, *Action Leakage Rates for Leak Detection Systems*, U.S. Environmental Protection Agency, Office of Solid Waste Management, Washington, D.C., January 29, 1992.

57 FR 19, *Liners and Leak Detection Systems for Hazardous Waste Land Disposal Units*, U.S. Environmental Protection Agency, January 1992.

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RPP-18489, Rev. 0C

# Integrated Disposal Facility (IDF) Detailed Design: Technical Specifications

*Final Design Submittal*

Prepared for

**CH2M HILL Hanford Group**

Richland, Washington

July 2005

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This report was prepared under the supervision
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**END OF SECTION**

# SECTION 02200--SITE PREPARATION

## PART 1--GENERAL

### WORK INCLUDED:

This section describes requirements for clearing, grubbing and stripping of the IDF project area and associated facilities.

### DEFINITIONS:

Interfering or Objectionable Material: Trash, rubbish, and junk.

Clearing: Removal of existing vegetation and interfering or objectionable material lying on or protruding above ground surface.

Grubbing: Removal of vegetation and other organic matter including sagebrush, stumps, buried logs, and roots greater than 2 inches caliper to a depth of 6 inches below subgrade.

Stripping: Removal of topsoil and other organic matter. Strippings suitable for topsoil shall be limited to upper 6 inches.

Project Limits: Areas actually needed for site improvements, stockpiles, and borrow areas, as shown or specified, within which Work is to be performed.

### RAW WATER SUPPLY:

Depending on the availability of connections to the raw water pipeline system, water for dust control may be obtained either from an existing water fill station on 4th Street near the west exit of the 200 East Area or from the raw water line that crosses the IDF site. A new raw water pipeline is being installed as part of Schedule A of the IDF project.

Whether water is obtained from the existing water fill station or from new facilities on the IDF site, use of connections to the raw water system shall be in accordance with guidance from the Hanford Site Water Purveyor. Use and discharge of raw water during construction for construction activities, including dust control and fire protection, shall be controlled through the Hanford Site Water Purveyor, and shall comply with WAC 173-200 and the State Waste Discharge Permit No. ST 4508. For any use of existing water fill station or a water connection on the IDF site, the rate of water withdrawal shall be limited to approximately 200 gpm through the use of an orifice plate. The plate shall be sized for a source water pressure of 115 psi. For any onsite fill station, Construction General Contractor shall provide a water storage tank (minimum size 20,000 gallons) equipped with a float actuated fill valve to minimize demand surges on the Hanford Water Supply.

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Site Preparation Plan: Prior to any mobilization of equipment to the site, the Construction General Contractor shall submit a Site Preparation Plan for approval. This plan shall include the following information as a minimum:

Detailed description of the proposed method for clearing, grubbing, and stripping the site. The plan shall identify those areas of the project site which will be cleared, grubbed and stripped. In addition, it will identify staging areas, stock pile areas, and the sequence in which the site preparation will be executed.

Dust Control Plan: Prior to any earthwork activities on the project site such as site preparation and excavation, Construction General Contractor shall submit a Dust Control Plan for approval. The plan shall identify methods and equipment to minimize/control dust generation during all earthwork operations and include the following minimum requirements:

Continuous control of dust generation during excavation and backfill placement, etc.

Continuous control of wind-generated dust, including disturbed areas that are not being actively worked.

Keep haul roads watered to control dust.

A minimum two full water trucks (5,000 gallons each) for the duration of the project.

Apply water or other approved dust suppressants as minimum to keep visible dust to a minimum during execution of Work.

Appropriate hand-held hose lines, sprinklers, and other equipment as needed to access and control non-vehicle access areas such as borrow and stockpile side slopes.

Maintain and protect native cover where possible, through minimization of site disturbance.

Limit access road development to minimum necessary to execute work.

Stabilization of inactive disturbed work areas by longer term methods such as matting, tack and mulch or crusting agents.

Implementation of permanent stabilization on a regular basis when sufficient area exists for application or as needed to control dust.

General Construction Contractor shall use daily field reports to document dust control measures implemented and their effectiveness.

These dust control plan items are required to satisfy the requirements of Section 3.0 - Mitigation of Potential Dust Impacts from Construction Activities of the "Mitigation Action Plan for USDOE, Hanford Site, Immobilized Low-Activity Waste (ILAW) Disposal Site Construction (Project W-520)," prepared by PNNL for USDOE.

Submit details of raw water supply, storage, and water withdrawal limiting equipment as part of the Dust Control Plan.

SCHEDULING AND SEQUENCING:

The sequence of the activities listed below shall be followed by the Construction General Contractor for the site preparation work.

Initial site preparation activities shall commence only after Dust Control Plan and Site Preparation Plan have been approved.

Following the approved Site Preparation Plan, establish an adequate water supply source for dust control use.

After establishing an adequate water supply and sediment controls, proceed with site preparation activities as specified.

PART 2--PRODUCTS (NOT USED)

PART 3--EXECUTION

GENERAL:

Clear, grub, and strip only areas actually needed for stockpiles, borrow, or site improvements within limits shown and specified.

Do not injure or deface vegetation that does not require removal.

As an initial step in clearing the site, the General Construction Contractor shall remove all trash, rubbish, and junk from the site. This material shall be disposed in accordance with Division 1 requirements.

CLEARING:

Cut off shrubs, brush, weeds, and grasses to within 4 inches of ground surface.

GRUBBING:

Grub all areas where excavations, fill, roadways, structures, and ditches are to be placed.

Vegetation other than noxious weeds, removed by the clearing and grubbing, shall be placed in stockpile with the strippings to be used as topsoil. Place vegetation at the base of the strippings stockpile area and track with equipment to break apart and crush the material. Obtain Construction Manager approval of the vegetation placement.

STRIPPING:

Strip all areas where excavations, borrow areas, stockpiles, fills, roadways, structures, and ditches are to be placed, to remove organic materials. Do not remove subsoil with topsoil.

Stockpile strippings from the upper 6 inches below ground surface after clearing and grubbing, meeting requirements for topsoil in Section 02920, RECLAMATION AND REVEGETATION, separately from other excavated material at either the designated stockpile area location shown on the Drawings, or other areas as approved by the Construction Manager.

IDF RAW WATER CONNECTIONS:

General Construction Contractor shall take necessary steps to prevent freezing and/or damage to the IDF raw water system connections.

DISPOSAL:

Clearing and Grubbing Debris: Bury vegetation that is not suitable for topsoil at a designated area as directed by the Construction Manager. Disposal of the remaining interfering or objectionable material shall be in accordance with Division 1 requirements.

Strippings: Dispose of strippings that are unsuitable for topsoil as specified above for clearing and grubbing debris.

Burning Prohibited: No burning of any materials generated during the site preparation work will be allowed at the site.

END OF SECTION 02200

# SECTION 02315--FILL AND BACKFILL

## PART 1--GENERAL

### WORK INCLUDED:

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

### REFERENCES:

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

ASTM INTERNATIONAL (ASTM)

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

### DEFINITIONS:

Relative Compaction:

Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM D698.

Apply corrections for oversize material to maximum dry density.

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

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

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

Lift: Loose (uncompacted) layer of material.

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

Well-Graded:

A mixture of particle sizes with no specific concentration or lack thereof of one or more sizes.

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

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

Influence Area: Area within planes sloped downward and outward at 60-degree angle from horizontal measured from:

1-foot outside outermost edge at base of foundations or slabs.
1-foot outside outermost edge at surface of roadways or shoulder.
0.5-foot outside exterior at spring line of pipes or culverts.

Imported Material: Materials obtained from sources offsite, suitable for specified use.

Standard Specifications: When referenced in this section, shall mean Standard Specifications for Road, Bridge and Municipal Construction, as published by the Washington State Department of Transportation, 2002 edition, English units.

Permanent Stockpile: Stockpile of material that remains at the completion of construction.

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Submit gradation test results for all imported materials from independent testing laboratory as specified in paragraph SOURCE QUALITY CONTROL in Part 2.

Stockpile Plan: Prior to any excavation activities associated with construction of the IDF, Construction General Contractor shall submit a Stockpile Plan for approval. The plan shall include the following information:

Scale drawing, using the project plans as a base, which shows the proposed location for stockpiles on the project site. Show all access roads around stockpiles. Address stockpile locations during construction of the IDF and permanent stockpiles which will remain upon completion of construction activities for this project.

Stockpile layout drawings which show the estimated location of toe of slope and top of slope for each stockpile. Drawings shall show plan and typical sections and shall be fully dimensioned.

Plan shall show how differing materials encountered during the excavation will be segregated for future use. This includes material for use as topsoil, admix base soil, and operations layer. Also show a stockpile area for material to be used in the future as clean backfill during landfill operations by the Tank Farm Contractor.

Method by which stockpile compaction will be achieved.

Dust control for the stockpiles during active use and until grass is established.

Placing of topsoil, seeding, fertilizing, and mulching each stockpile after active use of stockpile is finished in accordance with Section 02920, RECLAMATION AND REVEGETATION.

SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR):

Qualifications of independent testing laboratory.

Qualifications of construction quality control personnel.

SEQUENCING AND SCHEDULING:

Complete applicable Work specified in Sections 02316, EXCAVATION, and 02319, SUBGRADE PREPARATION, prior to placing fill or backfill.

PERMIT REQUIREMENTS:

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

CONSTRUCTION QUALITY ASSURANCE:

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

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

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

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

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

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

Earthfill: One per 5,000 square feet ($ft^2$) per lift.

Structural Fill: One per 2,500 $ft^2$ per lift.

Subgrade Preparation: Four per acre.

Operations Layer (Outside Edge of Liner): One per 5,000 $ft^2$ per lift.

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

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

PART 2--PRODUCTS

EARTHFILL:

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

STRUCTURAL FILL:

Conform to the requirements of Section 9-03.9(3) Crushed Surfacing-Base Course in the Standard Specifications, except for structural fill beneath leachate storage tank. At this location, utilize crushed surfacing-top course conforming to the requirements of Section 9-03.9(3).

Material selected from excavation meeting the requirements of Section 9-03.9(3) Crushed Surface-Base Course may be used for structural fill.

OPERATIONS LAYER:

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

DRAIN GRAVEL:

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

CRUSHED SURFACING:

Material for crushed surfacing-base course and top course shall conform to the requirements in Section 9-03.9(3) of the Standard Specifications.

QUARRY SPALLS:

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

Maximum Size: 8 inches.

50 percent by weight shall be larger than 3 inches.

Minimum Size: 3/4 inch.

SOURCE QUALITY CONTROL:

Gradation tests performed in accordance with ASTM D422 by a qualified independent testing laboratory shall be made for imported materials on samples taken at place of production prior to shipment. Imported materials shall not be shipped without submittal approval. Samples of the finished product for gradation testing shall be taken from each 2,000 tons of prepared materials in accordance with ASTM D75. Test results shall be submitted to Construction Manager within 48 hours after sampling.

BASE SOIL:

As specified in Section 02666, ADMIX LINER.

WATER FOR MOISTURE CONDITIONING:

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

PART 3--EXECUTION

GENERAL:

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

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

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

Tolerances:

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

Grade to establish and maintain slopes and drainage as shown. Reverse slopes are not permitted.

Settlement: Correct and repair any subsequent damage to structures, pavements, curbs, slabs, piping, and other facilities, caused by settlement of fill or backfill material.

BACKFILL UNDER AND AROUND STRUCTURES:

Under Facilities: Backfill with earthfill or structural fill, as shown on the Drawings, for each structure or facility. Place earthfill or structural fill in lifts of 6-inch maximum compacted thickness and compact each lift to minimum of 95 percent relative compaction as determined in accordance with ASTM D698.

FILL:

Outside Influence Areas Beneath Structures, Slabs, Piping, and Other Facilities: Unless otherwise shown, place earthfill as follows:

Allow for 6-inch thickness of topsoil where required.

Maximum 8-inch thick lifts.

Place and compact fill across full width of embankment.

Compact to minimum 95 percent relative compaction.

REPLACING OVEREXCAVATED MATERIAL:

Replace excavation carried below grade lines shown as follows:

Beneath IDF Cell: Earthfill as specified herein.

Beneath Fill or Backfill: Same material as specified for overlying fill or backfill.

Beneath Structures and Roadways: Structural fill or earthfill as shown on the Drawings and specified herein.

TOPSOIL:

Place topsoil on areas disturbed by construction and on permanent stockpile slopes in accordance with Section 02920, RECLAMATION AND REVEGETATION.

STOCKPILING:

Material shall be placed in permanent stockpiles as follows:

Place material in maximum 2-foot lifts and compact with a minimum four passes with earth-moving equipment.

Maximum slopes shall be 3H:1V. Minimum slopes shall be 3 percent to promote drainage.

Upper 2 feet of stockpile surface shall be placed in maximum 12-inch thick lifts and compacted to minimum 90 percent relative compaction as determined in accordance with ASTM D698.

Place 6-inch thick layer of topsoil on completed slopes in accordance with Section 02920, RECLAMATION AND REVEGETATION.

Permanent stockpiles shall be seeded, fertilized, and mulched when each stockpile is completed and as directed by the Engineer in accordance with Section 02920, RECLAMATION AND REVEGETATION.

PLACING CRUSHED SURFACING:

Place crushed surfacing base course and top course at locations shown on the Drawings. Placement shall conform to Section 4-04.3 of the Standard Specifications.

PLACING DRAIN GRAVEL AND OPERATIONS LAYER OVER GEOSYNTHETICS:

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

Compaction requirements for drain gravel around pipes and the sumps are specified in Section 02320, TRENCH BACKFILL.

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

Place material to the lines and grades shown and compact by tracking a minimum two passes with spreading equipment.

QUARRY SPALLS PLACEMENT:

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

CONSTRUCTION QUALITY CONTROL:

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

Material Placed by Stockpile (Upper 2 Feet): One per 10,000 $ft^2$ per lift.

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

END OF SECTION 02315

# SECTION 02316--EXCAVATION

## PART 1--GENERAL

### WORK INCLUDED:

This section describes all excavation necessary for completion of the Project, including excavation for structures, pipe trenches, and leachate sumps.

### REFERENCES:

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

CODE OF FEDERAL REGULATIONS (CFR)

| | |
|---|---|
| 29 CFR 1926 | OSHA Safety and Health Regulations for Construction; Subpart P – Excavations |

### EXCAVATION SUPPORT AND SAFETY:

Install and maintain adequate excavation safety and shoring systems that meet the requirements of OSHA (29 CFR 1926 Subpart P) and Washington Industrial Safety and Health Act, Chapter 49.17 RCW and WAC 296-155, "Safety Standards for Construction Work" Part IV-Excavation, Trenching and Shoring, and all other applicable local, state, and federal regulations.

Design, provide, and maintain shoring, sheeting, and bracing as necessary to support the sides of excavations and to prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed Work. Per OSHA requirements, 29 CFR 1926.652 requires that custom shoring installations shall be designed and stamped by a professional engineer licensed in the State of Washington.

### WEATHER LIMITATIONS:

Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

### PERMIT REQUIREMENTS:

An excavation permit is required for each excavation work element. Construction General Contractor shall obtain from Tank Farm Contractor and post before starting excavation work, as specified in Division 1, General Requirements.

## PART 2--PRODUCTS (NOT USED)

PART 3--EXECUTION

GENERAL:

Generally, excavate to lines, grades, and dimensions shown and as necessary to accomplish Work. Excavate subgrade to within tolerance of minus 0.5 foot to plus 0.1 foot except where dimensions or grades are shown or specified as maximum or minimum.

If unexpected, debris foreign material of any kind (e.g., contaminated soil) or cultured properties (e.g., bones and artifacts) is exposed or encountered during excavation, the Construction General Contractor shall stop work in the affected area and notify the Construction Manager. Obtain approval from Construction Manager before resuming excavation.

Control dust from excavation activities as specified in approved Dust Control Plan. See Section 02200, SITE PREPARATION, for Dust Control Plan requirements.

If soft or loose subgrade zones are encountered at the bottom of the excavation after proof-rolling, correct as specified in Section 02319, SUBGRADE PREPARATION.

STRUCTURE EXCAVATION:

Excavations for such structures as footings, foundations, slabs, and manholes shall be made to the depths shown on the Drawings and of sufficient width to allow adequate room for placement of structural fill setting and removing forms, installing accessories and inspection. Care shall be taken to prevent disturbing the bottom of the excavation. Excavation to final grade shall not be made until just before concrete forms are to be placed therein. Prepare bottom of structure excavation as specified in Section 02319, SUBGRADE PREPARATION, prior to placement of concrete foundations.

TRENCH AND SUMP EXCAVATION:

Trenches and sumps shall be of sufficient width to provide adequate room for workmen to perform any necessary service to the materials or items being installed therein and to permit proper compaction of the backfill.

Minimum Width of Trenches: As shown on Drawings.

Maximum Trench Width: Unlimited, unless otherwise shown or specified, or unless excess width will cause damage to existing facilities, adjacent property, or completed Work.

If wet or otherwise unsatisfactory soil is encountered in a trench excavation, at or below the trench bottom, it shall be brought to the attention of the Construction Manager and removed as directed. The bottom of the excavation shall then be brought to the required grade with stabilization as specified in Section 02320, TRENCH BACKFILL.

TEMPORARY STOCKPILE EXCAVATION:

Always keep stockpile neat and orderly and work there in a systematic manner. Take necessary precautions to maintain existing erosion control measures and prevent offsite sediment releases.

When work is completed in the stockpile area, grade area to drain surface water runoff to appropriate collection and discharge points. Reclaim disturbed areas of stockpile as specified in Sections 02315, FILL AND BACKFILL, and 02920, RECLAMATION AND REVEGETATION.

STOCKPILING EXCAVATED MATERIAL:

Stockpile excavated material that is suitable for use as embankment or backfill, as operations layer material, road gravel, or drain gravel, until material is needed. Place materials in stockpiles at the designated locations shown on the Drawings. Materials shall be placed in stockpiles as specified in Section 02315, FILL AND BACKFILL.

Confine stockpiles to within areas shown on Drawings. Do not obstruct roads or streets. Stockpiles should maintain clearance from existing permanent monitoring wells and disposed cribs as shown on the Drawings.

Do not stockpile excavated material adjacent to trenches and other excavations unless excavation sideslopes and excavation support systems are designed, constructed, and maintained for stockpile loads. The registered professional engineer responsible for the shoring design shall approve stockpile locations.

Do not stockpile excavated materials near or over existing facilities, adjacent property, or completed Work, if weight of stockpiled material could induce excessive settlement. The registered professional engineer responsible for the shoring design shall approve stockpile locations.

DISPOSAL OF SPOIL:

Dispose of excavated materials, which are unsuitable or not needed for fill or backfill, in designated stockpile areas shown on the Drawings, or spoil disposal areas as directed by Construction Manager. Materials shall be placed as specified in Section 02315, FILL AND BACKFILL.

TRENCH EXCAVATION FOR GEOSYNTHETIC ANCHOR TRENCHES:

Geosynthetic anchor trench excavation shall be as specified in Section 02661, GEOMEMBRANES.

CONSTRUCTION QUALITY CONTROL:

Construction General Contractor provides adequate survey control to avoid unauthorized overexcavation.

END OF SECTION 02316

# SECTION 02317--BORROW AREA EXCAVATION

## PART 1--GENERAL

### WORK INCLUDED:

This section describes requirements for borrow excavation from the Admix Base Soil Borrow Area as a source of base soil for the admix. The Admix Base Soil Borrow Area is located within the IDF site boundary approximately 1,000 feet south of the Phase I area as shown on the Drawings.

### SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Borrow Area Development Plan: Detailing development, operation, dust and erosion, mitigation measures, and reclamation of each borrow area.

## PART 2--PRODUCTS (NOT USED)

## PART 3--EXECUTION

### GENERAL:

Clear, grub, and strip only areas actually needed for borrow within limits shown or specified.

Do not injure or deface vegetation that does not require removal.

### CLEARING, GRUBBING, STRIPPING, AND DISPOSAL:

Clearing, grubbing, and stripping shall meet the requirements of Section 02200, SITE PREPARATION.

### DISPOSAL:

Clearing and Grubbing Debris: As specified in Section 02200, SITE PREPARATION.

Strippings: As specified in Section 02200, SITE PREPARATION.

### BORROW AREA OPERATION:

Borrow area shall be developed and operated in accordance with the mitigation measures identified in the approved Borrow Area Development Plan and these Specifications.

Always keep borrow pits neat and orderly, and work them in systematic manner. Continuously keep borrow pits graded to drain to a low point, and take necessary precautions

to control erosion and prevent offsite sediment releases. Dewater as necessary to develop, operate, and reclaim each borrow area. Control dust as specified in approved Dust Control Plan. See Section 02200, SITE PREPARATION, for Dust Control Plan requirements.

Material meeting the requirements for base soil as specified in Section 02666, ADMIX LINER, shall be excavated from the Borrow Area. Base soil should not be obtained below a depth of 5 feet below existing ground surface (after stripping) without evaluation of the material suitability and authorization from the Construction Manager.

Do not excavate more borrow material than required for Work. Leave surplus material in place.

Excavate material in an orderly manner to avoid inclusion of unacceptable material.

RECLAMATION:

At the completion of borrow area excavation, grade borrow pits to drain to low point so that ponded surface water may be removed by pumping. Where practical, blend graded surfaces neatly with surrounding terrain at completion of borrow operations.

Final Slopes:

Maximum: 4H:1V.

Minimum: 2 percent.

Do not use borrow pits for disposal, unless otherwise specified or shown.

Place 6-inch thick layer of topsoil and seed, fertilize, and mulch all disturbed areas as specified in Section 02920, RECLAMATION AND REVEGETATION.

END OF SECTION 02317

# SECTION 02319--SUBGRADE PREPARATION

## PART 1--GENERAL

### WORK INCLUDED:

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

### REFERENCES:

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

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D698 | Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft$^3$ (600 kN-m/m$^3$)) |

### DEFINITIONS:

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

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

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

SLDS: Secondary Leak Detection System.

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

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

### SEQUENCING AND SCHEDULING:

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

### CONSTRUCTION QUALITY ASSURANCE:

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

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

PART 2--PRODUCTS (NOT USED)

PART 3--EXECUTION

GENERAL:

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

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

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

PREPARED SUBGRADE FOR ROADWAY, EMBANKMENT, AND STRUCTURES:

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

LANDFILL BOTTOM FLOOR PREPARED SUBGRADE FOR ADMIX LINER:

Prior to admix liner placement, subgrade shall be backbladed to remove loose soil. Low spots or erosion rills shall be backfilled with structural fill as specified herein. Compact prepared subgrade to 95 percent relative compaction. Scarify and moisture condition subgrade soil as required to achieve specified compaction. If soft or loose zones are found, correct as specified herein. Proof-roll subgrade with a vibratory drum roller or equal to detect soft or loose subgrade or unsuitable material. ~~After compaction and proof rolling, scarify subgrade surface of 3H:1V side slopes to a minimum depth of 1/2 inch prior to admix liner placement.~~

LANDFILL SIDESLOPE (3H:1V) PREPARED SUBGRADE FOR ADMIX LINER

Prior to admix placement, the subgrade shall be backbladed to remove all loose material produced by trimming operations. Low spots or erosion rills shall be backfilled with structural fill as specified herein. The trimmed surface shall be watered so that moisture penetrates a minimum of 3 inches into the subgrade. Water shall be applied so that subgrade is not disturbed and erosion rills and gullies are prevented. The trimmed and watered surface shall be track-walked by D6-LGP dozer or equivalent with a minimum 4 passes to produce a firm and stable subgrade. Visual monitoring (no in-place density testing is required) of the subgrade preparation on sideslopes will be performed by the CQA Certifying Engineer.

PREPARED SUBGRADE FOR GEOMEMBRANE (SECONDARY AND SLDS) AND SECONDARY GCL:

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

CORRECTION:

Soft or Loose Subgrade:

Adjust moisture content and compact to meet density requirements, or

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

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

END OF SECTION 02319

# SECTION 02320--TRENCH BACKFILL

## PART 1--GENERAL

### WORK INCLUDED:

This section describes requirements for backfilling of trenches for pipe, conduit, and geosynthetics.

### REFERENCES:

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

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C136 | Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates |
| ASTM D698 | Test Method for Laboratory Compaction Characteristics of Soil using Standard Effort (12,400 ft-lbf/ft$^3$ (600 kN-m/m$^3$)) |
| ASTM D1140 | Standard Test Method for Amount of Material in Soils Finer than the No. 200 (75 micrometer) Sieve |
| ASTM D4318 | Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils |

### DEFINITIONS:

Pipe Bedding: Granular material upon which pipes, conduits, cables, or duct banks are placed.

Imported Material: Material obtained by the Construction General Contractor from source(s) offsite.

Lift: Loose (uncompacted) layer of material.

Pipe Zone: Backfill zone that includes full trench width and extends from prepared trench bottom to an upper limit above top outside surface of pipe, conduit, cable or duct bank.

Prepared Trench Bottom: Graded trench bottom after stabilization and installation of bedding material.

Relative Compaction: The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by ASTM D698. Corrections for oversize material may be applied to either the as-compacted field dry density or the maximum dry density.

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Submit gradation test results for all imported materials as specified in paragraph SOURCE QUALITY CONTROL in Part 2.

SUBMITTALS–APPROVAL NOT REQUIRED:

Vendor Information (VI): Locator ribbon product data.

PART 2--PRODUCTS

LOCATOR RIBBON:

Ribbon shall be 3 inches wide and shall be red for all electrical conduits, electrical cables, and telephone cables. Yellow ribbon shall be used for all buried pipelines.

Ribbon shall be tape manufactured by Reef Industries or Allen Markline or equal and shall have metal foil which is completely encased in plastic and can be easily detected by metal detectors.

The ribbon shall be printed with the manufacturer's standard wording, "CAUTION ELECTRIC LINE BURIED BELOW," for all electrical conduits, phone lines, etc., "CAUTION BURIED PIPELINE BELOW," for all buried pipelines.

TRENCH STABILIZATION MATERIAL:

Granular material from the excavation or stockpile meeting the requirements of structural fill as specified in Section 02315, FILL AND BACKFILL.

PIPE BEDDING:

Pipe bedding material for thermoplastic pipe shall be clean sand/gravel mixture free from organic matter and conforming to the following gradation:

| Sieve Size | Percent Passing |
|---|---|
| 3/4" square | 100 |
| 3/8" square | 70-100 |
| U.S. No. 4 | 55-100 |
| U.S. No. 10 | 35-95 |
| U.S. No. 20 | 20-80 |
| U.S. No. 40 | 10-55 |

| Sieve Size | Percent Passing |
|---|---|
| U.S. No. 100 | 0-10 |
| U.S. No. 200 | 0-3 |

All percentages are by weight.

PIPE ZONE MATERIAL:

Excavated granular material from required excavations, free from rocks, roots, and organic matter. The maximum particle size shall be 3/4 inch and the percent by weight passing the No. 200 U.S. sieve shall be a maximum 15 percent.

Pipe bedding may be used as substitute for pipe zone material.

EARTH BACKFILL:

Earthfill as specified in Section 02315, FILL AND BACKFILL.

STRUCTURAL FILL:

As specified in Section 02315, FILL AND BACKFILL.

SOURCE QUALITY CONTROL:

As specified in Section 02315, FILL AND BACKFILL.

PART 3--EXECUTION

TRENCH PREPARATION:

Water Control:

Promptly remove and dispose of water entering trench as necessary to grade trench bottom and to compact backfill and install manholes, pipe, conduit, direct-buried cable, or duct bank. Do not place concrete, lay pipe, conduit, direct-buried cable, or duct bank in water.

Remove water in a manner that minimizes soil erosion from trench sides and bottom.

Provide continuous water control until trench backfill is complete.

Remove foreign material and backfill contaminated with foreign material that falls into trench.

TRENCH BOTTOM:

Firm Subgrade: Grade with hand tools, remove loose and disturbed material, and trim off high areas and ridges left by excavating bucket teeth. Tamp with handheld equipment. Allow space for bedding material if shown or specified.

Soft Subgrade: If subgrade is encountered that may require removal to prevent pipe settlement, notify Engineer. Engineer will determine depth of overexcavation, if any, required.

TRENCH STABILIZATION MATERIAL INSTALLATION:

Rebuild trench bottom with trench stabilization material.

Place material over full width of trench in 8-inch maximum, loose measurement lifts to required grade, providing allowance for bedding thickness.

Compact each lift so as to provide a firm, unyielding support for the bedding material prior to placing succeeding lifts.

BEDDING:

Place over the full width of the prepared trench bottom in two equal lifts when the required depth exceeds 8 inches.

Hand grade and compact each lift to provide a firm, unyielding surface.

Minimum Compacted Thickness: As shown on the Drawings. For leachate collection and riser pipes, there shall be no bedding between lining system and pipe.

Direct-Buried Cable: 3 inches.

Duct Banks: 2 inches.

Check grade and correct irregularities in bedding material.

BACKFILL PIPE ZONE:

Upper limit of pipe zone shall not be less than following:

Pipe: 12 inches, unless shown otherwise.

Conduit: 3 inches, unless shown otherwise.

Direct-Buried Cable: 3 inches, unless shown otherwise.

Duct Bank: 3 inches, unless shown otherwise.

Restrain pipe, conduit, cables, and duct banks as necessary to prevent their movement during backfill operations.

Place pipe zone material simultaneously in lifts on both sides of pipe and, if applicable, between pipes, conduit, cables, and duct banks installed in same trench.

Pipes 10 Inches and Smaller Diameter: First lift less than or equal to 1/2 pipe-diameter.

Pipes Over 10-Inch Diameter: Maximum 8-inch, loose measurement lifts.

Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by "walking in" and slicing material under haunches with a shovel to ensure that voids are completely filled before placing each succeeding lift.

After the full depth of the pipe zone material has been placed as specified, compact the material by a minimum of three passes with a vibratory plate compactor only over the area between the sides of the pipe and the trench walls.

Do not use power-driven impact compactors to compact pipe zone material.

LOCATOR RIBBON INSTALLATION:

Continuously install locator ribbon along centerline of all buried piping, at depth of 16 inches below ground surface unless shown otherwise on the Drawings. Coordinate with piping installation drawings.

BACKFILL ABOVE PIPE ZONE:

General:

Do not allow backfill to free fall into the trench or allow heavy, sharp pieces of material to be placed as backfill until after at least 2 feet of backfill has been provided over the top of pipe. Trench backfill using water settling methods for compaction is not permitted.

Do not use power driven impact type compactors for compaction until at least 2 feet of backfill is placed over top of pipe. Hand-held jumpjack type compactors are acceptable for compaction of backfill over top of pipe.

Backfill to grade with proper allowances for topsoil, road gravel subbase, and pavement thicknesses, wherever applicable.

Backfill around structures with same backfill as specified for adjacent trench unless otherwise shown or specified.

Backfill Outside the Limits of Roadways, Utilities, and Other Facilities:

Place earthfill in lifts not exceeding 12-inch maximum, loose measurement thickness.

Mechanically compact each lift to a minimum of 90 percent relative compaction prior to placing succeeding lifts.

Backfill Under Facilities, Roadways, and Utilities: Backfill trench above the pipe zone with structural fill in lifts not exceeding 8 inches maximum, loose measurement thickness. Compact each lift to a minimum of 95 percent relative compaction prior to placing succeeding lifts.

REPLACEMENT OF TOPSOIL:

Where applicable, replace topsoil in top 6 inches of backfilled trench.

Maintain the finished grade of topsoil even with adjacent area and grade as necessary to restore drainage.

DRAIN GRAVEL BACKFILL FOR LEACHATE COLLECTION (SLOTTED) PIPE, RISER PIPES, AND SUMPS:

Use drain gravel as specified in Section 02315, FILL AND BACKFILL.

Drain gravel shall be placed in sumps by mechanical or hand methods that will not damage pipes or underlying geosynthetics. For areas within 3 feet of leachate collection or riser pipe centerline, the Construction General Contractor shall place drain gravel on both sides of pipe in 6-inch lifts. The Construction General Contractor shall thoroughly tamp each lift, including area under haunches with handheld equipment and tools to ensure that voids are completely filled before placing each succeeding lift. After the full depth of material has been placed as specified, the Construction General Contractor shall compact the material by a minimum of three passes with a hand-held vibratory plate compactor only over the area within 3 feet of pipe centerline. At all other locations, drain gravel shall be track-walked into place with a minimum two passes with a D6M-LGP bulldozer or equal. Equipment limitations and requirements for placing materials over geosynthetics is specified in Section 02315, FILL AND BACKFILL.

BACKFILL FOR GEOSYNTHETIC ANCHOR TRENCHES:

Backfill with material as shown on the Drawings in loose lifts not exceeding 6 inches in thickness and compact using hand-operated equipment to not less than 90 percent relative compaction.

CONSTRUCTION QUALITY CONTROL:

The Construction General Contractor shall perform in-place density and moisture content tests as specified in Section 02315, FILL AND BACKFILL, to be observed by the Construction Manager, on the following minimum schedule:

Backfill Above Pipe Zone: One per 500 linear feet per lift.

MAINTENANCE OF TRENCH BACKFILL:

After each section of trench is backfilled, maintain the surface of the backfilled trench even with the adjacent ground surface until final surface restoration is completed.

Topsoil: Add topsoil where applicable and as necessary to maintain the surface of the backfilled trench level with the adjacent ground surface.

Other Areas: Add excavated material where applicable and keep the surface of the backfilled trench level with the adjacent ground surface.

SETTLEMENT OF BACKFILL:

Settlement of trench backfill, or of fill or facilities constructed over trench backfill will be considered a result of defective compaction of trench backfill.

END OF SECTION 02320

SECTION 02371--GEOTEXTILES

PART 1--GENERAL

REFERENCES:

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

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D3776 | Standard Test Method for Mass Per Unit Area (Weight) of Fabric |
| ASTM D4355 | Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus) |
| ASTM D4491 | Standard Test Methods for Water Permeability of Geotextiles by Permittivity |
| ASTM D4533 | Standard Test Method for Trapezoid Tearing Strength of Geotextiles. |
| ASTM D4632 | Standard Test Method for Grab Breaking Load and Elongation of Geotextiles |
| ASTM D4751 | Standard Test Method for Determining Apparent Opening Size |
| ASTM D4833 | Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products |
| ASTM D5261 | Standard Test Method for Measuring Mass per Unit Area of Geotextiles |

DESCRIPTION:

The Work includes manufacture, fabrication (if needed), supply, and installation of geotextiles associated with the lining of the disposal facility and other applications as shown on the Drawings. This section also applies to geotextiles used in geocomposite drainage layers [see Section 02373, COMPOSITE DRAINAGE NET (GEOCOMPOSITE)].

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Manufacturer's descriptive data, specification sheets, literature, and other data as necessary to fully demonstrate that those materials proposed for use comply with the requirements of these Specifications.

Manufacturer's Quality Control (QC) test data for geotextile physical properties, verifying compliance with these Specifications. Data shall include test results, methods, and roll numbers. Frequency of manufacturer's QC testing shall be at the standard rate stated in the manufacturer's QC plan.

Manufacturer's written certification that materials meet the requirements of these Specifications and that geotextile is continuously inspected for presence of needles and found to be needle-free.

CONSTRUCTION QUALITY ASSURANCE (CQA):

Quality assurance procedures for geotextile are presented in the CQA Plan. CQA Plan requirements are discussed in Section 02661, GEOMEMBRANE. The Construction General Contractor shall accommodate all CQA activities described herein and in the CQA Plan for this project.

Prior to placing any materials over the installed geotextile, the Construction General Contractor shall allow time for acceptance of the Work as listed in the CQA Plan.

CQA CONFORMANCE TESTING:

Prior to deployment of the rolls of geotextile, the CQA Certifying Engineer will obtain samples at a frequency of one per production lot or 50,000 square feet of each material type, whichever results in the greater number of tests. The CQA Certifying Engineer will test the samples to determine conformance to both the design specifications and the list of certified properties.

As a minimum, the following tests will be performed on geotextiles (each type, except as noted):

Grab Strength: ASTM D4632.

Tear Strength: ASTM D4533.

Puncture Strength: ASTM D4833.

Permittivity: ASTM D4491 (Type 1 only).

The CQA Certifying Engineer shall be allowed to remove samples for testing and other activities. Sample dimensions, procedures, and frequency shall be the same as those specified in the CQA Plan. The Construction General Contractor shall assist the CQA Certifying Engineer as necessary in all sampling and testing activities.

Procedures for samples that fail conformance testing are outlined in the CQA Plan. The cost of additional conformance testing to demonstrate compliance of failed samples shall be borne by the Construction General Contractor.

PART 2--PRODUCTS

GENERAL:

Types of Geotextiles:

Type 1 (separation) geotextile shall be 6 oz/yd$^2$ nominal weight and shall be used for separation of soil layers, in the geocomposite drainage layers, and at other locations as shown on the Drawings.

Type 2 (cushion) geotextile shall be 12 oz/yd$^2$ nominal weight and shall be used for cushioning of geomembranes and at other locations as shown on the Drawings.

All geotextiles, regardless of type, shall be nonwoven, needlepunched polypropylene.

Manufacturer: The geotextile manufacturer shall be a commercial entity normally engaged in manufacture of geotextiles for landfill applications.

REQUIRED PROPERTIES:

Property Values:

Geotextile properties shall meet or exceed the values specified in Table 1, Required Geotextile Properties, contained in this section of the Specifications (Type 1 and Type 2 geotextiles).

The manufacturer shall provide test results for all properties listed in Table 1 (Type 1 and Type 2 geotextiles).

The manufacturer shall certify that the materials supplied meet the requirements of this Part (Type 1 and Type 2 geotextiles).

Integrity: Geotextiles shall retain their structure during handling, placement, and long-term service.

TRANSPORTATION, HANDLING, AND STORAGE:

Geotextiles shall be supplied in rolls wrapped in covers and marked or tagged with the roll number. Each material roll shall include information to demonstrate material tracebility through written documentation from the manufacturer and transport company. At a minimum this information shall include the Manufacturer's Name, Product Identification, Lot Number and Roll Dimension (Area and Width).

Transportation of the geotextiles to the site and all handling on site shall be the responsibility of the Construction General Contractor.

During shipment and storage, the geotextile shall be protected from mud, dirt, UV exposure, dust, puncture, cutting, or other damaging or deleterious conditions. Protective wrappings which are damaged shall be repaired or replaced, as necessary.

The Construction General Contractor shall be responsible for the storage of the geotextiles on site within the areas shown on the Drawings. The Construction General Contractor shall protect storage area(s) from theft, vandalism, passage of vehicles, etc.

## PART 3--EXECUTION

### GENERAL:

Unacceptable Materials and Work: Materials and Work which fail to meet the requirements of these Specifications shall be removed and disposed of at the Construction General Contractor's expense. This includes geotextile rolls that are not labeled or where the label has deteriorated to the point of being illegible.

### HANDLING AND PLACEMENT:

The Construction General Contractor shall handle all geotextiles in such a manner as to ensure that they are not damaged. Geotextile will be deployed on top of textured HDPE geomembrane in a manner that will not damage the geotextile. If necessary, use a smooth slip sheet under the geotextile.

Place geotextiles in a manner that prevents folds and wrinkles. Folds or wrinkles shall be pulled smooth prior to seaming.

In the presence of wind, all exposed geotextiles shall be weighted with sandbags or equivalent. Sandbags shall be installed during placement and shall remain until replaced with cover material.

