AR TARGET SHEET

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

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TITLE: Environmental Restoration Disposal Facility (ERDF) Cells 7-10 Detailed Design Package, Rev. 0

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WASHINGTON CLOSURE HANFORD	JOB NO. 14655

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CONSTRUCTION QUALITY ASSURANCE PLAN (CQAP)

FOR
ENVIRONMENTAL RESTORATION DISPOSAL FACILITY (ERDF)
CELLS 7 THROUGH 10

EXPIRES: 5/28/08

Rev.	Date	Reason for Revision	Originator	Checker	Project Engineer	LEAD Design Eng
0	9/28/07	Issued for Construction	Sam	JW	MK	SCB

Washington Closure Hanford, LLC	RIVER CORRIDOR CLOSURE CONTRACT	Job No. 14655 Contract No. 0600X-QA-G0004 Page 1 of 60

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CONSTRUCTION QUALITY ASSURANCE PLAN (CQAP)

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CONSTRUCTION QUALITY ASSURANCE PLAN (CQAP)

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) has contracted with Washington Closure Hanford, LLC (WCH) to construct four additional cells (Cells 7, 8, 9, and 10) at the Environmental Restoration Disposal Facility (ERDF) on the Hanford site near Richland, Washington. The initial cells (Cells 1 & 2) and support facilities were constructed during 1995 and 1996, Cells 3 & 4 were added during 1998 and 1999, and Cells 5 & 6 were added during 2003. Disposal of remediation waste, primarily contaminated soil, began in July, 1996. Cells 7 & 8 and 9 & 10 will be constructed adjacent to the existing cells and the liner systems will be joined to form a single uninterrupted liner system. This Construction Quality Assurance Plan (CQAP) describes the construction quality assurance activities required during the construction of Cells 7 through 10.

1.1 PURPOSE

During facility construction, Quality Assurance (QA) activities will be required to ensure that:

(1) components are constructed in accordance with the plans and specifications, and

(2) requirements of agencies related to documentation are satisfied. The agencies involved with ERDF are the Department of Energy and the U.S. Environmental Protection Agency (EPA.

This CQAP has been prepared to describe the activities that will be performed during construction to satisfy these objectives. Procedures invoked by the CQAP are intended to identify problems that may occur during construction and to document that these problems are corrected before construction is complete.

This CQAP is intended to satisfy the regulatory requirements and guidance established in 40 CFR 264.19 (EPA), WAC 173-303-665 (Ecology, 1994), and EPA/600/R-93-182 *Quality Assurance and Quality Control for Waste Containment Facilities, 2nd Edition, Waste Containment Facilities, ASCE Press, 2007.*

This CQAP is to function and be executed independently of the Construction SUBCONTRACTOR's Construction Quality Control (CQC) program, except when nonconformance in the Construction SUBCONTRACTOR's program or product are identified. The Construction SUBCONTRACTOR's CQC activities during construction, including test methods, location, frequency, and similar requirements, are defined in Exhibit "E" Technical Specifications for the construction subcontract and are not modified in any way by this CQAP.

1.2 SCOPE

This CQAP establishes general administrative and documentation procedures. With respect to specific inspection and testing activities, this plan addresses only those activities associated with

construction of the disposal trench and the support facilities that will be performed for Cells 7 through 10. Specific work items include:

- Excavation
- Soil testing
- Construction of admix soil liner test fill
- Production and placement of admix soil liner
- Construction of anchor trenches and side slope riser trenches
- Procurement, testing, and installation of geosynthetics
- Installation of components and facilities for leachate collection system and vadose zone monitoring system
- Placement of gravel drainage layers
- Placement of the operations layer
- Site grading (civil survey, layout, etc)

1.3 RELATIONSHIP TO WCH'S QUALITY ASSURANCE PROGRAM

This CQAP is a secondary document, developed under the requirements of the project QA program embodied in the current approved versions of the *River Corridor Closure Contract Quality Assurance Program Description (QAPD)*, (WCH-51). The QAPD is the site-wide River Corridor Closure Contractor's quality assurance document. The CQAP draws upon the records management, document control, technical review, and other procedural resources invoked by the QAPD.