Geotextiles shall be cut using an approved geotextile cutter only. Special care shall be taken to protect underlying geosynthetic materials from damage during cutting.

During geotextile placement, care shall be taken not to entrap stones, excessive dust, or moisture that could damage the geomembrane, clog drains or filters, or hamper subsequent seaming.

Geotextiles shall be placed with the machine direction (long dimension) downslope or normal to the natural slope.

After installation and immediately prior to placing overlying materials, the geotextile shall be examined over its entire surface to ensure that no potentially harmful foreign objects, such as needles, are present. Any foreign objects encountered shall be removed, or the geotextile shall be replaced.

If light colored geotextile is used, precautions shall be taken against "snowblindness" of personnel.

After deployment, all geotextile shall be covered to prevent exposure to ultraviolet (UV) radiation (sunlight) within a maximum period of 14 days. If the geotextile is exposed for more than 14 days, a temporary cover may be deployed for the duration of the delay or samples may be submitted to an independent testing laboratory to ensure that detrimental levels of UV degradation have not occurred. Detrimental level of UV degradation is defined as greater than 10 percent loss of required geotextile properties listed in Table 1 for the following:

Grab strength.

Trapezoidal tear strength.

Puncture strength.

JOINTS:

Edge of roll seams are not required to be sewn and shall be overlapped a minimum of 6 inches. End of roll seams are not required to be sewn and shall be overlapped a minimum of 12 inches. No end-of-roll seams shall be allowed on slopes 6H:1V and steeper. Overlaps shall be in the direction of flow with the upstream fabric on top of the downstream fabric.

On the landfill floor, no horizontal seam shall be closer than 3 feet to the toe of the slope or other areas of potential stress concentrations.

Areas to be seamed shall be clean and free of foreign material.

REPAIR:

Any holes or tears in the geotextile shall be repaired as follows:

Remove any soil or other material which may have penetrated the torn geotextile.

Replace torn areas and holes by placing a geotextile patch having dimensions of at least 12 inches greater than the tear or hole. The geotextile patch shall be sewn or heat bonded.

For repairs of the geotextile component of the CDN, a patch shall be heat bonded.

MATERIALS IN CONTACT WITH GEOTEXTILES:

The Construction General Contractor shall place all soil materials located on top of a geotextile in such a manner as to ensure that the following conditions are satisfied:

No damage to the geotextile.

Minimal slippage of the geotextile on underlying layers.

No excess tensile stresses in the geotextile.

END OF SECTION 02371

Table 1. REQUIRED GEOTEXTILE PROPERTIES

| Property | Unit | Value[a] Type 1 | Value[a] Type 2 | Test Method |
|---|---|---|---|---|
| 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<br>100 min opening | — | ASTM D4751 |
| Grab Strength | lb | 140 | 300 | ASTM D4632 |
| Trapezoidal Tear Strength | lb | 70 | 110 | ASTM D4533 |
| Puncture Strength | lb | 65 | 135 | ASTM D4833 |
| Permittivity | $sec^{-1}$ | 1.2 | — | ASTM D4491 |
| UV Resistance (500 hours) | % strength retained | 70 | 70 | ASTM D4355 |

Notes:
[a]All values are minimum average values, except as noted.
[b]Nominal values.

# SECTION 02373--COMPOSITE DRAINAGE NET (CDN)

## PART 1--GENERAL

### REFERENCES:

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

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D413 | Standard Test Method for Rubber Property Adhesion to Flexible Substrate |
| ASTM D1505 | Standard Test Method for Density of Plastics by the Density-Gradient Technique |
| ASTM D1603 | Standard Test Method for Carbon Black in Olefin Plastics |
| ASTM D1777 | Standard Test Method for Measuring Thickness of Textile Materials |
| ASTM D4218 | Test Method for Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique |
| ASTM D4716 | Standard Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products |
| ASTM D5199 | Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes |
| ASTM D5321 | Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method |

GEOSYNTHETIC RESEARCH INSTITUTE (GRI)

| | |
|---|---|
| GRI-GC7 | Determination of Adhesion and Bond Strength of Geocomposites |

### DESCRIPTION:

The Work includes manufacture, fabrication (if needed), supply, and installation of geocomposite (hereinafter referred to as composite drainage net (CDN)) drainage layers associated with the lining of waste disposal facility. The CDN shall consist of a layer of geotextile thermally bonded to each side of a geonet. Requirements for geotextiles are contained in Section 02371, GEOTEXTILES, of these Specifications. Requirements for geonets and the finished CDN are contained in this section.

### SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Manufacturer's descriptive data, specification sheets, literature, and other data as necessary to fully demonstrate that those materials proposed for use comply with the requirements of these Specifications.

Construction General Contractor shall submit required interface strength data, as specified in PART 2--PRODUCTS, prior to shipment of material to allow Engineer to evaluate if submitted material meets strength requirements for project design criteria. Allow Engineer 20 working days for this evaluation upon receipt of data.

Installation Plan: The Construction General Contractor shall submit a plan describing the proposed methods for CDN deployment, panel layout, seaming, repair, and protection. The plan shall include a quality assurance program for the Construction General Contractor's activities related to CDN installation.

Manufacturer's Quality Control (QC) test data for CDN composition and physical properties, verifying compliance with these Specifications. The data shall include roll numbers, test results, and test methods. Frequency of manufacturer's QC testing shall be at the standard rate stated in the manufacturer's QC plan.

Manufacturer's written certifications that CDN satisfy the requirements of these Specifications.

CONSTRUCTION QUALITY ASSURANCE (CQA):

Quality assurance procedures for CDN installation are presented in the Construction Quality Assurance Plan (CQA Plan). CQA Plan requirements are discussed in Section 02661, GEOMEMBRANE. The Construction General Contractor shall accommodate all quality assurance activities described herein and in the CQA Plan for this project.

Prior to placing any materials over the installed CDN, the Construction General Contractor shall allow time for acceptance of the Work as listed in the CQA Plan.

CQA CONFORMANCE TESTING:

Upon delivery of the rolls of geonet and CDN, the CQA Certifying Engineer will obtain samples at a frequency of one per production lot or one per 50,000 square feet of each material type, whichever results in the greater number of tests, transmissivity shall be as noted below. The CQA Certifying Engineer will test the samples to determine conformance to both the design specifications and the list of certified properties.

CDN fabricated from non-conforming components shall be rejected at the Construction General Contractor's expense.

As a minimum, the following tests will be performed on geonets:

Polymer specific gravity (ASTM D1505).

Thickness (ASTM D5199).

Nominal transmissivity (ASTM D4716 – one per production lot).

As a minimum, the following tests will be performed on CDNs:

Adhesion (GRI-GC7 or ASTM D413).

Transmissivity (ASTM D4716 – one per production lot).

The CQA Certifying Engineer shall be allowed to remove samples of geonet and CDN for testing and other activities. Sample dimensions, procedures, and frequency shall be the same as those specified in the CQA Plan. The Construction General Contractor shall assist the CQA Certifying Engineer as necessary in all sampling and testing activities.

Procedures for samples that fail conformance testing are outlined in the CQA Plan. The cost of additional conformance testing to demonstrate compliance of failed samples shall be borne by the Construction General Contractor.

PART 2--PRODUCTS

GENERAL:

Composition:

The geonet shall be high density polyethylene (HDPE), manufactured by extruding two crossing strands to form a bi-planar drainage net structure.

The CDN shall consist of Type 1 geotextile thermally bonded to each side of the HDPE geonet.

Manufacturer: The CDN manufacturer shall have a minimum of 5 years' experience as a commercial manufacturer of CDNs for landfill drainage applications.

REQUIRED PROPERTIES:

Property Values:

Geonet: Geonet properties shall meet or exceed the values specified in the table of required geonet properties contained in this section of the Specifications.

Geotextile: Geotextile properties shall meet or exceed the values specified in Section 02371, GEOTEXTILES, of these Specifications unless otherwise approved by the Engineer.

Finished CDN: CDN properties shall meet or exceed the values specified in the table of required CDN properties contained in this section of the Specifications.

Required Interface Shear Strength Data: Provide data prior to material shipment for the interface friction angle between the CDN and textured geomembrane, and between the CDN and operations layer material, as specified in Article SUBMITTALS. Perform two interface shear strength tests on each interface. Friction angle shall be determined by direct shear testing under fully saturated conditions (ASTM D5321) at nominal normal loads of 100, 250, and 500 psf. Report results for both peak and large displacement (minimum 2 inches) strength.

The Engineer will review this data for conformance with project design strength requirements. Construction General Contractor shall not order material for shipment until approved by Engineer. Any product or material changes required as a result of inadequate strength data will be addressed by Change Order provided submitted material meets all other requirements of this section.

Manufacturer's Information: The manufacturer shall provide specification sheets, literature, and test results for all properties listed in these Specifications. The manufacturer shall certify that the materials supplied meet the requirements of this Part.

Integrity: Geonets and CDNs shall retain their structure during handling, placement, and long-term service.

TRANSPORTATION, HANDLING, AND STORAGE:

Geonets and CDNs shall be supplied in rolls wrapped in covers and marked or tagged with the roll number. Each material roll shall include information to demonstrate material tracebility through written documentation from the manufacturer and transport company. At a minimum this information shall include the Manufacturer's Name, Product Identification, Lot Number and Roll Dimension (Area and Width).

Transportation of the CDN to the site and all handling on site will be the responsibility of the Construction General Contractor.

During shipment and storage, the geonet and CDN shall be protected from mud, dirt, UV exposure, dust, puncture, cutting, or other damaging or deleterious conditions. Protective wrappings which are damaged shall be repaired or replaced, as necessary.

The Construction General Contractor shall be responsible for the storage of the CDN on site within the limits of construction. The Construction General Contractor shall protect storage area(s) from theft, vandalism, passage of vehicles, etc.

PART 3--EXECUTION

GENERAL:

Unacceptable Materials and Work: Materials and Work which fail to meet the requirements of these Specifications shall be removed, disposed of, and replaced at the Construction General Contractor's expense.

HANDLING AND PLACEMENT:

The Construction General Contractor shall handle all CDNs in such a manner as to ensure that these materials are not damaged.

Clean geomembrane surface prior to placing CDN.

On slopes, CDN may be deployed over slip sheets with the roll at the top of the slope. An alternative method is to secure the CDN and then roll it down slope in a manner to continually keep it in tension. If necessary, position the CDN after deployment to minimize wrinkles and remove the slip sheet, if used.

Do not drag the CDN across textured geomembrane in any way that damages the geotextile component or reduces the friction at the geomembrane/CDN interface.

In the presence of wind, all exposed CDNs shall be weighted with sandbags or equivalent. Sandbags shall be installed during CDN placement and shall remain until replaced with cover material.

Unless otherwise specified, CDNs shall not be welded to geomembranes.

CDNs shall only be cut using approved cutting tools. Protect underlying geosynthetics when cutting.

The Construction General Contractor shall take any necessary precautions to prevent damage to underlying layers during placement of the CDN.

During placement of CDNs, care shall be taken not to entrap dirt or excessive dust that could cause clogging of the drainage system, and/or stones that could damage the adjacent geomembrane. Dirt or excessive dust entrapped in the CDN shall be cleaned prior to placement of the next material on top of it. Excessive dust is defined as any thickness greater than 20 mils (0.02 inch) within the geonet core of the CDN. In this regard, care shall be taken with the handling of sandbags, to prevent rupture or damage of the sandbag.

Tools shall not be left in the CDN.

After deployment, all CDN shall be covered within a maximum period of 14 days to prevent exposure of geotextile component to ultraviolet (UV) radiation (sunlight). See Section 02371,

GEOTEXTILES, for requirements of geotextile exposed to UV radiation longer than 14 days.

JOINING:

Adjacent sections of CDN shall be overlapped according to the manufacturer's directions.

Overlaps shall be secured by spot welding or tying. Acceptable tying devices include strings, plastic fasteners, or polymer braid. Tying devices shall be white or yellow for easy observation. Metallic devices are not allowed.

Overlaps shall be secured every 5 feet along slopes and on the floor of the landfill. Overlaps shall be secured every 6 inches in anchor trenches. Along end-to-end seams, spot weld or tie each row at 6-inch intervals; stagger weld or ties between rows.

In joining CDNs, tearing the geotextile away from the geonet shall only be allowed at panels ends in order to seam same material components together and shall be minimized to the extent necessary to perform the required work.

No horizontal seams shall be allowed on side slopes except at roll ends.

If more than one layer of CDN is installed, joints shall be staggered.

REPAIR:

Remove the damaged area of CDN.

Cut a piece of geonet to fit into the repair area. Geonet shall fit into repair area to form a flush surface with the CDN. Cut geonet so that ribs are in the same orientation as existing CDN.

Remove any dirt or other foreign material which may have entered the CDN.

Place CDN patch over damaged area. Geonet component of patch shall be tied to in-place geonet component according to manufacturer's recommendations.

Place Type 1 geotextile over the exposed geonet component with an overlap of 4 inches of geotextile. Heat seam repair geotextile to existing geotextile.

MATERIALS IN CONTACT WITH CDNS:

The Construction General Contractor shall place all soil materials located on top of a CDN layer in such a manner as to ensure that the following conditions are satisfied:

No damage to the CDN.

No slippage of the CDN on underlying layers.

No excess tensile stresses in the CDN.

END OF SECTION 02373

Table 1. REQUIRED GEONET PROPERTIES

| Property | Qualifier | Unit | Value | Test |
|---|---|---|---|---|
| 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 | $3 \times 10^{-3}$ | ASTM D4716 |

Table 2. REQUIRED CDN PROPERTIES

| Property | Qualifier | Unit | Value | Test |
|---|---|---|---|---|
| Ply Adhesion | ARV | lb/in | 1.0 | ASTM D413 or GRI-GC7 |
| Transmissivity[1] | MARV | $m^2$/sec | $5 \times 10^{-4}$ | ASTM D4716 |

Notes:

MARV = Minimum Average Roll Value.
ARV = Average Roll Value.

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

# SECTION 02500--RAW WATER CONVEYANCE PIPING - GENERAL

## PART 1--GENERAL

### SUMMARY:

This section is for furnishing and installing raw water piping and associated components.

### REFERENCES:

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

AMERICAN CONCRETE INSTITUTE (ACI)

| | |
|---|---|
| ACI 301 | Standard Specification for Structural Concrete |

AMERICAN WATER WORKS ASSOCIATION (AWWA)

| | |
|---|---|
| AWWA C110/A21.10 | Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in. (75 mm Through 1200 mm), for Water and Other Liquids |
| AWWA C115/A21.15 | Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges |
| AWWA C207 | Steel Pipe Flanges for Waterworks Service - Sizes 4 in. Through 144 in. (100 mm Through 3,600 mm) |
| AWWA C210 | Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines |
| AWWA C213 | Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines |
| AWWA C217 | Cold-Applied Petroleum Tape and Petroleum Wax Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Buried Steel Water Pipelines |
| AWWA C219 | Bolted, Sleeve-Type Couplings for Plain-End Pipe |
| AWWA C221 | Fabricated Steel Mechanical Slip-Type Expansion Joints |
| AWWA C606 | Grooved and Shouldered Joints |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A497 | Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement |
| ASTM A615/A615M | Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement |
| ASTM C94/C94M | Standard Specification for Ready-Mixed Concrete |
| ASTM C150 | Standard Specification for Portland Cement |

NSF INTERNATIONAL (NSF)

NSF 61B Drinking Water System Components - Health Effects

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Detailed pipe fabrication drawings showing pipe details, special fittings and bends, dimensions, coatings, and other pertinent information.

Documentation for pipe pressure class.

SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR):

Submit results of pressure leakage testing for raw water conveyance piping.

Submit results for materials and test certificate after completion of the system in accordance with NFPA 24 Chapter 9.

DELIVERY, STORAGE, AND HANDLING:

In accordance with manufacturer's recommendations.

Marking at Plant: Mark each pipe and fitting at plant. Include date of manufacture, manufacturer's identification, specification standard, diameter of pipe, dimension ratio, pipe class, and other information required for type of pipe.

Pipe, specials, and fittings received at Project site in damaged condition will not be accepted.

Gasket Storage: Store rubber gaskets in cool, well ventilated place, and do not expose to direct rays of sun. Do not allow contact with oils, fuels, petroleum, or solvents.

Store and support pipe securely to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials.

Handling:

Pipe shall be handled with proper equipment in a manner to prevent distortion or damage. Use of hooks, chains, wire ropes, or clamps that could damage pipe, damage coating or lining, or kink and bend pipe ends is not permitted.

Use heavy canvas, or nylon slings of suitable strength for lifting and supporting materials.

Lifting pipe during unloading or lifting into trench shall be done using two slings placed at quarter point of pipe section. Pipe may be lifted using one sling near center of pipe, provided pipe is guided to prevent uncontrolled swinging and no damage will result to pipe or harm to workmen. Slings shall bear uniformly against pipe.

Pipe and fittings shall not be stored on rocks or gravel, or other hard material that might damage pipe. This includes storage area and along pipe trench.

PART 2--PRODUCTS

PIPE:

As specified in Section 02502, RAW WATER DUCTILE IRON PIPE AND FITTINGS, Section 02509, RAW WATER POLYVINYL CHLORIDE (PVC) PRESSURE PIPE AND FITTINGS, and the Carbon Steel Pipe and Galvanized Steel Pipe Data Sheets attached to this section.

JOINTS:

As specified in Section 02502, RAW WATER DUCTILE IRON PIPE AND FITTINGS, Section 02509, RAW WATER POLYVINYL CHLORIDE (PVC) PRESSURE PIPE AND FITTINGS, and the Carbon Steel Pipe and Galvanized Steel Pipe Data Sheets attached to this section.

FLEXIBLE LOCK COUPLINGS:

General:

Couplings shall be rated for 173 psi.

Buried, bolted, sleeve-type couplings shall be lined and coated with fusion-bonded epoxy in accordance with AWWA C213.

Locking pins shall be integral to coupling, number and diameter of pins per manufacturer's standard.

For Pipe with Plain-Ends: Bolted, sleeve-type coupling, in accordance with AWWA C219.

Manufacturer of couplings shall observe same quality control requirements as specified in AWWA C221 for fabrication of pipe expansion joints.

Manufacturers and Products: Dresser; Style 167.

SERVICE SADDLES:

Double strap type with minimum strap width of 2 inches.

Straps shall be Type 304 stainless steel. Saddles shall be ductile iron, epoxy-coated, 10 mils minimum thickness.

Minimum Pressure Rating: 200 psi.

FLANGES, FLANGE GASKETS, AND BOLTING MATERIALS:

As specified in individual raw water specifications for each piping material.

CONCRETE FOR THRUST BLOCKS:

Thrust Block Concrete: As specified in Section 03301, CONCRETE.

Reinforcing Steel: ASTM A615/A615M, Grade 60 deformed bars.

Welded Wire Fabric: ASTM A497.

Formwork: Plywood; earth cuts may be used as approved by Construction Manager.

LOCATOR RIBBON:

As specified in Section 02320, TRENCH BACKFILL.

PIPE BEDDING AND PIPE ZONE MATERIAL:

Granular material as specified in Section 02320, TRENCH BACKFILL.

TRENCH STABILIZATION MATERIAL:

As specified in Section 02320, TRENCH BACKFILL.

PART 3--EXECUTION

GENERAL:

Installation shall be in accordance with NFPA 24 Standard for the Installation of Private Service Mains and Their Appurtenances.

Notify Construction Manager at least 2 weeks prior to field fabrication of pipe or fittings.

Furnish feeler gauges of proper size, type, and shape for use during installation for each type of pipe furnished.

Distributing Materials: Place materials along trench only as will be used each day, unless otherwise approved by Construction Manager. Placement of materials shall not be hazardous to traffic or to general public, obstruct access to adjacent property, or obstruct others working in area.

EXAMINATION:

Verify size, material, joint types, elevation, and horizontal location of existing pipeline to be connected to new pipeline or new equipment.

Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

Damaged Coatings and Linings: Repair using coating and lining materials in accordance with manufacturer's instructions.

PREPARATION OF TRENCH:

Prepare trench as specified in Section 02316, EXCAVATION.

Unless otherwise permitted by Construction Manager, maximum length of open trench shall not exceed 500 feet.

INSTALLATION:

General:

Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.

Install individual pipe lengths in according to approved lay diagram. Misplaced pipe shall be removed and replaced.

Inspect pipe and fittings before installation, clean ends thoroughly, remove foreign matter and dirt from inside.

Flanged Joints:

Install perpendicular to pipe centerline.

Bolt Holes: Straddle vertical centerline, aligned with connecting equipment flanges or as shown on Drawings.

Use torque-limiting wrenches to provide uniform bearing and proper bolt tightness.

Flange Type: Use flat-faced flange when joining with flat-faced ductile or cast iron flange.

Couplings:

Install in accordance with manufacturer's written instructions.

Before coupling, clean pipe holdback area of oil, scale, rust, and dirt.

Remove pipe coating, if necessary, to obtain smooth surface.

Clean gaskets before installation.

If necessary, lubricate with gasket lubricant for installation on pipe ends.

Tighten coupling bolts progressively, drawing up bolts on opposite sides gradually until bolts have uniform tightness.

Buried Pressure Pipe:

Placement:

Keep trench dry until pipe laying and joining is completed.

Exercise care when lowering pipe into trench to prevent twisting or damage to pipe.

Excavate trench bottom and sides of ample dimensions to permit proper joining, visual inspection, and testing of entire joint.

Prevent foreign material from entering pipe during placement.

Close and block open end of last laid pipe section when placement operations are not in progress and at close of day's work.

In general, lay pipe upgrade with bell ends pointing in direction of laying.

Deflect pipe at joints for pipelines laid on a curve using unsymmetrical closure of spigot into bell. Pipe joints shall be pushed together in straight alignment and then deflected. If joint deflection of standard pipe lengths will not accommodate horizontal or vertical curves in alignment, provide:

Shorter pipe lengths.

Special mitered joints.

Standard or special fabricated bends.

Check gasket position with feeler gauge to assure proper seating.

After joint has been made, check pipe alignment and grade.

Place sufficient pipe zone material to secure pipe from movement before next joint is installed.

Prevent uplift and floating of pipe prior to backfilling.

Tolerances:

Deflection From Horizontal Line: Maximum 2 inches.

Deflection From Vertical Line: Maximum 1 inch.

Joint Deflection: Maximum of 75 percent of manufacturer's recommendation.

Horizontal position of pipe centerline on alignment around curves maximum variation of 1 foot from position shown.

Cover Over Top of Pipe: Minimum 3.5 feet, unless otherwise shown.

Disposal of Excess Excavated Material: As specified in Section 02316, EXCAVATION.

THRUST RESTRAINT:

Location: At pipeline tees, plugs, caps, bends, and locations where unbalanced forces exist.
Thrust Blocking:

Quantity of Concrete: Sufficient to cover bearing area of pipe and provide required soil bearing area as shown on Drawings. For vertical bends, concrete shall be sufficient to provide required volume as shown on Drawings.

Place blocking so pipe and fitting joints are accessible for repairs.

Place concrete in accordance with Section 03301, CONCRETE.

CORROSION PROTECTION:

Buried Pipe: As specified in the individual specifications following this section.

Notify Construction Manager at least 3 days prior to start of surface preparation, coating application, and corrosion protection work.

PLACEMENT OF PIPE LOCATOR RIBBON:

Place pipe locator ribbon in accordance with Section 02320, TRENCH BACKFILL.

PIPE BEDDING AND ZONE MATERIAL:

Place pipe bedding and pipe zone material in accordance with Section 02320, TRENCH BACKFILL.

CONSTRUCTION QUALITY CONTROL:

Pressure Leakage Testing for Raw Water Ductile Iron and PVC: As specified in the individual piping Specification(s) following this section.

Pressure Leakage Testing for Raw Water Carbon Steel Pipe and Fittings and Valves Upstream of 12-Inch Gate Valve:

Shop Test: After fabrication of carbon steel spools (as specified in carbon steel pipe supplement at the end of this section) and prior to lining or coating, blind flanges shall be installed on each flange. One blind flange shall be tapped as necessary for a test port. A hydrostatic leak test shall be performed at 173 psig for 30 minutes; no visible leaks shall be allowed.

Field Test: An in-service leak test shall be performed with excavation open. Retighten bolts on fittings/valves as necessary and within manufacturer's recommendations to stop any visible leaks.

Pressure Leakage Testing for Raw Water Galvanized Steel Pipe and Malleable Iron Fittings: Perform in conjunction with leakage test for raw water ductile iron and PVC.

SUPPLEMENTS:

Supplement 1—Carbon Steel Pipe and Fittings.

Supplement 2—Galvanized Steel Pipe and Malleable Iron Fittings.

END OF SECTION 02500

## CARBON STEEL PIPE AND FITTINGS

| Item | Size | Description |
|---|---|---|
| Pipe | 24" | Black carbon steel, ASTM A106, Grade B seamless or ASTM A53, Grade B seamless or ERW. Threaded, butt-welded, and flanged joints:<br><br>Schedule 20 (24" OD, 0.375" wall thickness)<br><br>For pressure testing purposes of 24" OD flange x plain end spools, initially construct one flange x flange spool. After completion of pressure testing per Article CONSTRUCTION QUALITY CONTROL of this Specification section, the flange x flange spool shall be cut in half. Each half shall then be coated, lined, and installed per the Drawings. Other flange x flange spools shall be pressure tested prior to coating and lining per Article CONSTRUCTION QUALITY CONTROL. |
| Joints | | Flanged at valves as shown. |
| Flanges | | Forged carbon steel, ASTM A105/A105M, ANSI B16.5 Class 150 slip-on or welding neck; weld neck bore to match pipe internal diameter.<br><br>Welding shall conform to AWS D1.1, AWWA C206, approved welding procedures, and referenced welding codes. In case of conflict, AWS D1.1 shall govern. |
| Bolting | All | Carbon steel ASTM A193/A193M, Grade B7 studs and ASTM A194/A194M, Grade 2H hex head nuts.<br><br>When mating flange on equipment is cast iron and gasket is flat ring, provide ASTM A307, Grade B hex head bolts and ASTM A563, Grade A heavy hex nuts. |
| Gaskets | All | General Service and Oil/Gas: 1/16" thick compressed nonasbestos composition flat ring type. Garlock, Style 3000; Manville, Style 978. |

| Item | Size | Description |
|---|---|---|
| Coating | | General: Holdback of, and coating shall be as follows: For flex couplings, 8 inches. |
| | | Coal-Tar Enamel Coating: |
| | | Coating system for pipe and flanges (except machined surfaces) shall conform to AWWA C203. |
| | | Application of coal-tar enamel coatings shall be in accordance with federal, state, and local regulations. |
| | | Coatings shall be shop-applied, except for field repairs and holdback areas. |
| | | Materials shall be suitable for temperatures that may be encountered in Project location, and for time of year when materials are being applied and pipeline is being installed. |
| | | Coating shall be tested in accordance with AWWA C203. Defects shall be repaired in accordance with AWWA C203. |
| | | Furnish and apply in field, coat tar epoxy paint, Koppers 300M, or equal, on holdback areas after installation of flex couplings and at damaged coating locations. |
| Lining | | Coal-Tar Lining: Conform to AWWA C203. |
| | | Furnish and apply in field, coat tar epoxy paint, Koppers 300M, or equal, for repair of lining. |

## GALVANIZED STEEL PIPE AND MALLEABLE IRON FITTINGS

| Item | Size | Description |
|---|---|---|
| Pipe | | Galvanized carbon steel, ASTM A106, Grade B seamless or ASTM A53, Grade B seamless or ERW. |
| | 2" and smaller | Schedule 80. |
| | 2-1/2" through 6" | Schedule 40. |
| Joints | All | Threaded or flanged at valves and equipment. |
| Fittings | | Threaded: 150- or 300-pound galvanized malleable iron, ASTM A197 or ASTM A47, dimensions in accordance with ANSI B16.3. |
| Flanges | | Galvanized forged carbon steel, ASTM A105/A105M, ANSI B16.5 Class 150 or Class 300, threaded, 1/16-inch raised face. |
| Unions | | Threaded malleable iron, ASTM A197 or A47, 300-pound WOG, brass to iron seat, meeting the requirements of ANSI B16.3. |
| Bolting | | Flanges: Carbon steel ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts. |
| Gaskets | All flanges | Flanged, Water and Sewage Service: 1/8 inch thick, red rubber (SBR), hardness 80 (Shore A), rated to 200 degrees F, conforming to ANSI B16.21, AWWA C207, and ASTM D1330, Grades 1 and 2. |
| Thread Lubricant | 2" & smaller | Teflon tape or joint compound that is insoluble in water. |

# SECTION 02502—RAW WATER DUCTILE IRON PIPE AND FITTINGS

## PART 1--GENERAL

### SUMMARY:

This section is for furnishing and installing 6-inch ductile iron raw water piping and associated components.

### REFERENCES:

The following is a list of standards that may be referenced in this section:

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| AASHTO T99 | Standard Specification for the Moisture-Density Relations of Soils Using a 2.5 kg (5.5LB) Hammer and a 305mm (12 in.) Drop |

AMERICAN WATER WORKS ASSOCIATION (AWWA)

| | |
|---|---|
| AWWA C104 | Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water |
| AWWA C105 | Polyethylene Encasement for Ductile Iron Pipe Systems |
| AWWA C110 | Ductile Iron and Grey Iron-Fittings, 3-inch through 48-inch |
| AWWA C111 | Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings. |
| AWWA C115 | Flanged Ductile Iron Pipe with Ductile Iron and Grey Iron Fittings |
| AWWA C150 | Thickness Design of Ductile-Iron Pipe |
| AWWA C151 | Ductile-Iron Pipe. Centrifugally Cast, for Water |
| AWWA C153 | Ductile Iron Compact Fittings, 3-inch through 24-inch and 54-inch through 64-inch for Water Service |
| AWWA C207 | Steel Pipe Flanges for Waterworks Service, Sizes 4-inch Through 144-inch (100mm through 3600mm) |
| AWWA C600 | Installation of Ductile-Iron Water Mains and Their Appurtenances |
| AWWA C606 | Grooved End, Shouldered Joints |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A307 | Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength |
| ASTM A563 | Standard Specification for Carbon and Alloy Steel Nuts |
| ASTM B16.21 | Standard Specification for Nonmetallic Flat Gaskets for Pipe Flanges |
| ASTM D882 | Standard Test Method for Tensile Properties of Thin Plastic Sheeting |

| | |
|---|---|
| ASTM D1330 | Standard Specification for Rubber Sheet Gaskets |
| ASTM D1922 | Standard Test Method for Propagation Tear Resistance of Plastic Film and Thin Sheeting by Pendulum Method |
| ASTM D2000 | Standard Classification System for Rubber Products in Automotive Applications |
| ASTM D4976 | Standard Specification for Polyethylene Plastics Molding and Extrusion Materials |

DUCTILE IRON PIPE RESEARCH INSTITUTE (DIPRA)

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Flushing Procedure: The flushing procedure shall outline the method and materials for handling flush water, i.e., pipe, valves, fittings for filling pipeline and similar for discharging flush water, method for restraining aboveground pipe, and preventing erosion damage.

Field Hydrostatic Testing Plan: Submit at least 15 days prior to testing and at minimum, include the following:

Testing dates.

Piping systems and section(s) to be tested.

Method of isolation.

Method of conveying water from source to system being tested.

Calculation of maximum allowable leakage for piping section(s) to be tested.

Certifications of Calibration: Approved testing laboratory certificate if pressure gauge for hydrostatic test has been previously used. If pressure gauge is new, no certificate is required.

As-Built Survey Data: Before final acceptance of raw water piping system, provide as-built locations of systems and components, showing pressure pipe lines, including grade breaks or alignment, horizontal and vertical locations of all utility crossings, finished grade profile on all alignments, and valve locations. The submitted data shall be certified by a Washington licensed land surveyor.

Shop Drawings: Marking plan and details of standard pipe section showing dimensions, pipe joints, fitting and special fitting pressure rating and thickness, size, coating and lining data.

SUBMITTALS--APPROVAL NOT REQUIRED:

Information/Record (IR):

Hydrostatic test documentation form and results.

PART 2--PRODUCTS

MATERIALS:

Pipe:

General:

Centrifugally cast, grade 60-42-10 iron.

Meet requirements of AWWA C150, C153 and C111.

Lined and coated as specified.

Pipe wall thickness Class 50.

Pipe wall thickness of threaded pipe for a flanged pipe end shall be minimum special thickness Class 53 from 12-inch to 54-inch diameter pipe in accordance with AWWA C115.

Grooved end pipe, for all pipe diameters, shall be minimum Special Class 53.

Pipe shall be new and recently manufactured. Refurbished pipe shall not be provided.

Joints:

Push-On Joint: Rated at minimum working pressure equal to pipe material design.

Restrained Joint:

Manufactured proprietary joint that mechanically restrains pipe to adjoining pipe.

Manufacturers and Products:

American Cast Iron Pipe; Flex-Ring and Lok-Ring.

Pacific States Pipe; Thrust-Lock.

U.S. Pipe; TR Flex.

Mechanical Wedge Action Type Joint:

Use only in areas where adjoining to fixed points where laying length is determined in field.

Prior to purchase and installation, type and application of this joint shall be approved by Construction Manager.

Use of set screws for restraint or field-lock gaskets shall not be allowed.

Flanged Joint: Threaded 250 psi working pressure ductile iron flanges conforming to AWWA C115.

Fittings:

Ductile Iron, Push-On, Flanged or Restrained Joint: In accordance with AWWA C110, at 250 psi minimum working pressure for 3- to 24-inch fittings and 150 psi minimum working pressure for 30- to 48-inch fittings.

Mechanical Joint Fittings: In accordance with AWWA C111.

Fittings shall be new and recently manufactured. Refurbished fittings will not be accepted.

A. Welded Outlet: Only weld to pipe in manufacturer's shop.

Lining: Pipe and fittings for clean water applications shall be cement lined and asphaltic seal coated in accordance with AWWA C104.

Coating: Asphaltic type, 1 mil thick, in accordance with AWWA C151, C115, C110 and C153.

Bolting: Bolts for flanged connections shall be carbon steel, ASTM A307, Grade A hex bolts and ASTM A563, Grade A hex head nuts.

Gaskets: Gaskets for flat faced 150 and 250 psi working pressure flanges shall be 1/8 inch thick, red rubber (SBR), hardness 80 (Shore A), rated to 200 degrees F, conforming to ANSI B16.21, AWWA C207, and ASTM D1330, Grades 1 and 2.

PART 3--EXECUTION

EXAMINATION:

Inspect pipe and fittings to ensure no cracked, broken, or otherwise defective materials are being used.

PREPARATION:

Trench Grade:

Grade bottom of trench by hand to specified line and grade, with proper allowance for pipe thickness and pipe base, when specified. Trench bottom shall form a continuous and uniform bearing and support for pipe between bell holes.

Before laying each section of pipe, check grade and correct irregularities found. Grade may be disturbed for removal of lifting tackle.

Bell (Joint) Holes: At each joint, dig bell holes of ample dimensions in bottom of trench, and at sides where necessary, to permit joint to be made properly and to permit easy visual inspection of entire joint.

INSTALLATION:

General:

Provide and use proper implements, tools, and facilities for safe and proper prosecution of Work.

Lower pipe, fittings, and appurtenances into trench, piece by piece, by means of a crane, slings, or other suitable tools and equipment, in such a manner as to prevent damage to pipe materials, protective coatings and linings.

Do not drop or dump pipe materials into trench.

Cleaning Pipe and Fittings:

Remove lumps, blisters, and excess coal tar coating from bell and spigot ends of each pipe. Wire brush outside of spigot and inside of bell and wipe clean, dry, and free from oil and grease before pipe is laid.

Wipe ends of mechanical joint pipe and fittings and of rubber gasket joint pipe and fittings clean of dirt, grease, and foreign matter.

Laying Pipe:

Direction of Laying: Lay pipe with bell end facing in direction of laying. For lines on an appreciable slope, face bells upgrade at discretion of Construction Manager.

Mechanical Joint, Push-On Joint, and Restrained Joint Pipe: After first length of pipe is installed in trench, secure pipe in place with approved backfill material tamped under and along sides to prevent movement. Keep ends clear of backfill. After each section is jointed, place backfill as specified to prevent movement.

Take precautions necessary to prevent floating of pipe prior to completion of backfill operation.

When using movable trench shield, take necessary precautions to prevent pipe joints from pulling apart when moving shield ahead.

Do not allow foreign material to enter pipe while it is being placed in trench.

Close and block open end of last laid section of pipe to prevent entry of foreign material or creep of gasketed joints when laying operations are not in progress, at close of day's work, or whenever workers are absent from job.

Joining Push-On Joint Pipe and Mechanical Joint Fittings:

Join pipe with push-on joints and mechanical joint fittings in strict accordance with manufacturer's recommendations.

Provide special tools and devices, such as, special jacks, chokers, and similar items required for installation.

Lubricate pipe gaskets using lubricant furnished by pipe manufacturer. No substitutes will be permitted.

Clean ends of fittings of dirt, mud, and foreign matter by washing with water and scrubbing with a wire brush, after which, slip gland and gasket on plain end of pipe. If necessary, lubricate end of pipe to facilitate sliding gasket in place, then guide fitting onto spigot of pipe previously laid.

Cutting Pipe:

General: Cut pipe for inserting valves, fittings, or closure pieces in a neat and workmanlike manner without damaging pipe or lining and so as to leave a smooth end, at right angles to axis of pipe.

Pipe: Cut pipe with milling type cutter or saw. Do not flame cut.

Dressing Cut Ends: Dress cut end of mechanical joint pipe to remove sharp edges or projections, which may damage rubber gasket. Dress cut ends of push-on joint pipe by beveling, as recommended by manufacturer.

Field Welding:

Use of field welded outlets will not be allowed. Welding for outlets shall be performed only in pipe manufacturer's shop.

Field installed outlets may be installed with saddle approved by Construction Manager. Opening in pipe shall be machined cut and not with cutting torch.

Field welding of bars for restrained joint systems will not be allowed. All welding shall be performed in pipe manufacturer's shop.

Line and Grade:

Minimum Pipe Cover: 3.5 feet, unless otherwise indicated.

Install pipe to uniform grades and minimize high points.

Maintain pipe grade between invert elevations.

Deviations exceeding 6 inches from specified line or 1 inch from specified grade will not be allowed without express approval of Construction Manager.

Pipeline sections that are not installed to elevations shown or installed as approved by Construction Manager shall be reinstalled to proper elevation.

CONSTRUCTION QUALITY CONTROL:

Cleaning:

Following assembly and testing, and prior to final acceptance, flush pipelines with water at 2.5 fps minimum flushing velocity until foreign matter is removed.

If impractical to flush large diameter pipe at 2.5 fps, clean pipe by use of pipe pig as approved by Construction Manager. Multiple passes of pipe pig may be required to adequately clean line.

Remove accumulated debris through blowoffs 2 inches and larger or by removing spools and valves from piping.

Pipeline Hydrostatic Test:

General:

Notify Construction Manager in writing 5 days in advance of testing. Construction Manager will coordinate with other parties required to witness testing. Perform testing in presence of Construction Manager.

Test newly installed pipelines. Using water as test medium, pipes shall successfully pass a leakage test prior to acceptance.