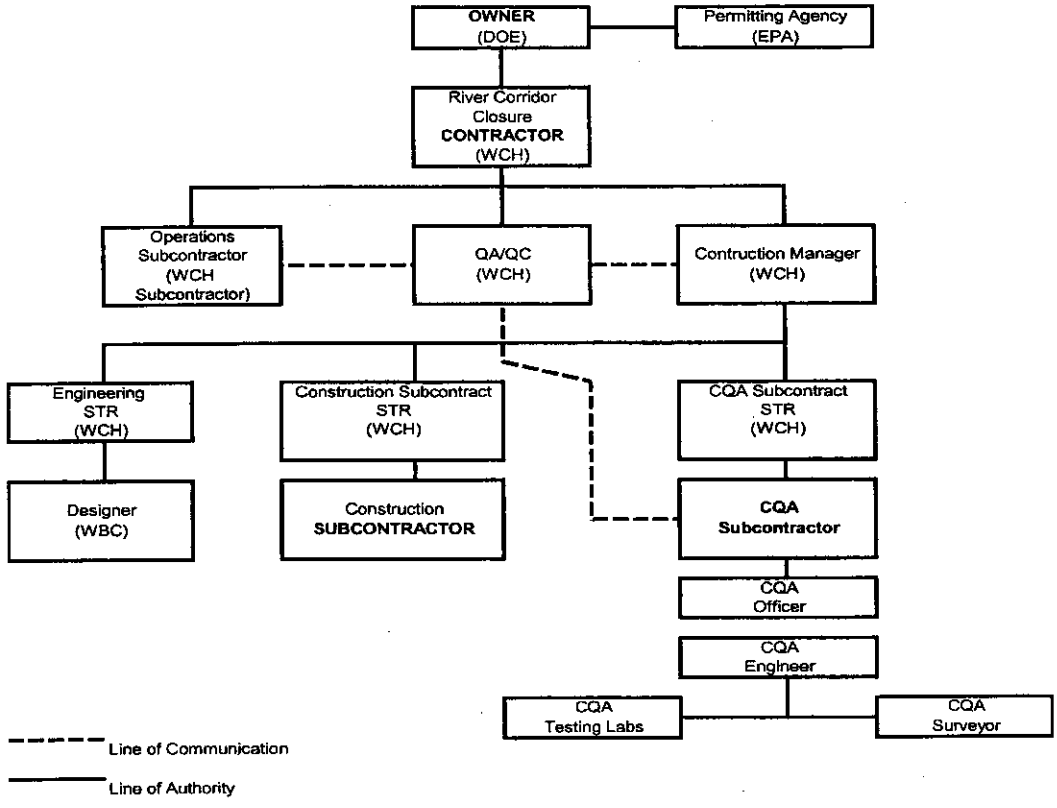
1.4 CHANGE CONTROL PROCEDURES

The CQAP and implementing procedures are subject to the change control requirements defined by the procedures established in WCH's QAPD.

2.0 PROJECT ORGANIZATION

This section describes the project organization for the construction of the ERDF Cells 7 through 10. The following sub-sections address the organizations involved in the ERDF construction, their respective roles in construction activities, and methods of interactions between organizations.

Figure 1. ERDF Construction/Quality Assurance Organization



2.1 RESPONSIBILITY AND AUTHORITY

The quality assurance organization chart for ERDF construction is shown on Figure 1. Each major organization is described in the following sections.

2.1.1 Owner

The OWNER of the ERDF is the U.S. Department of Energy - Richland Operations Office (DOE).

2.1.2 Permitting Agencies

Cells 7 through10 of the ERDF are being constructed to meet regulations established by the U.S. Environmental Protection Agency (EPA). This CQAP is specifically designed to support those regulations.

2.1.3 River Corridor Closure Contractor

WCH is the River Corridor Closure Contractor for ERDF and is responsible for design, construction, and operation of the ERDF. WCH interfaces with DOE and the regulatory

agencies and is responsible for ensuring that the permitting requirements of the regulatory agencies are satisfied. WCH manages the activities of the Designer, Construction SUBCONTRACTOR, (SUBCONTRACTOR) and CQA SUBCONTRACTOR. These three activities may be conducted by different subcontractors to maintain the required degree of independence. WCH has procurement authority for ERDF Subcontracts.