Furnish testing equipment and perform tests in manner satisfactory to Construction Manager. Testing equipment shall provide observable and accurate measurements of leakage under specified conditions.

Isolate new pipelines that are connected to existing pipelines.

Conduct tests on entire pipeline after trench has been backfilled. Testing may be done prior to placement of asphaltic concrete or roadway structural section.

Construction General Contractor may, if field conditions permit and as determined by Construction Manager, partially backfill trench and leave joints open for inspection and conduct an initial service leak test. Hydrostatic test shall not, however, be conducted until backfilling has been completed.

Procedure:

Maximum filling velocity shall not exceed 0.25 foot per second, calculated based on the full area of pipe.

Expel air from pipe system during filling. Expel air through air release valve or through corporation stop installed at high points and other strategic points.

Test pressure shall be 173 psi as measured at low point of pipeline.

Apply and maintain specified test pressure with hydraulic force pump. Valve off piping system when test pressure is reached.

Maintain hydrostatic test pressure continuously for 2 hours minimum, adding additional make-up water only as necessary to restore test pressure.

Determine actual leakage by measuring quantity of water necessary to maintain specified test pressure for duration of test.

If measured leakage exceeds allowable leakage or if leaks are visible, repair defective pipe section and repeat hydrostatic test.

Identify method of disposing of water after system testing.

Allowable Leakage: Maximum allowable leakage shall not exceed amount stated in AWWA C600.

END OF SECTION 02502

# SECTION 02509--RAW WATER POLYVINYL CHLORIDE (PVC) PRESSURE PIPE AND FITTINGS

## PART 1--GENERAL

### SUMMARY:

This section is for furnishing and installing 1-inch and 4-inch Schedule 80 solvent weld, 4-inch and 12-inch bell and spigot, raw water piping and associated components.

### REFERENCES:

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

AMERICAN WATER WORKS ASSOCIATION (AWWA)

| | |
|---|---|
| AWWA C110 | Ductile-Iron and Gray-Iron Fittings, 3 inch Through 48 inch (75 mm Through 1200 mm), for Water and Other Liquids |
| AWWA C605 | Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water |
| AWWA C900 | Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 inch Through 12 inch (100 mm Through 300 mm), for Water Distribution |
| AWWA C905 | Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 inches Through 48 inches (350 mm Through 1,200 mm) for Water Transmission and Distribution |
| AWWA C907 | Polyvinyl Chloride (PVC) Pressure Fittings for Water, 4 inch Through 8 inch (100 mm Through 200 mm) |
| AWWA Manual M23 | PVC Pipe - Design and Installation |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D1784 | Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds |
| ASTM D1785 | Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 |
| ASTM D2241 | Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) |
| ASTM D2321 | Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications |

| | |
|---|---|
| ASTM D2467 | Standard Specification for Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 |
| ASTM D2564 | Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems |
| ASTM D2672 | Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement |
| ASTM D2855 | Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings |
| ASTM D3139 | Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals |

NSF INTERNATIONAL (NSF)

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Flushing Procedure: The flushing procedure shall outline the method and materials for handling flush water, i.e., pipe, valves, fittings for filling pipeline and similar for discharging flush water, method for restraining aboveground pipe, and preventing erosion damage.

Qualifications:

Solvent Welders: List of solvent welders and current test records for solvent welder(s) for field solvent welding.

Hydrostatic Testing Plan: Submit at least 15 days prior to testing and at minimum, include the following:

Testing dates.

Piping systems and section(s) to be tested.

Method of isolation.

Method of conveying water from source to system being tested.

Calculation of maximum allowable leakage for piping section(s) to be tested.

Certification of Calibration: Approved testing laboratory certificate if pressure gauge for hydrostatic test has been previously used. If pressure gauge is new, no certificate is required.

As-Built Survey Data: Before final acceptance of raw water piping system, provide as-built locations of systems and components, showing pressure pipe lines, including grade breaks or alignment, horizontal and vertical locations of all utility crossings, finished grade profile on all alignments, and valve locations. The submitted data shall be certified by a Washington licensed land surveyor.

Shop Drawings: Drawings showing pipe diameter, pipe class, and fitting details.

SUBMITTALS--APPROVAL NOT REQUIRED:

Information/Record (IR):

Hydrostatic test documentation form and results.

PART 2--PRODUCTS

MATERIALS:

Bell and Spigot Pipe:

PVC, conforming to requirements of AWWA C900.

DR shall be 14, 200 psi pressure class.

Joints:

Rubber gasketed.

Conform to AWWA C900.

Fittings: Ductile iron, conforming to AWWA C153 or C110.

Solvent Weld PVC Pipe and Fittings: As specified on Piping Data Sheet located at the end of this section as a supplement.

PART 3--EXECUTION

INSTALLATION OF SCHEDULE 80 SOLVENT WELD PIPE:

In accordance with Section 02500, RAW WATER CONVEYANCE PIPING - GENERAL.

INSTALLATION OF C900 BELL AND SPIGOT PIPE:

In accordance with AWWA C605.

Joints:

Rubber Gasketed: In accordance with manufacturer's written instructions.

Restrained Joint Systems: In accordance with manufacturer's written instructions.

Pipe Bending for Horizontal or Vertical Curves:

Radius of curves shall not exceed 75 percent of manufacturer's recommended values.

Use blocks or braces at pipe joints to ensure axial deflection in gasketed or mechanical joints does not exceed allowable deflection.

Maximum Joint Deflection: 75 percent of manufacturer's recommended values.

CONSTRUCTION QUALITY CONTROL:

Cleaning:

Following assembly and testing, and prior to final acceptance, flush pipelines with water at 2.5 fps minimum flushing velocity until foreign matter is removed.

If impractical to flush large diameter pipe at 2.5 fps, clean pipe by use of pipe pig as approved by Construction Manager. Multiple passes of pipe pig may be required to adequately clean line.

Remove accumulated debris through blowoffs 2 inches and larger or by removing spools and valves from piping.

Pipeline Hydrostatic Test:

General:

Notify Construction Manager in writing at least 5 days in advance of testing. Construction Manager will coordinate with other parties required to witness testing. Perform testing in presence of Construction Manager.

Using water as test medium, all newly installed pipelines shall successfully pass hydrostatic leakage test prior to acceptance.

Conduct field hydrostatic test on buried piping after trench has been completely backfilled. Testing may, as approved by Construction Manager, be done prior to placement of asphaltic concrete or roadway structural section.

Construction General Contractor may, if field conditions permit and as approved by Construction Manager, partially backfill trench and leave joints open for inspection and conduct initial service leak test. Final field hydrostatic test shall not, however, be conducted until backfilling has been completed as specified above.

Install temporary thrust blocking or other restraint as necessary to prevent movement of pipe and protect adjacent piping or equipment. Make necessary taps in piping prior to testing.

Wait a minimum of 5 days after concrete thrust blocking is installed to perform pressure tests. If high-early strength cement is used for thrust blocking, wait may be reduced to 2 days.

Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.

Procedure:

Furnish testing equipment, as approved by Construction Manager, which provides observable and accurate measurements of leakage under specified conditions.

Maximum Filling Velocity: 0.25 foot per second calculated based on full area of pipe.

Expel air from piping system during filling.

Test Pressure: 173 psi as measured at low point of pipeline.

Apply and maintain specified test pressure with hydraulic force pump. Valve off piping system when test pressure is reached.

Maintain hydrostatic test pressure continuously for 2 hours minimum, adding make-up water only as necessary to restore test pressure.

Determine actual leakage by measuring quantity of water necessary to maintain specified test pressure for duration of test.

Identify method of disposing water after system testing.

Maximum Allowable Leakage:

$$L = \frac{ND(P)^{1/2}}{7400}$$

where:

L = Allowable leakage, in gallons per hour.
N = Number of joints in tested line.
D = Nominal diameter of pipe, in inches.
P = Average test pressure during leakage test, in pounds per square inch.

SUPPLEMENTS:

Supplement 1—Solvent Weld Polyvinyl Chloride (PVC) Pipe and Fittings.

END OF SECTION 02509

## SOLVENT WELD POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

| Item | Size | Description |
|---|---|---|
| Pipe | All | Schedule 80 PVC: Type I, Grade I or Class 12454-B conforming to ASTM D1784 and ASTM D1785. Pipe shall be manufactured with 2 percent titanium dioxide for ultraviolet protection.<br><br>Threaded Nipples: Schedule 80 PVC. |
| Fittings | All | Schedule to Match Pipe Above: ASTM D2466 and ASTM D2467 for socket-weld type and Schedule 80 ASTM D2464 for threaded type. Fittings shall be manufactured with 2 percent titanium dioxide for ultraviolet protection. |
| Joints | All | Solvent socket-weld except where connection to threaded valves and equipment may require future disassembly. |
| Flanges | All | One piece, molded hub type PVC flat face flange in accordance with Fittings above, 125-pound ANSI B16.1 drilling |
| Bolting | All | ASTM A193/A193M Type 316 stainless steel Grade B8M hex head bolts and ASTM A194/ A194M Grade 8M hex head nuts. |
| Gaskets | All | Flat Face Mating Flange: Full faced 1/8-inch thick ethylene propylene (EPR) rubber.<br><br>Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EPR) rubber, with filler gasket between OD of raised face and flange OD to protect the flange from bolting moment. |
| Solvent Cement | All | As recommended by the pipe and fitting manufacturer conforming to ASTM D2564. |
| Thread Lubricant | All | Teflon tape. |

# SECTION 02631--CATCH BASINS

## PART 1--GENERAL

### REFERENCES:

The following is a list of standards that may be referenced in this section:

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| AASHTO M105 | Standard Specification for Gray Iron Castings |
| AASHTO M198 | Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A536 | Standard Specification for Ductile Iron Castings |
| ASTM C387 | Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete |
| ASTM C478 | Standard Specification for Precast Reinforced Concrete Manhole Sections |

## PART 2--PRODUCTS

### PRECAST UNITS:

Precast units shall conform to ASTM C478 except dimensions shall be as shown on the Drawings.

The joints shall be the tongue-and-groove type or the shiplap type, sufficiently deep to prevent lateral displacement. Precast concrete units shall be furnished with knockouts or cutouts.

Rubber gaskets for use in joints of precast catch basin sections shall conform to the applicable requirements of AASHTO M198. Rubber gasket material shall be stored in a clean, cool place, protected from sunlight and contaminants. They shall be protected from direct sunlight at all times except during actual installation.

Concrete risers for extensions shall be a maximum of 6 inches high and of same quality as sections. Risers shall be reviewed by Engineer before installation.

MORTAR:

Standard premixed mortar conforming to ASTM C387, Type S, or proportion 1 part portland cement to 2 parts clean, well-graded sand which will pass a 1/8-inch screen. Admixtures may be used not exceeding the following percentages of weight of cement: Hydrated lime, 10 percent; diatomaceous earth or other inert materials, 5 percent. Consistency of mortar shall be such that it will readily adhere to concrete.

RINGS AND COVERS:

Castings for catch basin rings shall be gray-iron conforming to the requirements of AASHTO M105, Grade 30B. Covers shall be ductile iron conforming to ASTM A536, Grade 80-55-06.

Catch basin rings and covers shall meet the strength requirements of Federal Specification RR-F-621E. All mating surfaces shall be machine finished to ensure a nonrocking fit.

The horizontal surface and inside vertical recess face of the ring, and the horizontal seating surface and vertical outside edge of the cover, shall be machine finished to the following tolerances:

Ring: +3/32 inch to -3/32 inch.

Cover: +3/32 inch to -3/32 inch.

All catch basin rings and covers shall be identified by the name or symbol of the manufacturer and country of casting origin. This identification shall be in a plainly visible location when the ring and cover are installed. Ductile iron shall be identified by the following, "DUC" or "DI." The manufacturer's identification and material identification shall be adjacent to each other and shall be minimum 1/2-inch to maximum 1-inch high letters, recessed to be flush with the adjacent surfaces.

PART 3--EXECUTION

EXCAVATION AND BACKFILL:

The excavation for all catch basins shall be sufficient to leave 1 foot in the clear between their outer surfaces and the earth bank. Backfilling of catch basins shall be done in accordance with the provisions of Section 02320 TRENCH BACKFILL. Backfilling around the work will not be allowed until the concrete and mortar have thoroughly set. Any excavation safety systems shall meet the requirements of Section 02316, EXCAVATION.

PLACING PRECAST UNITS:

If material in bottom of trench is unsuitable for supporting unit, excavate and backfill to required grade with 3-inch minus, clean, pit-run material. Set units to grade at locations shown.

Ladder rungs shall be grouted in the precast concrete walls. Rungs shall be uniformly spaced at 12 inches and be vertically aligned.

The ends of all pipes shall be trimmed flush with the inside walls.

Rubber gaskets may be used in tongue-and-groove joints of precast units. All other joints and all openings cut through the walls shall be grouted and watertight.

If gaskets are used, handling of the precast units after the gasket has been affixed shall be done carefully to avoid disturbing or damaging the gasket or contaminating it with foreign material. Care shall be exercised to attain proper alignment before the joints are entirely forced home. During insertion of the tongue or spigot, the units shall be partially supported to minimize unequal lateral pressure on the gasket and to maintain concentricity until the gasket is properly positioned.

Catch basins shall be watertight.

EXTENSIONS:

Install extensions to height determined by Engineer. Lay risers in mortar with sides plumb and tops to grade. Joints shall be sealed with mortar, with interior and exterior troweled smooth. Prevent mortar from drying out and cure by applying a curing compound. Extensions shall be watertight.

INSTALLATION OF RINGS AND COVERS:

Set rings and covers at elevations indicated or as determined in field and in conformance with Drawings.

Rings may be cast in, or shall be set in mortar.

The cover of a catch basin shall not be grouted to final grade until the final elevation of the adjacent ground surface has been established. Covers shall be seated properly to prevent rocking.

CLEANING:

Upon completion, clean each structure of all silt, debris, and foreign matter.

END OF SECTION 02631

SECTION 02632—STORMWATER PIPING

PART 1--GENERAL

REFERENCES:

The following is a list of standards which may be referenced in this section and any supplemental Data Sheets:

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| AASHTO M294 | Standard Specifications for Corrugated Polyethylene Pipe, 300- to 1200-mm Diameter |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM F477 | Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe |

SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR):

Catalog and manufacturer's data sheets for stormwater pipe and fittings.

PART 2--PRODUCTS

PIPE AND FITTINGS:

Pipe and fittings for culverts and stormwater pipes shall be corrugated polyethylene (CPE) in accordance with the following:

| Item | Description |
|---|---|
| Pipe | AASHTO M294 |
| Pipe Stiffness (Minimum) | In accordance with specified AASHTO Specification. |
| Profile | Type S. |
| Joints | Bell and spigot, gasketed type and water-tight. |
| Gaskets | ASTM F477. |
| Fittings | Manufacturer's standard; same stiffness as adjacent pipe. |
| Source Quality Control | In accordance with specified AASHTO Specification. |

| Item | Description |
|---|---|
| Factory Testing | Pipe lengths used for deflection testing shall be destroyed after testing. |

PART 3--EXECUTION

INSTALLATION OF PIPE, FITTINGS, AND APPURTENANCES:

General:

Pipe laying shall proceed upgrade with spigot ends pointing in direction of flow.

Excavate bell holes at each joint to permit correct assembly and inspection of entire joint.

Pipe invert may deviate from line or grade up to 1/2 inch for line and 1/4 inch for grade, provided that finished pipe line will present a uniform bore, and such variation does not result in a level or reverse sloping invert, or less than minimum slope shown.

Pipe bedding shall form continuous and uniform bearing and support for pipe barrel between joints. Pipe shall not rest directly on bell or pipe joint.

Prevent entry of foreign material into gasketed joints.

Plug or close off pipes that are stubbed off for manhole, concrete structure, or for connection by others, with temporary watertight plugs.

Trench excavation and placement of pipe bedding and pipe zone materials shall be in accordance with Section 02320, TRENCH BACKFILL.

Any excavation safety systems shall be in accordance with Section 02316, EXCAVATION.

PIPE CLEANING:

Prior to final acceptance and final inspection of the stormwater pipes by Engineer, flush and clean all stormwater pipes and catch basins. Remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material. If necessary, use mechanical rodding or bucketing equipment.

Upon Engineer's final inspection of the stormwater pipes, if any foreign matter is still present in the system, reflush and clean the sections and portions of the lines as required.

END OF SECTION 02632

# SECTION 02661--GEOMEMBRANES

## PART 1--GENERAL

### REFERENCES:

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

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D638 | Standard Test Method for Tensile Properties of Plastics |
| ASTM D1004 | Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting |
| ASTM D1238 | Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer |
| ASTM D1505 | Standard Test Method for Density of Plastics by the Density-Gradient Technique |
| ASTM D1603 | Standard Test Method for Carbon Black in Olefin Plastics |
| ASTM D4218 | Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique |
| ASTM D4833 | Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products |
| ASTM D5199 | Standard Test Method for Measuring the Nominal Thickness of Geosynthetics |
| ASTM D5321 | Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method |
| ASTM D5397 | Evaluation of Stress Crack Resistance of Polyolefin Geomembrane Using Notched Constant Tension Load Test (Appendix A, Single Point) |
| ASTM D5596 | Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics |
| ASTM D5994 | Standard Test Method for Measuring Core Thickness of Textured Geomembranes |
| ASTM D6243 | Standard Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method |
| ASTM D6392 | Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods |

GEOSYNTHETIC RESEARCH INSTITUTE (GRI)

| | |
|---|---|
| GRI-GM12 | Asperity Measurement of Textured Geomembranes Using a Depth Gage |
| GRI-GM13 | Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembrane |

DESCRIPTION:

The Work includes IDF manufacture, fabrication (if needed), supply, and installation of geomembrane for the lining system, and for other geomembrane applications, as shown on the Drawings. Geomembrane is also referred to as flexible membrane liner (FML).

DEFINITIONS:

CQA Certifying Engineer: Engineer providing independent oversight and responsible for implementing the CQA Plan. Independent is defined as an organization that operates separately from the Construction General Contractor, DOE-ORP, and the Tank Farm Contractor.

Engineer: Design Engineer for the IDF, providing technical design support during construction.

Construction Manager: Construction coordinator overseeing the IDF construction activities in the field and the Tank Farm Contractor's onsite technical representative.

Construction General Contractor: Responsible for overall construction activities and operations, including Construction Subcontractors.

Installer: Construction Subcontractor responsible for installation of geosynthetics (geomembrane, GCL, CDN, and geotextiles).

LCRS: Leachate collection and removal system.

LDS: Leak detection system.

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Manufacturer's descriptive data, specification sheets, literature, and other data as necessary to fully demonstrate that those materials proposed for use comply with the requirements of these Specifications.

Construction General Contractor shall submit required interface strength data as specified in PART 2--PRODUCTS prior to shipment of material to allow Engineer to evaluate if submitted material meets strength requirements for project design criteria. Allow Engineer 20 working days for this evaluation upon receipt of data.

Installation Plan: The Construction General Contractor shall submit an installation plan describing the proposed methods for geomembrane deployment, panel layout, seaming, repair, and protection. The installation plan shall provide for no field seam locations within the LCRS sump trough under the leachate collection and riser pipes. Construction General Contractor shall orient panel layout such that one full panel width spans the LCRS sump trough. The plan shall also include a quality control program for the Construction General Contractor's activities related to geomembrane installation.

Manufacturer's Quality Control (QC) test data for geomembrane composition and properties as specified in paragraph MANUFACTURING QUALITY CONTROL - POLYETHYLENE GEOMEMBRANES.

Manufacturer's QC certification as specified herein.

The Construction General Contractor shall submit Geomembrane Installer's organizational and seaming personnel qualifications, and other as required to provide the information described in these Specifications.

The Construction General Contractor shall submit Geomembrane Installer's Certificate of Subgrade Acceptability to the CQA Certifying Engineer as specified herein.

Calibration certification for construction quality control test equipment.

SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR):

Documentation of test results from construction quality control testing.

CONSTRUCTION QUALITY ASSURANCE (CQA):

CQA Plan: A CQA Plan has been prepared as part of the landfill design. The CQA Plan discusses the testing procedures that will be followed by the CQA Certifying Engineer during installation of the geosynthetics (geotextile, CDN, geomembrane, GCL) and the documentation of the process. The CQA Plan is made part of these Specifications by reference. The Construction General Contractor shall conform to the requirements of the CQA Plan for all aspects of the geosynthetics, including submittals, supply, storage, installation, testing, documentation, covering, and protection.

Quality assurance procedures are presented in the CQA Plan. The Construction General Contractor shall accommodate all quality assurance activities described in this section and in the CQA Plan for this project.

Prior to placing any materials over the installed geomembrane, the Construction General Contractor shall allow time for acceptance of the Work as listed in the CQA Plan.

CQA CONFORMANCE TESTING:

Upon delivery of the rolls of geomembrane, the CQA Certifying Engineer will obtain samples at a frequency of one per production lot or one per 50,000 square feet of geomembrane, whichever results in greater number of tests. The CQA Certifying Engineer will test the samples to determine conformance to both the design specifications and the list of guaranteed properties.

As a minimum, tests to determine the following characteristics will be performed on geomembranes:

Thickness (ASTM D5994).

Tensile characteristics (yield strength, elongation at yield; ASTM D638).

Asperity (GM-12).

Puncture resistance (ASTM D4833).

Where optional procedures are noted in the test method, the requirements of these Specifications will prevail.

Sampling Procedures: Samples will be taken across the entire width of the roll and will not include the first 3 feet. Unless otherwise specified, samples will be 3 feet long by the roll width. The CQA Certifying Engineer will mark the machine direction on the samples with an arrow.

The CQA Certifying Engineer shall be allowed to remove samples for testing and other activities. Sample dimensions, procedures, and frequency shall be the same as those specified in the CQA Plan. The Construction General Contractor shall assist the CQA Certifying Engineer as necessary in all sampling and testing activities.

Procedures for samples that fail conformance testing are outlined in the CQA Plan. The cost of additional conformance testing to demonstrate compliance of failed samples shall be borne by the Construction General Contractor.

WARRANTY:

The geomembrane manufacturer(s) shall provide warranties on all geomembrane materials installed at the project site. The warranties shall be provided to the Construction General Contractor as purchaser with the Tank Farm Contractor named as beneficiary and shall be signed by an authorized representative of the geomembrane manufacturer. The terms of the warranties shall, at a minimum, include the provisions contained in the most recent version of GRI Test Method GM-13.

PART 2--PRODUCTS

GENERAL:

Type: High density polyethylene (HDPE). Unreinforced, 60-mil nominal thickness, textured both sides.

Manufacturer: The HDPE geomembrane manufacturer(s) shall have a minimum of 5 years of experience as a commercial manufacturer of HDPE geomembranes for landfill applications. Examples of potential manufacturers include: GSE Lining Technology, Inc., Houston, TX; and Poly-Flex, Inc., Grand Prairie, TX. Use of these examples is not intended to restrict potential manufacturers.

REQUIRED PROPERTIES - POLYETHYLENE GEOMEMBRANES:

Use of Recycled Polymer: The raw material shall be new polyethylene resin containing no more than two percent clean recycled polymer by weight. Two percent recycled polymer shall not include any finished sheet material that has actually seen some type of service performance. Regrind, reworked, or trim materials in the form of chips or edge strips that have not actually seen some type of use may be added, if the material is from the same manufacturer and is the same formulation as the geomembrane being produced.

Resin Properties: The resin shall meet the following Specifications:

HDPE:

Resin Specific Gravity (ASTM D1505): >0.932.

Melt Index (ASTM D1238 Condition 190/2.16): 0.1-1.1 g/10 min.

Finished Sheet Properties: The physical, mechanical, and environmental properties of the finished sheet shall meet or exceed the values specified in Table 1 contained in this part of the Specifications. Where applicable, values in Table 1 are Minimum Average Values.

Required Interface Shear Strength Data: Provide data prior to material shipment for the interface friction angle between the textured geomembrane and other materials (including CDN, GCL, and Admix Liner) directly in contact with the geomembrane as specified in

Article SUBMITTALS. Perform two interface shear strength tests on each interface under each set of normal loads.

Friction angle shall be determined by direct shear testing under fully saturated conditions (ASTM D5321 or D6243 for GCL interface) at both low normal loads of 100, 250, and 500 pounds per square foot (psf), and high normal loads of 2,000, 8,000, and 15,000 psf. Report results for both peak and large displacement (minimum 2 inches) strength.

The Engineer will review this data for conformance with project strength requirements. Construction General Contractor shall not order material for shipment until approved by Engineer. Any product or material changes required as a result of inadequate strength data will be addressed by Change Order provided submitted material meets all other requirements of this section.

MANUFACTURING QUALITY CONTROL - POLYETHYLENE GEOMEMBRANES:

Quality Control Testing: Quality control testing shall be carried out by the manufacturer to demonstrate that the geomembrane meets the Specifications in this section. Additional testing may be carried out for purposes of determining conformance by the CQA Certifying Engineer. If the results of the manufacturer's and the CQA Certifying Engineer's testing differ significantly, the testing shall be repeated by the CQA Certifying Engineer, and the manufacturer shall be allowed to monitor this testing. The results of this latter series of tests will prevail, provided that the applicable test methods have been followed.

Required Information: Prior to the delivery of any geomembrane material, the manufacturer shall submit the following information:

The origin (resin supplier's name, resin production plant), identification (brand name, number), and production date of the resin.

A list of quantities and descriptions of materials other than the base polymer which comprise the geomembrane.

Copies of the quality control certificates issued by the resin supplier.

Reports on the tests conducted by the manufacturer to confirm that the quality of the resin used to manufacture the geomembrane satisfies these Specifications.

A statement that recycled polymer (if any) is clean and does not exceed 2 percent by weight.

A properties sheet including, at a minimum, all specified properties, measured using test methods indicated in these Specifications, or equivalent.

Reports on the tests, including sampling procedures, conducted by the manufacturer to confirm that the geomembrane meets the Specifications.

A certification that property values given in the properties sheet are guaranteed by the geomembrane manufacturer.

QC Certification: Prior to shipment, the geomembrane manufacturer shall provide a quality control certificate for each roll of geomembrane. The quality control certificate shall be signed by a responsible party employed by the geomembrane manufacturer, such as the production manager. The quality control certificate shall include:

Roll numbers and identification, resin lot, and batch numbers.

Sampling procedures and results of quality control tests. As a minimum, results shall be given for thickness, asperity, tensile strength, and tear resistance in accordance with methods indicated in these Specifications. Tests shall be conducted on each production lot of geomembrane or every 50,000 square feet, whichever results in the greater number of tests.

Manufacturing Plant Visit: The manufacturer shall allow the CQA Certifying Engineer or his designated representative to visit the manufacturing plant, if the CQA Certifying Engineer so chooses. If possible, the visit shall be prior to or during the manufacturing of the geomembrane rolls for the specific project. The CQA Certifying Engineer or his designated representative shall review the manufacturing process, quality control, laboratory facilities, and testing procedures. During the visit, visiting personnel will also:

Confirm that the measurements of properties by the manufacturer are properly documented and test methods used are acceptable.

Spot inspect the rolls and confirm that they are free of holes, blisters, or any sign of contamination by foreign matter.

Review packaging and transportation procedures to confirm that these procedures are not damaging the geomembrane.

Confirm that roll packages have a label indicating the name of the manufacturer, type of geomembrane, thickness, and roll number.

If applicable, confirm that extrusion rods and/or beads are derived from the same base resin type as the geomembrane.

The geomembrane manufacturer shall accommodate these activities.

EXTRUDATE:

Extrudate for Fusion Welding of HDPE Geomembrane: Formulated from same HDPE resin as geomembrane and shall meet applicable physical property requirements.

FIELD-FABRICATED BOOTS:

Pipes and other structures penetrating the lining system shall be sealed to the geomembrane with fabricated boots made of the same material and workmanship as the lining system geomembrane. The flange portion of each boot shall match the angle of the slope or bottom, be sealed to the geomembrane, and fit smoothly without folds or stretching of the material.

SEALANT CAULKING:

Where shown on the Drawings, the caulking used shall be a one-component sealant formulated of butyl rubber and other selected ingredients, equivalent to Biddle Co., St. Louis, MO, Butylgrip Sealant, or as recommended by the manufacturer of the geomembrane materials.

STAINLESS STEEL CLAMPS:

As indicated on the Drawings, clamps shall be used to secure the HDPE geomembrane to pipes, poles, or risers that are intended to protrude through the cover. One-half-inch wide clamps shall meet or exceed specifications for "Make-a-Clamp" as manufactured by Breeze Clamp Products Division, Federal Laboratory, Inc., Saltsburg, PA.

BUTYL MASTIC TAPE:

Shall be as manufactured by Tremco, Cleveland, OH; or of a type recommended by HDPE geomembrane manufacturer.

NEOPRENE RUBBER PAD:

As indicated on the Drawings, neoprene rubber shall be used as compression strip beneath the stainless steel clamps (ASTM D2240). One-half-inch thick neoprene rubber shall be 35 to 40 durometer hardness, as supplied by Aero Rubber Co., Inc., Bridgeview, IL, or approved equal. Cut to a continuous 2-inch wide piece of neoprene to form the gasket. Neoprene rubber contact cement recommended by the supplier shall be used to bond butt ends of joined strips and to bond neoprene rubber in position on surface. Butt joints in neoprene strips shall be offset from adjacent joints by at least 6 inches.

TENSIOMETER FOR FIELD TESTING:

Motor driven with jaws capable of traveling at measured rate of 2 inches per minute. Equipped with gauge which measures force in unit pounds exerted between jaws.

PLYWOOD SHEETING:

Use APA rated sheeting EXT for protection of the HDPE geomembrane at termination edges on south side of Phase I.

PART 3--EXECUTION

GENERAL:

Personnel Qualifications - Polyethylene Geomembranes:

Installer Organization: At a minimum, the Construction General Contractor organization shall have successfully completed at least five projects consisting of installation of at least 5,000,000 square feet (total) of HDPE liner. Projects shall include RCRA landfills.

Seaming Personnel: All personnel performing seaming operations shall be qualified by experience or by successfully passing seaming tests similar to those described in this section. The superintendent and lead welder foreman shall have experience seaming a minimum of 1,000,000 square feet of polyethylene geomembrane using the same type of seaming apparatus proposed for use on this project. These individuals shall provide direct supervision over less experienced seamers. No field seaming shall take place without one of these individuals being present. Key personnel are defined as the superintendent, foreman, and lead welder. Key personnel shall be full time employees of the Geosynthetics Installer.

Applicability: The primary and secondary geomembranes shall be installed at the locations, lines, and grades shown on the Drawings. All geomembranes shall be installed in accordance with these Specifications and the CQA Plan.

Installation Plan: Prior to beginning geomembrane installation, the Construction General Contractor shall submit a plan describing the proposed size, number, position and sequence of geomembrane panel placement, and location of field seams.

SOIL BENTONITE LINER SURFACE PREPARATION - POLYETHYLENE GEOMEMBRANES:

The Construction General Contractor shall be responsible for preparing the surface of the soil bentonite liner for the geomembrane. Prepare the underlying soil surface as specified in Section 02319, SUBGRADE PREPARATION, and as approved by the Geomembrane Installer.

The Geomembrane Installer shall certify in writing that the surface on which the geomembrane will be installed is acceptable. The certificate of acceptance shall be given by the Installer to the Construction General Contractor prior to commencement of geomembrane installation in the area under consideration. The CQA Certifying Engineer shall be given a copy of this certificate by the Construction General Contractor. The form for Geomembrane Installer certification is provided as Supplement to this Specification. Submittal of this form only applies to soil surfaces underlying the geomembrane. In this case Geomembrane Installer Certification of Subsurface Acceptability is only required for the surface on which the secondary geomembrane shall be installed.

After the admix liner surface has been accepted by the Installer, it shall be the Installer's responsibility to indicate to the Construction General Contractor any change in the admix liner surface condition that may require repair work.

Special care shall be taken to avoid desiccation cracking or freezing of the soil bentonite liner. Specifications for allowable desiccation cracking of soil liner and repair measures are contained in Section 02666, ADMIX LINER. The surface of the admix liner shall be maintained in the required condition throughout the course of geomembrane installation.

ANCHOR TRENCH EXCAVATION AND BACKFILLING:

The anchor trench shall be excavated to the lines and widths shown on the design Drawings, prior to geomembrane placement. The corners of the trench shall be rounded so as to avoid sharp bends in the geomembrane. No loose soil shall be allowed to underlie the geomembrane in the anchor trench. Backfill with material as shown on the Drawings and compact as specified in Section 02320, TRENCH BACKFILL.

GEOMEMBRANE PLACEMENT - POLYETHYLENE GEOMEMBRANES:

Field Panel Identification: A field panel is the unit area of geomembrane which is to be seamed in the field. Two cases are defined:

> If the geomembrane is fabricated into panels in a factory, a field panel is a factory panel or a portion of factory panel cut in the field.
>
> If the geomembrane is not fabricated into factory panels, a field panel is a roll or a portion of roll cut in the field.

It will be the responsibility of the CQA Certifying Engineer to assign each field panel an "identification code" (number or letter-number) consistent with the layout plan. This identification code shall be agreed upon by the Construction Manager, Installer, and CQA Certifying Engineer. This field panel identification code shall be as simple and logical as possible. (Note that roll numbers assigned in the manufacturing plant are usually cumbersome and are not related to location in the field.)

The CQA Certifying Engineer will establish a table or chart showing correspondence between roll numbers, factory panels, and field panel identification codes. The field panel identification code shall be used for all quality assurance records, including Installer's quality control (QC) testing.

Field Panel Placement:

> Location: Field panels shall be installed at the locations indicated in the Installer's layout plan, as approved or modified.

Installation Schedule: In general seaming of geomembrane will be performed the same day as deployment. However, at the discretion of Geosynthetic Installer, seaming may be carried over to the following workday.

Placement Conditions: Geomembrane placement shall not proceed at an ambient temperature below 32 degrees F or above 104 degrees F as measured 6 inches above the geomembrane surface unless installation procedures approved by the CQA Certifying Engineer are in place to address environmental conditions. Geomembrane placement shall not be done during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, or in the presence of excessive winds. Placement methods shall prevent damage to underlying soil liner or geosynthetic materials.

Factors such as expansion, contraction, overlap at seams, anchorage requirements, seaming progress, and drainage shall be considered. Textured-surface sheets shall be aligned in a manner which maximizes their frictional capabilities along the slope. Maneuver sheets of geomembrane into place in a manner which prevents wrinkles, folds, or similar distress which can damage the geomembrane or prevent its satisfactory alignment or seaming. A smooth-surface HDPE geomembrane rub sheet shall be used when placing textured HDPE geomembrane over underlying GCL. The rub sheet shall be maintained in good condition without tears, rough edges, holes, or scuff marks that can catch, displace, or otherwise disturb the underlying GCL, or the overlying geomembrane.

Damage: Damaged panels or portions of damaged panels which have been rejected shall be removed from the work area. Any repairs shall be made according to procedures described in this Part of the Specifications.

Exposed Geomembrane Protection: After panel deployment, all geomembrane, except those shown as permanently exposed on the Drawings, shall be covered to within a maximum period of 10 working days to minimize exposure to temperature cycles that cause expansion/ contraction of the geomembrane and desiccation of the underlying admix liner. Geomembrane panels shall be covered by other geosynthetic components of the lining system or overlying soil cover materials as shown on the Drawings.

FIELD SEAMING - POLYETHYLENE GEOMEMBRANES:

Seaming Equipment and Products: Approved processes for field seaming are extrusion welding and fusion welding, except that use of extrusion welding shall be limited to areas (such as sumps or repairs) where fusion welding cannot be employed. Proposed alternate processes shall be documented and submitted by the Installer to the Construction Manager and CQA Certifying Engineer for approval. Only equipment which has been specifically approved by make and model shall be used.

Extrusion Process: The extrusion-welding machine shall be equipped with gages capable of measuring the temperature at the nozzle or the preheat temperature.

The Installer shall provide documentation regarding the extrudate and shall certify that the extrudate is compatible with these Specifications and is comprised of the same resin type as the geomembrane sheeting.

The Installer shall comply with the following:

The Installer shall maintain on-site a sufficient number of spare operable seaming machines (at least one at all times) to ensure continuous operation.

The equipment used for seaming shall not be likely to damage the geomembrane.

The extruder shall be purged prior to beginning a seam until all heat-degraded extrudate has been removed from the barrel.

The electric generator shall be placed on a smooth base such that no damage occurs to the geomembrane.

Grinding shall be completed no more than 1 hour prior to seaming. A smooth insulating plate or fabric shall be placed beneath the hot welding machine after usage.

The geomembrane shall be protected from damage in heavily trafficked areas.

Fusion Process: The fusion-welding machines shall be automated vehicular-mounted devices. The fusion-welding machines shall be equipped with gages giving the pertinent temperatures.

The Installer shall comply with the following:

The Installer shall maintain on site a sufficient number of spare operable seaming machines (at least one at all times) to ensure continuous operations.

The equipment used for seaming shall not be likely to damage the geomembrane.

For cross seams, the edge of the cross seam shall be ground to a smooth incline (top and bottom) prior to welding.

The electric generator shall be placed on a smooth base such that no damage occurs to the geomembrane.

A smooth insulating plate or fabric shall be placed beneath the hot welding machine after usage.

The geomembrane shall be protected from damage in heavily trafficked areas.

If a build-up of moisture is observed prior to seaming a movable protective layer shall be used directly below each overlap of geomembrane to be seamed to prevent buildup of moisture between the sheets.

Seam Layout:

In general, seams shall be oriented parallel to the line of maximum slope, i.e., oriented up and down, not across, the slope to the maximum extent practical. In corners and odd-shaped geometric locations, the number of seams shall be minimized. No seams shall be permitted within the LCRS sump trough for leachate collection and riser pipes. One full panel width shall span the LCRS sump trough.

On the landfill floor:

No horizontal seam shall be less than 5 feet from the toe of the slope, or other area of potential stress concentrations.

Over the LCRS and LDS sump areas in each cell, no horizontal seam shall be placed less than 150 feet from the toe of the north slope for a distance of at least 100 feet in each direction from the LCRS and LDS sump centerline.

Seams shall be aligned to produce the fewest possible number of wrinkles and "fishmouths."

A seam numbering system consistent with the panel numbering system shall be utilized.

Weather Conditions for Seaming: The allowable weather conditions for seaming are as follows:

Unless authorized in writing by the Construction Manager, no seaming shall be attempted at ambient temperatures below 32 degrees F or above 104 degrees F as measured 6 inches above the geomembrane surface.

The geomembrane shall be dry, protected from wind, and free of dust.

If the Installer wishes to use methods which may allow seaming at ambient temperatures below 32 degrees F, the Installer shall certify in writing that the quality of the seams welded at these temperatures is the same as the quality of seams welded at temperatures above 32 degrees F. In addition, if the Installer wishes to seam at ambient temperatures below 32 degrees F, the following conditions shall be satisfied in addition to the general seaming procedures:

For extrusion welding, preheating shall be performed. Preheating may be waived by the Construction Manager if it is demonstrated to the satisfaction of the CQA Certifying Engineer that welds of equivalent quality may be obtained without preheating at the expected temperature of installation.

Sheet grinding, if required, may be performed before preheating.

Observe all areas of the geomembrane that have been preheated to determine that they have not been subjected to excessive melting.

Confirm that geomembrane surface temperatures have not decreased below the minimum specified for welding, due to wind or other adverse conditions. Wind protection for the seam area may be required.