2.1.4 Operations Subcontractor

The ERDF is operated by WCH for the DOE. WCH has subcontracted the operation of ERDF to an Operations Subcontractor. During construction, WCH will be responsible for review and approval of any field changes which would affect facility operations.

2.1.5 QA/QC

WCH provides quality assurance and quality control (QA/QC) oversight of the SUBCONTRACTOR and CQA SUBCONTRACTOR'S activities during construction.

2.1.6 Construction Manager

The Construction Manager, an employee of WCH, has overall responsibility for construction of the ERDF cells. The Construction Manager directs the activities of the construction project and personnel, including the Engineering STR, Construction Subcontract STR, and CQA Subcontract STR.

2.1.7 Engineering STR

The Engineering Subcontract Technical Representative (STR), an employee of WCH, serves as the point of contact between the Designer and WCH. The Engineering STR oversees the preparation and review of technical documents related to the design of ERDF Cells 7 through 10.

2.1.8 Designer

ERDF Cells 7 through 10 were designed by WCH through their subcontractor, Weaver Boos Consultants, LLC (WBC). The responsibilities of the Designer include clarifying and interpreting the plans and specifications, preparing Design Change Notices (DCNs), incorporation of new or changed requirements, and reviewing submittals as directed by the Engineering STR. The Designer may also assist with document distribution and control if directed by the Engineering STR.

2.1.9 Construction Subcontract STR

The Construction Subcontract Technical Representative (STR), an employee of WCH, serves as the point of contact between the SUBCONTRACTOR and WCH. The Construction STR oversees the daily construction field activities and is the on site representative for WCH.

2.1.9.1 Construction Subcontractor

The SUBCONTRACTOR will perform the work activities associated with actual construction of the ERDF. The SUBCONTRACTOR will be responsible for implementing their own internal QC activities as defined in the Construction Subcontract, approved submittals, and other supporting documentation. The construction subcontractor will report directly to and receive direction from the WCH Construction STR. This document refers to an Installer. The Installer is responsible to the Construction SUBCONTRACTOR and refers to the geosynthetics installer.

2.1.10 CQA Subcontract STR

The CQA Subcontract Technical Representative (STR), an employee of WCH, serves as the point of contact between the CQA Subcontractor and WCH. The CQA STR oversees the daily CQA field activities and is the on site representative for WCH.

2.1.10.1 CQA Subcontractor

A third-party CQA subcontractor shall perform the work specified in the CQAP. The CQA Officer, an employee of the CQA SUBCONTRACTOR, has the overall responsibility of implementing the CQAP and directly supervises the on site CQA Engineer. The CQA Officer shall be a registered professional engineer in the State of Washington and has the authority to provide certification that the ERDF cells were constructed in accordance with the Permitting Agency-approved CQAP and construction Technical Specifications and Drawings.

The CQA SUBCONTRACTOR shall review the SUBCONTRACTOR'S plans and other submittals, as required by the CONTRACTOR. The CQA SUBCONTRACTOR shall also be responsible for training and qualifying CQA inspection personnel on requirements, procedures, scheduling, and inspection activities, and ensuring that the CQA testing laboratories and surveyors conform to CQA Subcontract requirements. The CQA SUBCONTRACTOR shall ensure that sample custody procedures are followed and test data are accurately reported and maintained for preparation of periodic reports. The most important duty of the CQA SUBCONTRACTOR is confirming that the facility was constructed in accordance with plans and specifications approved by the permitting agency. The CQA SUBCONTRACTOR shall report directly to and receive direction from the CQA Subcontract STR.

2.1.10.2 CQA Engineer

The CQA Engineer works on site under the direction of the CQA Officer and manages the on site quality assurance personnel and CQA work; location and frequency of tests, schedule and monitor results of tests, identify deficiencies and verify that deficiencies have been corrected, complete reports and provide peer review of completed data, testing, and oversight activities. CQA field personnel work under the direction of the onsite CQA Officer and perform testing and observations in accordance with the CQAP.

2.1.10.3 CQA Testing Labs

CQA testing labs conduct the CQA tests specified in the CQAP that are not completed on site. CQA Testing labs shall be provided by the CQA SUBCONTRACTOR.

2.1.10.4 CQA Surveyor

The CQA Surveyor shall provide surveys necessary for conducting the work specified in the CQAP. The CQA Surveyor shall be provided by the CQA SUBCONTRACTOR. CQA surveying work shall be performed under the direction of a registered professional land surveyor in the State of Washington.

2.2 PROJECT MEETINGS

This section includes a discussion of various progress and status meetings to be held throughout construction activities. The intent of the meetings is to ensure communication between organizations involved in the construction of ERDF cells.

2.2.1 CQA/Construction Coordination Meeting

A meeting will be held to resolve any uncertainties following the award of the Construction and CQA Subcontracts. The meeting will include the organizations involved in the Construction and CQA activities, including representatives of DOE and regulatory agencies as agreed upon. The topics of this meeting will include but are not limited to:

- Reviewing the responsibilities of each organization;
- Integrated work control;
- Interface protocol (e.g. points of contact, notification process, etc.);
- Reviewing lines of authority and communication for each organization;
- Providing each organization with CQA documents and supporting information;
- Familiarizing each organization with the CQAP and its role relative to the design criteria, plans, and specifications;
- Determining any changes to the CQAP that may be needed to document that the facility will be constructed to meet or exceed the specified design requirements;
- 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 retesting, 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; and
- Conducting a site walk-around to review construction material and inspect equipment storage locations.

The meeting will be documented in the CQA SUBCONTRACTOR's meeting minutes.

2.2.2 Daily Progress Meetings

An informal progress meeting will be held daily. The purpose of the meetings is to:

- Discuss any health and safety issues;
- Review the previous day's activities and accomplishments;
- Review the work location and activities for the day;
- Discuss the SUBCONTRACTOR's personnel and equipment assignments for the day;
- Review any new test data; and
- Discuss any potential construction problems.

This meeting will be documented in the CQA SUBCONTRACTOR's daily field monitoring reports.

2.2.3 Weekly Progress Meetings

Weekly progress meetings will be held. The purpose of the meetings is to:

- Review the previous weeks activities and accomplishments;
- Review claims, change orders, delays, and similar items;
- Review planned activities for the upcoming week;

- Review project schedule;
- Finalize resolution of problems from the previous week; and
- Discuss the potential problems with the work planned for the upcoming week.

This meeting will be documented in the CQA SUBCONTRACTOR's daily field monitoring reports in accordance with WCH requirements.

2.2.4 Problem or Work Deficiency Meetings

Meetings will be convened as necessary to address deficiencies, scheduling, and nonconformances. Deficiencies observed during construction will be brought to the attention of the SUBCONTRACTOR and the STR(s). Material, construction, testing, discrepancies, etc shall be documented directly on a SUBCONTRACTOR nonconformance report (NCR) in accordance with WCH procedures. The CQA SUBCONTRACTOR and Designer will participate in nonconformance review meetings as requested by the WCH.

2.3 HOLD POINTS

Mandatory hold points will be established for certain key activities as identified in Section 4 and listed in Table 4-3. At these points, the SUBCONTRACTOR, manufacturer, or shipper shall cease work on the affected activity until it has been reviewed by the appropriate CQA personnel and CQA STR. The CQA schedule for hold points will be determined when the SUBCONTRACTOR develops the procurement and construction schedule for the project. The SUBCONTRACTOR will update these schedules weekly and provide the CQA at least one week notice prior to a hold point inspection. The CQA hold point schedule will be updated and provided to the STR on a weekly basis.

3.0 PERSONNEL QUALIFICATIONS AND TRAINING

This section describes the qualifications and training required for CQA personnel.

The CQA SUBCONTRACTOR shall develop and submit a Training Matrix for each position required for performance of work on the CQA Subcontract. The CQA SUBCONTRACTOR is responsible for qualification, certification, and maintenance of these requirements for the personnel fulfilling these positions. The CQA SUBCONTRACTOR shall submit a certification form documenting the qualifications of CQA personnel to the CONTRACTOR.