Trial seams, as described in paragraph Trial Seams of this section, shall be made in the immediate area where seaming will occur, under the same ambient temperature and preheating conditions as the actual seams. New trial seams shall be made if the ambient temperature decreases by more than 5 degrees F from the previous trial seam conditions. Such new trial seams shall be conducted as soon as seams in progress during the temperature drop have been completed.

Additional destructive seam tests, as described in paragraph Destructive Seam Strength Testing of this section, shall be performed at intervals of 250 to 500 feet of seam length at the CQA Certifying Engineer's discretion.

The Installer shall provide sample coupons cut from each end of the seam.

Seam Preparation:

Cleaning: Prior to seaming, the seam area shall be clean and free of moisture, dust, dirt, debris of any kind, and foreign material. Special attention shall be paid to cleaning the existing geomembrane at tie-in locations.

Overlap: Cross slope seams on both the trench floor and sideslopes shall be overlapped so that liquids are not trapped, i.e., seams shall be shingled downslope. If seam overlap grinding is required, the process shall be completed according to the geomembrane manufacturer's instructions within 1 hour of the seaming operation, and in a way that does not damage the geomembrane. Panels of geomembrane shall

have a finished overlap of a minimum of 3 inches for extrusion welding and 5 inches for fusion welding.

Use of Solvents: No solvent or adhesive shall be used.

Temporary Bonding: The procedure used to temporarily bond adjacent panels together shall not damage the geomembrane; in particular, the temperature of hot air at the nozzle of any spot welding apparatus shall be controlled such that the geomembrane is not damaged.

General Seaming Procedure: The general seaming procedure used by the Installer shall be as follows:

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

If required, a firm substrate shall be provided by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support.

If seaming operations are carried out at night, adequate illumination shall be provided.

"Fishmouths" or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut "fishmouths" or wrinkles shall be seamed, and any portion where the overlap is inadequate shall then be patched with an oval or round patch of the same geomembrane extending a minimum of 6 inches beyond the cut in all directions.

CONSTRUCTION QUALITY CONTROL TESTING - POLYETHYLENE GEOMEMBRANES:

General: Testing requirements specified herein are intended for the Construction General Contractor (and Geomembrane Installer) during geomembrane installation. Testing requirements for the CQA Certifying Engineer are provided in the CQA Plan.

Trial Seams: Trial seams shall be made on fragment pieces of geomembrane liner to verify that seaming conditions are adequate. A trial seam shall be made prior to each seaming period (maximum of 6 hours) for each seaming machine used that day. Also, each seamer shall make at least one trial seam each day. Trial seams shall be made under the same conditions as actual seams.

The trial seam sample shall be at least 2 feet long by 1 foot wide (after seaming) with the seam centered lengthwise. Seam overlap shall be as indicated in this Part.

Test three specimens for peel and two specimens for shear. Each specimen shall be at least 1 inch wide and shall be cut from the trial seam sample by the Installer. The specimens shall be tested respectively in shear and peel using a field tensiometer, and

they shall not fail in the seam. All trial seam specimens must meet the minimum requirements of Table 2, Required Seam Properties, for trial seam acceptance. If a specimen fails, the entire operation shall be repeated. If the additional specimen fails, the seaming apparatus and seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful full trial seams are achieved.

All test equipment shall be in calibration and conform to manufacturer's specifications. The Installer shall provide the Construction Manager and CQA Certifying Engineer with current calibration certificates.

Nondestructive Seam Continuity Testing:

General: The Installer shall nondestructively test all field seams over their full length using a vacuum test unit, air pressure test (for double fusion seams only), or other approved method (i.e., spark test). Vacuum testing and air pressure testing are described below. The purpose of the nondestructive test is to check the continuity of seams. It does not provide any information on seam strength. Continuity testing shall be done as the seaming work progresses. Nondestructive testing will not be permitted before sunrise or after sunset unless the Construction General Contractor demonstrates to the CQA Certifying Engineer their capability to perform testing under reduced light conditions. Any seams which fail nondestructive testing shall be repaired in accordance with these Specifications. Seams which cannot be nondestructively tested because of seam geometry shall be double welded or capped.

All test equipment shall be in calibration and conform to manufacturer's specifications. The Installer shall submit current calibration certificates.

Vacuum Testing: The equipment shall be comprised of the following:

A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole or valve assembly, and a vacuum gage.

A steel vacuum tank and pump assembly equipped with a pressure controller and connections.

A rubber pressure/vacuum hose with fittings and connections.

A bucket and wide paint brush.

A soapy solution.

The following procedures shall be used:

Energize the vacuum pump and reduce the tank pressure to a minimum of 5 inches of mercury.

Wet a strip of geomembrane approximately 12 inches wide by 48 inches long with the soapy solution.

Place the vacuum box over the test area.

Close the bleed valve and open the vacuum valve.

Ensure that a leak tight seal is created.

For a period of not less than 10 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.

If no bubbles appear coming from the seam after 10 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3-inch overlap, and repeat the process.

All areas where soap bubbles appear shall be marked and repaired in accordance with this Part.

Air Pressure Testing: The following procedures are applicable only to those processes which produce a double seam with an enclosed air channel. All double seams with an enclosed air channel shall be air pressure tested. The equipment shall be comprised of the following:

An air pump (manual or motor driven) capable of generating and sustaining a pressure of 60 to 65 psi.

A rubber hose with fittings and connections.

A sharp hollow needle, or other approved pressure feed device.

A calibrated pressure gage capable of reading pressures up to 65 psi.

The following procedures shall be used:

Seal both ends of the seam to be tested.

Insert needle with pressure gage, or other approved pressure feed device, into the air channel created by the fusion weld.

Energize the air pump and pressurize the channel to a minimum 25 psi for a 1/2-inch wide channel, or 55 psi for a 1-inch wide channel. Close the valve and sustain the pressure for a minimum of 5 minutes.

If loss of pressure exceeds 2 psi, or does not stabilize, locate faulty area and repair in accordance with this section. If significant changes in geomembrane temperature occur during the test (e.g., due to cloud cover), the test shall be repeated after the geomembrane temperature has stabilized.

Cut end of seam opposite to the pressure gage and observe that the pressure drops. If the pressure does not drop, locate the obstruction(s) in the seam, repair, and retest seam.

Remove needle or other approved pressure feed device and repair seam.

Destructive Seam Strength Testing:

General: Destructive seam tests shall be performed at selected locations. The purpose of these tests is to evaluate seam strength. Seam strength testing shall be done as the seaming work progresses. The samples shall meet the requirements of Table 2, Required Seam Properties.

All test equipment shall be in calibration and conform to manufacturer's specifications. The Installer shall submit current calibration certificates.

Each sample shall be tested for bonded seam shear and peel strength by an independent testing laboratory.

Test at least five specimens for each seam test method (shear and peel). Four out of five specimens must meet the minimum requirements of Table 2, Required Seam Properties, for field seam acceptance.

Location and Frequency: Destructive seam samples shall be obtained from actual fabricated field seams as work progresses, not at the completion of field seaming. The CQA Certifying Engineer will select locations where seam samples will be removed.

Sampling frequency shall be a minimum of one sample per 500 feet of seam length per welding machine (this minimum frequency shall be determined as an average taken from all the panels, including welds for caps), or a minimum of two samples per factory panel, whichever gives the largest number of samples. If agreed by all parties (Construction General Contractor, Construction Manager, and the CQA Certifying Engineer) the frequency of destructive seam testing may be reduced to one sample per 1,000 feet of seam if test results and other nondestructive seam tests appear adequate for assuring seam quality. If, based on the specified test frequency, a destructive test location should fall within the LCRS or LDS sump area (as shown on the

Drawings), the distance between destructive tests shall be reduced to relocate the destructive test location outside the sump area.

Sampling Procedures: Samples shall be cut by the Installer as the seaming progresses in order to provide laboratory test results before completion of installation. The CQA Certifying Engineer shall assign a number to each sample, mark it accordingly, and record the sample location on the layout drawing.

All holes in the geomembrane resulting from destructive seam sampling shall be immediately repaired in accordance with repair procedures. The continuity of the new seams in the repaired area shall be tested as described in this Part.

Sample Size: The samples shall be minimum 12 inches wide by minimum 42 inches long with the seam centered lengthwise. One 1-inch wide strip shall be cut from each end of the samples, and these shall be tested in the field as described below. The remaining sample shall be distributed as follows:

One portion (minimum 12 inches by 12 inches) to the Installer for laboratory testing at his discretion.

One portion (minimum 12 inches by 12 inches) to the Construction Manager for archive storage.

One portion (minimum 12 inches by 18 inches) to the CQA Certifying Engineer for laboratory testing.

Field Testing: The two 1-inch wide strips described above shall be tested in the field by tensiometer for peel and shear and shall not fail in the seam. If any test sample fails to pass, then the procedures outlined below (Procedures for Areas Failing Destructive Tests) shall be followed.

The CQA Certifying Engineer will mark all samples and portions with its number. The CQA Certifying Engineer will also record the date and time, ambient temperature, number of seaming unit, name of seamer, welding apparatus temperatures and pressures, and pass or fail descriptions, and attach a copy to each sample portion.

Procedures for Areas Failing Destructive Tests: The following procedures shall apply whenever a sample fails a destructive test, whether that test is conducted by the independent testing laboratory, the Installer's laboratory, or by field tensiometer. The Installer has two options:

The Installer shall cap the seam between any two passing test locations, or

The Installer shall trace the seam to two intermediate locations 10 feet minimum from the point of the failed test in each direction and take a small

sample for an additional field test at each location. If these additional samples pass the test, then full samples shall be taken for laboratory testing. If these laboratory samples pass the tests, then the seam shall be capped between these locations. If either sample fails, then the sampling and testing process shall be repeated to establish the zone over which the seam shall be capped.

All acceptable capped seams shall be bounded by two locations from which samples passing CQA laboratory destructive tests have been taken. In cases where the length of the capped seam exceeds 150 feet, a sample of the capping seam shall be taken and shall pass destructive testing as described in this Part.

REPAIRS - POLYETHYLENE GEOMEMBRANES:

General: Any portion of the geomembrane exhibiting a flaw or failing a destructive or nondestructive test shall be repaired. All repairs shall be conducted in accordance with this Part. All repairs shall be subjected to the nondestructive seam testing procedures described in this Part.

Each patch or other type of repair will be numbered and recorded.

Repair Procedures:

Patching, used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter.

Grinding and rewelding, used to repair small sections (typically with a maximum length of no more than several inches) of extruded seams.

Spot welding or seaming, used to repair pinholes.

Capping, used to repair large lengths of failed seams or areas where large wrinkles or fish mouths have been cut to flatten the geomembrane sheet.

Topping, used to repair areas of inadequate seams which have an exposed edge. Topping shall be limited to an aggregate length of no more than 3 m (10 feet) on any given seam.

Removing bad seam and replacing with a strip of new material welded into place, used with large lengths of fusion seams.

For all repair methods, the following provisions shall be satisfied as applicable:

Surfaces of the geomembrane which are to be repaired shall be abraded no more than one hour prior to the repair.

All surfaces shall be clean and dry at the time of the repair.

Patches or caps shall extend at least 6 inches beyond the edge of the defect, and all corners of patches shall be rounded with a radius of at least 3 inches.

The geomembrane below large caps shall be appropriately cut to avoid water or gas collection between the two sheets.

Verification of Repairs: Each repair shall be numbered and recorded. Each repair shall be nondestructively tested using the methods described in this Part. Large caps may be of sufficient extent to require destructive test sampling. Repairs that fail nondestructive or destructive tests shall be redone and retested until a passing test is obtained.

PROTECTION OF TERMINATION EDGES:

Along the south termination of the geomembrane, and along any termination edges of the membrane that may be exposed or buried for extended periods of time prior to their joining to adjacent subsequent sections, the Construction General Contractor shall protect leading edges with protective (sacrificial) layers of cushion geotextile and plywood sheet as shown on the Drawings.

MATERIALS IN CONTACT WITH GEOMEMBRANE:

The requirements of this Part are intended only to assure that the installation of other materials does not damage the geomembrane. Additional requirements as established in other sections of these Specifications are necessary to assure that systems built with these other materials are constructed in such a way as to provide proper performance. Material requirements for operations layer and drain gravel are specified in Section 02315, FILL AND BACKFILL.

Requirements of this Part apply to geomembranes that are directly in contact with overlying soil or are covered with a layer of geotextile or geocomposite.

Do not place granular materials in manner that will cause wrinkles to fold over or become confined to form a vertical ridge. Maximum wrinkle height shall be 4 inches and spacing between wrinkles shall be greater than 10 feet prior to placement of granular materials over the geomembrane.

Minimum Thickness: Equipment used for spreading granular material shall not be driven directly on the geomembrane. A minimum thickness of 1 foot of granular material shall be maintained between spreading equipment and the geomembrane. A minimum thickness of 3 feet of granular material shall be maintained between rubber-tired hauling vehicles and the geomembrane. Construction haul vehicles shall have a maximum ground contact pressure of 25 psi.

Spreading Equipment: Equipment used for spreading granular material shall be a light low ground pressure dozer (such as a wide-pad Caterpillar D6M LGP or lighter), low ground pressure excavator (Bucyrus-Erie 325H with 0.91-m [36-in] wide treads or lighter), or approved equal, with a maximum ground contact pressure of 5 psi.

Spreading Operations: Spreading equipment operating on soil materials shall not spin their tracks, make sharp turns, or make sharp, rapid starts or stops. Soil materials shall be pushed carefully from previously placed material and not dumped directly onto geosynthetics except for the drain gravel in the LDS sump. This material shall be carefully dumped onto the geotextile. Cushion from a maximum height of 24 inches.

The spreading operation on the sideslope (3H:1V) shall begin at the lower elevations and shall proceed either upslope or laterally at about the same elevation such that a full layer of granular material is always covering the geomembrane downslope from the area being covered. In no case shall the lift thickness be less than the stated minimum. Material shall be placed in such a manner that no air is trapped underneath the geomembrane. Provide and maintain a means of continuously observing the depth of granular materials such as by freestanding markers until placement is complete, at intervals of 50 feet maximum each way. Sharpened stakes or methods that could damage the geomembrane will not be allowed.

## LINING SYSTEM ACCEPTANCE - POLYETHYLENE GEOMEMBRANES

The Installer shall retain all ownership of and responsibility for the geosynthetics in the lining system until acceptance by the Construction Manager.

The geosynthetic lining system will be accepted by the Construction Manager when all of the following requirements have been satisfied:

The installation is finished.

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

A written construction report, including "as built" drawings and all other installation documents, has been prepared by the CQA Certifying Engineer, sealed by a registered professional engineer, and received by the Construction Manager.

SUPPLEMENTS:

The supplements listed below, following "END OF SECTION," are a part of this Specification.

Table 1. Required Geomembrane Properties, 60-mil Textured HDPE.

Table 2. Required Seam Properties.

Geomembrane Installer's Certification of Subsurface Acceptability.

END OF SECTION 02661

## Table 1. REQUIRED GEOMEMBRANE PROPERTIES 60-MIL TEXTURED HDPE

| Property | Qualifier | Unit | Specified Value | Test Method |
|---|---|---|---|---|
| **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 | 0.1-1.1 | ASTM D1238 condition 190/2.16 |
| Asperity | min avg. value[1] | mils | 10 | GRI-GM12 |
| **Mechanical Properties** | | | | |
| Tensile Properties (each direction) | | | | ASTM D638 (Type IV) |
| 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 8 of 10 | category | 1 or 2 | ASTM D5596 |
| Environmental Stress Crack | minimum[3] | hrs | 200 | ASTM D5397 |

[1]Of 10 readings, 8 out of 10 must be greater or equal to 7 mils, and lowest individual reading must be greater or equal to 5 mils. Provide data for both sides of textured geomembrane.
[2]Yield elongation is calculated using a gauge length of 1.3 inches.
[3]Minimum = mean minus 3 standard deviations from documented manufacturer's quality control (MQC) testing.

## Table 2. REQUIRED SEAM PROPERTIES HDPE GEOMEMBRANES

| Property | Qualifier | Unit | Specified Value | Test Method |
|---|---|---|---|---|
| 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 |

[1]Also called "Bonded Seam Strength."
[2]FTB = Film Tear Bond (failure occurs through intact geomembrane, not through seam).

## GEOMEMBRANE INSTALLER'S CERTIFICATION OF SUBSURFACE ACCEPTABILITY

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

_____

_____

_____

_____

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

Signed:_____
Geomembrane Installer

_____
Date Signed

Signed:_____
Construction General Contractor

_____
Date Signed

SECTION 02666--ADMIX LINER

PART 1--GENERAL

REFERENCES:

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

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D698 | Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbs/ft$^3$) (600 Kn-m/m$^3$) |
| ASTM D422 | Method for Particle-Size Analysis of Soils |
| ASTM D2216 | Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass |
| ASTM D6391 | Standard Test Method for Field Measurement of Hydraulic Conductivity Limits of Porous Materials Using Two Stages of Infiltration from a Borehole |

DESCRIPTION:

This section describes the low permeability admix that will be used in the liner of the disposal facility. In addition requirements for base soil in the evaporation pond lining system are specified.

The admix liner is an admixture that consists of natural base soil which is mixed with bentonite and moisture conditioned.

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

The Construction General Contractor shall submit a detailed plan for preparation of the admix material, including a description of the equipment and procedures to be used, personnel qualifications, and methods for monitoring bentonite additions and moisture conditioning. This plan shall be approved by the Engineer prior to the start of admix production.

The Construction General Contractor shall submit an admix liner placement plan to specify lift thickness control and to allow for required testing, specified herein and described in the CQA Plan, on the soil liner during placement operations. This plan shall be approved by the Engineer prior to the start of admix placement.

Supplier's descriptive data, specification sheets, literature, and other data as necessary to fully demonstrate that the bentonite proposed for use in the admix complies with the requirements of these Specifications. The manufacturer shall certify that the bentonite furnished complies with these Specifications. A certificate shall be submitted to the CQA Certifying Engineer for each railcar or every three truckloads of bentonite delivered.

Certificates for equipment calibration.

CONSTRUCTION QUALITY ASSURANCE:

Construction Quality Assurance testing will be provided by the CQA Certifying Engineer and shall be performed in accordance with the CQA Plan. The Construction General Contractor shall make allowances for sampling and testing by the CQA Certifying Engineer in both his production operations and schedule.

Prior to placing any materials over the completed admix liner, the Construction General Contractor shall allow time for acceptance of the Work as listed in the CQA Plan. The Construction General Contractor shall accommodate all CQA testing and sampling activities, as specified in the CQA Plan (i.e., in addition to the QC testing), and shall repair sample locations as specified herein.

DEFINITIONS:

Grain Size: Determined by ASTM D422.

Imported Material: Meets requirements of this Specification and is obtained offsite and transported to site.

Natural Moisture Content: Determined by ASTM D2216.

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

Admix: Natural material (base soil), as specified in this section, that when mixed with bentonite.

Admix Liner: Compacted liner component consisting of admix materials, designed, formulated, and constructed to provide low-permeability barrier against infiltration of liquids or contaminants.

TOLERANCES:

Thickness of the admix liner shall be a minimum of 3 feet and tolerances for the top of admix grade shown on Phase I Primary Liner Plan shall be minus 0.1 foot to plus 0.3 foot. The minimum required thickness of the soil liner layer shall be maintained. The as-built

elevations of the underlying prepared subgrade shall be used as the basis for determining the final elevation of the soil liner layer.

PART 2--PRODUCTS

BENTONITE:

The bentonite shall be Bara-Kade 90, manufactured by Bentonite Performance Materials, Inc.; or approved equal. Do not provide calcium bentonites or chemically treated sodium bentonites.

The bentonite to be used in the admix shall consist of a commercially prepared material and shall have the following index properties:

High Swelling: Ability of 2 grams of base bentonite, when mechanically reduced to minus 100 mesh, to swell in water to an apparent volume of 20 cubic centimeters or more when added gradually to 100 cubic centimeters of distilled water contained in graduated cylinder.

Dry Fineness: 65 percent minimum passing No. 200 U.S. Sieve.

The Construction General Contractor shall provide suitable containers on site to store bentonite in a dry condition prior to use.

BASE SOIL:

The base soil for the admix liner shall consist of natural soil derived from the admix base soil borrow area shown on the Drawings, as specified in Section 02317, BORROW AREA EXCAVATION, or from site excavations. Base soil from either source shall not be excavated below a depth of 5 feet below ground surface (after stripping) without evaluation of the material suitability and approval from the Engineer. This material may be temporarily stockpiled at the stockpile area as shown on the Drawings, or within processing area within Phase I as approved by the Construction Manager.

Base soil excavated from dune sand borrow area or site excavation shall meet the following requirements: The base soil shall be free of roots, woody vegetation, frozen material, rubbish, and other deleterious material. Rocks greater than 1 inch in dimension shall not comprise more than 2 percent by weight of the base soil. Base soil shall have 20 percent minimum passing No. 200 U.S. Sieve. Base soil shall be screened or otherwise processed if necessary to meet this requirement.

For evaluating compliance with these requirements, test results shall be considered acceptable when the average value of the data satisfies the associated criterion. Testing and sampling frequency for base soil compliance is provided in the CQA Plan.

ADMIX LINER MATERIAL (ADMIX):

Composition: The admix shall consist of the base soil mixed with a nominal bentonite content of 12 percent by dry weight of base soil by dry weight. The acceptable range for bentonite content shall be a minimum of 11 percent and maximum of 14 percent of base soil by dry weight. The bentonite percentage and moisture content range may change as a result of preconstruction testing performed on the test pad as described in the CQA Plan, and may be modified by the Construction General Contractor with the approval of the Construction Manager, Engineer, and the CQA Certifying Engineer at any time during the admix processing to reflect changes in the base soil or other components. The moisture content and bentonite dispersion in the admix shall be uniform and homogenous. The finished admix shall be a uniform homogenous material.

CQA Testing: The admix shall be prepared by the Construction General Contractor and tested by the CQA Certifying Engineer in accordance with the CQA Plan. The Construction General Contractor shall make the admix stockpiles available to the CQA Certifying Engineer at all times for sampling, testing, or visual observation.

Raw Water Supply: See Section 02200, SITE PREPARATION, and the Drawings for information on raw water supply availability and requirements for admix processing and admix liner placement and compaction.

PART 3--EXECUTION

ADMIX PROCESSING:

Bentonite Use Monitoring: Record weight of bentonite used and volume of admix produced each day.

Processing Using Pugmill:

The Construction General Contractor shall process and condition admix material using a central type pugmill plant prior to compaction. The pugmill shall have automated controls to continuously control the established proportions of bentonite and water as ratios of the base soil. It shall have provisions to easily change the proportions. It shall be capable of maintaining a constant time of mixing and varying the rate of discharge so that the degree of mixing can be controlled if necessary to achieve complete mixing.

The Construction General Contractor shall provide all necessary equipment and labor to operate the pugmill, load material into pugmill, offload admix, and stockpile admix.

Equipment: Admix shall be prepared using a pugmill with the following characteristics and ancillary equipment:

Continuous mixing pugmill. Blades shall be adjustable for angular position on shafts and shall be reversible to retard flow of mix.

Belt scales on base soil, bentonite, and finished product belts.

Feed rate meters and totalizers for bentonite, base soil, and water.

Production rate meters and totalizers for finished product.

Variable speed hydraulic supply water pumps capable of producing 500 tons per hour of admixture.

Calibration:

After setting up the pugmill, it shall be calibrated to determine the accuracy of the feed rate for each material being mixed. When the feed controls are set at any desired rate, the measured accuracy shall be within 1 percent by weight of the indicated feed rate for the item being mixed. The accuracy will be determined by operating each feed control separately and collecting and weighing the material over a given period of time as determined by the CQA Certifying Engineer. The material shall be collected in a dump truck (or appropriate container) supplied by the Construction General Contractor, and the truck will be weighed by the Construction General Contractor and verified by the CQA Certifying Engineer before and after loading. During admix production, the CQA Certifying Engineer may request a recalibration of the feed rate for each material as described above.

All measuring equipment shall be calibrated and calibration certificates provided to the CQA Certifying Engineer prior to starting admix production.

Preparation Requirements:

The base soil shall be processed through a pugmill to add bentonite at the specified rate, to add additional water if required, and to provide mechanical mixing action required to homogeneously blend the bentonite and water into the mix. Additional mixing by rotovator or other approved means shall be performed at the Construction General Contractor's sole expense as required to further break down the soil clumps or if additional mixing is needed to achieve a homogenous blend of soil, water, and bentonite. The admix shall be broken down in size sufficiently to result in at least 80 percent of the soil clumps broken down to 1/2 inch in maximum size. Clods are defined as dry hard particles in the admix that cannot be remolded by hand pressure.

If mixing is found to be insufficient to produce a thoroughly blended, uniform mixture of base soil and bentonite, or the base soil and bentonite are not being mixed in the specified proportions, the Construction General Contractor shall stop production of admix material. The Construction General Contractor shall not restart production and installation of admix liner until procedures and equipment have been modified so that the specified material is produced. Admix liner that is installed without complete mixing or the correct percentage of bentonite shall be removed and modified by the Construction General Contractor to meet the

Specifications. After being modified to meet the Specifications, the material may be reinstalled in the lining. Additional work and delays caused by inadequate or incorrect mixing shall be performed at the Construction General Contractor's sole expense. The Construction General Contractor shall not change the bentonite application rate unless directed to do so by the Engineer in writing.

Admix shall be processed and allowed to cure at least 12 hours prior to placement. The Construction General Contractor shall be responsible for maintaining the moisture content of the admix within the specified limits. Admix that does not meet Specifications shall not be reused as feed stock unless approved by the Engineer and CQA Certifying Engineer.

TEST PAD(S):

Test pads for the admix liner shall be constructed as specified in Article ADMIX LINER PLACEMENT AND COMPACTION, by the Construction General Contractor to determine acceptable placement and compaction methods to produce a low-permeability admix liner that satisfies the requirements of this section. Both a horizontal and sideslope test pad shall be constructed. The location of the test pads will be designated by the Construction Manager and the CQA Certifying Engineer.

Test Pad Material: The Construction General Contractor will prepare a sufficient quantity of soil for the test pad in accordance with the requirements of Article ADMIX LINER MATERIAL. All specified procedures for mixing, conditioning, and stockpiling of the soil material will be followed.

Horizontal Test Pad Construction:

The test pad will be constructed on a horizontal surface within the limits of the IDF in an area representative of conditions beneath the waste disposal cells. The pad will be located in a well-drained area to prevent surface water intrusion or saturation of the test pad soils. The test pad location will be cleared and grubbed, and the subgrade will be compacted in the same manner anticipated for construction beneath the waste disposal cells. Prior to placement of the test pad materials, the Contractor's Site Superintendent and the CQA Certifying Engineer will evaluate the condition of the subgrade; areas containing potentially unsuitable materials will be replaced, or another location will be selected for the test pad.

So that the test pad will accurately represent the performance of the full-scale facility, the following guidelines will be followed:

Construction of the test pad will use the same soil materials, design specifications, equipment, and procedures as proposed for the full-scale facility.

The test pad will be constructed at least four times wider than the construction compactor drum width to be used for the full-scale facility and allow for

installation of field permeability testing per method ASTM D6391 or 50 feet minimum (whichever is greater). This is required to ensure a sufficient representative area for testing, avoiding the edges of the test pad. The test pad may be subdivided into "lanes" to facilitate evaluation of different compaction methods; however, the width of any individual lane shall be no less than twice the width of the construction compactor drum equipment.

The test pad will be long enough to allow construction equipment to achieve normal operating speed before reaching the area that will be used for testing or 80 feet minimum (whichever is greater).

The test pad will be constructed with at least six lifts to evaluate the methodology used to tie lifts together. Lift thickness will be as described in Article ADMIX PLACEMENT AND COMPACTION, and the total thickness of the test pad will be at least 3 feet.

The test pad constructed will include the removal and replacement of a portion of the soil to evaluate the method proposed for repairing defective portions of the full-scale liner as specified in Article REPAIR OF ADMIX LINER.

Sideslope Test Pad Construction:

The sideslope test pad will be constructed on a 3H:1V sideslope (within the lined area of Phase I) to evaluate compaction methods and performance on the sideslope. Field permeability testing is not required for sideslope test pad. Sideslope test pad will be used to demonstrate that compaction and placement methods to achieve acceptable moisture and density requirements can be achieved.

So that the test pad will accurately represent the performance of the full-scale facility, the following guidelines will be followed:

Construction of the test pad will use the same soil materials, design specifications, equipment, and procedures as proposed for the full-scale facility.

The test pad will be constructed at least four times wider than the widest piece of construction equipment to be used for the full-scale facility or 40 feet minimum (whichever is greater). This is required to ensure a sufficient representative area for testing, avoiding the edges of the test pad. The test pad may be subdivided into "lanes" to facilitate evaluation of different compaction methods; however, the width of any individual lane shall be no less than twice the width of the widest piece of construction equipment.

The test pad will be long enough to allow construction equipment to achieve normal operating speed before reaching the area that will be used for testing or 80 feet minimum (whichever is greater).

The test pad will be constructed with at least six lifts to evaluate the methodology used to tie lifts together. Lift thickness will be as described in Article SOIL BENTONITE PLACEMENT AND COMPACTION, and the total thickness of the test pad will be at least 3 feet.

Demonstrate the Following During Test Pad(s) Construction:

Base soil/bentonite mixing process prior to compaction.

Compaction equipment type, configuration and weight.

The method used to break down clods before compaction and maximum resulting clod size.

The speed of compaction equipment travelling over the test pad.

Moisture content of soil bentonite at time of compaction.

Lift thicknesses (compacted), compaction procedures, and number of passes for proposed compaction equipment.

Dry unit weight achieved and measured by field density testing.

Hydraulic conductivity of compacted test fill on undisturbed samples (Shelby Tubes) as described in the Construction Quality Assurance (CQA) Plan.

Field permeability of compacted test fill using ASTM D6391 (horizontal test pad only) as described in the CQA Plan.

Excavate at least four holes, each 3 feet square, through each completed pad for observation, sampling, and testing of compacted material. These holes shall be used for the purpose of demonstrating repair methods as specified herein.

No admix liner shall be placed until the associated test pad has been constructed and the results from all test methods indicate that the admix liner will satisfy the permeability requirements specified in this section. Testing for each test pad shall be as described in the CQA Plan. At the completion of the test pad(s), the CQA Certifying Engineer, as described in the CQA Plan, will prepare an interim report with recommendations for compaction and placement methods to be applied to the full-scale admix liner construction.

After all testing has been completed and approved, the material in the test pad can be used by the Construction General Contractor for liner construction provided that the material satisfies the requirements of these Specifications.

SUBGRADE PREPARATION:

As specified in Section 02319, SUBGRADE PREPARATION, Article PREPARED SUBGRADE FOR ADMIX LINER.

ADMIX LINER PLACEMENT AND COMPACTION:

Lift Thickness: Admix liner material, as specified in Article ADMIX LINER MATERIAL, shall be placed in loose lifts and compacted such that the compacted lift thickness is 6 inches or less. However, the first lift of admix liner placed over subgrade soils may be placed and compacted to a maximum thickness of 8 inches.

Placement methods shall prevent excessive mixing of admix liner with subgrade soil.

Compaction: The intent of this Specification is that admix liner shall be produced to meet an in-place performance specification of less than $1x10^{-7}$ cm/sec hydraulic conductivity within the limits of edge of liner shown on the Drawings. See paragraph Outside Edge of Liner in this Article for compaction and hydraulic conductivity requirements beyond edge of liner. The Construction General Contractor is responsible to develop and use compaction methods that produce the required relative compaction.

The moisture-density range of the compacted admix shall lie within a trapezoidal-shaped field with the following corners:

| Moisture Content (%) | Dry Density (pcf) |
|---|---|
| 8 | 126 |
| 12 | 110 |
| 14 | 126 |
| 19 | 110 |

Hydraulic Conductivity: The in-place compacted admix liner shall achieve a saturated hydraulic conductivity as listed below:

All field (in-situ) test results shall be $1 \times 10^{-7}$ cm/sec or less. Field (in-situ) hydraulic conductivity tests will be performed only on admix liner of the horizontal test pad.

All hydraulic conductivity during admix production placement will be verified on undisturbed Shelby tube samples (see ASTM D1587) obtained from in-place admix liner per the CQA plan and then tested in laboratory using methods as described in ASTM D5084.

Hydraulic conductivity will be verified on undisturbed samples from completed areas of the liner as described in the CQA Plan. The arithmetic average of laboratory test results on undisturbed Shelby tube samples shall be less than or equal to ~~2.~~ $5 \times 10^{-8}$ cm/sec, with no individual test result exceeding ~~5~~ $1 \times 10^{-7}$ ~~-8~~cm/sec. The

acceptable values for laboratory test results will be verified or adjusted prior to admix liner production placement based on the correlation of field and laboratory hydraulic conductivity test results from the horizontal test pad. The final laboratory hydraulic conductivity requirement will be approved by the CQA Certifying Engineer and documented in the horizontal test pad report.

Outside Edge of Liner: Admix liner shall be placed in maximum 6-inch compacted lift thickness. Compact admix liner to minimum 92 percent relative compaction from optimum moisture content to 4 percent wet of optimum. Performance specification for admix hydraulic conductivity do not apply to admix placed beyond edge of liner.

Uniformity: The compacted soil distribution and gradation throughout the liner shall be free from lenses, pockets, streaks, layers, or material differing substantially in texture, moisture content, dry density, or gradation from surrounding material. The admix liner material shall be free of organic debris, frozen material, rubbish, construction debris, and other deleterious material. Any soil containing unacceptable material shall be removed and discarded in the permanent stockpile, placed in accordance with Section 02315, FILL AND BACKFILL.

Moisture Conditioning: The moisture content of the admix liner shall be uniform throughout each lift prior to and during compaction of the material. If the moisture content of a lift of compacted admix liner falls below the acceptable limit during placement operations, the Construction General Contractor shall moisture condition the dry soil and re-compact the lift prior to placement of additional lifts. If the moisture content of a lift of compacted soil exceeds the acceptable limit due to precipitation or over watering, the Construction General Contractor, before placement of additional lifts, shall either allow the wet soil to dry back or remove the wet soil. If the admix liner material cannot be conditioned to meet the placement specifications, the material shall be removed and replaced with new admix liner.

When the final lift of admix liner placement will be interrupted for more than a few hours or when precipitation is imminent, as determined by the Contractor's Site Superintendent, the lift surface shall be sealed with a smooth drum roller to prevent excessive moisture infiltration. This surface shall be scarified with a rotovator, or other equivalent equipment, immediately prior to resuming soil placement. The Construction General Contractor shall verify that existing moisture content is within the range specified in Article ADMIX LINER PLACEMENT AND COMPACTION, prior to resumption of soil placement activities.

Placement Equipment: The Construction General Contractor shall place layers of the admix liner to form a continuous monolithic material. All admix liner shall be placed and compacted with a self-propelled pegfoot or padfoot roller compactor having a minimum operating weight of 68,000 pounds. Smaller compaction equipment may be used in limited areas as necessary provided that the required moisture/density, lift bonding and hydraulic conductivity can be achieved. Hydraulic conductivity performance specification for the admix liner will be verified in areas where the lighter equipment is used. Hauling and spreading equipment will not be considered as compaction equipment. The compactor feet shall be sufficiently long to knead (bond) new lifts into previously placed lifts. The feet shall be kept free of large amounts of dried soil that might restrict foot penetration or become

incorporated into the soil lift. The top of each lift may be scarified with a rotovator, or other equivalent equipment or procedures, prior to placing the subsequent lift. The final lift of admix liner may be compacted with a smooth drum roller provided that all other requirements are met.

Provide a smooth soil surface on the final lift prior to placement of the HDPE geomembrane as specified in Article SURFACE FINISHING.

Tie-in Areas: Where new admix liner is tied in to existing admix of a previous day's placement, any areas of the existing admix which are soft, cracked, or otherwise unsuitable shall be removed until acceptable material is exposed. Where new admix will be placed, the surface of the existing admix liner shall be scarified and moisture conditioned as described in this section. New admix liner shall be placed in accordance with the requirements of this section and shall be thoroughly kneaded into the existing admix liner to form a monolithic mass free of seams or other discontinuities.

Placement Method: Admix liner may be placed on the sideslopes in either horizontal lifts (along the contour) or in lifts parallel to the slope (up and down the slope). If admix liner is placed parallel to the slope, compaction equipment shall not spin their wheels or in any other way disturb the previously placed lifts. If this occurs, the Construction General Contractor shall place all of the admix liner in horizontal lifts.

Restrictions: Production, mixing, and stockpiling of admix or native clay soil shall be restricted to the area shown on the Drawings or within the Phase I footprint as approved by the Construction Manager.

SURFACE FINISHING:

The surface of the admix liner shall be trimmed to the design grades and tolerances as shown on the Drawings. The surface of the admix liner shall be rolled with a smooth-drum roller to remove all ridges and surface irregularities as specified in Section 02319, SUBGRADE PREPARATION. All wheel ruts in excess of depths specified in Section 02319, SUBGRADE PREPARATION, on the surface of the admix liner shall be repaired by the Construction General Contractor prior to placement of the geomembrane. Acceptable methods for repair of the admix liner are specified in Article REPAIR OF ADMIX LINER.

MAINTENANCE:

The Construction General Contractor shall maintain the admix liner surface in a condition suitable for geomembrane installation until the surface is covered. The admix liner shall be protected from desiccation or excessive moisture. This may be accomplished by periodic watering, exclusion of traffic, placement of a temporary removable plastic cover, or other methods. Desiccation cracks larger than 1 inch deep or 0.25 inch wide shall be excavated to the full depth of the crack and repaired as specified in Article REPAIR OF ADMIX LINER. In the event that the geomembrane cannot be installed within 12 hours after placement of the

final admix liner lift, the final lift of admix liner shall be constructed 4 to 6 inches thicker than required and cut to finish grade immediately before geomembrane deployment.

The Construction General Contractor shall take measures to prevent the admix liner from freezing. Lifts of admix liner shall not be placed on frozen surfaces. Geomembrane shall not be placed on a surface which is frozen or has been frozen and thawed until directed by the Construction Manager and the CQA Certifying Engineer.

REPAIR OF ADMIX LINER:

The Construction General Contractor shall repair the surface of any areas identified to be out of tolerance. The size of the repair area shall be as required to remove and/or repair defective areas of the admix liner. Repair as follows:

Remove soil that does not meet specifications.

Scarify surface and spray with water.

Place additional approved admix material.

Compact soil with self-propelled pegfoot or padfoot type compactor as described above.

Trim and roll the surface as described above to design grades and tolerances.

Alternative methods for repair of the admix liner will be allowed if submitted by the Construction General Contractor and approved by the Engineer and Construction Manager.

Construction General Contractor will repair small holes (up to a maximum 6-inch diameter) resulting from sampling and other CQA activities. Such holes shall be repaired by backfilling with admix liner or powdered bentonite material in lifts of no more than 2-inch thickness and hand tamping with a steel rod or other suitable device to firmly compact each lift.

CONSTRUCTION QUALITY ASSURANCE AND ACCEPTANCE:

Testing and criteria for admix liner acceptance is provided in the CQA Plan, which is made part of these Specifications by reference.