3.1 CQA OFFICER

The CQA Officer shall have landfill construction certification experience. The CQA Officer shall possess, as a minimum, a Bachelor's degree and Washington State Professional Engineer license in civil or construction engineering, engineering geology, or a closely related discipline, and shall have at least 10 years practical, technical, and managerial experience to successfully direct the CQA activities discussed in this plan. The CQA Officer's qualifications shall be

documented by training records, copies of licenses, and professional resume. Qualification documentation shall be reviewed by WCH; if acceptable, a qualification certification form (approved by the WCH) shall be completed and retained in the project QA records. Certifications shall be valid for the entire subcontract period (provided retraining, certifications, etc remain in place.

The CQA Officer shall receive formal training in the requirements of the QAPD and the CQAP, including but not limited to documentation, receiving inspection, equipment calibration, design control, and personnel training. The CQA Officer shall also have completed any DOE, WCH, SUBCONTRACTOR, or other training required to perform work on the site.

3.2 CQA ENGINEER

The CQA Engineer shall have landfill construction certification experience. The CQA Engineer shall have at least 10 years practical, technical, and managerial experience to successfully direct the on-site CQA activities discussed in this plan. The CQA Engineer's qualifications shall be documented by training records, copies of licenses, and professional resume. Qualification documentation shall be reviewed by WCH; if acceptable, a qualification certification form (approved by the WCH) shall be completed and retained in the project QA records. Certifications shall be valid for the entire subcontract period (provided retraining, certifications, etc remain in place.

The CQA Engineer shall receive formal training in the requirements of the QAPD and the CQAP including but not limited to documentation, receiving inspection, equipment calibration, design control, and personal training. The CQA Officer shall also have completed any DOE, WCH, SUBCONTARCTOR, or other training required to perform work on the site.

3.3 CQA FIELD PERSONNEL

1. CQA field personnel will have a high school diploma and at least four years of construction-related experience, including at least one year of experience conducting CQA monitoring for earthworks and geosynthetics installation, or a Bachelor of Science degree from a four year college or university and at least one year of experience conducting CQA monitoring for earthworks and geosynthetics installation. Field personnel performing the inspection and testing will have the following certifications:

    1. For soils, aggregate and admix:

        - National Institute for Certification of Engineering Technicians or
        - Western Alliance for Quality Transportation Construction

    2. For Geotextiles

        - Construction Quality Assurance-Inspectors Certification Program. (CQA-ICP), by the Geosynthetic Research Institute.

Qualifications of CQA Personnel shall be documented by training records and professional resumes. WCH shall provide a certification form documenting the qualifications on CQA personnel. Certifications shall be maintained by the WCH for the duration of the CQA Subcontract.

Prior to undertaking project activities, CQA Personnel shall receive formal training in the requirements of the QAPD, the CQAP, and applicable technical requirements. In addition, CQA Personnel shall be trained in the use of visual-manual soil classification techniques. Project plans and specifications shall be reviewed. The purpose of the training is to provide CQA staff with a clear understanding of expected conditions, methods of construction, and the scope of plans and specifications. Prior to beginning project activities, CQA personnel must also receive training required to perform work on the site.

4.0 INSPECTION ACTIVITIES

This section describes the inspection activities (observations and tests) that will be conducted by the CQA SUBCONTRACTOR during construction of the ERDF trench and support facilities. The following subsections address each facility component separately and, if appropriate, are further subdivided into sections on pre-construction, construction, and post-construction testing and observation activities unique to each component. Soil testing requirements are summarized in Table 4-1. Geosynthetic testing requirements are summarized in Table 4-2. Hold points during construction are summarized in Table 4-3.

Sampling of soil, geosynthetic materials, and other materials will be required for testing purposes. Every sample shall be assigned a unique identification number which describes the sample location and type. Sample numbers shall be recorded by the CQA SUBCONTRACTOR.

4.1 EARTHWORKS

Prior to the start of earthworks activities, the SUBCONTRACTOR will submit an earthworks operation plan and a schedule to the CONTRACTOR for approval. This plan will include a description of the methods to be used for excavation, backfilling, and grading operations. The CQA Personnel shall review this plan for conformance with Technical Specification requirements and advise the CONTRACTOR of its adequacy.