END OF SECTION 02666

# SECTION 02667--GEOSYNTHETIC CLAY LINER (GCL)

## PART 1--GENERAL

### REFERENCES:

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

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D4632 | Standard Test Method for Grab Breaking Load and Elongation of Geotextiles |
| ASTM D4643 | Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method |
| ASTM D4833 | Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products |
| ASTM D5084 | Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter |
| ASTM D5887 | Standard Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter |
| ASTM D5890 | Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liner |
| ASTM D5891 | Standard Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners |
| ASTM D5993 | Standard Test Method for Measuring Mass Per Unit of Geosynthetic Clay Liners |

### DESCRIPTION:

The Work includes supply and installation of geosynthetic clay liners (GCLs) for the landfill lining system as shown on the Drawings.

### SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Submit manufacturer's descriptive data, specification sheets, literature, and other data as necessary to fully demonstrate that the materials proposed for use comply with the requirements of these Specifications.

Submit manufacturer's quality control test results, written properties certification guarantee, and QC certificates, as specified in PART 2--PRODUCTS.

CONSTRUCTION QUALITY ASSURANCE (CQA):

Quality assurance procedures are presented in the CQA Plan. CQA Plan requirements are discussed in Section 02661, GEOMEMBRANES. The Construction General Contractor shall accommodate all quality assurance activities described herein and in the Construction Quality Assurance Plan (CQA Plan) for this project.

Prior to placing any materials over the installed GCL, the Construction General Contractor shall allow time for acceptance of the Work as listed in the CQA Plan.

CQA CONFORMANCE TESTING:

Prior to deployment of the GCL, CQA personnel will remove samples and forward them to an approved geosynthetics laboratory for testing to document conformance to both the design specifications and the list of guaranteed properties. Unless otherwise specified, samples shall be taken at a rate of one per lot or one per 50,000 square feet, whichever results in the greater number of tests. Samples shall be taken from any portion of the roll that has not been damaged. Unless otherwise specified, samples shall be 3 feet long by the roll width. The machine direction shall be marked on the samples with an arrow.

As a minimum, the following tests shall be performed on GCL:

1. Bentonite Swell Index: ASTM D5890.

2. GCL Index Flux: ASTM D5887.

3. Bentonite Mass per Unit Area: ASTM D5993.

The CQA Certifying Engineer shall be allowed to remove samples of GCL for testing and other activities. Sample dimensions, procedures, and frequency shall be the same as those specified in the CQA Plan. The Construction General Contractor shall assist the CQA Certifying Engineer as necessary in all sampling and testing activities.

Procedures for samples that fail conformance testing are outlined in the CQA Plan. The cost of additional conformance testing to demonstrate compliance of failed samples shall be borne by the Construction General Contractor.

PART 2--PRODUCTS

GCL:

GCL shall be BENTOMAT(R) DN as manufactured by Colloid Environmental Technologies Co. (CETCO), Arlington Heights, IL; or Bentofix NWL as manufactured by GSE Lining Systems, Houston, TX; or approved equal, and shall meet the following requirements:

| Property | Requirement | Test Method |
|---|---|---|
| Bentonite Mass/Area, lb/sq ft at 0% moisture content, MinARV | 0.75 | ASTM D5993 |
| Bentonite Fluid Loss, mL, MaxARV | 18 | ASTM D5891 |
| Bentonite Swell Index, mL/2g, MinARV | 24 | ASTM D5890 |
| Grab Strength, lb, Tested Dry, MinARV | 150 | ASTM D4632 |
| Peel Strength, lb, Tested Dry, MinARV | 15 | ASTM D4632 |
| Index Flux, $m^3/m^2/sec$, MaxARV<br>• 2 psi Water Head Pressure<br>• 5 psi Effective Confining Pressure | $1x10^{-8}$ | ASTM D5887 |
| Permeability with Water, cm/sec, MaxARV<br>• 2 psi Water Head Pressure<br>• 5 psi Effective Confining Pressure | $5x10^{-9}$ | ASTM D5084 |
| Finished GCL Roll Width, Feet, MinARV | 14 | Linear Measurement |
| Finished GCL Roll Length, Feet, MinARV | 150 | Linear Measurement |

The bentonite in the GCL shall be a sodium montmorillonite clay.

The GCL shall be manufactured so that the bentonite shall be continuously contained throughout the GCL and to support the geotextiles so that no displacement of the bentonite occurs when the material is unrolled, moved, cut, torn, or punctured. GCL products that utilize an alternate edge system with grooves cut in seam overlap areas are permitted subject to approval of the Engineer. Any adhesive used shall be inert, nontoxic, and water soluble. GCL materials made without the use of adhesives shall be stabilized to contain the granular bentonite by a process such as needle-punching or stitching through the top and bottom layers of geotextile and the bentonite.

Encapsulating geotextile materials shall be polypropylene, consisting of two nonwoven geotextile components which are needle-punched together. The nonwoven components of the GCL shall have a nominal mass per unit area of 6 ounces per square yard needle-punched geotextile.

Quality control testing shall be carried out by the manufacturer to demonstrate that the GCL meets the specifications in this section. Tests shall be conducted on each production lot of GCL or every 50,000 square feet, whichever results in the greater number of tests.

The manufacturer shall provide a written guarantee that the GCL has the properties listed on the specification sheet.

The GCL manufacturer shall provide a quality control certification that the GCL has the properties listed on the specification sheet for each roll of GCL shipped to the project site. The quality control certificate shall be signed by a responsible party employed by the manufacturer, such as the production manager. The quality control certificate shall include:

1. Roll numbers and production lot identification.

2. Results of manufacturer quality control tests.

3. Results of bentonite supplier quality control tests for bentonite used in GCL production.

ACCESSORY BENTONITE:

Accessory bentonite for seaming shall be as recommended by the GCL manufacturer.

TRANSPORTATION, HANDLING, AND STORAGE:

Transportation of the GCL shall be the responsibility of the manufacturer, and the Construction General Contractor. All handling on site shall be the responsibility of the Construction General Contractor.

Upon delivery at the site, the Construction General Contractor shall observe the surfaces of all rolls for defects and for damage. This inspection shall be conducted without unrolling rolls unless defects or damages are found or suspected. The Construction General Contractor will determine:

Rolls, or portions thereof, which should be rejected and removed from the site because they have severe flaws.

Rolls that are not properly labeled. No unlabelled rolls shall be used for any application. Unlabelled rolls shall be removed from the site and replaced at the Construction General Contractor's expense.

The Construction General Contractor shall be responsible for the storage of the GCL onsite. The Construction General Contractor shall provide storage space in a location as shown on the Drawings or as approved by the Construction Manager such that on-site transportation and handling are optimized to the extent possible. Storage space shall be protected from theft,

vandalism, passage of vehicles, etc. Stored GCLs shall be protected from moisture and other damaging conditions in accordance with the manufacturer's recommendations.

PART 3--EXECUTION

GENERAL:

Install GCLs at the locations, lines, and grades shown on the Drawings. All GCLs shall be installed in accordance with these Specifications.

Materials and Work which fail to meet the requirements of these Specifications shall be removed and disposed of at the Construction General Contractor's expense. This includes GCL rolls that are not labeled or where the label has deteriorated to the point of being illegible.

HANDLING AND PLACEMENT:

The Construction General Contractor shall handle and deploy all GCLs in such a manner as to ensure that they are not damaged.

SURFACE PREPARATION—GCL:

For the IDF project, GCL will be deployed over the CDN surface. GCL shall be placed over a firm, unyielding surface. Wrinkle height in the underlying CDN shall be minimized as to allow GCL deployment on a flat unyielding surface. Maximum wrinkle height for geosynthetics is specified in Section 02661, GEOMEMBRANES.

DEPLOYMENT:

GCL shall be deployed so that seams run up and down (not across) the slope.

Prior to placement of cover material over the GCL and HDPE geomembrane, the moisture content of the bentonite component of the GCL shall not exceed 100 percent. Only areas of GCL suspected of exposure to excessive moisture, in the judgement of the CQA Certifying Engineer, shall be sampled for moisture content. GCL panels with bentonite component moisture content greater than 100 percent shall be removed and replaced at Construction General Contractor's expense, regardless of the source of moisture, including adsorption from subgrade soil and/or condensation under the HDPE geomembrane or temporary plastic cover.

Any wrinkles in excess of the maximum wrinkle height specified in Section 02661, GEOMEMBRANES, shall be reduced to below specified height by adjusting and smoothing the GCL after placement.

GCL shall not be deployed during precipitation or in the presence of moisture, ponded water, snow, or in other situations that could cause premature hydration of the bentonite. Any GCL

that hydrates prematurely shall be removed and replaced at the Construction General Contractor's expense.

The panels shall be placed to provide an overlap of 6 inches on longitudinal (edge of roll) seams, regardless of slope steepness. The panels shall be placed to provide an overlap of 24 inches on transverse (end of roll) seams for slopes flatter than 6H:1V. No transverse seams shall be allowed on slopes 6H:1V and steeper.

No more GCL shall be deployed than can be covered with geomembrane or other protective layer the same day.

Provide protection from wind uplift as necessary using sandbags or other method that will not damage the GCL.

OVERLAPPING GCL PANELS:

Overlap marks 6 inches from the panel edge shall be marked longitudinally on the GCL to assist in obtaining the proper overlap.

Prior to lapping, remove all dirt, gravel, or other debris from the overlap area. Apply 1/4 pound of accessory per linear foot of seam. Lap areas that have been contaminated by soil and/or sand shall receive additional accessory bentonite in the amount of 1/4 pound per linear foot evenly spread across the longitudinal seam area. GCL products with alternate edge treatment system with grooves cut in the seam overlap area, that eliminate the requirement for accessory bentonite, are permitted for edge of roll seams with prior approval by the Engineer. Accessory bentonite shall be required for end of roll seams.

End of roll overlap on slopes less than 6H:1V shall be shingled so that the direction of flow is from the top panel onto the bottom panel. On slopes 6H:1V and steeper, the panels shall be placed with the long dimension (length) continuous from the crest to the toe and the upper end anchored in a trench with soil backfill as shown on the Drawings.

REPAIRS:

Replace or repair damaged or hydrated areas of GCL.

Place a patch of GCL that extends at least 12 inches beyond the edges of the damaged area in all directions.

Overlap areas shall conform to requirements for seams described above.

PLACEMENT OF OVERLYING MATERIALS ON GEOSYNTHETIC CLAY LINING:

The GCL shall be completely covered with HDPE geomembrane or temporary plastic cover and protected at the end of each shift or workday. The Construction General Contractor shall

be fully responsible to protect the GCL from damage, shrinkage, or prehydration and shall replace all affected materials at the Construction General Contractor's sole expense.

To prevent premature hydration or shrinkage in hot weather, only the amount of GCL that can be anchored, inspected, repaired, and covered with HDPE geomembrane or temporary plastic cover in the same day shall be installed.

Equipment used to install the overlying materials shall not operate directly on the GCL.

Construction General Contractor shall use a "rub sheet" of smooth HDPE geomembrane between the GCL and textured HDPE geomembrane to prevent damage to the GCL while maneuvering the textured HDPE geomembrane into position for seaming. Construction General Contractor shall develop method(s) of removing rub sheet that, after maneuvering textured HDPE geomembrane into place, prevents damage to toe underlying GCL.

Overlying materials shall be placed over the GCL and HDPE geomembrane as specified in Section 02661, GEOMEMBRANES.

END OF SECTION 02667

# SECTION 02920--RECLAMATION AND REVEGETATION

## PART 1--GENERAL

### SUMMARY:

This section includes, but is not limited to, stabilization measures to prevent wind and water caused erosion of areas disturbed by the construction.

### REFERENCES:

ASTM INTERNATIONAL (ASTM)

ASTM D586 Standard Test Method for Ash in Pulp, Paper, and Paper Products

### SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for procedures.

Manufacturer's technical data and installation recommendations for erosion control matting, including type and spacing of anchorage devices.

Manufacturer's written certification that wood fiber mulch product contains less than 250 parts per million boron, is nontoxic to plant and animal life, and satisfies the specified organic matter content as determined by ASTM D586.

### SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR):

Tackifier and Mulch: Submit manufacturer's information and/or product data sheets for the tackifier selected for use on this project. Include confirmation of the application rate which will be used. Submit Material Safety Data Sheets for the tackifier and any dye used in the tackifier and mulch application.

Installation warranty.

## PART 2--PRODUCTS

### MATERIALS:

Topsoil: Strippings that are free from toxic minerals, noxious weeds, and other objectionable material shall be used for topsoil in accordance with Section 02200, SITE PREPARATION. Vegetation shall be removed during clearing and grubbing in accordance with Section 02200, SITE PREPARATION. The removed vegetation, other than noxious weeds, shall be reduced to pieces that are no larger than 1 inch in any dimension and shall be incorporated uniformly

into the strippings. Large clods, hard lumps, rocks 2 inches in diameter and larger, and litter shall be removed from the topsoil.

Topsoil shall be stockpiled in accordance with Section 02200, SITE PREPARATION.

Grass Seed: Grass seed shall be crested wheatgrass var. Nordan. The grass seed shall conform to the standards for "Certified" grade seed or better as outlined by the State of Washington Department of Agriculture "Rules for Seed Certification," latest edition.

Seed shall be furnished in standard containers on which shall be shown the following information:

Common name of seed.

Lot number.

Net weight.

Percentage of purity.

Percentage of germination.

Percentage of weed seed content and inert material clearly marked in accordance with applicable state and federal laws.

The maximum allowable noxious weed percentage (by weight) is 0.5 percent. The maximum allowable inert percentage is 7 percent.

Upon request, the Construction General Contractor shall furnish to the Construction Manager duplicate copies of a statement signed by the vendor certifying that each lot of seed has been tested by a recognized seed testing laboratory within 6 months before the date of delivery on the project. Seed which has become wet, moldy, or otherwise damaged in transit or storage will not be accepted.

Fertilizer: Fertilizer shall be either fertilizer Type A or fertilizer Type B.

Fertilizer Type A shall be an organic product developed from byproducts of the manufacture of various antibiotics, enzymes, and proteins. Fertilizer Type A shall provide a slow release of organically bound nutrients including nitrogen, potassium, and phosphorous. It shall have a minimum analysis (nutrient ratio) of 7-2-3 (nitrogen-phosphorous-potassium) with pH in the range of 5.3 to 6.0. Fertilizer Type A shall be sterilized and weed free. Fertilizer Type A shall be supplied in dried, granulated form with the dried weight, contents, and chemical analysis clearly marked on each bag. One suggested product name for fertilizer Type A is Biosol Mix, Rocky Mountain Bio-Products, Inc., Edwards, CO.

Fertilizer Type B shall be an organic product manufactured from seedmeal (60 percent), protein-derived, and fortified with calcium-rich (300 pounds per ton) composted chicken manure. Fertilizer Type B shall provide a slow release of organically bound nutrients including nitrogen, potassium, and phosphorous. It shall have a minimum analysis (nutrient ratio) of 6-4-1 (nitrogen-phosphorous-potassium) with pH in the range of 5.3 to 6.0. Fertilizer Type B shall be biodegradable, nonpolluting, nonvolatile, nontoxic, sterilized and weed free, and contain no heavy metals or salts. Fertilizer Type B shall be supplied in dried, pelletized form with the dried weight, contents, and chemical analysis clearly marked on each container. One suggested product name for fertilizer Type B is Fertile-Fibers Nutrimulch™, Quattro Environmental, Coronado, CA.

Wood Fiber Mulch: Wood fiber mulch shall be produced from natural or recycled (pulp) fiber, such as wood chips or similar wood materials, or from newsprint, corrugated cardboard, or a combination of these processed materials. The fibers shall not contain any rock, metal, or plastic. It shall be suitable for hydromulching and shall be treated with a nontoxic green dye to facilitate inspection of the placement of the material. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the material will become uniformly suspended to form a homogenous slurry. When hydraulically sprayed on the ground, the material shall allow the absorption and percolation of moisture. The product shall contain less than 250 parts per million boron and shall be nontoxic to plant and animal life. The organic matter content shall be at least 93 percent on any oven-dry basis as determined by ASTM D586. The moisture content shall be no more than 15 percent as determined by oven-dried weight. Each package of the wood fiber mulch shall be marked by the manufacturer to show the dried weight. Wood fiber mulch shall be added to the tackifier at the rate of 1,500 pounds per acre minimum.

Straw Mulch: Straw mulch shall be air dried straw free of noxious weeds and other materials detrimental to plant life. Straw shall be seasoned before baling or loading. Straw mulch so provided shall be suitable for spreading with mulch blower equipment.

Tackifier: The tackifier shall be an organic guar tackifier derived form natural organic plant sources or a 100 percent polyacrylamide. The tackifier used shall contain no growth or germination inhibiting materials. The guar based tackifier shall be applied at a rate of 60 pounds per acre minimum. If polyacrylamide is used as the tackifier instead of guar, it shall be applied at 5 pounds per acre minimum.

Erosion Control Matting: Erosion control matting shall be used to prevent erosion of soil due primarily to wind. Erosion control matting shall be a long-life dense matting composed of nylon fiber, polyolefin fiber, or polyester fibers. The matting shall be of a consistent thickness with the fiber evenly distributed over the entire area of the matting. The fibers shall be encased between two layers of heavy polypropylene or polyolefin netting. The fibers and the netting shall be stitched top to bottom to form a three-dimensional matrix using polyester or polyolefin thread. All components of the erosion control matting shall be stabilized against ultraviolet degradation and inert to chemicals normally encountered in a natural soil environment. The erosion control matting shall have a minimum thickness of 0.5 inch and a minimum weight of 10 ounces per square yard. Three suggested product names for erosion

control matting are Landlok ECRM 450, Synthetic Industries, Chattanooga, TN; P300, North American Green, Evansville, IN; and Recylex TRM, American Excelsior Company, Arlington, TX.

Anchorage devices for erosion control matting shall be as recommended by the manufacturer of the erosion control matting and as approved by the Construction Manager.

Soil Stabilization Cover: Soil stabilization cover shall be applied on the finished grade inside side slopes of the Phase I excavation to reduce wind and water caused erosion. Soil stabilization cover shall be a waterborne copolymer emulsion consisting of nonflammable concentrated PVA liquid copolymer with acrylic base having 60 percent solids. On drying the soil stabilization cover shall from a colorless transparent net-like film. Such film shall have permeability to allow exchange of air and moisture and have an effective life of at least 1 year. The copolymer shall not re-emulsify when cured. The liquid copolymer emulsion shall be nontoxic to plants and animals. One suggested product name for soil stabilization cover is Marloc, Reclamare Company, Des Moines, WA.

## PART 3--EXECUTION

### PLACING TOPSOIL:

A 6-inch thick layer of topsoil, or as otherwise ordered by the Construction Manager, shall be evenly spread over all areas where material has either been excavated from or has been placed in that are to be seeded, including all borrow areas and permanent stockpiles.

Topsoil shall not be placed when the ground or topsoil is frozen, excessively wet, or in the opinion of the Construction Manager in a condition detrimental to the work.

Upon physical completion of the work, remaining topsoil shall be stockpiled at the location shown on the Drawings. The permanent topsoil stockpile shall than be seeded, fertilized, and mulched.

### SEEDING, FERTILIZING, AND MULCHING:

General: Areas to be seeded, fertilized, and mulched are indicated on the Drawings. No seeding, fertilizing, and mulching shall be done within the Phase I excavation, unless directed otherwise by the Construction Manager. Areas to be seeded, fertilized, and mulched include at a minimum the east and west infiltration areas, the berm and ditch located south of the Phase I excavation, soil stockpiles that will remain after the completion of the construction, and borrow areas. Other areas outside of the Phase I excavation that are disturbed by the construction and are not otherwise stabilized shall be seeded, fertilized, and mulched as directed by the Construction Manager.

Season of Work: Seeding shall be done between September 1 and November 15. Specific ideal seeding times within this window shall be as required for proper seedbed preparation.

Weed Control: Areas to be seeded shall be maintained reasonably free of weeds. Weeds shall be kept from going to seed.

Seedbed Preparation: Soil shall be tilled to a minimum depth of 6 inches. The seedbed shall be firm below seeding depth and well pulverized and loose on top. It shall be free of clods and weeds. Tillage shall leave cross-slope furrows. Seedbed preparation shall not be performed when soil conditions are not suitable for tilling: too dry, too wet, frozen, etc.

Areas to be seeded that have not either had material excavated from them or placed in them shall not receive any seedbed preparation unless directed otherwise by the Construction Manager. The seedbed preparation would destroy any existing soil crust. Existing soil crust provides erosion protection.

Application of Seed and Fertilizer: Seeding and fertilizing shall be done closely following seedbed preparation and shall not be done during windy weather or when the ground is frozen or excessively wet. The Construction General Contractor shall notify the Construction Manager not less than 24 hours in advance of any seeding operation and shall not begin the work until areas prepared or designated for seeding have been approved. Following the Construction Manager's approval, seeding of the approved areas shall begin immediately.

Seed and fertilizer shall be applied by one of the following methods:

> Hydroseeding: Use a hydroseeder that utilizes water as the carrying agent, and maintains continuous agitation through paddle blades. It shall have an operating capacity sufficient to agitate, suspend, and mix into a homogeneous slurry the specified amount of seed and water or other material. Distribution and discharge lines shall be large enough to prevent stoppage and shall be equipped with a set of hydraulic discharge spray nozzles that will provide a uniform distribution of the slurry. Seed and fertilizer may be applied in one application provided that the fertilizer is placed in the hydroseeder tank no more than 1 hour prior to application.
>
> Hand Broadcasting: Apply fertilizer first. The seed shall be incorporated into the top 1/4 inch of soil by hand raking or other method that is approved by the Construction Manager.

Wood fiber mulch shall be added as a tracer to visibly aid uniform application. The application rate of wood fiber mulch used as a tracer shall not exceed 250 pounds per acre.

Seed shall be applied at a rate of 10 to 12 pounds pure live seed per acre. Fertilizer shall be applied at a rate of 1,000 pounds per acre.

Mulching: Straw mulch shall be evenly applied at a rate of 1.0 ton per acre within 48 hours after seeding. Mulching shall not be performed when wind interferes with mulch placement. Distribution of straw mulch material shall be by means of a mulch spreader that utilizes forced air to blow mulch material on the seeded areas. In spreading straw mulch, the spreader shall not cut or break the straw into short stalks. Straw mulch may be spread by hand over

areas that were seeded by hand. Straw mulch shall be crimped into the soil to a depth of 2 inches and with no more than one pass of the equipment.

In areas where it is not possible to crimp the straw mulch into the soil, tackifier shall be applied over the straw mulch. The method of application for tackifier shall be in accordance with the manufacturer's instructions. The tackifier application rate shall be as specified herein. Tackifier shall be sprayed over mulch, seed, and fertilizer. The Construction Manager shall indicate which areas (if any) shall have the straw mulch held down with tackifier.

Protection: Traffic over seeded areas shall be prohibited.

Installation Warranty: The warranty period for seeding, fertilizing, and mulching will begin upon the date of acceptance of the completed installation. Acceptance will be certified in writing by the Construction Manager.

Seeded areas shall be guaranteed by the Construction General Contractor for a period of 1 year. Mulch coverage will be used to evaluate the materials and workmanship of the application of seed, fertilizer, and mulch. Seed, fertilizer, and mulch will be reapplied one time only as directed by the Construction Manager at the Construction General Contractor's expense in areas where the coverage does not meet the following criteria. Three inspections of mulch coverage will occur:

Initial inspection will occur between 1 to 3 business days following completion of the installation for the purposed of Construction Manager acceptance. Mulch coverage must equal 100 percent of the area over which it was spread before Construction Manager acceptance will occur.

Mulch coverage will be inspected 60 days after Construction Manager acceptance at which time mulch coverage must equal 100 percent of the area over which it was spread.

A final inspection will occur 30 days prior to the end of the warranty period. At this time, mulch coverage must equal at least 80 percent of the area over which it was spread.

PLACING EROSION CONTROL MATTING:

Erosion control matting shall be installed in the locations shown on the Plans and as directed by the Construction Manager. The erosion control matting shall be securely anchored to resist the wind. The erosion control matting shall be installed following the manufacturer's recommendations and the following minimum requirements. Where more than one strip of erosion control matting is required, it shall overlap the adjacent matting a minimum of 6 inches. The ends of the erosion control matting shall overlap a minimum of 6 inches with the uphill section on top.

PLACING SOIL STABILIZATION COVER:

Soil stabilization cover shall be applied with hydroseeding equipment in two passes of opposite directions. Copolymer shall be applied at a minimum rate of 200 gallons per acre; dilution rate for copolymer and water shall be per the manufacturer's recommendation. Wood fiber mulch shall be added as a tracer to visibly aid uniform application. The application rate of wood fiber mulch used as a tracer shall not exceed 250 pounds per acre.

Soil stabilization cover shall be applied when adequate weather conditions for proper curing, as determined by the manufacturer, are anticipated. The Construction General Contractor shall apply soil stabilization cover only to finish graded areas unless directed otherwise by Construction Manager.

END OF SECTION 02920

SECTION 03301--CONCRETE

PART 1--GENERAL

WORK INCLUDED:

This section is a ready-mix concrete and reinforcing bar specification for concrete.

REFERENCES:

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

AMERICAN CONCRETE INSTITUTE (ACI)

| | |
|---|---|
| ACI 117 | Standard Specifications for Tolerances for Concrete Construction and Materials |
| ACI 301 | Specifications for Structural Concrete for Buildings |
| ACI 305R | Hot Weather Concreting |
| ACI 306.1 | Standard Specification for Cold Weather Concreting |
| ACI 318/318R | Building Code Requirements for Reinforced Concrete |
| ACI 347 | Formwork for Concrete |

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

| | |
|---|---|
| ASTM A185 | Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement. |
| ASTM A615 | Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement. |
| ASTM C31 | Standard Practice for Making and Curing Concrete Test Specimens in the Field. |
| ASTM C33 | Standard Specification for Concrete Aggregates. |
| ASTM C39 | Standard Test Methods for Compressive Strength of Cylindrical Concrete Specimens. |
| ASTM C94 | Standard Specification for Ready-Mix Concrete. |
| ASTM C150 | Standard Specification for Portland Cement. |
| ASTM C260 | Standard Specification for Air-Entraining Admixtures for Concrete. |
| ASTM C309 | Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete. |
| ASTM C494 | Standard Specification for Chemical Admixtures for Concrete. |
| ASTM C618 | Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete. |

ASTM D994 Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI Manual of Standard Practice.
Recommended Practice for Placing Reinforcing Bars.

1997 UNIFORM BUILDING CODE (UBC)

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Shop Drawings:

Reinforcing steel in accordance with CRSI Manual of Standard Practice and ACI SP-66, Detailing Manual.

Curing compound data.

Complete data on the concrete mix, including aggregate gradations and admixtures, in accordance with ASTM C94.

Statement identifying aggregates reactivity.

Concrete mix design signed by a qualified mix designer that is a licensed professional engineer in the State of Washington.

SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR):

Qualifications of independent qualified testing laboratory for concrete construction quality control.

Manufacturer's application instructions for curing compound.

Statement for batch plant currently certified by the National Ready Mixed Concrete Association. If batch plant cannot be certified, then Construction General Contractor shall demonstrate to the Construction Manager's satisfaction by providing additional testing as determined by the Construction Manager such that the concrete may be determined to be acceptable. These test results shall be submitted to Construction Manager.

Certification for proper functioning of concrete transport trucks including blades, drum rotators, counters, and other components. Certification shall be acceptable only for concrete batch plants certified by the National Ready Mixed Concrete Association. Batch plants that are not certified shall require concrete transport trucks to undergo independent assessment to the satisfaction of the Construction Manager.

Ready-mix delivery tickets for each truck in accordance with ASTM C94.

Concrete crack repair epoxy injection statement of qualifications for manufacturer's site representative, injector applicator, and injector pump operating technician. Submit only if crack repair is required.

Pour slip shall be required prior to any concrete placement to serve as a checklist between the Construction Manager and the Construction General Contractor. This checklist will be used to document Construction General Contractor's readiness for concrete placement. Pour slip form shall be provided to the Construction General Contractor from the Construction Manager.

Results of construction quality control testing.

ENVIRONMENTAL REQUIREMENTS:

Do not place concrete when the ambient temperature is below 40 degrees F or approaching 40 degrees F and air temperature less than 40 degrees F for the first 7 days, without special protection to keep concrete above 40 degrees F.

Do not use curing compound where solvents in the curing compounds are prohibited by state or federal air quality laws.

Form sealer shall be a ready-to-use water based material formulated to reduce or eliminate surface imperfections, containing no mineral oil or organic solvents. Environmentally safe, meeting local, state, and federal regulations.

PART 2--PRODUCTS

FORM MATERIALS:

All formwork shall conform to the guidelines in ACI 347.

Forms for Exposed Finish Concrete: Provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without visible bow or deflection:

Plywood shall comply with American Plywood Association, grade "EXT-DFPA PLYFORM" or better.

Forms for Unexposed Finish Concrete: Form concrete surfaces, which will be, unexposed in finished structure with plywood, lumber, or metal.

Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

Form Ties: Steel form ties with conical or spherical spreader insert that will leave no metal closer than 1 inch to concrete surface after tie ends are removed. Wire ties shall not be used.

Water stop ties shall be perpendicular to water stop and symmetrical about the center of tie and designed to prevent rotation or disturbance of center portion of tie during removal of ends and to prevent water leaking along the tie. Maximum spacing shall be 12 inches, and all corners shall be tied.

CONCRETE MATERIALS:

Portland Cement: Cement shall conform to ASTM C150, Type I-II. The cement shall contain no more than 0.60 percent by weight of alkalies calculated as ($Na_2O + 0.658\ K_2O$).

Pozzolans: Pozzolans (fly ash) shall conform to ASTM C618 Class F, except that the loss on ignition (LOI) shall be less than 2 percent.

Aggregate: Fine and coarse aggregate shall conform to ASTM C33. Maximum coarse aggregate size shall conform to ACI 318, paragraph 3.3.2. Unless otherwise specified, maximum aggregate size shall be 1-1/2 inches. Aggregate shall be nonpotentially reactive in accordance with ASTM C33, Appendix XI, paragraph X1.1.

Mixing Water: Potable having no pronounced taste or odor, and containing no deleterious materials.

Air-Entraining Agents (AEA): ASTM C260.

Water-Reducing Admixtures: If water-reducing admixtures are used they shall conform to ASTM C494, Type A, and contain no more than 1 percent chloride ions.

Calcium Chloride: Calcium chloride is not permitted.

REINFORCING STEEL:

Deformed Bars: ASTM A615, Grade 60. Welding of reinforcing shall not be permitted.

Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing in place. Use wire bar type supports complying with CRSI recommendations, or approved substitute. Use

supports with sand plates or horizontal runners where base material will not support chair legs. Pumice blocks, adobe, bricks, rocks, etc. are not acceptable for rebar or wire mesh supports.

ANCILLARY MATERIALS:

Concrete Crack Repair Epoxy Injection Manufacturers:

Contech Group, Seattle, WA, or Portland, OR.

Sika Group, Lindhurst, NJ.

Euclid Chemical Co., Cleveland, OH.

Expansion Joint Filler: ASTM D994, 1/2 inch thick, or as shown.

Nonshrink Grout:

Color: To match concrete.

Manufacturers and Products:

Master Builder Co., Cleveland, OH; Master Flow 928.

Euclid Chemical Co., Cleveland, OH; Hi-flow Grout.

Curing Compound:

Material: Water-based curing compound in accordance with ASTM C309, Type I, Class A, with additional requirement that the moisture loss not exceed 0.035 gram per centimeter squared per 72 hours.

Manufacturers and Products:

Master Builders Co.; Masterkure 200W.

Euclid Chemical Co.; Super Diamond Clear Vox.

Water Stop: Extruded elastomeric plastic compound with basic resin to be polyvinyl chloride.

Manufacturers and Products:

Vinylex Corp., Knoxville, TN; Catalog No. 03250/VIN, RBG-38H.

A. C. Horn, Inc., Beltsville, MD; Catalog No. CSP-162, Type 9 (6-inch by 3/8-inch).

Hydrophilic Water Stop:

Material shall be a non-bentonite hydrophilic rubber compound. Material shall be a combination of chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties.

Manufacturers and Products:

Greenstreak Plastic Products, St. Louis, MO; Hydrotite CJ-1020-K with Leakmaster LV-1 adhesive and sealant.

Adeka Ultra Seal, JLM Associates, Spearfish, SD; MC-2010M with 3M-2141 adhesive and P-201 sealant.

Red Coloring for Electrical Duct Encasement: Commercial grade red iron oxide, 3 pounds per sack of cement.

CONCRETE SLAB COATING:

As specified in Section 09900, PAINT COATING SYSTEMS.

PROPORTIONING AND DESIGN OF MIXES:

Mix Design: Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 318 and 1997 UBC. The more stringent requirements of ACI 318 and 1997 UBC shall apply. Existing mix design test records shall be acceptable only if the facility is certified by National Ready Mixed Concrete Association. Uncertified concrete batch plant shall require testing from a qualified independent testing agency to develop the test and number of tests for an acceptable standard deviation to be developed.

Design mixes to provide normal weight concrete with the following specified 28-day compressive strengths, minimum, as indicated on drawings and schedules:

Class 30: 3,000 psi (secondary concrete elements such as sidewalks, guard posts, equipment pads, fences, post and pole foundations, conduit encasement, and thrust blocks).

Class 40: 4,000 psi (structural concrete).

Class 50: 5,000 psi (truck loading pad).

See CONSTRUCTION QUALITY CONTROL of this specification for acceptance criteria.

Concrete mixes incorporating pozzolan (fly ash) shall contain a minimum of 15 percent fly ash by weight and the maximum 25 percent fly ash of the total cementitious materials.

Air content shall be 4 to 6 percent when tested in accordance with ASTM C231; 3 percent maximum for interior slabs where heavy-duty concrete floor finish is required.

Concrete in hard-to-place locations may utilize a high-range water reducer. No other water-reducer shall be used with a high-range water-reducer.

Class 40 and Class 50: Concrete shall be air-entrained and shall incorporate the usage of high-range water reducer. Concrete mix design shall contain fly ash. Add air entraining agent (AEA) at the manufacturer's prescribed rate to result in concrete at point of placement having air content complying with ACI 301.

Unless specifically stated otherwise, water-cement ratio (or water-cement plus fly ash ratio) shall control amount of total water added to concrete as follows:

Water-Cement Ratio

| Coarse Aggregate Size | Maximum W/C Ratio w/Superplasticizer | Maximum W/C Ratio w/o Superplasticizer |
|---|---|---|
| 1-1/2" | 0.40 | 0.45 |
| 1" | 0.40 | 0.45 |
| 3/4" | 0.40 | 0.45 |

Slump Range at Site:

4-1/2 inches minimum, 8 inches maximum for concrete with a high range water reducing admixture.

3 inches minimum and 5 inches maximum for concrete without high range water reducing admixture.

Red Concrete for Conduit Encasement: Not less than 3 inches and not more than 6 inches.

Combined Aggregate Gradation:

Select one of the gradations shown in the following table.

Combined Gradation Limits: Limits shown are for coarse aggregates and fine aggregates mixed together (combined).

| | Combined Gradation Percentage Passing | | |
|---|---|---|---|
| Sieve Sizes | 1-1/2" Max. | 1" Max. | 3/4" Max. |
| 2" | - 100 | - | - |
| 1-1/2" | 95 - 100 | - 100 | - |
| 1" | 65 - 85 | 90 - 100 | - 100 |
| 3/4" | 55 - 75 | 70 - 90 | 92 – 100 |
| 1/2" | - | | 68 – 86 |
| 3/8" | 40 - 55 | 45 - 65 | 57 – 74 |
| No. 4 | 30 - 45 | 31 - 47 | 38 – 57 |
| No. 8 | 23 - 38 | 23 - 40 | 28 – 46 |
| No. 16 | 16 - 30 | 17 - 35 | 20 – 36 |
| No. 30 | 10 - 20 | 10 - 23 | 14 – 25 |
| No. 50 | 4 - 10 | 2 - 10 | 5 – 14 |
| No. 100 | 0 - 3 | 0 - 3 | 0 – 5 |
| No. 200 | 0 - 2 | 0 - 2 | 0 – 2 |

Minimum Cement Content (or Combined Cement Plus Fly Ash Content When Fly Ash is Used):

517 pounds per cubic yard for concrete with 1-1/2-inch maximum size aggregate.

540 pounds per cubic yard for 1-inch maximum size aggregate.

564 pounds per cubic yard for 3/4-inch maximum size aggregate.

Increase cement content or combined cement plus fly ash content, as required to meet strength requirements and water-cement ratio.

MIXING AND DELIVERY:

The manufacture and delivery of all concrete shall conform to ASTM C94 except as modified herein. Hand-mixed concrete is prohibited.

When concrete arrives at the jobsite with slump below that suitable for placing, as indicated by the Specification, water may be added only if the maximum permissible water-cement ratio and the maximum permissible slump is not exceeded. Any water thus added to bring the slump within required limits shall be injected in such a manner that uniformity requirements are met. Water shall be incorporated by additional mixing equal to at least half of the total mixing required or 30 drum revolutions at rated mixing speed, whichever is more. Additional AEA may be introduced during this mixing period if necessary to meet Specifications. Neither water or AEA shall be added to the batch at any later time.

Concrete uniformity shall meet the requirements of ASTM C94 except as modified herein. After final mixing is complete, visible lumps, nonconformance to uniformity requirements, or failure to meet specified slump, entrained air, and temperature requirements shall be considered cause for rejecting the remainder of the load. In addition, failure of the ready-mix truck drum to meet uniformity requirements will be deemed cause for rejection of the mixing equipment until adequate repairs have been made.

Discharge of the concrete shall be completed within 1-1/2 hours, or before the drum has revolved 300 revolutions, whichever comes first, after the introduction of mixing water to the cement and aggregates unless special approved time delay admixtures are used. Coordinate time delay admixture information with manufacturer and Construction Manager prior to placing concrete. In hot weather or under conditions contributing to quick stiffening of the concrete a time limit less than 1-1/2 hours may be designated by the Construction General Contractor.

Additional high-range water-reducing admixtures (superplasticizer) may be added to the mixer at the jobsite using manufacturer-approved dispensing when unexpected delays cause too great of slump loss.

Concrete that is rejected for failure to meet any of the above requirements will be evaluated by the Engineer and may be removed and replaced at the expense of the Construction General Contractor.

Hot or Cold Weather Concreting: Methods and means of batching, mixing, and delivery of concrete in hot or cold weather shall comply with ACI 305R or ACI 306.1.

## PART 3--EXECUTION

### FORMWORK:

Unless otherwise shown on the drawings, all forms shall be straight and plumb, rigid and mortar tight. All forms shall be braced, tied, and supported sufficiently to maintain their required position during and after the placing of concrete. Joints shall be sufficiently tight to prevent mortar leakage. Where shown on the Drawings, embedded items shall be placed in forms to shape edges or surfaces to that of the concrete members. All formwork shall conform to the guidelines in ACI 347.

All exposed corners of concrete shall be chamfered 3/4 inch.

#### Form Removal:

Formwork Not Supporting Weight of Concrete: This formwork may be removed after cumulatively curing at not less than 50 degrees F for 32 hours after placing concrete, provided concrete is sufficiently hard not to be damaged by form removal or

subsequent operations. Curing must then continue through the minimum curing period.

Formwork Supporting Weight of Concrete: This formwork may not be removed until concrete has attained its 28-day design compressive strength, except as permitted under "Early Loading of New Concrete" as specified below.

Early Loading of New Concrete: Early loading of concrete structures shall comply with requirements of ACI 318, Section 6.2. When construction loading is proposed before concrete has achieved its 28-day design strength, structural calculations and concrete strength test data shall be submitted and approved by the Construction Manager prior to loading.

Form Sealer:

Material: Surface sealer will not bond with, stain, or adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces when applied to forms.

Manufacturers and Products:

Master Builders, Inc.; Rheofinish.

Burke Chemicals; Burke Release No. 1.

PLACING REINFORCING STEEL:

Unless otherwise specified, place reinforcing steel in accordance with CRSI Recommended Practice for Placing Reinforcing Bars and ACI 301.

Splicing:

Follow ACI 318/318R.

Use lap splices, unless otherwise shown or permitted in writing by Engineer.

Stagger splices in adjacent bars where indicated.

PLACING CONCRETE:

Place concrete in accordance with ACI 301.

Prior to placing concrete, remove water from excavation and debris and foreign material from forms. Check reinforcing steel for proper placement and correct discrepancies.

Before depositing new concrete on old concrete, clean surface using sandblast or bushhammer or other mechanical means to obtain a 1/4-inch rough profile, and pour a cement-sand grout to minimum depth of 1/2-inch over the surface. Proportion 1 part cement to 2.5 parts sand by weight.

Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 2 feet deep. Place within 1-1/2 hours after adding cement to mix.

Eight feet maximum vertical drop to final placement, when not guided with chutes or other devices to prevent segregation due to impact with reinforcing.

Concrete shall be placed near its final location to avoid segregation.

Cold Weather Placing: Protect concrete work from damage or reduced strength which could be caused by frost, freezing, or low temperatures, in compliance with ACI 306.1 and as specified herein. Minimum concrete temperature as placed and maintained shall be 55 degrees F, or as required by ACI-306.1, Table 3.2.1.

Hot Weather Placing: When hot weather conditions that would seriously impair quality and strength of concrete exist, place concrete in compliance with ACI 305 and as specified herein:

Cool mixing drum and/or ingredients before mixing to maintain concrete temperature below 90 degrees F at time of placement.

COMPACTION:

Vibrate concrete as follows:

Apply approved vibrator at points spaced not farther apart than vibrator's effective radius.

Apply close enough to forms to vibrate surface effectively but not damage form surfaces.

Vibrate until concrete becomes uniformly plastic.

Vibrator must penetrate fresh placed concrete and into previous layer of fresh concrete below.

Vibrator shall not be used to move concrete.

CONSTRUCTION JOINTS:

Locate as shown or as approved.

Provide waterstops in construction joints as indicated and with other Construction General Contractor-required construction joints that is approved by the Engineer.

Maximum Spacing Between Construction Joints: 40 feet.

INSTALLATION OF EMBEDDED ITEMS:

Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by cast-in-place concrete. Secure all such items firmly in position.

FINISHING:

Floor Slabs and Tops of Walls:

Finish slabs to grades shown on Drawings.

Screed surfaces to true level planes.

After initial water has been absorbed, float with wood float and trowel with steel trowel to smooth finish free from trowel marks.

Do not absorb wet spots with neat cement.

Unexposed Slab Surfaces: Screed to true surface, bull float with wood float, and wood trowel to seal surface. Finish surfaces to grades shown on Drawings.

Tolerances: Floors shall not vary from level or true plane more than 1/4-inch (plus or minus) in 10 feet when measured with a straightedge. Floors shall conform to grades shown on Drawings. Conform to ACI 117.

Exterior Slabs and Sidewalks:

Bull float with wood float, wood trowel, and lightly trowel with steel trowel.

Finish with broom to obtain nonskid surface.

Finish exposed edges with steel edging tool.

Mark walks transversely at 5-foot intervals with jointing tool.

FINISHING AND PATCHING FORMED SURFACES:

Smooth Form Finish (SmFm): Provide as-cast smooth form finish for formed concrete surfaces that are exposed to view, or that are covered with a coating material applied directly to concrete, or a covering material bonded to concrete such as waterproofing, dampproofing, painting, or other similar system.

Produce smooth form finish (SmFm) by selecting form material to impart a smooth, hard, uniform texture and arranging them orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.

Cut out honeycombed and defective areas.

Cut edges perpendicular to surface at least 1 inch deep. Do not feather edges. Soak area with water for 24 hours.

Patch with nonshrink grout.

Finish surfaces to match adjacent concrete.

Keep patches damp for minimum 7 days or spray with curing compound to minimize shrinking.

Fill form tie holes with Nonshrink Grout.

CONCRETE PROTECTION AND CURING:

General: Protect freshly placed concrete from injurious action by sun, rain, wind, flowing water, mechanical injury, and premature drying for not less than seven (7) consecutive days after placement.

Protect concrete against damage from frost or freezing for a minimum of 3 days. Provisions of ACI 306.1 shall apply for cold weather unless otherwise specified.

Remove and replace concrete damaged by freezing.

Curing Methods: Perform curing of concrete by one or more of the following methods:

Moist Curing: Cover concrete surfaces with moisture retaining cover for curing period. Exposed horizontal concrete surfaces may be covered with sand or other approved material and kept wet for the required period. Wood forms shall be kept sufficiently wet at all times to prevent the forms from separating at the joints and the concrete from drying.

Membrane Curing: Concrete surfaces to receive membrane curing shall be treated with a curing compound as specified or otherwise approved. The curing compound shall be applied in strict accordance with the directions of the manufacturer of the compound.

Temperature, Wind, and Humidity:

Cold Weather: When the mean daily outdoor temperature is less than 40 degrees F, the temperature of the concrete surface shall be maintained between 55 and 90 degrees F for the required curing period. When necessary, arrangements for heating, covering, insulating, or housing the concrete work shall be made in advance of placement and shall be adequate to maintain the required temperature without injury due to concentration of heat. Combustion heaters shall not be used during the first 24 hours unless precautions are taken to prevent exposure of the concrete to exhaust gases that contain carbon dioxide. If early loading is anticipated during cold weather, provide temperature protection to ensure necessary strength development.

The concrete surface temperature requirements (based on section thickness) in ACI 306.1 may be used in lieu of the 55 degrees F minimum specified before.

If concrete surface temperatures as measured by the inspecting agency are below the minimum curing temperature but meet the freeze protection requirements, the concrete curing period shall be extended to ensure adequate strength is developed. The extension time shall be at least equivalent to the time period in which temperatures were too low.

Hot Weather: The concrete surfaces shall be kept below 100 degrees F for the curing period. When necessary, provision for windbreaks, shading, fog spraying, sprinkling, ponding, or wet covering with a light colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as concrete hardening and finishing operations will allow.

Rate of Temperature Change: Changes in temperature of the air immediately adjacent to the concrete during and immediately following the curing period shall be kept as uniform as possible and shall not exceed 5 degrees F in any 1-hour or 50 degree F in any 24-hour period.

Use curing compound only where approved by Construction Manager. Cure formed surfaces with curing compound applied in accordance with manufacturer's directions as soon as forms are removed and finishing is completed.

WATER STOPS: PLASTIC AND HYDROPHILIC:

Install in accordance with manufacturer's instructions.

REPAIRING CONCRETE CRACKS:

Cracks requiring repair shall be determined by the Engineer and shall be repaired using epoxy injection. Method of epoxy injection shall be approved by the Construction Manager prior to application.

CONSTRUCTION QUALITY CONTROL:

Construction General Contractor Supplied Testing: The Construction General Contractor shall provide the necessary testing and monitoring services for the following:

Construction General Contractor shall procure the services of a qualified independent testing laboratory to control or monitor the production, transportation, placement, protection, curing, or temperature of the concrete as specified herein. Construction General Contractor shall submit qualifications of independent testing laboratory.

Evaluation of Concrete Field Strength:

Provide adequate facilities for safe storage and proper curing of concrete test cylinders onsite for first 24 hours, and for additional time as may be required before transporting to test lab.

Provide concrete for testing of slump, air content, and for making cylinders from the point of discharge into forms. When concrete is pumped, Samples used shall be taken from discharge end of pump hose.

Evaluation will be in accordance with ACI 301, Chapter 17, and Specifications.

Specimens shall be made, cured, and tested in accordance with ASTM C31 and ASTM C39.

Pumped Concrete: Take concrete samples for slump (ASTM C143) and test cylinders (ASTM C31 and C39).

Reject concrete represented by cylinders failing to meet strength and air content specified.

END OF SECTION 03301

# SECTION 05500--METAL FABRICATIONS AND CASTINGS

## PART 1--GENERAL

### REFERENCES:

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

THE ALUMINUM ASSOCIATION, INC. (AA)

The Aluminum Design Manual

AMERICAN GALVANIZERS ASSOCIATION (AGA)

Inspection of Products Hot-Dip Galvanized After Fabrication

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

| | |
|---|---|
| AISC S329 | Allowable Stress Design Specification for Structural Joints using ASTM A325 or A490 Bolts |

AMERICAN IRON AND STEEL INSTITUTE (AISI)

Stainless Steel Types

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

| | |
|---|---|
| ANSI A10.11 | Safety Requirements for Personnel and Debris Nets |
| ANSI A14.3 | Ladders - Fixed - Safety Requirements |
| ANSI B1.1 | Unified-inch Screw Threads (UN and UNR Thread Form) |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS D1.1 | Structural Welding Code - Steel |
| AWS D1.2 | Structural Welding Code - Aluminum |
| AWS D1.6 | Structural Welding Code - Stainless Steel |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A36/A36M | Specification for Carbon Structural Steel |
| ASTM A48 | Specification for Gray Iron Castings |
| ASTM A53/A53M | Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |

| | |
|---|---|
| ASTM A108 | Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality |
| ASTM A123/A123M | Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A143 | Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement |
| ASTM A153/A153M | Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| ASTM A193/A193M | Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service |
| ASTM A194/A194M | Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both |
| ASTM A240/A240M | Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels |
| ASTM A276 | Specification for Stainless Steel Bars and Shapes |
| ASTM A278 | Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650 Degree |
| ASTM A283/A283M | Specification for Low and Intermediate Tensile Strength Carbon Steel Plates |
| ASTM A307 | Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile |
| ASTM A325 | Specification for Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength |
| ASTM A380 | Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems |
| ASTM A384 | Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies |
| ASTM A385 | Practice for Providing High-Quality Zinc Coatings (Hot-Dip) |
| ASTM A489 | Specification for Carbon Steel Lifting Eyes |
| ASTM A500 | Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes |
| ASTM A501 | Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing |
| ASTM A563 | Specification for Carbon and Alloy Steel Nuts |
| ASTM A653 | Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM A780 | Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings |

| | |
|---|---|
| ASTM A786/A786M | Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates |
| ASTM A793 | Specification for Rolled Floor Plate, Stainless Steel |
| ASTM A967 | Specification for Chemical Passivation Treatments for Stainless Steel Parts |
| ASTM A992/A992M | Specification for Steel for Structural Shapes for Use in Building Framing |
| ASTM B209 | Specification for Aluminum and Aluminum-Alloy Sheet and Plate |
| ASTM B308/B308M | Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles |
| ASTM B429 | Specification for Aluminum-Alloy Extruded Structural Pipe and Tube |
| ASTM B632/B632M | Specification for Aluminum-Alloy Rolled Tread Plate |
| ASTM D1056 | Specification for Flexible Cellular Materials - Sponge or Expanded Rubber |
| ASTM F436 | Specification for Hardened Steel Washers |
| ASTM F468 | Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use |
| ASTM F593 | Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs |
| ASTM F594 | Specification for Stainless Steel Nuts |
| ASTM F844 | Specification for Washers, Steel, Plain (Flat), Unhardened for General Use |
| ASTM F1554 | Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength |

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

Evaluation Reports for Concrete and Masonry Anchors

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

| | |
|---|---|
| 29 CFR 1910.27 | Fixed Ladders |
| 29 CFR 1926.105 | Safety Nets |
| 29 CFR 1926.502 | Fall Protection Systems Criteria and Practices |

SPECIALTY STEEL INDUSTRY OF NORTH AMERICA (SSINA)

Specifications for Stainless Steel
Design Guidelines for the Selection and Use of Stainless Steel

Stainless Steel Fabrication
Stainless Steel Fasteners

DEFINITIONS:

Submerged: Location at or below top of wall of open water-holding structure, such as a basin or channel, or wall, ceiling or floor surface inside a covered water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered.

Exterior Area: Location not protected from the weather by a building or other enclosed structure.

Interior Wet Area: Location inside building or structure where floor is sloped to a sump, floor drains or gutters and is subject to liquid spills or washdown, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.

Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or washdown, nor where wall or roof slab is common to a water-holding or earth-retaining structure.

Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Shop Drawings:

Metal fabrications, including welding, shop and field weld WPSs, PQRs, and fastener information.

Specific instructions for concrete anchor installation, including drilled hole size, preparation, placement, procedures, and instructions for safe handling of anchoring systems.

Submit source quality control data specified herein.

Samples: Color samples of abrasive stair nosings.

SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR):

Concrete and Masonry Drilled Anchors:

Manufacturer's product description and installation procedures.

ICBO evaluation report.

Adhesive Anchor Installer Certification.

Welding:

WPSs and WPQs.

CWI credentials and CWI reports.

Welding documentation.

U-Channel Concrete Inserts:

Manufacturer's product description.

Allowable load tables.

Ladders: Certification of load and fatigue tests.

Passivation method for stainless steel members.

Documentation of construction quality control inspections specified herein.

QUALIFICATIONS:

Adhesive Anchor Installers: Trained and certified by manufacturer.

Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

Welding: WPSs and WPQs in accordance with AWS D1.1.

DELIVERY, STORAGE, AND HANDLING:

Insofar as practical, factory assemble items specified herein. Assemblies that due to necessity have to be shipped unassembled shall be packaged and tagged in manner that will protect materials from damage and will facilitate identification and field assembly.

Package stainless steel items in a manner to provide protection from carbon impregnation.

Protect painted coatings and hot-dip galvanized finishes from damage due to metal banding and rough handling. Use padded slings and straps.

Store fabricated items in dry area, not in direct contact with ground.

PART 2--PRODUCTS

GENERAL:

Unless otherwise indicated, meet the following requirements:

| Item | ASTM Reference |
|---|---|
| Steel Shapes and Plates | A36/A36M or A992 |
| Steel Pipe | A501 or A53/A53M, Type E or S, Grade B |
| Structural Steel Tubing | A500, Grade B |
| Stainless Steel: | |
| Bars and Angles | A276, AISI Type 316 |
| Shapes | A276, AISI Type 304 |
| Steel Plate, Sheet, and Strip | A240/A240M, AISI Type 316 |
| Bolts, Threaded Rods, Anchor Bolts, and Anchor Studs | F593, AISI Type 316, Condition CW |
| Nuts | F594, AISI Type 316, Condition CW |
| Steel Bolts and Nuts: | |
| Carbon Steel | A307 bolts, with A563 nuts |

| Item | ASTM Reference |
|---|---|
| High-Strength | A325, Type 1 bolts, with A563 nuts |
| Anchor Bolts and Rods | F1554, Grade 55, with weldability supplement S1 |
| Eyebolts | A489 |
| Threaded Rods | A36/A36M |
| Flat Washers (Unhardened) | F844 |
| Flat and Beveled Washers (Hardened) | F436 |
| Thrust Ties for Steel Pipe: | |
| Threaded Rods | A193/A193M, Grade B7 |
| Nuts | A194/A194M, Grade 2H |
| Plate | A283/A283M, Grade D |
| Welded Anchor Studs | A108, Grades C-1010 through C-1020 |
| Aluminum Plates and Structural Shapes | B209 and B308/B308M, Alloy 6061-T6 |
| Aluminum Bolts and Nuts | F468, Alloy 2024-T4 |
| Cast Iron | A48, Class 35 |

Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, zinc-plated steel, and aluminum material types as indicated in FASTENER SCHEDULE at end of this section.

ANCHOR BOLTS AND ANCHOR BOLT SLEEVES:

Cast-In-Place Anchor Bolts:

Headed type, unless otherwise shown on Drawings.

Material type and protective coating as shown in FASTENER SCHEDULE at end of this section.

Anchor Bolt Sleeves:

Plastic:

Single unit construction with corrugated sleeve.

Top of sleeve shall be self-threading to provide adjustment of threaded anchor bolt projection.

Material: High density polyethylene.

Manufacturer: Sinco Products, Inc., Middletown, CT. (800-243-6753).

Fabricated Steel: ASTM A36/A36M.

CONCRETE DRILLED ANCHORS:

General:

AISI Type 316 stainless, hot-dip galvanized, or zinc-plated steel, as shown in FASTENER SCHEDULE at end of this section.

Current evaluation and acceptance reports by ICBO.

Wedge Anchors:

Manufacturers and Products:

ITW Ramset/Red Head, Wood Dale, IL; Trubolt Wedge Anchor.

Hilti, Inc., Tulsa, OK; Kwik-Bolt II Stud Anchor.

Powers Rawl, New Rochelle, NY; Power-Stud Anchor.

Simpson Strong-Tie Co., Inc., Pleasanton, CA; Wedge-All Anchor.

Wej-It Corp., Tulsa, OK; ANKRtite Wedge Anchor.

U.S. Anchor, Pompano Beach, FL; Kingpin Wedge Anchor.

Expansion Anchors:

Self-drilling anchors, snap-off or flush type, zinc-plated.

Nondrilling Anchors: Flush type for use with zinc-plated or stainless steel bolt, or stud type with projecting threaded stud.

Manufacturers and Products:

ITW Ramset/Red Head, Wood Dale, IL; Multi-Set II Drop-In and Self Drill Anchor.

Hilti, Inc., Tulsa, OK; Hilti HDI Drop-In Anchor.

Powers Rawl, New Rochelle, NY; Steel Drop-In Anchor.

Simpson Strong-Tie Co., Inc., Pleasanton, CA; Drop-In Anchor.

Sleeve Anchors:

Manufacturers and Products:

ITW Ramset/Red Head, Wood Dale, IL; Dynabolt Hex Nut Sleeve Anchor.

Powers Rawl, New Rochelle, NY; Hex Head Power-Bolt Anchor.

Simpson Strong-Tie Co., Inc., Pleasanton, CA; Sleeve-All Hex Head Anchor.

Wej-It Corp., Tulsa, OK; Wej-It Sleeve Anchor.

Adhesive Anchors:

Threaded Rod:

ASTM F593 stainless steel threaded rod, diameter as shown on Drawings.

Length as required, to provide minimum depth of embedment.

Clean and free of grease, oil, or other deleterious material.

Adhesive:

Two-component, designed to be used in adverse freeze/thaw environments, with gray color after mixing.

Cure Temperature, Pot Life, and Workability: Compatible for intended use and environmental conditions.

Nonsag, with selected viscosity base on installation temperature and overhead application where applicable.

Packaging and Storage:

Disposable, self-contained cartridge system capable of dispensing both components in the proper mixing ratio and fitting into a manually or pneumatically operated caulking gun.

Store adhesive cartridges on pallets or shelving in covered storage area, in accordance with manufacturer's written instructions.

Cartridge Markings: Include manufacturer's name, product name, material type, batch or serial number, and adhesive expiration date.

Dispose of cartridges if shelf life has expired.

Manufacturers and Products:

ITW Ramset/Red Head, Wood Dale, IL; Epcon Ceramic 6 Epoxy or A7 Adhesive Anchor System.

Hilti, Inc., Tulsa, OK; HIT Doweling Anchor System, HIT HY 150 (HIT HY 20 for hollow masonry).

Powers Rawl, New Rochelle, NY; Power Fast Epoxy Injection Gel Cartridge System.

Simpson Strong-Tie Co., Inc., Pleasanton, CA; Epoxy-Tie Adhesive ET or Acrylic-Tie Adhesive. (Use only Acrylic-Tie Adhesive for temperatures below 40 degrees F.)

Covert Operations, Inc., Long Beach, CA; CIA-Gel 7000 Epoxy Anchors.

U.S. Anchor, Pompano Beach, FL; Ultrabond 1.

Unitex, Kansas City, MO; Pro-Poxy 300 and Pro-Poxy 300 Fast Epoxy Adhesive Anchors.

Adhesive Threaded Inserts:

Stainless steel, internally threaded insert.

Manufacturer and Product: Hilti, Inc., Tulsa, OK; HIS-R Insert with HIT HY 150 adhesive.

WELDED ANCHOR STUDS:

Headed anchor studs (HAS) or threaded anchor studs (TAS), as indicated on Drawings.

Carbon Steel: ASTM A108, Standard Quality Grades 1010 through 1020, inclusive either semikilled or killed aluminum or silicon dioxidation, unless indicated otherwise.

Stainless Steel: ASTM F593, AISI Type 316, Condition CW, where indicated.

Manufacturers:

Nelson Stud Welding, FabriSteel Co., Elyria, OH.

Stud Welding Associates, Inc., Elyria, OH.

EMBEDDED STEEL SUPPORT FRAMES FOR FLOOR PLATE AND GRATING:

Steel angle support frames to be embedded in concrete shall be stainless steel, ASTM A276, AISI Type 316, unless indicated otherwise.

Welded anchors for stainless steel support frames shall also be stainless steel.

ABRASIVE NOSING FOR STAIRS

Unless otherwise shown on Drawings, furnish flush type abrasive nosing on stairs.

Nosing Components:

Homogeneous epoxy abrasive, with minimum 50 percent aluminum oxide content, formed and cured upon an extruded aluminum base.

Epoxy abrasive shall extend over and form curved front edge of nosing.

Base of Nosing: Extruded aluminum alloy, 6063-T5, heat-treated.

Anchoring System: Double-set anchors consisting of two rows of integrally extruded anchors.

Size: 3 inches wide by 1/4 to 3/8 inch thick by length as shown.

Color: Selected by Tank Farm Contractor from manufacturer's standard color range.

Manufacturers and Products:

Wooster Products, Inc., Wooster, OH; Spectra Type WP3C.

American Safety Tread Co., Inc., Helena, AL; Type FA-311D.

FABRICATION:

General:

Fabricate as shown and in accordance with AISC Specification for Structural Steel Buildings and AISC Code of Standard Practice for Steel Buildings and Bridges.

Finish exposed surfaces smooth, sharp, and to well-defined lines.

Grind cut edges smooth and straight. Round sharp edges to small uniform radius. Grind burrs, jagged edges, and surface defects smooth.

Fit and assemble in largest practical sections for delivery to site.

Materials:

Use steel shapes, unless otherwise noted.

Steel to be hot-dip galvanized: Limit silicon content to less than 0.04 percent or to between 0.15 and 0.25 percent.

Welding:

Weld connections and grind exposed welds smooth. When required to be watertight, make welds continuous.

Welded fabrications shall be free from twisting or distortion caused by improper welding techniques.

Steel: Meet fabrication requirements of AWS D1.1, Section 5.

Stainless Steel: Meet requirements of AWS D1.6.

Welded Anchor Studs: Prepare surface to be welded and weld with stud welding gun in accordance with AWS D1.1, Section 7, and manufacturer's instructions.

Complete welding before applying finish.

Painting:

Coat all fabricated carbon steel as specified in Section 09900, PAINT COATING SYSTEMS, unless otherwise indicated.

Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs and stainless steel anchor bolts, unless indicated otherwise.

Galvanizing:

Fabricate steel to be galvanized in accordance with ASTM A143, ASTM A384, and ASTM A385. Avoid fabrication techniques that could cause distortion or embrittlement of the steel.

Provide venting and drain holes for tubular members and fabricated assemblies in accordance with ASTM A385.

Remove welding slag, splatter, burrs, grease, oil, paint, lacquer, and other deleterious material prior to delivery for galvanizing.

Remove by blast cleaning or other methods surface contaminants and coatings not removable by normal chemical cleaning process in the galvanizing operation.

Hot-dip galvanize steel members, fabrications, and assemblies after fabrication in accordance with ASTM A123/A123M.

Hot-dip galvanize bolts, nuts, washers, and hardware components in accordance with ASTM A153/A153M. Oversize holes to allow for zinc alloy growth. Shop assemble bolts and nuts.

Galvanized steel sheets in accordance with ASTM A653.

Galvanize components of bolted assemblies separately before assembly. Galvanizing of tapped holes is not required.

Accessories: Furnish as required for a complete installation. Fasten by welding or with stainless steel bolts or screws.

SOURCE QUALITY CONTROL:

Visually inspect all fabrication welds and correct any deficiencies.

Steel: AWS D1.1, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.

Stainless Steel: AWS D1.6.

Welded Anchor Studs: AWS D1.1 or AWS D1.6 as applicable.

PART 3--EXECUTION

INSTALLATION OF METAL FABRICATIONS:

General:

Install metal fabrications plumb or level, accurately fitted, free from distortion or defects.

Install rigid, substantial, and neat in appearance.

Install manufactured products in accordance with manufacturer's recommendations.

Obtain Construction Manager approval prior to field cutting steel members or making adjustments not scheduled.

CAST-IN-PLACE ANCHOR BOLTS:

Accurately locate and hold anchor bolts in place with templates at the time concrete is placed.

Use anchor bolt sleeves for location adjustment and provide two nuts and one washer per bolt of same material as bolt.

Minimum Bolt Size: 1/2-inch diameter by 12 inches long, unless otherwise shown.

CONCRETE AND MASONRY DRILLED ANCHORS:

Begin installation only after concrete or masonry to receive anchors has attained design strength.

Install in accordance with manufacturer's instructions.

Provide minimum embedment, edge distance, and spacing as follows, unless indicated otherwise by anchor manufacturer's instructions or shown otherwise on Drawings:

| Anchor Type | Min. Embedment (bolt diameters) | Min. Edge Distance (bolt diameters) | Min. Spacing (bolt diameters) |
|---|---|---|---|
| Wedge | 9 | 6 | 12 |
| Expansion and Sleeve | 4 | 6 | 12 |
| Adhesive | 9 | 9 | 13.5 |

Use only drill type and bit type and diameter recommended by anchor manufacturer. Clean hole of debris and dust with brush and compressed air.

When embedded steel or rebar is encountered in the drill path, slant drill to clear obstruction. If drill must be slanted more than 10 degrees to clear obstruction, notify Construction Manager for direction on how to proceed.

Adhesive Anchors:

Do not install adhesive anchors when temperature of concrete is below 40 degrees F (25 degrees F for Simpson Strong-Tie Acrylic-Tie Adhesive) or above 100 degrees F.

Remove any standing water from hole with oil-free compressed air. Inside surface of hole shall be dry where required by manufacturer's instructions.

Do not disturb anchor during recommended curing time.

Do not exceed maximum torque as specified in manufacturer's instructions.

ELECTROLYTIC PROTECTION:

Aluminum and Galvanized Steel:

Coat surfaces of galvanized steel fabricated and aluminum items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09900, PAINT COATING SYSTEMS, unless indicated otherwise.

Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless indicated otherwise.

Allow coating to dry before installation of the material.

Protect coated surfaces during installation.

Should coating become marred, prepare and touch up in accordance with paint manufacturer's written instructions.

Stainless Steel:

During handling and installation, take necessary precautions to prevent carbon impregnation of stainless steel members.

After installation, visually inspect stainless steel surfaces for evidence of iron rust, oil, paint, and other forms of contamination.

Remove contamination in accordance with requirements of ASTM A380 and A967.

Brushes used to remove foreign substances shall utilize only stainless steel or nonmetallic bristles.

After treatment, visually inspect surfaces for compliance.

REPAIR OF GALVANIZED STEEL:

Conform to ASTM A780.

For minor repairs at abraded areas, use sprayed zinc conforming to ASTM A780.

For flame cut or welded areas, use zinc-based solder, or zinc sticks, conforming to ASTM A780.

Use magnetic gauge to determine that thickness is equal to or greater than the base galvanized coating.

FASTENER SCHEDULE:

Provide fasteners as follows:

| Service Use and Location | Product | Remarks |
|---|---|---|
| 1. Anchor Bolts Cast Into Concrete for Structural Steel Column Base Plates | | |
| Interior Dry Areas | Hot-dip galvanized steel headed anchor bolts, unless indicated otherwise | |
| Exterior and Interior Wet Areas | Stainless steel headed anchor bolts | |
| 2. Anchor Bolts Cast Into Concrete for Equipment Bases | | |
| Interior Dry Areas | Stainless steel headed anchor bolts, unless otherwise specified with equipment | |
| 3. Anchor Bolts Cast Into Concrete for Metal Fabrications and Structural Components | | |
| Interior Dry Areas | Stainless steel headed anchor bolts | |

| Service Use and Location | Product | Remarks |
|---|---|---|
| 4. Drilled Anchors for Metal Components to Cast-in-Place Concrete (e.g., Ladders, Handrail Posts, Electrical Panels, and Equipment) | | |
| Interior Dry Areas | Zinc-plated or stainless steel wedge or expansion anchors | |
| Submerged, Exterior, Interior Wet, and Corrosive Areas | Adhesive stainless steel anchors | |
| 5. Connections for Structural Steel Framing | | |
| Exterior and Interior Wet and Dry Areas | High-strength steel bolted connections | Use hot-dipped galvanized high-strength bolted connections for galvanized steel framing members |
| 6. Connections for Steel Fabrications | | |
| Exterior and Interior Wet and Dry Areas | Stainless steel bolted connections | |
| 7. All Others | | |
| Exterior and Interior Wet and Dry Areas | Stainless steel fasteners | |

Antiseizing Lubricant: Use on all stainless steel threads.

Do not use adhesive anchors to support fire-resistive construction or where ambient temperature will exceed 120 degrees F.

CONSTRUCTION QUALITY CONTROL:

Construction General Contractor shall inspect concrete drill anchor installation to verify compliance with anchor size, embedment, edge length, and spacing as specified herein and shown on the Drawings. Provide inspection documentation to Construction Manager.

END OF SECTION 05500

# SECTION 07210--BUILDING INSULATION

## PART 1--GENERAL

### REFERENCES:

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

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C578 | Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation. |
| ASTM C665 | Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing. |
| ASTM D4397 | Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications. |

### SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Product Data: Submit product data indicating compliance with the requirements of this section.

### MATERIAL STORAGE:

Store off ground and keep dry at all times. Protect against weather condensation and damage.

## PART 2--PRODUCTS

### MATERIALS:

Mineral/Glass Fiber Blanket/Batt Insulation: ASTM C665, Type III, Class B, fiberglass batts with vinyl vapor retarder; R-30 for roof and R-19 for walls.

Rigid Insulation: ASTM C578, Type IV, extruded polystyrene; R-value as shown.

Vapor Retarder: ASTM D4397 plastic sheeting, 6 mils minimum.

PART 3--EXECUTION

INSTALLATION:

Batt Insulation:

Install in accordance with the manufacturer's instructions.

Fasten flanges to the sides of framing members with the vapor retarder facing the warm side. Fit tightly to ensure a continuous seal.

Where electrical outlets, ducts, pipes, vents, or other utility items occur, place insulation on the cold weather side of the obstruction.

Provide fasteners, adhesive, tape, and sealant as recommended by insulation manufacturer.

Vapor Retarder:

Apply to inside face of exterior wall and ceiling framing in sheets as large as possible, lapping all joints 6 inches and sealing with sealant and tape recommended by manufacturer.

Fit tightly and seal around all penetrations.

Replace torn and punctured sheets.

Repair minor tears or holes with tape.

Repair by replacement major tears or holes that require more than a 6-inch length of tape to repair.

Rigid Insulation:

Install with fasteners or adhesive recommended by manufacturer.

Butt joints tightly together.

Where thicker than 2 inches, install in two layers, staggering all joints.

CLEANUP AND PROTECTION:

Remove from site all containers, wrappings, and scrap insulation material. Leave floors broom clean.

Protect installed insulation from tears or other damage until covered with finish material. Replace damaged material.

END OF SECTION 07210

# SECTION 09900—PAINT COATING SYSTEMS

## PART 1--GENERAL

### REFERENCES:

The following documents and others referenced therein form part of Contract to the extent designated. Referenced documents are those current, unless otherwise indicated.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

| | |
|---|---|
| ANSI N512 | Protective Coatings (paints) for the Nuclear Industry |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D412 | Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers- Tension |
| ASTM D570 | Test Method for Water Absorption of Plastics |
| ASTM D638 | Test Method for Tensile Properties of Plastics |
| ASTM D714 | Test Method for Evaluating Degree of Blistering of Paints |
| ASTM D772 | Test Method for Evaluating Degree of Flaking (Scaling) of Exterior Paints |
| ASTM D1653 | Test Methods for Water Vapor Transmission of Organic Coating Films |
| ASTM D3912 | Test Method for Chemical Resistance of Coatings Used in Light-Water Nuclear Power Plants |
| ASTM D4060 | Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser |
| ASTM D4082 | Test Method for Effects of Gamma Radiation on Coatings for Use in Light-Water Nuclear Power Plants |
| ASTM D4256 | Test Method for Determination of the Decontaminability of Coatings Used in Light-Water Nuclear Power Plants |
| ASTM D4259 | Standard Practice for Abrading Concrete |
| ASTM D4263 | Test Method for Indicating Moisture Content in Concrete by the Plastic Sheet Method |
| ASTM D4541 | Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers |
| ASTM D5139 | Sample Preparation for Qualification Testing of Coatings to be Used in Nuclear Power Plants |
| ASTM D5144 | Guide for Use of Protective Coating Standards in Nuclear Power Plants |

| | |
|---|---|
| ASTM E84 | Test Method for Surface Burning Characteristics of Building Materials |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 255 | Method of Test of Surface Burning Characteristics of Building Materials |

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

| | |
|---|---|
| SSPC-SP 3 | Power Tool Cleaning |
| SSPC-SP 6 | Commercial Blast Cleaning |

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures

List of Materials: Before delivery, submit colors and location to be used and manufacturer catalog data sheets and charts showing adequate information to substantiate compliance to the requirements of this section. Submittal shall also enumerate percentage of volatile and nonvolatile materials, percentage of component parts of each type of material, and the conversion factors to determine dry film thickness from applied wet film thickness. Also, submit Material Safety Data Sheets (MSDS) for materials proposed to be used.

Installer's Certificate (Decontaminable Coatings Only): Before application, submit documentation that the application crew has been certified by the coating system manufacturer as qualified to apply the selected coating system. As an alternative to crew certification, a submittal documenting onsite training by a technical representative from the coating manufacturer would be acceptable.

Cleaning and Disposal Plan: Before application, submit a plan for proper collection, storage, and disposal of all materials spotted or soaked with paint, oil, solvents, and other flammable waste materials. The plan shall also address handling and disposal of empty cans. The plan shall address both daily cleanup requirements and cleanup at the completion of the coatings application activities.

Submit documentation and test results from construction quality control testing specified herein.

DELIVERY, STORAGE, AND HANDLING:

Obtain inspection and acceptance by Tank Farm Contractor before opening containers or removing labels.

PROJECT CONDITIONS:

Environment for Coating: Coat exterior surfaces only when ambient and surface temperatures are within the range recommended by the coating manufacturer for the respective coating, which is within 40 to 120 degrees F, and ambient temperature is a minimum of 5 degrees F above the dewpoint.

PART 2--PRODUCTS

MATERIALS:

Shop Primer for Carbon Steel Assemblies: Ameron-Amerlock 400.

Decontaminable Coatings for all Metal and Concrete: (Service Level II as defined in ASTM D5144)

Decontaminability: Finish and top coatings shall demonstrate decontaminability to radioactive solutions by having a minimum decontamination factor (DF) of 100 as determined by ASTM D4256, Method A, or ANSI N512, Section 4. After the initial water wash, the DF shall be a minimum of 20. Test samples shall be prepared in accordance with ASTM D5139 or ANSI N512, Section 7.

Radiation Tolerance: Coatings applied to the specified thickness shall demonstrate tolerance to a total accumulated dose in air of $6 \times 10^7$ Rads of gamma radiation in accordance with ASTM D4082 or ANSI N512, Section 3. Test samples shall be prepared in accordance with ASTM D5139 or ANSI N512, Section 7.

Physical Properties: Base and finish coatings shall have the physical property strengths shown in the tables below as determined by the respective test method.

For Rigid Decontaminable Coatings (High Solids Epoxies):

| Test | Method | Results |
|---|---|---|
| Adhesion to Substrate (steel) | ASTM D4541 | Minimum 900 psi |
| Elongation at break at 75°F | | Minimum 5% |
| Water Absorption<br>or<br>Moisture Vapor Transmission | ASTM D570 (24 hr)<br><br>ASTM D1653 | Maximum 0.5%<br><br>Maximum 8 $gm/m^2$ |
| Wear Resistance (Finish or Top Coat Only) | ASTM D4060,<br>1,000 cycles,<br>1,000 g weight,<br>CS-17 wheel | Less than 100 mg lost |

Chemical Resistance: The coating system shall be resistant to the standard decontamination solutions listed in ASTM D3912, Figure 1. Chemical resistance testing shall be in accordance with ASTM D3912, or an equivalent standard, for occasional splash and spillage service, except test samples shall be prepared in accordance with ASTM D5139 or ANSI N512, Section 7. Submit manufacturer's chemical resistance test plan, including procedure for exposing coating samples for evaluating occasional splash and spillage conditions, for evaluation and approval. Criteria for acceptance shall be based on the following:

Flaking: As evaluated in accordance with ASTM D772, flaking and peeling shall not be permitted

Blistering: As evaluated in accordance with ASTM D714, blisters shall be limited to size 4, 6, or 8, and a frequency no more than a "few."

Delamination will not be permitted.

Slight discoloration will be permitted.

Coating shall be volatile organic content (VOC) compliant with a maximum VOC of 2.9 lbs/gal.

Fire Characteristics: Coatings used shall not develop significant qualities of toxic or other harmful products of combustion when exposed to fire. Coatings shall have a UL (ASTM E84/NFPA 255) flame spread rating of 25 or less and smoke developed rating of 50 or less.

Coatings shall be repairable for cracks appearing through the applied-coated surface to the substrate and for chips and flaking due to mechanical damage.

Coating shall have a design life of 12 years. In addition to radiation tolerance requirements, coating shall be resistant to humidity ranging from 0 to 100 percent and an ambient air temperature range of 120 degrees F to minus 32 degrees F, with a maximum 24-hour differential of 52 degrees F.

Primers, thinners, and coating accessory materials shall be produced or approved for use by the same manufacturer as the finish coating system.

Decontaminable Coating Systems (Epoxies), or Approved Substitute:

| Manufacturer Product | Ameron |
|---|---|
| Steel and Concrete Primer | Amerlock 400 |
| Concrete Surfacer | Nu-Klad 114A |
| Base Coating | Amerlock 400 |
| Intermediate and Finish Coating | PSX 700 Siloxane |

Joint Sealant: "Nu-Klad 750A/760A" by Ameron, or approved substitutes, shall be used.

Scrim Cloth: Glass fiber reinforcing fabric as recommended by coating system manufacturer.

PART 3--EXECUTION

EXAMINATION:

Examine surfaces scheduled to receive coatings for conditions that will adversely affect execution, performance, or quality of work, and that cannot be put into acceptable condition through preparatory work.

Report conditions that could adversely affect proper application of coatings, in writing, to Tank Farm Contractor. Do not begin surface preparation or coating application until defects have been corrected and conditions have been made suitable.

PREPARATION:

Before application, remove as much dust and debris as possible from space or area to receive coating to allow for proper installation.

Pre-Priming:

Ferrous Metal and Carbon Steel:

Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.

Prepare shop assemblies in accordance with SSPC-SP 6. Remove abrasive residue and dust, and prime within 4 hours after preparation. Apply minimum of 3.0 mil of shop primer in accordance with manufacturer's recommendations.

Select type and size of abrasive to produce a surface profile that meets coating manufacturer's recommendations for particular primer to be used.

Prepare field erections in accordance with SSPC-SP 3 or SSPC-SP 6. Remove abrasive residue and dust.

Surface Preparation: Shop and field surface cleaning and surface preparation requirements for all substrates shall be in accordance with the manufacturer's written instructions and these Specifications. Where the specified degree of surface preparation differs from the manufacturer's recommendations, the more stringent shall apply.

Concrete shall be at least 30 days old before coating is applied.

Prior to application of coating system or surfacer to new concrete surfaces, perform a plastic sheet test in accordance with ASTM D4263. The test shall be initiated in the afternoon and completed the following morning. The absence of condensation on the test sheet shall indicate the concrete is ready to have the coating system applied. Document test results.

Clean new concrete surfaces to be coated by Abrasive Blast Cleaning Procedures in accordance with ASTM D4259.

Prepare or repair construction joints, shrinkage cracks, and other non-expanding cracks, gaps, or crevices in the surface to be coated, in accordance with coating manufacturer's recommendations. Scratches, cracks, holes, pinholes, and abrasions shall be cut back to proper key and filled with surfacer.

Post-Priming:

Feather abrasions, chips, skips, and holidays occurring in prime coat by sanding, and recoat with material and color to minimum dry film thickness specified.

Previously coated surfaces shall be recoated only after existing film is completely dry. Some coating systems require the application of succeeding coats within a set time frame for it to properly adhere to the previous coat. Should the time frame recommended by the coating manufacturer be exceeded, prepare the base coat as recommended by the coating manufacturer.

Protection:

Provide and install drop cloths, shields, and other protective devices required to protect surfaces adjacent to areas being coated. Keep spatter, smears, droppings, and over-run of coating materials to a minimum and remove as coating work progresses.

Protect coating from rain until dry to touch.

Upon completion of each coating application, protect coated surfaces from physical damage or chemical contamination.

APPLICATION:

Apply coating materials in accordance with manufacturer's recommendations.

Apply with equipment recommended by coating manufacturer.

Number of Coats, Film Thickness:

Apply the minimum number of coats specified without regard to coating thickness. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.

Maximum film build per coat shall not exceed coating manufacturer's recommendations.

Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thickness is likely to be present, and ensure proper millage in these areas.

Sealant Application:

Rigid Coating Systems: After pre-primer is installed (see Article COAT SCHEDULE), apply sealant to expansion joints at the coated surface boundary. Mask limits of joint to provide a neat appearance. Roughen contact surfaces with sandpaper. Prime and install sealant in accordance with manufacturer's instructions.

Identify each coat of opaque material by its relation to color of finish coat. Prime coat shall be darkest tint of specified color with each succeeding coat lighter, up to finish coat, which shall be color, tint, and sheen specified in Article COAT SCHEDULE or as shown on the Drawings. Tints of identical coats of identical color and material shall not vary.

Recoat and repair as necessary for compliance with the Specifications.

CLEANING:

Collect and dispose of materials spotted or soaked with paint, oil, or solvents, and other flammable waste materials daily in accordance with the coating manufacturer's recommendations. Minimize volume of potentially contaminated solids and liquids that must be disposed.

Salvageable brushes, rollers, spatulas, and spray equipment shall be thoroughly cleaned after use and shall contain no oils, thinners, or other residue after cleaning.

Dispose of empty cans at end of each shift in accordance with the cleaning and disposal plan.

At completion of coating work, remove and dispose of materials, containers, rags, cloths, brushes, equipment, and miscellaneous other debris in accordance with the cleaning and disposal plan. Clean up spills and report, if required, in accordance with the cleaning and disposal plan.

CONSTRUCTION QUALITY CONTROL:

The Construction General Contractor shall perform the field tests specified herein with properly calibrated instruments. All testing shall be performed and recorded by personnel trained in the use of the test instruments.

Thickness Testing:

Measure coating thickness on steel with a properly calibrated, magnetic type dry film thickness gauge (as manufactured by Nordson; or approved equal).

Measure the wet film thickness (WFT) of each coat of material with a notched WFT gage (Nordson 790-015) at a minimum of five evenly spaced points for each 100 square feet of surface area or portion thereof to verify the application will provide the specified minimum dry film thickness.

Adhesion Testing:

Perform adhesion testing at each field or shop location where surfaces are prepared and coatings are applied.

After surface preparation and coating application procedures have been observed and approved by the paint manufacturer's representative, select one representative location for an adhesion pull test. If the adhesion pull test does not meet the specified requirement, perform additional pull tests to determine the area of inadequate adhesion. Remove and replace coatings with inadequate adhesion.

If changes are observed in the shop or field application procedures that may affect coating adhesion, Construction Manager may require additional adhesion tests.

Construction General Contractor shall provide all test equipment required for adhesion testing.

Repair all coatings damaged by adhesion testing in accordance with the coating manufacturer's directions.

Inspection: Perform tests to ascertain that coating materials have been applied as specified in this section. Document test results. Document surface preparation, application of all coats of material, and performance of wet and dry film thickness testing in accordance with this section.

APPLICATION SCHEDULE:

Concrete: Coat exposed concrete surfaces of building slabs, truck loading slab, sump, and other concrete surfaces as shown on the Drawings.

Carbon Steel:

Coat all exposed carbon steel with the coating system specified in Article COATING SCHEDULE.

Coat concrete embedded anchor bolts with carbon steel coating system; delete intermediate and finish coats for concrete embedded anchor bolts. Repair coating on threads after nuts are installed in accordance with the manufacturer's recommendations.

See Section 13122, METAL BUILDING SYSTEMS, for painting requirements associated with prefabricated steel buildings and Section 13205, LINED BOLTED STEEL LIQUID STORAGE TANKS, for painting requirements associated with the bolted steel tank.

Aluminum and Galvanized Steel in Contact with Concrete: Coat aluminum and galvanized steel in contact with concrete with carbon steel coating system, primer only. Provide a minimum dry film thickness of 4 mils.

COAT SCHEDULE:

| Coat | Description | Color (*see Note 1) | Minimum Dry Film µm (mils) |
|---|---|---|---|
| Concrete – Rigid Coating System (Epoxies): | | | |
| Pre-Prime | Amerlock 400-thinned approx. 20-25% with #65 thinner. | N/A | Enough to seal surface |
| Joint Sealer | NuKlad 760A | N/A | N/A |
| Surfacer | NuKlad 114A | N/A | As required to fill voids |
| Prime and Base | Amerlock 400 | * | Two coats:<br>Prime 75 (3.0)<br>Base 100 (4.0) |
| Intermediate and Finish. Between coats wipe entire surface with clean thinner #65, #12, or equal. | PSX 700 Siloxane | * | Two coats:<br>Intermediate 100 (4.0)<br>Finish 100 (4.0)<br>(See Note 2) |

| Coat | Description | Color (*see Note 1) | Minimum Dry Film µm (mils) |
|---|---|---|---|
| Carbon Steel: | | | |
| Shop and Field Primer | Amerlock 400, see Note 3 | * | 75 (3.0) |
| Base | Amerlock 400, see Note 3 | * | 100 (4.0) |
| Intermediate | See Note 4 PSX 700 Siloxane | * | 100 (4.0) |
| Finish | PSX 700 Siloxane | * | 100 (4.0) |

Notes:

1. Contrast each coat from primer-darker to finish-lighter. Finish coat to be off-white to white, except bollards and truck loading connection piping support which shall be yellow.
2. Verify recoating times between intermediate and finish coats with the coating manufacturer if relative humidity is less than 40 percent.
3. Prime and base coats may be applied in single 180 µm coat if base coat is self-priming.
4. For anchor bolts, delete intermediate and finish coats.

END OF SECTION 09900

# SECTION 11305--COMBINED AND BUILDING SUMP PUMPS

## PART 1--GENERAL

### REFERENCES:

The following is a list of standards that may be referenced in this section:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI).

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A48 | Standard Specification for Gray Iron Castings |
| ASTM A576 | Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality |

HYDRAULIC INSTITUTE STANDARDS (HIS)

NATIONAL ELECTRIC CODE (NEC)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | National Electric Code |

UNDERWRITERS LABORATORIES INC. (UL)

### DEFINITIONS:

Terminology pertaining to pumping unit performance and construction shall conform to ratings and nomenclature of Hydraulic Institute Standards.

### SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Make, model, weight, and horsepower of each equipment assembly.

Complete catalog information, descriptive literature, specifications, and identification of materials of construction.

Performance data curves showing head, capacity, horsepower demand, and pump efficiency over entire operating range of pump, from shutoff to maximum capacity. Indicate separately

head, capacity, horsepower demand, overall efficiency, and minimum submergence required at guarantee point.

Power and control wiring diagrams, including terminals and numbers.

Complete motor nameplate data, as defined by NEMA, from motor manufacturer.

Functional testing plan demonstrating compliance with requirements specified herein.

SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR):

Results of construction quality control testing.

Vendor Information (VI):

Manufacturer's printed installation instructions and operations and maintenance data.

Suggested spare parts list to maintain equipment in service for period of 5 years. Include list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

Factory finish system.

EXTRA MATERIALS:

Furnish for each pump: One set mechanical seals.

PART 2--PRODUCTS

SUPPLEMENTS:

Specific requirements are attached to this section as supplements.

COMPONENTS:

Pump equipment shall consist of pump(s) complete with motor(s), anchoring brackets, power cable(s), and pump lifting cable(s).

Lifting Arrangement: 2 feet minimum, stainless steel chain, and one "grip-eye." Attach chain permanently to pump and access platform with stainless steel wire rope. "Grip-eye" will be capable of being threaded over and engaging links of stainless steel chain so pump and motor may be lifted with "grip-eye" and independent hoist.

Components – Typical:

Oil chamber between seals shall be equipped with drain and inspection plug. Plug shall have positive anti-leak seal and shall be easily accessible from outside.

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

Pump motor and sensor cables shall be suitable for submersible pump application and cable sizing shall conform to NEC specifications for pump motors. Cable shall be of sufficient length to reach junction boxes without strain or splicing.

Cable Entry System:

Junction chamber and motor shall be separated by stator lead sealing gland or terminal board that shall prevent foreign material entering through pump top.

Utilize cable with factory-installed sealing gland with nonshrink epoxy seal system.

O-ring compression seal between sealing gland and cable entry point shall also be acceptable.

ACCESSORIES:

Equipment Identification Plate: 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in readily visible location.

Lifting Lugs: Equipment weighing over 100 pounds.

FACTORY FINISHING:

Manufacturer's standard enamel finish.

PART 3--EXECUTION

INSTALLATION:

Install in accordance with manufacturer's printed instructions.

Connect suction and discharge piping without imposing strain to pump flanges.

CONSTRUCTION QUALITY CONTROL:

Construction General Contractor shall perform functional testing in accordance with approved test plan. Functional testing shall be performed in presence of Construction

Manager or representative designated by the Construction Manager. Notify Construction Manager in writing at least 5 days in advance of testing.

Functional Test: Conduct on each pump.

Flow Output: Measured by plant instrumentation and/or storage volumes.

Amp Draw: Verify motor current agrees with motor nameplate.

Test for continuous 30-minute period.

SUPPLEMENTS:

The supplements listed below, following "END OF SECTION," are part of this Specification.

Sump Pump Data Sheet, 11305-01.

Sump Pump Data Sheet, 11305-02.

END OF SECTION 11305

SUMP PUMP DATA SHEET, 11305-01

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

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

Manufacturer and Model Number: (1) Hydromatic Pump Co.; Model SB3S
(2) Barnes
(3) Or approved equal

SERVICE CONDITIONS:

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

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

Specific Gravity at 60 Degrees F: 1.0 Viscosity Range: NA pH: 5-9

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

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

Largest diameter solid pump can pass (inches) 0.5

PERFORMANCE REQUIREMENTS:

Capacity (US gpm): Rated: 250

Total Dynamic Head (Ft): Rated: 19

Maximum Shutoff Pressure (Ft): 50

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

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

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

DESIGN AND MATERIALS:

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

Volute Material: Cast Iron ASTM A48

Pump Casing Material: Cast Iron ASTM A48

Motor Housing Material: Cast Iron ASTM A48

INDUCTION DRIVE MOTOR:

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

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

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

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

SUMP PUMP DATA SHEET, 11305-02

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

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

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

SERVICE CONDITIONS:

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

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

Specific Gravity at 60 Degrees F: 1.0 Viscosity Range: NA pH: 5-9

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

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

Largest diameter solid pump can pass (inches) 0.5

PERFORMANCE REQUIREMENTS:

Capacity (US gpm): Rated: 28

Total Dynamic Head (Ft): Rated: 14

Maximum Shutoff Pressure (Ft): 30

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

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

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

DESIGN AND MATERIALS:

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

Volute Material: Cast Iron ASTM A48

Pump Casing Material: Cast Iron ASTM A48

Motor Housing Material: Cast Iron ASTM A48

INDUCTION DRIVE MOTOR:

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

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

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

Enclosure: Submersible

# SECTION 11306--LEACHATE PUMPS

## PART 1--GENERAL

### GENERAL:

Provide multi-stage, centrifugal, submersible pumps specifically designed for landfills and sideslope installations. Pumps shall be designed for pumping contaminated water and leachate. Provide all necessary pump appurtenances including lifting cable for lowering and removing the pump, power cable, a minimum 4-wheel system at each end of the pump specifically designed for transporting the pump in HDPE butt-fused carrier pipe, outlet pipe attachments and flex hose as necessary, and all other fittings or accessories required for a complete and fully functional installation.

The pump and all associated appurtenances shall be designed by the pump manufacturer to operate as a fully functional and reliable pump system. Provide a pump system capable of operating unattended with a high degree of reliability with multiple cycles per day.

Provide vent valve system, if necessary, to purge air from pumps to prevent pump air lock. Vacuum air release valves are provided in system piping at top of riser.

Provide quick-couple fitting at end of pump where outlet pipe attaches.

Remove pump discharge check valve or drill hole in check valve to prevent water from accumulating above pump outlet. Pump shall be fully capable of operating with check valve removed.

Provide stainless steel tag numbers and mounting fasteners and engrave with the equipment tag number and model number for each pump.

Note that pump control will be accomplished through software programming and the PLC mounted in the system control panels (by others) located in each Crest Pad Building.

### SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Make, model, weight, and horsepower of each equipment assembly.

Complete catalog information, descriptive literature, specifications, and identification of materials of construction.

Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the guarantee point.

Functional testing plan demonstrating compliance with requirements specified herein.

Detailed mechanical and electrical drawings showing the equipment dimensions, size, and locations of connections and weights of associated equipment.

Detailed catalog information, descriptive literature, and specifications of all components associated with pump removal system.

Power and control wiring diagrams, including terminals and numbers.

Complete motor nameplate data, as defined by NEMA, motor manufacturer.

Results of source quality control testing.

SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR):

Manufacturer's certification of factory testing to establish conformance with specified requirements. Certification must include certificates of calibration traceable to a nationally recognized standards organization such as National Institute of Standards and Technology (NIST).

Special shipping, storage and protection, and handling instructions.

Manufacturer's Certificate of Proper Installation.

Results of field quality control testing.

Vendor Information (VI):

Suggested spare parts list to maintain the equipment in service for a period of 1 year. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

Manufacturer's printed installation instructions.

Operation and maintenance manual.

PART 2--PRODUCTS

PUMPS:

All major components shall be Type 304 stainless steel including the housing, fasteners, shaft, diffuser chamber, and impeller(s). Components shall be highly corrosion resistant and suitable for contaminated water and leachate service. Gaskets, O-rings, and seals shall have compatibility properties equivalent to Viton material as a minimum.

Pump bearings shall have better heat and wear resistance than Teflon bearings.

Provide power and stainless steel cable as recommended by manufacturer and to the length and configuration as shown on the Drawings.

Motors:

Provide sealed pump motors suitable for continuous submerged service. Provide continuous motor leads without splices along the full length of the discharge pipe. Leads shall be fully insulated with chemical and waterproof insulation properties. Provide motor designed for continuous duty and multiple cycle times of 60 starts per hour. Motors shall have thermal overload protection.

Source Quality Control:

Construction General Contractor shall perform source quality testing at the factory as specified herein. Notify Construction Manager in writing at least 10 days in advance of testing. Construction Manager will coordinate with personnel required to witness testing.

Factory Tests and Adjustments: Test all equipment actually furnished.

Factory Test Report: Include test data sheets, curve test results, performance test logs.

Performance Test:

Conduct on each pump.

Perform under simulated operating conditions, at a minimum of six operating points on the pump curve.

Test for a continuous 30-minute period without malfunction. Check for excessive or abnormal vibrations and correct deficiencies.

Test Log: Record the following:

Total head.

Flow measured by factory instrumentation and/or storage volumes.

Average distance from suction well water surface to pump discharge centerline for duration of test.

Pump discharge pressure converted to feet of liquid pumped and corrected to pump discharge centerline.

Driving motor voltage and amperage measured for each phase.

Adjust or modify units and retest if necessary.

Pump Removal System:

Provide one common manual pump removal winch for raising and lowering the leachate pumps and associated discharge piping in the riser. Winch shall be brake (spur gear) winch with automatic brake; Thern Model No. M4032PB, or equal. Provide winch with sufficient capacity to handle required length of lifting cable (stainless steel wire rope). Lifting cable shall include and the winch accommodate a swage ball fitting cable end for quick connect/disconnect.

Winch shall be mounted on structural steel support. The winch support shall only be installed for pump installation/removal. Three sets of drop-in anchors shall be installed in floor that match the winch support base bolt pattern. Each set of drop-in anchors shall be located to align the winch support with each HDPE riser pipe such that the lifting cable does not rub the HDPE riser pipe during pump installation/ removal. Coordinate location of the drop-in anchors with Construction Manager.

Provide two manual hose reels for separately handling the leachate pump power and level transducer cables. Hose reels shall be heavy-duty hand crank reels with adjustable spool rotation drag and spool lock pins. Hose reels shall be Reelcraft Model No. C33118LI, or equal. Each reel shall be located as required for proper alignment with appropriate riser pipe. Drop-in anchors shall be installed in floor that match hose reel "feet" bolt pattern for both reels. Bolts shall be left in place to prevent accumulation of dirt, etc., in anchor threads. Bolts shall be tapered flathead to eliminate tripping hazard.

LEVEL SENSORS:

Provide level sensors integral to Cell 1 and Cell 2 LDS leachate pump (two total) as shown on the Drawings. Level elements shall be designed and constructed for landfill leachate service, i.e., fully submersible and chemically resistant.

The level sensor shall include a transmitter with built-in temperature compensation and an accuracy of plus or minus 1.0 percent. Sensor output shall be a conditioned compensated 4 to 20 mA signal.

The sensor control cable shall be shielded to prevent signal disruption and include a vent tube for atmospheric pressure compensation. Control cables shall include polyurethane jacket and Kevlar tension members.

Level sensors shall be mounted on the pump housing and be field serviceable without having to disassemble the pump.

PART 3--EXECUTION

INSTALLATION:

Install in accordance with manufacturers' printed instructions and manufacturers' representatives' guidance and recommendations.

CONSTRUCTION QUALITY CONTROL:

Construction General Contractor shall perform functional testing in accordance with approved testing plan. Functional testing shall be performed in the presence of the Construction Manager. Notify Construction Manager in writing at least 5 days in advance of testing.

Function Tests:

After installation of the side slope riser pipe, verify exact length of pump discharge and level transducer piping required by using a long tape measure to measure actual dimension. Test the insertion and extraction of each pump from the side slope riser pipe and into the crest pad buildings. Perform testing while the perforated carrier pipe sections in the sumps are exposed to allow observation of the pump removals and insertions from the carrier pipe.

Test the pumps under simulated conditions using a temporary tank located at the bottom of the landfill. Place pump in the tank and connect temporary flexible hose between the pump and discharge pipe routed up the side slope surface and between the discharge pipe and riser connection in Crest Pad Building. Run the pumps at full output for a period of not less than 1 hour. Record flows and pressures at 10-minute intervals and/or until readings stabilize. Keep the tank full to supply adequate water to the pumps during the pump test. Record amp draw readings.

SUPPLEMENTS:

The supplements listed below, following "END OF SECTION," are a part of this Specification.

Data Sheets:

Supplement 1—Leachate Pump Data Sheet, 11306-01.
Supplement 2—Leachate Pump Data Sheet, 11306-02.
Supplement 3—Leachate Pump Data Sheet, 11306-03.

END OF SECTION 11306

LEACHATE PUMP DATA SHEET, 11306-01:

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

Pump Locations and I.D.: Cell 1 LCRS Sump, Low Flow
Cell 2 LCRS Sump, Low Flow

Manufacturer and Model Number: (1) EPG Companies; Model WSD 3-3
(2) Or equal

SERVICE CONDITIONS:

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

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

Specific Gravity at 60 Degrees F: 1.0 Viscosity Range: NA pH: 5-9

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

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

PERFORMANCE REQUIREMENTS AT PRIMARY DESIGN POINT:

Capacity (US gpm): Rated: 13

Total Dynamic Head (Ft): Rated: 66

Min. Hydraulic Efficiency (%): 60

Maximum Shutoff Pressure (Ft): 90

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

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

DESIGN AND MATERIALS:

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

Discharge Orientation: Center

Casing Materials: Type 304 SST

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

Impeller: Type: Closed  Material: Type 304 SST

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

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

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

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

Drive Type: Direct Coupled

INDUCTION DRIVE MOTOR:

Horsepower: 0.5  Voltage: 460  Phase: 3

Speed (rpm): 3,450

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

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

Enclosure: Submersible

LEACHATE PUMP DATA SHEET, 11306-02:

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

Pump Location and I.D.: Cell 1 LCRS Sump, High Flow
Cell 2 LCRS Sump, High Flow

Manufacturer and Model Number: (1) EPG Companies; Model WSD 30-4
(2) Or equal

SERVICE CONDITIONS:

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

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

Specific Gravity at 60 Degrees F: 1.0 Viscosity Range: NA pH: 5-9

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

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

PERFORMANCE REQUIREMENTS AT PRIMARY DESIGN POINT:

Capacity (US gpm): Rated: 155

Total Dynamic Head (Ft): Rated: 118

Min. Hydraulic Efficiency (%): 60

Maximum Shutoff Pressure (Ft): 208

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

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

DESIGN AND MATERIALS:

Design: Wheeled enclosure frame (Y/N) Y

Discharge Orientation: Center

Casing Materials: Type 304 SST

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

Impeller: Type: Closed Material: Type 304 SST

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

Shaft Material: Type 304 SST Shaft Sleeve Material: E-Glide (engineered plastic), or equal

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

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

Drive Type: Direct Coupled

INDUCTION DRIVE MOTOR:

Horsepower: 7.5 Voltage: 460 Phase: 3

Speed (rpm): 3,450

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

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

Enclosure: Submersible

LEACHATE PUMP DATA SHEET, 11306-03:

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

Pump Locations and I.D.: Cell 1 LDS Sump
Cell 2 LDS Sump

Manufacturer and Model Number: (1) EPG Companies; Model WSD 1.5-3
(2) Or equal

SERVICE CONDITIONS:

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

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

Specific Gravity at 60 Degrees F: 1.0 Viscosity Range: NA pH: 5-9

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

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

PERFORMANCE REQUIREMENTS AT PRIMARY DESIGN POINT:

Capacity (US gpm): Rated: 4

Total Dynamic Head (Ft): Rated: 65

Min. Hydraulic Efficiency (%): 60

Maximum Shutoff Pressure (Ft): 80

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

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

DESIGN AND MATERIALS:

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

Discharge Orientation: Center

Casing Materials: Type 304 SST

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

Impeller: Type: Closed  Material: Type 304 SST

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

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

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

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

Drive Type: Direct Coupled

INDUCTION DRIVE MOTOR:

Horsepower: 0.5  Voltage: 460  Phase: 3

Speed (rpm): 3,450

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

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

Enclosure: Submersible

# SECTION 11312--HORIZONTAL END SUCTION CENTRIFUGAL PUMPS

## PART 1--GENERAL

### REFERENCES:

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

AMERICAN BEARING MANUFACTURERS' ASSOCIATION (ABMA)

AMERICAN IRON AND STEEL INSTITUTE (AISI)

Type 416 Stainless Steel
Type 1035 Steel
Type 1045 Carbon Steel
Type 4140 Alloy Steel

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A48 | Standard Specification for Gray Iron Castings |
| ASTM A53/A53M | Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A276 | Standard Specification for Stainless Steel Bars and Shapes |
| ASTM A576 | Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality |
| ASTM B62 | Standard Specification for Composition Bronze or Ounce Metal Castings |
| ASTM B148 | Standard Specification for Aluminum-Bronze Sand Castings |
| ASTM B584 | Standard Specification for Copper Alloy Sand Castings for General Applications |

HYDRAULIC INSTITUTE STANDARDS

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE 112 | Standard Test Procedure for Polyphase Induction Motors and Generators |

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA MG 1 | Motors and Generators |

DEFINITIONS:

Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Make, model, weight, and horsepower of each equipment assembly.

Complete catalog information, descriptive literature, specifications, and identification of materials of construction.

Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the guarantee point.

Detailed mechanical and electrical drawings showing the equipment dimensions, size, and locations of connections and weights of associated equipment.

Functional testing plan demonstrating compliance with requirements specified herein.

Power and control wiring diagrams, including terminals and numbers.

Complete motor nameplate data, as defined by NEMA, motor manufacturer.

Results of source quality control testing.

SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR):

Special shipping, storage and protection, and handling instructions.

Manufacturer's Certificate of Proper Installation.

Results of field quality control testing.

Vendor Information (VI):

Suggested spare parts list to maintain the equipment in service for a period of 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

Manufacturer's printed installation instructions.

Operation and maintenance data.

Factory finish system data sheets.

EXTRA MATERIALS:

Furnish for each pump:

Complete set packing.

Complete set bearings.

Complete set gaskets and O-ring seals.

Complete set of shaft sleeves.

Complete set keys, dowels, pins, etc.

Complete mechanical seal.

Impeller.

Impeller shaft.

Impeller wear ring.

Head shaft.

One complete set of any special tools required to dismantle pump.

PART 2--PRODUCTS

GENERAL:

Coordinate pump requirements with drive manufacturer and be responsible for pump and drive requirements.

Where adjustable speed drives are required, furnish a coordinated operating system complete with pump, drive, and speed controller.

SUPPLEMENTS:

Some specific requirements are attached to this section as supplements.

ACCESSORIES:

Equipment Identification Plate: 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in a readily visible location.

Lifting Lugs: Equipment weighing over 100 pounds.

Anchor Bolts: Galvanized, sized by equipment manufacturer, 1/2-inch minimum diameter, and as specified in Section 05500, METAL FABRICATIONS AND CASTINGS.

FACTORY FINISHING:

Manufacturer's standard enamel finish.

SOURCE QUALITY CONTROL:

Construction General Contractor shall perform source quality control testing at the factory as specified herein. Notify Construction Manager at least 10 days in advance of testing.

Performance Test: Perform manufacturer's standard motor test on equipment.

PART 3--EXECUTION

INSTALLATION:

Install in accordance with manufacturer's printed instructions.

Level base by means of steel wedges (steel plates and steel shims). Wedge taper not greater than 1/4 inch per foot. Use double wedges to provide a level bearing surface for pump and driver base. Accomplish wedging so that there is no change of level or springing of the baseplate when the anchor bolts are tightened.

Adjust pump assemblies such that the driving units are properly aligned, plumb, and level with the driven units and all interconnecting shafts and couplings. Do not compensate for misalignment by use of flexible couplings.

After pump and driver have been set in position, aligned, and shimmed to proper elevation, grout the space between the bottom of the baseplate and the concrete foundation with a poured, nonshrinking grout. Remove wedges after grout is set and pack void with grout.

Connect suction and discharge piping without imposing strain to pump flanges.

Anchor Bolts: Accurately place using equipment templates and as specified in Section 05500, METAL FABRICATIONS AND CASTINGS.

CONSTRUCTION QUALITY CONTROL:

Construction General Contractor shall perform field quality control testing in accordance with approved testing plan. Functional testing shall be performed in the presence of the Construction Manager. Notify Construction Manager in writing at least 5 days in advance of testing.

Functional Tests:

Conduct on each pump.

Perform under simulated operating conditions.

Test for a continuous 1-hour period without malfunction.

Test Log: Record the following:

Total head.

Capacity.

Horsepower requirements.

Flow measured by factory instrumentation and/or storage volumes.

Average distance from suction well water surface to pump discharge centerline for duration of test.

Pump discharge pressure converted to feet of liquid pumped and corrected to pump discharge centerline.

Driving motor voltage and amperage measured for each phase.

Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.

Vibration Test:

Test with units installed and in normal operation, and discharging to the connected piping systems at rates between the low discharge head and high discharge head conditions specified shall not develop, at any frequency or in any plane, peak-to-peak vibration amplitudes of 3 mils.

If units exhibit vibration in excess of the limits, adjust or modify as necessary. Units which cannot be adjusted or modified to conform as specified shall be replaced.

Operating Temperatures: Monitor bearing areas on pump and motor for abnormally high temperatures.

MANUFACTURER'S SERVICES:

Manufacturer's Representative: Present at site or classroom designated by Tank Farm Contractor, for minimum person-days listed below, travel time excluded:

1 person-day for installation assistance and inspection.

1 person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.

SUPPLEMENTS:

The supplements listed below, following "END OF SECTION," are a part of this Specification.

Pump Data Sheet, 11312-01

END OF SECTION 11312

HORIZONTAL END SUCTION CENTRIFUGAL PUMP DATA SHEET, 11312-01:

Tag Numbers: 219A1-LH-P-302, 219E1-LH-P-302

Pump Name: Buildings 219A1 and 219E1, Leachate Transfer Pump

Manufacturer and Model Number: (1) Paco; Model 30707
(2) Or equal

SERVICE CONDITIONS:

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

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

Specific Gravity at 60 Degrees F: 1.0 Viscosity Range: NA pH: 5-9

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

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

Largest diameter solid pump can pass (inches) 0.25

PERFORMANCE REQUIREMENTS AT PRIMARY DESIGN POINT:

Capacity (US gpm): Rated: 250

Total Dynamic Head (Ft): Rated: 25

Min. Hydraulic Efficiency (%): 75

Maximum Shutoff Pressure (Ft): 40

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

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

DESIGN AND MATERIALS:

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

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

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

Shaft Seal: Packing (Y/N) N

Mechanical (Y/N) Y

Lubrication: Process water

Drive Type: Direct-Coupled: Y  Belt N  Adjustable Speed N

INDUCTION DRIVE MOTOR:

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

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

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

Enclosure: Totally enclosed fan cooled

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

TESTING:

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

Factory Hydrostatic Casing Pressure Test (Y/N) N

Field Functional (Y/N) Y  Field Performance (Y/N) N

Field Vibration (Y/N) Y

# SECTION 13122--METAL BUILDING SYSTEMS

## PART 1--GENERAL

### WORK INCLUDED:

The Construction Subcontractor shall furnish and install four prefabricated pre-engineered metal building, complete, as shown on the Drawings and as specified herein.

### REFERENCES:

The following Codes and Standards, including others referenced therein, form a part of this Section to the extent specified herein:

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

| | |
|---|---|
| AISC | Specification for Structural Steel for Buildings – Allowable Stress Design (ASD) |

AMERICAN IRON AND STEEL INSTITUTE (AISI)

| | |
|---|---|
| AISI | Specification for the Design of Cold-Formed Steel Structural Members |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A36 | Standard Specification for Carbon Structural Steel |
| ASTM A53 | Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A325 | Standard Specification for Structural Bolts, Steel, Heat-Treated, 120/105 ksi Minimum Tensile Strength |
| ASTM A500 | Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes |
| ASTM A501 | Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing |
| ASTM A529 | Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality |
| ASTM A570 | Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality |
| ASTM A572 | Standard Specification for High-Strength, Low-Alloy Columbium-Vanadium Structural Steel |
| ASTM A607 | Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled, and Cold-Rolled |

ASTM F959 Standard Specification for Compressible-Washer-Type Direct Tension Indicator for Use with Structural Fasteners

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1 Structural Welding Code – Steel

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

Recommended Design Practices Manual, for applicable loads and load combinations

Metal Building Systems Manual, for collateral loads

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

UBC, Uniform Building Code

STEEL DOOR INSTITUTE (SDI)

SDI 100 Recommended Specifications for Standard Steel Doors and Frames

SDI 117 Manufacturing Tolerances Standard Steel Doors and Frames

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Shop Drawings:

Manufacturer's Standard Details and Structural Calculations: Clearly mark those portions that apply to specific Project and those parts that do not apply.

Manufacturer's Literature and Technical Data: Drawings and Specifications for proposed metal building system.

Painting System: Specifications including paint manufacturer's name, product trade-name, and preparation for shop and field coats. Provide minimum 20 color samples for Tank Farm Contractor to choose.

Drawings Stamped by Engineer Registered in the State of Washington and Prepared Specifically for this Project:

Materials and Details: Show materials, details of components (including doors and other accessories), finishes, fastenings, methods of joining, sealants, anchor bolt, shear angle, and baseplate details including all sizes and dimensions, size and location of structural members and bracing, wall

structural members, bracing, openings, and structural wind columns as required.

Calculations Stamped by Engineer Registered in the State of Washington: Complete structural stress and deflection analysis of structural components and connections; consider prying action of bolts should proposed design use bolted moment-resistant connections in main frames. Provide anchor bolt calculations and separately tabulate anchor bolt reaction for all case loads and load combinations.

Samples: Minimum 2-inch by 3-inch metal for components requiring color selection.

Submit documentation of construction quality control testing as specified herein.

SUBMITTALS–APPROVAL NOT REQUIRED:

Information/Record (IR):

Statements of Qualification:

Documentation of past 5 years' experience record to include project name, location, type and date completed, building manufacturer and owner's contact person.

Certification of approval by manufacturer.

Vendor Information (VI):

Manufacturer's written instructions for shipping, handling, storage, protection and erection or installation of building and components.

Manufacturer's certification or proof of current membership in Metal Building Manufacturer's Association (MBMA).

Manufacturer's Certificate of Proper Installation.

Operations and maintenance manual.

QUALIFICATIONS:

Provide prefabricated metal buildings as produced by a manufacturer who is regularly engaged in fabrication of pre-engineered metal structures of type and quality indicated. All components shall be provided from one manufacturer.

WARRANTIES:

Warranty shall begin at the time of Substantial Completion.

The roofing and siding shall be warranted for a minimum of 20 years against wind damage, leakage, paint fade, chipping, peeling, attachment and rusting. Warranty shall include labor and materials for replacement of defective panels. Warranty shall not be pro-rated over 20-year period.

Finish on metal roof and wall panels, flashing, and trim will not chalk, crack, check, blister, peel, flake, chip, or loose adhesion shall be warrantied for 5 years.

PART 2--PRODUCTS

MANUFACTURER:

Dimensions of the 12-foot by 12-foot buildings are based on Panl-Line Building System as manufactured by Butler Manufacturing Co. Dimension and sizes of the 21-foot by 16-foot buildings are based on the Parkline Building Systems, Inc. (Type AL), and VP Buildings, Inc. If an "or equal" building manufacturer is submitted and approved by the Engineer, all dimensions and clearances shall be taken as minimums for evaluation of submittal. Construction Subcontractor shall be responsible for all adjustments required to plans as a consequence of changing building manufacturer. All shop drawings and special process procedures as welding, painting and structural bolting, shall be submitted for approval and shall be stamped by a registered professional engineer licensed to practice in the State of Washington.

Type: The metal building shall be a prefabricated, weather-tight, free-standing building having a structural steel frame. The 12-foot by 12-foot buildings shall be self-framing buildings incorporating diagonal bracing. The 21-foot by 16-foot buildings shall be rigid frame in all walls with no diagonal bracing in the wall. The roof slope and the eave height shall be at as specified on Construction Drawings.

DESIGN LOADS:

The building shall be designed for the following applied loads in addition to dead load:

Roof Live Loads: Roof covering shall be designed for 20 psf uniformly distributed load.

Roof Snow Load: Ground snow load is 15 psf, $C_e = 10$, $I = 0.8$ designed per ASCE 7.

Wind Loads: The wind load on the structure shall be designed per ASCE 7 and DOE STD-1020-02 using a 3-second gust wind velocity of 85-mph wind speed. Design and calculate according to the ASCE 7 exposure Class "C" with an Importance Factor = 1.0.

Seismic Loads: Seismic loads shall be determined and applied in accordance with the UBC Zone 2B, Importance Factor = 1.0, Soil $S_c$. Out-of-plane system stability, nonstructural components, and equipment shall be evaluated using UBC 1632.

Collateral Loads: All additional dead loads, other than the weight of the metal building system, such as fire sprinklers, mechanical HVAC systems, electrical systems, and ceilings. Collateral loads shall be a minimum of 10 pounds per square foot as defined in the Metal Building Systems Manual published by the MBMA.

Maximum Deflection: Deflection shall be limited to L/240 for DL and DL+LL for all building components.

Combination of Loads: Combined loads shall be as prescribed in the UBC.

Building Code Requirement: Design building, roof system, roof overhang including support framing, roof and wall panels, and fasteners for horizontal and uplift wind loads and earthquake forces.

MATERIALS:

Hot-Rolled Structural Shapes: Conform to ASTM A36 or A529.

Tubing or Pipe: Conform to ASTM A500, Grade B; ASTM A501, or ASTM A53.

Members Fabricated from Plate or Bar Stock: 42,000 psi minimum yield strength; Conform to ASTM A529, A570, or A572.

Members Fabricated by Cold Forming: Conform to ASTM A607, Grade 50.

Galvanized Steel Sheet: Conform to ASTM A446 with G90 coating. "Class" to suit building manufacturer's standards.

STRUCTURAL FRAMING COMPONENTS:

Rigid Frames:

Rigid frames shall be hot-rolled structural steel, factory welded, and shop painted. Furnish complete with attachment plates, bearing plates, and splice members. Factory drilled for bolted field assembly.

Length of span and spacing of frames shall be as shown on Drawings except slight roof slope variations are acceptable to meet manufacturer's standard.

Wind Bracing: No "x" type rod bracing shall be used in bays where bracing would cross windows or door openings, or where the interior of the exterior walls are to be finished. Use portal frames where bracing is required at window or door openings.

Secondary Framing: Purlins, eave girts, girts, flange and sag bracings shall be "Z" or "C" roll formed sections no pre-punched for fasteners, and shall be shop prime painted. Roof purlins shall be spaced a maximum of 5-foot 0-inch O.C. Base channel, sill angle, purlin spacers; minimum 14-gauge cold-formed steel; and shall be shop prime painted.

Anchor Bolts: The anchor bolts for the rigid frames shall be carbon steel and designed by the pre-engineered building manufacturer. Location and placement shall be coordinated with the foundation rebar shown on the Drawings. Any changes in rebar placement shall be brought to the attention of the Construction Subcontractor and engineering calculations shall be provided taking into account the changed rebar location.

Bolts: Bolts shall be ASTM A325 in quantities necessary for design loads and connection details. Provide zinc- or cadmium-plated units when in direct contact with panels. Direct tension indicators shall conform to ASTM F959.

Fabrication:

Shop fabricate to the indicated size and section, complete with base plates, bearing plates, and other plates as required for erection, welded in place, and with all required holes for anchoring or connections shop drilled or punched to template dimensions.

Shop connections shall be power riveted, bolted, or welded.

Field connections shall be bolted. Install high strength threaded fasteners in accordance with "Specifications for Structural Joints Using ASTM A325 or A490 Bolts."

Weld Construction:

Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in connecting welding work. Welding shall not be performed at the project site.

Construction General Contractor shall provide Certified Weld Inspector (CWI) to perform visual examination of all off-site welds in accordance with AWS D1.1, Section 6. Document weld acceptance on Construction Subcontractor Weld History.

Shop Painting:

Surfaces to be primed shall be cleaned of loose mill scale, rust, dirt, oil, grease, and other matter precluding paint bond. Follow procedures of SSPC-SP3 for power tool cleaning, SSPC-SP7 for brush-off blast cleaning, and SSCP-SP1 for solvent cleaning.

Prime structural steel primary and secondary framing members with manufacturer's standard rust-inhibitive primer having over 50 percent rust-inhibitive pigment, such as organic zinc. No lead or chromate will be allowed.

Prime galvanized members, after phosphoric acid pretreatment, with zinc dust-zinc oxide primer.

ROOFING AND SIDING:

General: Provide roofing and siding sheets formed to general profile or configuration as specified. Provide flashings, closers, fillers, ridge covers, and other sheet metal accessories, factory formed of same material and finish as roofing and siding. Factory-applied baked enamel, in color selected by the Engineer.

Roof Panels:

The Interlocking-Standing Seam Roof Covering shall carry an Underwriters' Laboratories, Inc., Uplift Classification of not less than Class 90 and shall consist of material not less than 24-gauge aluminized coated steel with Kynar finish on exterior face. The panels shall be installed with the ribs upstanding and parallel to the roof slope.

All longitudinal interlocking ribs as well as any transverse end laps shall be properly sealed, according to the manufacturer's instructions, with non-drying sealant.

The roof panels shall be secured to each structural support by a steel clip concealed between the adjacent male and female ribs and fastened under that panel's weather surface. Clip shall be long enough to allow Styrofoam thermal spacer on top of purlin.

Penetrations through the roof panel by fasteners shall be limited to only those required at the rake eaves, at end laps and at the ridge. All exposed fasteners shall be fitted with weather-seal washers of hydrocarbon-based elastomer (synthetic rubber) with a compatible metal backing.

Thermal (break) spacers shall be provided continuously at each structural support to minimize thermal conductivity. The thermal spacer shall be a continuous Styrofoam strip, 3 inches by 1 inch thick.

Wall Panels Exterior:

The interlocking-ribbed wall covering shall consist of panels of not less than 24 U.S. gauge, fluoropolymer enamel finished, aluminized coated steel with male and female ribs. The wall panels shall be applied to the structural framing with the interlocking ribs toward the interior of the structure. The interlocking ribs shall be secured at the base, at each intermediate girt, and at the support at which it terminates, by means of concealed fasteners, thus eliminating any through-wall fastening. Trim finish to match wall panel.

All interior fasteners, i.e., screws, bolts and nuts, etc., shall be of carbon steel having a protective coating of either zinc or cadmium.

Interior Liner Panels: Interior wall liner panels shall be provided throughout the building on all perimeter walls. The panels shall be 24 gauge, white with concealed fasteners. All panel joints shall be provided with sealer along the edges of each panel. The liner panels shall function as a vapor barrier. Length of panels shall be full height with no horizontal joints. finish shall be as described below.

Sealing Tape: Sealing tape shall be 100 percent solids, pressure sensitive grey polyisobutylene compound tape with release paper backing. Not less than 1/2 inch wide and 1/4 inch thick, nonsag, nontoxic, nonstaining and permanently elastic.

Joint Sealant: Joint sealant shall be one-part elastomeric; polyurethane, polysulfide, or silicon rubber as recommended by building manufacturer.

Ice Stops: Provide ice stops to prevent snow and ice damage to gutters. Ice stops shall be "ICEJAX" as manufactured by Snowjax Inc., Mechanicsburg, Pennsylvania, or approved equal. "ICEJAX" shall be adhered with Loctite "Depend", or approved equal, to metal roof panels.

Rain Gutter and Downspouts: The rain gutter shall be continuous along the eaves of the building. The gutter shall be a surface mounted type with downspout size and number as called for by the building manufacturer or as shown on the drawings. Gutter shall be minimum 5 x 5 inches in cross section. Gutter and downspouts shall be standard design as manufactured by Metal Building Manufacturer, or approved equal. Gutter shall be installed with 1/4 inch per 10-foot 0-inch slope to downspout. Factory finish to match wall panels.

INSULATION AND VAPOR RETARDER:

As specified in Section 07210, BUILDING INSULATION.

DOORS:

Steel Doors: 1-3/4-inch doors, conforming to ANSI/SDI 100, with manufacturer's standard. Provide exterior doors with top and bottom edges finished flush. Provide doors of materials and ANSI/SDI 100 grades and models specified below, or as indicated on drawings and schedules.

Exterior Doors: Unless otherwise indicated, Grade III, extra heavy duty, Model 2 (seamless) design), minimum 16 gauge galvanized steel sheet faces.

DOOR FRAMES:

Provide metal frames for doors and other openings according to ANSI/SDI 100 and of types and styles as shown on drawings and schedules. Conceal fastenings unless otherwise indicated. Frames shall be No. 14 USS gage or heavier cold-rolled steel sheet. Form exterior frames of hot dip galvanized steel. Fabricate frames with mitered and welded corners.

Available manufacturers of steel doors include the following:

AMWELD Building Products Div.

Ceco Corp.

Curries

Fenestra

Republic Builders Products Corp.

Steelcraft Mfg. Co.

Thermal-Rated (Insulating) Assemblies: At all exterior locations, provide doors which have been fabricated as thermal insulating door and frame assemblies and tested in accordance with ASTM C 236 or ASTM C 976. Unless otherwise indicated, provide assemblies with maximum apparent U factor for thermal-rated assemblies is 0.24 Btu/hr ($ft^2$) degrees F.

HEATING, VENTILATING, AND AIR CONDITIONING SYSTEM:

As specified in Section 15500, HEATING, VENTILATING, AND AIR CONDITIONING SYSTEM.

FIXED LOUVERS:

Material: Factory finish to match wall panels.

Free Airflow: Minimum 50 percent.

Weather Projection: Drainage-type louver.

Insect Screen: Manufacturer's standard 14-Ga to 18-Ga galvanized steel wire mesh screen.

PIPE PENETRATIONS:

For pipe penetrations through the roof use a "DEKTITE" pipe flashing unit as manufactured by ITW Buildex, or approved equal. Provide a stainless steel hose clamp for positive sealing of flashing to pipe.

WALL PENETRATIONS:

Provide opening as required by HVAC air conditioning manufacturer.

ELECTRICAL AND LIGHTING:

As specified in Section 16005, ELECTRICAL.

PART 3--EXECUTION

ERECTION:

Framing: Erect structural framing true to line, level and plumb, rigid and secure. Level base plates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use a non-shrinking grout as specified in Section 03301, CONCRETE, to obtain uniform bearing and to maintain a level base line elevation. Moist cure grout for not less than 7 days after placement.

Bracing:

Install diagonal rod or angle bracing in roof as required.

Diagonal/rod bracing shall not interfere with ceiling purlins.

Install portal frame bracing in sidewalls as specified.

Framed Openings: Provide shapes of proper design and size to reinforce opening and to carry loads and vibrations imposed, including equipment furnished under mechanical or electrical work. Securely attach to building structural frame.

ROOFING AND SIDING:

General:

Install panels and associated items for neat and weather tight enclosure. Avoid "panel creep" or application not true to line. Protect factory finish from damage.

Provide weather seal under ridge cap. Flash and seal roof panels at eave, swaged joints and rake with manufacturer's standard rubber, neoprene, or other closures to exclude weather.

Roof Sheets:

Provide sealant tape at lapped joints of ribbed or fluted roof sheets, and between roof sheeting and accessories.

Apply sealant tape continuous to clean, dry surface of weather side of fastenings on end laps and on sidelaps of corrugated or nesting type, ribbed or fluted panels and elsewhere to make weatherproof to driving rains.

Wall Sheets:

Apply elastomeric sealant continuous between metal base channel (sill angle) and concrete foundation and elsewhere as necessary for waterproofing. Handle and apply sealant and backup in accordance with sealant manufacturer's recommendations.

Align bottoms of wall panels. Fasten flashings, trim around openings, etc., with self-tapping screws.

Provide small quantities of paint material and touch-up coatings damaged during construction in accordance with the manufacturer's direction.

Sheet Metal Accessories: Install louvers and other sheet metal accessories in accordance with manufacturer's recommendations for positive anchorage to building and weathertight mounting.

Interior Wall Liner Panels: Install all wall liner panels as shown on the Drawings.

Certification: The Construction Subcontractor shall submit a certified statement that all standing seam metal roofing, flashings, rain gutter and downspout, wall panels, structural framing, and anchor bolts have been installed in strict accordance with the manufacturer's printed instructions and this specification.

Door Installation: Fit hollow metal doors accurately in frames, within clearance specified in SDI-100.

HARDWARE SCHEDULE:

Group No. 2:

Butts: 1-1/2 pair Mckinney T4A3386 4.5 x 4.5 x BHMA 630.

Lockset: 1 Best 84-7-C-15D-S3 x BHMA 626.

Closer: 1 LCN P4041 x BHMA 673.

Rain Drip: 1 Pemko 346C.

Kick Plate: 1 SST–10 inches high by 0.05 inch thick.

Weatherstripping: 1 set Pemko 319CN x S88 x BHMA 628.

Door Bottom: 1 Pemko 430CRL x BHMA 628.

Threshold: 1 Pemko 254X4AFG x BHMA 628.

CONSTRUCTION QUALITY CONTROL:

High Strength Bolted Connections: Construction General Contractor shall provide special inspections to verify field connections with high strength bolts are installed in accordance with plans and specifications and AISC requirements.

END OF SECTION 13122

# SECTION 13205--LINED BOLTED STEEL LIQUID STORAGE TANKS

## PART 1--GENERAL

### REFERENCES:

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

AMERICAN WATER WORKS ASSOCIATION (AWWA)

| | |
|---|---|
| AWWA D103 | Factory-Coated Bolted Steel Tanks for Water Storage |
| AWWA D130 | Flexible-Membrane-Lining and Floating-Cover Materials for Potable Water Storage |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A446 | Steel Sheet, Zinc-Coated by the Hot-Dip Process, Structural Quality |
| ASTM A525 | General Requirements for Steel Sheet, Zinc-Coated by the Hot-Dip Process |
| ASTM D413 | Standard Test Methods for Rubber Property-Adhesion to Flexible Substrate |
| ASTM D751 | Standard Test Method for Coated Fabrics |

FEDERAL STANDARDS (FS)

| | |
|---|---|
| FS 5100 | Preservation and Packing of Hand Tools; Tools and Tool Accessories for Power-Driven Metal Woodworking Machinery |

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS

| | |
|---|---|
| UBC | Uniform Building Code |

### DESCRIPTION:

This Specification sets the minimum standards for design and construction of two lined, bolted liquid storage tanks. The tanks shall be constructed from corrugated galvanized steel panels bolted together such that no field welding or onsite coating is required. The system shall provide an interior geosynthetic fabric to protect the factory fabricated membrane liner. A tank primary and secondary liner system shall be utilized.

QUALIFICATIONS:

Tank Manufacturer: At least five tanks presently in service, of similar size and character required for this Project, and minimum of 5 years' satisfactory operation.

Tank Installer: Certified by tank manufacturer that installer is qualified to do the Work.

Registered Professional Engineer: Licensed in the state of Project with training and expertise in tank system design and installation. Able to recognize signs of potential tank system failure during the intended operating life of the tank. Able to assess and interpret information on the waste to be stored in the tank and the waste compatibility with the materials used for the tank and piping system.

Installation Inspector: Knowledge of the physical sciences and the principals of engineering acquired by a professional education and related practical experience. Trained and experienced in the proper installation of tank systems or components. Certified by tank manufacturer that the inspector is qualified and experienced in type of Work to be performed.

SUBMITTALS–APPROVAL REQUIRED:

See Section 01300, SUBMITTALS, for submittal procedures.

Statements of Qualifications:

Tank manufacturer.

Tank installer.

Registered professional engineer.

Installation inspector.

Tank Secondary and Primary Liners and Floating Cover:

Material Samples: Within 15 days from Notice to Proceed: Samples of the materials proposed for use. Submit fifty (50) sample coupons, each 8 inches by 10 inches in size, for use by the Engineer to conduct leachate compatibility testing.

Manufacturer's Data: Manufacturer's descriptive data, specifications sheets, literature, and other data as necessary to fully demonstrate that those materials proposed for use comply with the requirements of these Specifications.

Installation Plan: Submit an installation plan for the liners and cover describing the proposed methods for liner and cover deployment, panel layout, seaming, repair, and protection. The plan shall also include a quality control program for the Construction General Contractor's activities related to liner and cover materials installation.

Factory Fabrication Inspection Data (Source Quality Control): Submit documentation of factory inspection as specified herein.

Drawings:

Tank and Equipment: Detailed drawings for tanks, anchor bolts and anchor bolt chains, and equipment, such as wall construction, pipe connections, floating cover, secondary containment system, and level controls shall be stamped by the Registered Professional Engineer. Drawings shall include a complete list of equipment and materials, including manufacturer's descriptive and technical literature, and installation instructions.

Calculations:

Stamped by the Registered Professional Engineer. Complete structural stress analysis of structural components and connections and anchorage system to the concrete ringwall. Include anchor bolt reaction for all load cases and load combinations.

Design Assessment Report:

A written report providing the results of the tank system design assessment prepared and certified by the Registered Professional Engineer attesting that the tanks furnished under this section of the Specifications has sufficient structural integrity and is acceptable for the storing and treating of dangerous waste.

The assessment report shall contain the following:

Site map of the facility showing the proposed location of the tank system within the overall facility.

A sketch of the tank system including connected piping and fittings. Individual tanks shall be clearly labeled.

Structural design standards and criteria used with reference to applicable industry standards and recommended practice codes. Include all calculations for tanks and anchoring. Tank shell shall be designed based on full tank. Design parameters used in calculations shall be clearly indicated and labeled on clarifying sketches. Seismic considerations that are appropriate to the seismic risk zone shall be accounted for in the calculations.

Assessment of the compatibility of the leachate to be stored in the tank with the tank system materials. Show that the characteristics of the leachate to be stored are compatible with the material properties of the tank system, including material properties of the interior lining. Include the results of the chemical compatibility testing provided by the Engineer in this assessment.

Description and assessment of the secondary containment system including prevention of migration of leachate out of the secondary containment system; detection and collection of releases into the secondary containment system; compatibility of the materials in the secondary containment system with the leachate to be stored in the tank; strength of secondary containment system to withstand stresses from static head during a release, climatic conditions, nearby vehicle traffic, and daily operations; description of the leak detection system that will detect the failure of either the primary or secondary containment structure or the presence of any release of leachate or accumulated liquid in the secondary containment system within 24 hours; a description of the corrosion protection for the exterior surface of the tank.

Assessment of the design of any ancillary equipment (piping, fittings, flanges, valves, and pumps) associated with the tank including support and protection against damage and excessive stress due to excessive settlement, vibration, expansion, or contraction. Verify that peak flows and internal stresses are within the design limits specified by the manufacturer of the ancillary equipment.

The recommended inspection schedule once the tank is placed in service based on the performance of similarly designed tank systems operating under similar conditions.

A statement by the Registered Professional Engineer certifying that the tank system has been adequately designed and that the tank system has sufficient structural strength to ensure that it will not collapse, rupture, or fail under the design conditions. The certification shall include the following statement:

> "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

The Registered Professional Engineer's signature and stamp must be placed below the certification statement.

SUBMITTALS–APPROVAL NOT REQUIRED:

Vendor Information (VI):

Installation: Tank Installation Instructions.

O&M Manual:

Tank Materials and Level Indicator: Submit operating and maintenance instructions prior to completion of the Project. The manual shall include the manufacturer's cut sheets, parts lists, and a brief description of all equipment and their operating features. Maintenance instructions shall include all routine maintenance procedures, possible breakdowns and repairs, and trouble shooting guiding. As-built diagrams of the piping system including valve locations shall be submitted with the O&M manual.

Information/Record (IR):

Submit documentation of construction quality control as specified herein.

Installation Inspection Report: A written report prepared by the Installation Inspector or the Registered Professional Engineer documenting the results of the tank system installation inspection. The installation inspection report shall contain the following:

The as-built site plan showing the location of the installed tank system.

An as-built drawing of the installed tank system including connected piping. Individual tanks shall be clearly labeled with ID numbers.

Inspection notes, photographs, and any other material used to document inspection activities.

An assessment of the tank system for structural damage or inadequate construction/installation including weld breaks, punctures, damage to protective coatings, cracks, and corrosion, and documentation of any defects discovered in materials, equipment, or installation procedures and measurements taken to correct these defects.

Documentation of tightness testing results demonstrating the tank system is tight prior to placing it in service.

A statement certifying the proper installation of the tank system liner, signed by the liner installer's representative.

A signed and dated statement by the Installation Inspector or Registered Professional Engineer certifying the proper installation of the tank system. The certification shall include the following statement:

> "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person

or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

LEACHATE COMPATIBILITY TESTING:

The Engineer will conduct leachate compatibility testing on the tank liner and cover material samples submitted by the Construction General Contractor in accordance with EPA SW 846, Method 9090, or ASTM D5322 and D5747 procedures. At the completion of the testing, the Engineer will evaluate the testing data for conformance with the project requirements and approve or reject the material. The Engineer will provide the results of the evaluation and approval or rejection to the Construction General Contractor within 180 days after receipt of material samples. Construction General Contractor shall not order materials or proceed with fabrication until after receiving results and approval from the Engineer. Any product or material changes required as a result of inadequate leachate compatibility results will be addressed by Change Order, provided that the submitted material meets all other requirements of this section.

DELIVERY AND STORAGE:

All materials and equipment delivered and placed in storage shall be stored with protection from the weather, excessive humidity, and excessive temperature variation; and dirt, dust, or other contaminants. The tank components shall be shipped in crate(s) or pallet(s) designed to prevent physical damage to the tank coating, linings, and structural components.

WARRANTY:

The tank shall have a 3-year warranty from the date of Substantial Completion covering workmanship, materials, all steel components, and the liners and floating cover. The warranty shall provide for correction, or, at the option of the Tank Farm Contractor, removal and replacement of Work specified in this Specification section found defective during the period of the warranty.

The Construction General Contractor shall provide the manufacturer's written warranty for the liners and cover. The warranty shall be provided to the Construction General Contractor as purchaser with the Tank Farm Contractor named as beneficiary and shall be signed by an authorized representative of the liner and cover manufacturer. The warranty shall guaranty the liner and cover material for the above-stated period against:

Manufacturing defects.

Deterioration due to ozone, ultraviolet, and other exposure to the elements, including the stored leachate.

Defects in material and factory seams.

Defects resulting from installation.

PART 2--PRODUCTS

MANUFACTURER:

Dimensions are based on bolted steel tank as manufactured by Environetics, Inc. All dimensions and clearances shall be taken as minimum if an "or equal" tank manufacturer is submitted and approved by the Engineer. Construction General Contractor shall be responsible for all adjustments required to Drawings as a consequence of changing tank manufacturer.

STANDARD PRODUCTS:

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Engineer, reasonably convenient to the site. The items specified under this section shall be furnished by constructors having experience and regular practice in the design, fabrication, and construction of steel tanks.

TANK SIZE REQUIREMENTS:

Number of Tanks Required: Two.

Required Diameter: 101.46 feet.

Required Height: 8.17 feet.

Cover Required: Yes.

Leachate Volume: 375,000 gallons.

Top Capacity Level (TCL): 6.20 feet above tank floor.

DESIGN:

Design shall be in accordance with the requirements of AWWA D103.

Design Loads:

Specific Gravity: The tank shall be designed for liquids with a specific gravity of 1.00.

Earthquake: The tank shall be designed for Seismic Zone 2B per UBC and AWWA D103, site amplification soil profile C, I=1.0. For seismic, use leachate top capacity level (TCL).

Wind Force: The tank shall be designed to the greater requirements of a 100-mph wind with pressure loads as calculated with AWWA D103 or an 85-mph with pressure loads determined using ASCE 7, 1998. Wind force calculations shall include wind analysis with an empty tank case as well as a full tank case.

Hydrostatic Pressure: Design tank for static pressure to top of tank shell height.

Stored Leachate Characteristics:

Based on previous testing, the stored leachate is expected to have the following characteristics:

| Chemical Compound | Concentration (g/l) |
|---|---|
| $NaNO_3$ | 185.0 |
| $Na_2SO_4$ | 11.86 |
| NaF | 1.46 |
| $Na_2CO_3$ | 3.45 |
| $NaHCO_3$ | 2.44 |
| pH | $9.2 \pm 0.1$, using NaOH or $HNO_3$ as required |

TANK COMPONENTS:

The tank and liner system shall consist of the following components: Corrugated steel wall panels with anchor embedded in concrete ringwall, geotextile base and wall buffer, secondary containment liner, drainage net, primary liner and floating cover, and piping for level and leak detection measurement.

Corrugated Steel Wall Panels:

The tank walls shall be constructed from individual rings of corrugated, hot-dip galvanized steel, mill-rolled to finished diameter. Sheet materials shall be ASTM A446, Grade D; or equal. Sheet materials shall be mill galvanized to ASTM A525, Class G90 standards, or equal. Shell plate thickness shall be based on AWWA D103 structural requirements. Wall plate thickness shall be a minimum of 12 gauge. Provide wind stiffeners as required by design.

Sheet materials shall receive an electrostatically applied, thermally cured, polyester powdercoat finish. The coating shall be applied in two coats with a minimum dry film thickness of 5.0 mils. The finished coating shall be white in color.

Anchor Bolts: Shall conform to the requirements of AWWA D103.

Bolted Joints: Structural bolts conform to the requirements of AWWA D103 and shall be zinc electroplated. Bolted joints shall utilize a minimum two vertical rows as required to withstand structural loads.

Geotextile Base and Wall Buffer: An 8-ounce geotextile polypropylene nonwoven needle-punched fabric shall be placed on the tank floor and wall as a buffer for the liner. The fabric shall be designed to protect the liner from irregular surfaces on the tank wall. The material properties shall conform with the following:

| Fabric Property | Unit | Test Method | Value |
|---|---|---|---|
| Grab Tensile Strength | lb | ASTM D4632 | 203 |
| Grab Elongation | % | ASTM D4632 | 50 |
| Puncture Strength | lb | ASTM D4833 | 130 |
| Mullen Burst | psi | ASTM D3786 | 400 |
| Trapezoid Tear Strength | lb | ASTM D4533 | 80 |

| Fabric Property | Unit | Test Method | Value |
|---|---|---|---|
| Permittivity | $sec^{-1}$ | ASTM D4491 | 1.5 |
| Water Flow Rate | gpm/sq ft | ASTM D4491 | 110 |
| AOS | sieve | ASTM D4751 | 100 |
| UV Resistance | % strength @ 500 hrs | ASTM D4355 | 70 |

Tank Secondary and Primary Liners and Floating Cover:

The liners and floating cover shall be fabricated from polyester reinforced polymeric alloy. Sheet materials shall have UV resistance and weathering qualities and conform to the following properties:

| Physical Property | Physical Values | Test Method |
|---|---|---|
| Thickness | 30.0 mils min. | ASTM D751 |
| Weight | $30.0 \pm 2$ oz/yd$^2$ | ASTM D751 |
| Tear Strength | 35/35 $lb_f$ min. | ASTM D4533, Trapezoid Tear |

| Physical Property | Physical Values | Test Method |
|---|---|---|
| Breaking Yield Strength | 550/550 $lb_f$ min. | ASTM D751, Grab Tensile |
| Low Temperature | Pass @ -30°F | ASTM D2136, 4 hr – 1/8" mandrel |
| Dimensional Stability | 1.5% max. each direction | ASTM D1204, 212°F – 1 hr |
| Adhesion - Heat Sealed Seam | 35 $lb_f$/2 in min. | ASTM D751, Dielectric Weld |
| Dead Load - Seam Shear Strength | 2 in seam, 4 hr, 1 in strip<br>210 $lb_f$ @ 70°F<br>105 $lb_f$ @ 160°F | ASTM D751 |
| Bursting Strength | 650 $lb_f$ min.<br>800 $lb_f$ typical | ASTM D751 Ball Tip |
| Hydrostatic Resistance | 800 psi min. | ASTM D751, Method A |
| Blocking Resistance | # 2 Rating max. | ASTM D751 (180°F/82°C) |
| Adhesion - Ply | 15 $lb_f$/in min. or Film Tearing Bond | ASTM D413 |
| Bonded Seam Strength | 550 $lb_f$ min. | ASTM D751 as modified by NSF 54 |
| Abrasion Resistance | 2,000 cycles (min.) before fabric exposure<br>50 mg/100 cycles max weight loss | ASTM D3389 (H-18 Wheel, 1,000 g load) |
| Weathering Resistance | 8,000 hrs (min.) – No appreciable changes or stiffening or cracking of coating | ASTM G23 (Carbon-Arc) |

| Physical Property | Physical Values | Test Method |
|---|---|---|
| Water Absorption | 0.025 kg/m2 max. @ 70°F/21°C<br>0.14 kg/m2 max. @ 212°F/100°C | ASTM D471, Section 12, 7 days |
| Wicking Shelter-Rite® Procedure | 1/8 in max. | |
| Puncture Resistance | 250 lbf min. | ASTM D4833 |
| Coefficient of Thermal Expansion/Contraction | $8 \times 10^{-6}$ in/in/°F max. | ASTM D696 |

Secondary and Primary Tank Liners: Shall be fabricated in a controlled factory environment into complete liners or large prefabricated panels. Size shall be limited to 3,000 pounds for ease of installation.

Tank Liner Source Quality Control: The tank liner(s) and cover shall be fabricated from standard width sheeting into a full-size fitted liner by means of minimum 1-inch wide dielectric and 2-inch wide thermal welds. The liner(s) and cover shall be thoroughly inspected by the fabricator for flaws in materials or fabrication prior to shipment. Inspection shall be performed by 100 percent visual inspection and proprietary inflation-light test methods. Construction General Contractor shall provide documentation of factory inspections to the Construction Manager.

Floating Cover: The cover shall be designed to comply with applicable AWWA D103 design standards. The cover shall incorporate closed cell polyethylene foam floatation elements in cover membrane pockets to provide the required buoyancy, drainage, and wind stability. The cover shall incorporate center and perimeter vents to evacuate air during fill cycle. The manufacturers shall provide a pump system with pump to remove excess surface water. Floating cover shall drain towards the perimeter of the tank and pump where excess water may be collected and pumped out.

Drainage Net: The floor area of the tank shall be covered with fitted panels of high density polyethylene (HDPE) drainage net with a geotextile laminated to both sides of the drainage net to prevent clogging and to provide a cushion for the HDPE drainage net against the tank liners. The drainage net shall be installed between the primary and secondary liners to convey liquids between the liners to a leak detection sump. Properties for the drainage net and geotextile are as follows:

| Physical Properties | Test Method | Physical Value |
|---|---|---|
| Combined: | | |
| Transmissivity, m/sec | ASTM D4716 | $4 \times 10^{-5}$ |
| Drainage Net Component: | | |
| Transmissivity, m/sec | ASTM D4716 | $1 \times 10^{-3}$ |
| Thickness, mill | ASTM D1777 | 200 |
| Density g/cm$^3$ | ASTM D105 | 0.94 |
| Tensile Strength, lb/in | ASTM D5034/5035 | 45 |
| Carbon Black Content, % | ASTM D1603 | 2.0 |
| Geotextile Component: | | 8 oz/yd$^2$ |
| Thickness, mill | ASTM D5199 | 90 |
| Grab Tensile, lb | ASTM D4632 | 210 |
| Puncture Strength, lb | ASTM D4833 | 135 |
| AOS, US Sieve | ASTM D4751 | 80 |
| Flow Rate, gpm/ft | ASTM D4491 | 110 |
| UV Resistance, % retained | ASTM D4355 | 70 |

Pipe Connections: Pipe fittings and connections shall be in accordance with manufacturer's requirements for double containment connections. Location of pipe connections shall be as shown on the Drawings.

Tank Level and Leak Detection Measurement:

Provide as part of tank construction two 2-inch diameter (Schedule 80 PVC) internal slotted level sensor pipes (stilling wells) that extend the whole interior operating height of tank, for the purpose of facilitating the installation of a submersible pressure transmitter (in one pipe), and a multipoint level sensor (in the other pipe). Level measurement instrumentation provided under Section 13401, PROCESS INSTRUMENTATION AND CONTROL SYSTEMS (PICS), and installed by Construction General Contractor under this section.

Construction General Contractor shall furnish and install all necessary equipment and personnel to properly support installation of measurement devices (i.e., PVC flanges, straps, and gaskets).

Foundation: Tank shell to bear on a Type 1 concrete ringwall per AWWA D103 as shown on the Drawings. A 1-1/2-inch minimum space between the tank bottom and the top of the ringwall shall be filled with a nonshrink grout as specified in Section 03301, CONCRETE. Cane fiber joint filler shall not be used.

PART 3--EXECUTION

GENERAL:

Tank construction shall be in accordance with AWWA D103.

TANK INSTALLATION:

Field erection of lined bolted steel tanks, including, but not limited to, shell plates, pipe connections, awning, primary and secondary containment, and floating cover, shall be in strict accordance with the manufacturer's recommendations.

CONSTRUCTION QUALITY CONTROL:

The Construction General Contractor shall establish and maintain a quality control system to assure compliance with contract requirements and shall maintain records of its quality control for all operations including, but not limited to the following:

Inspection of materials delivered to project site against approved material data.

Storage and handling of materials.

Finished appearance.

Completion of required testing.

Copies in duplicate of these records and tests, as well as records of corrective action taken when results are unsatisfactory, shall be furnished to the Construction Manager within 24 hours following the inspection or test.

Tank System Installation Inspection:

The Construction General Contractor shall provide the services of an Installation Inspector or Registered Professional Engineer to provide full-time supervision of the installation of the storage tanks. No work shall be performed without the presence in the field of the Installation Inspector or Registered Professional Engineer. The Installation Inspector or Registered Professional Engineer shall observe and verify that correct materials and procedures are used for the following activities:

Visual inspection and testing.

Subgrade and foundation preparation.

Placement and compaction of backfill.

Placement of reinforcing steel and anchor bolts.

Concrete placement.

Placement of shop-fabricated tank parts.

Erection of field-erected tank parts.

Installation of tank liner systems. Tank liner inspection requirements are specified herein.

Installation of piping, pumping, and other ancillary equipment.

Tightness testing.

Tank Liner Inspection:

Visual Inspection: 100 percent visual inspection along all seams of the liners.

Air Jet Inspection: 100 percent air jet inspection of all seams.

Any required repairs shall be corrected in accordance with the manufacturer's recommendations. Results of all testing shall be provided to the Construction Manager.

Floating Cover Drainage Test:

Add water on floating cover to test that water drains towards the perimeter. Manufacturer to revise ballast if water does not completely drain.

Tank Tightness Testing:

Upon completion of tank installation, the tank shall be visually inspected for any signs of physical damage. Any questionable areas shall be repaired in accordance with the manufacturer's instructions. The tank shall be filled with water and let stand for a period of not less than 2 days. The Construction General Contractor shall maintain a level not less than 7.2 feet for the duration of 2 days. Following the 2 days, the Construction General Contractor shall cyclically change the tank water level at a constant rate from 0.5 foot to 7.2 feet for four cycles over the next 28 days. During the 30 days, there shall be no signs of leakage to the secondary containment system of the tank. At the end of the 30 days, the tank shall also undergo an electronic leak location survey to check for leakage. Any leaks discovered by this test shall be corrected by the Construction General Contractor in accordance with the manufacturer's recommendations. The tank system shall be successfully tested before it is accepted. Results of all testing shall be provided to the Construction Manager.

END OF SECTION 13205

# SECTION 13401--PROCESS INSTRUMENTATION AND CONTROL SYSTEMS (PICS)

## PART 1--GENERAL

### UL AND NRTL COMPLIANCE:

Materials manufactured within the scope of UL or another nationally recognized testing laboratory (NRTL) shall conform to UL or NRTL standards and have an applied UL or NRTL listing mark. References to UL throughout this section imply conformity with UL or NRTL standards and guidelines.

PICS control panels shall be manufactured, assembled, tested, approved, and clearly labeled in accordance with UL 508A when required, prior to delivery to construction site.

Approval by Authority Having Jurisdiction (AHJ): As specified in Section 16005, ELECTRICAL.

### WORK INCLUDES:

Engineering, furnishing, installing, calibrating, adjusting, testing, documenting, starting up, and Tank Farm Contractor training for a complete Process Instrumentation and Control System for plant.

Detailed Design: PICS as shown and specified includes functional and performance requirements and component specifications. Complete detailed PICS design.

Major Cell No. 1 and Cell No. 2 components and controls to integrate into PICS and to program include:

Crest Pad Building Control Panel, PLC, and Operator Interface Assemblies.

Crest Pad Building Sump, Combined Sump, Leachate Tank, and Leachate Transfer Building Transfer Pump Local Control Panel Assemblies.

Leachate Collection and Removal, and Leak Detection System Pump Control.

Leachate Collection and Removal, and Leak Detection System Pump Discharge Flow and Flow Totalization.

Leachate Collection and Removal System Continuous Level Measurement.

Leak Detection System Continuous Level Measurement.

Leachate Storage Tank Continuous Level Measurement.

Leachate Storage Tank, Crest Pad Building Sump, Carrier Pipe, and Combined Sump Leak Detection Chamber Discrete Level Measurement.

Crest Pad Building Sump Discrete Level Measurement, and Pump Control.

Combined Sump Discrete Level Measurement, and Pump Control.

Interlock Control between Crest Pad Building Sump and Leachate Collection, and Removal and Leak Detection System Pump Controls

Crest Pad and Leachate Transfer Building Continuous Temperature Measurement.

Leachate Transfer Pump Control and Flow Measurement, and Flow Totalization.

Crest Pad Building Discrete Power Measurement.

DEFINITIONS:

Abbreviations:

CP: Control Panel.

FDT: Factory Demonstration Test.

LCP: Local Control Panel.

MCC: Motor Control Center.

OIU: Operator Interface Unit.

ORT: Operational Readiness Testing.

PAT: Performance Acceptance Test.

PLC: Programmable Logic Controller.

SLC: Small Programmable Logic Controller.

Rising/Falling: Terms used to define actions of discrete devices about their set points.

Rising: Contacts change state when an increasing process variable rises through set point.

Falling: Contacts change state when a decreasing process variable falls through set point.

Signal Types:

Analog Signals, Current Type:

4 to 20 mA dc signals conforming to ISA S50.1.

Unless otherwise indicated for specific PICS Subsystem components, use the following ISA 50.1 options:

Transmitter Type: Number 2, two-wire.

Transmitter Load Resistance Capacity: Class L.

Fully isolated transmitters and receivers.

Analog Signals, Voltage Type: 1 to 5 volts dc within control panels only.

Discrete signals, two-state logic signals using dc or 120V ac sources as indicated.

Special Signals: Other types of signals used to transmit analog and digital information between field elements, transmitters, receivers, controllers, and digital devices.

Instrument Tag Numbers: In accordance with DOE-RL Standards.

SUBMITTALS–APPROVAL REQUIRED

See Section 01300, SUBMITTALS, for submittal procedures.

Shop Drawings:

General:

Shop Drawings, full-scaled details, wiring diagrams, catalog cuts, and descriptive literature.

Identify proposed items and options. Identify installed spares and other provisions for future work (e.g., reserved panel space; unused components, wiring, and terminals).

Bill of Materials: List of required equipment.

Group equipment items as follows:

I&C Components: By component identification code.

Other Equipment: By equipment type.

Data Included:

Equipment tag number.

Description.

Manufacturer, complete model number, and all options not defined by model number.

Quantity supplied.

Component identification code where applicable.

Catalog Cuts: I&C Components, Electrical Devices, and Mechanical Devices:

Catalog information, mark to identify proposed items and options.

Descriptive literature.

External power and signal connections.

Scaled drawings showing exterior dimensions and locations of electrical and mechanical interfaces.

Component Data Sheets: Data sheets for I&C components.

Format and Level of Detail: In accordance with ISA-S20.

Include component type identification code and tag number on data sheet.

Specific features and configuration data for each component:

Location or service.

Manufacturer and complete model number.

Size and scale range.

Set points.

Materials of construction.

Options included.

Name, address, and telephone number of manufacturer's local office, representative, distributor, or service facility.

Panel Construction Drawings:

Scale Drawings: Show dimensions and location of panel mounted devices, doors, louvers, and subpanels, internal and external.

Panel Legend: List front of panel devices by tag numbers, nameplate inscriptions, service legends, and annunciator inscriptions.

Bill of Materials: List devices mounted within panel that are not listed in panel legend. Include tag number, description, manufacturer, and model number.

Construction Details: NEMA rating, materials, material thickness, structural stiffeners and brackets, lifting lugs, mounting brackets and tabs, door hinges and latches, and welding and other connection callouts and details.

Construction Notes: Finishes, wire color schemes, wire ratings, wire and terminal block, numbering and labeling scheme.

Panel Control Diagrams: For discrete control and power circuits.

Diagram Type: Ladder diagrams. Include devices, related to discrete functions, that are mounted in or on the panel and that require electrical connections. Show unique rung numbers on left side of each rung.

Item Identification: Identify each item with attributes listed.

Wires: Wire number and color. Cable number if part of multiconductor cable.

Terminals: Location (enclosure number, terminal junction box number, or MCC number), terminal strip number, and terminal block number.

Discrete Components:

Tag number, terminal numbers, and location ("FIELD", enclosure number, or MCC number).

Switching action (open or close on rising or falling process variable), set point value and units, and process variable description (e.g., Sump Level High).

Relay Coils:

Tag number and its function.

On right side of run where coil is located, list contact location by ladder number and sheet number. Underline normally closed contacts.

Relay Contacts: Coil tag number, function, and coil location (ladder rung number and sheet number).

Show each circuit individually. No "typical" diagrams or "typical" wire lists will be permitted.

Ground wires, surge protectors, and connections.

Panel Wiring Diagrams: Show point-to-point and terminal-to-terminal wiring within panel.

Loop Diagrams: Individual wiring diagram for each analog or pulse frequency loop.

Conform to the DOE-RL Standards.

Drawing Size: Individual 11-inch by 17-inch sheet for each loop.

Divide each loop diagram into areas for panel face, back-of-panel, and field.

Show:

Terminal numbers, location of dc power supply, and location of common dropping resistors.

Switching contacts in analog loops and output contacts of analog devices. Reference specific control diagrams where functions of these contacts are shown.