4.1.1 Excavation

Requirements for excavation activities are described in the construction subcontract Exhibit "D" Scope of Work, Exhibit "E" Technical Specifications, and Exhibit "F" Drawings. During excavation, CQA Personnel shall generally observe the excavated material and subgrade conditions and shall perform the following activities:

- Observe stripping and excavation to document that there are no moisture seeps and that soft, organic, and otherwise undesirable materials are removed.

- Observe soil types during trench excavation, and record depth and location of changes in soil type, as well as any other pertinent geologic information on geologic map. Notify the CONTRACTOR immediately if changed or unexpected geologic conditions are encountered.

- Coordinate with the CQA Surveyor to confirm that the depth and slope of the excavations, sumps, ramps, side slope riser trenches, surface water drainage ditches, roadways, foundations, and other construction components meet design requirements.

- Review submittals for dust suppressant. Observe dust suppressant application. Chemical dust suppressant agent must be approved by the CONTRACTOR (chemicals shall not impact personnel, the environment, construction material [liners, admix, etc.]).

Observations shall be recorded on daily field monitoring report forms, drawings, and geologic maps as appropriate.

Provide a daily excavation report to the CQA STR that contains, at a minimum, excavation quantities, observations, problems, NCRs, deficiencies, CQA hold points witnessed/released, and observed safety issues. The report shall be provided by 8 am on the following work day.

4.1.2 Fill

Requirements for fill are described in the construction subcontract Exhibit "D" Scope of Work, Exhibit "E" Technical Specifications, and Exhibit "F" Drawings. CQA Personnel shall perform the following activities:

- Prior to placement of any structural backfill or roadway top course material in the trench or on the embankment, verify that the subgrade has been prepared (scarified, moisture-conditioned, and compacted) in accordance with the requirements of the Technical Specifications. CQA Personnel shall test the subgrade with in-place density methods at the frequency specified in Table 4-1. This shall be done prior to filling and shall constitute a hold point. If nuclear density methods are used (e.g., American Society for Testing and Materials (ASTM) D2922), at least one direct measurement using ASTM D1556, ASTM D2167, or other method approved by the CQA Officer shall be performed each shift for verification purposes.

- During fill and roadway top course placement in the trench or on the embankment, conduct tests and observations to document that the quality of compacted fill meets project specifications. This will include visual observation, measurement of lift thickness, verifying grain size analysis, determining moisture-compaction characteristics, and measuring in-place density and moisture content, and other tests. Field in-place density tests shall be conducted at a listed in Table 4-1. Additional tests may be conducted at the discretion of the CQA Officer. If nuclear density methods are used (e.g., ASTM D2922), at least one direct measurement using ASTM D1556, ASTM 02167, or other method approved by the CQA Officer shall be performed each shift for verification purposes.

- Coordinate with the CQA Surveyor to verify that final lines and grades conform to design requirements.

- Review SUBCONTRACTOR's soil testing and field density data to verify that materials satisfied the requirements of the Technical Specifications and that specified compaction was achieved.

Observations shall be recorded on daily field monitoring report forms, drawings, and test data forms.

Provide a daily fill report to the CQA STR that contains, at a minimum, fill quantities, locations, observations, problems, NCRs, deficiencies, CQA hold points witnessed/released, and observed safety issues. The report shall be provided by 8 am on the following work day.

4.2 ADMIX SOIL LINER

The requirements for the admix soil liner are described in Specification No. 0600X-SP-C0067, Cell Construction-Admix Layer, of the Technical Specifications. The CQA Personnel shall perform the following activities:

4.2.1 Pre-Construction

Preconstruction CQA activities include review of bentonite manufacturer certificates, inspection and testing of base soil preparation, inspection and testing of admix soil liner preparation, and inspection and testing of test fill construction. Each is described below:

The SUBCONTRACTOR will submit to the CQA STR the manufacturer's certificates on the bentonite. The CQA STR shall review the bentonite certification to confirm that they meet the requirements of the specifications.

Base soil liner materials shall be inspected to document that they satisfy the requirements of the specifications. Material inspection shall continue throughout the liner construction period. If base soil material for admix production is obtained onsite, the inspections can be performed as the material is excavated or as it is placed in the storage pile. Visual observation and classification of the excavated base soils used in admix production shall be performed. Unsuitable material shall be rejected. If base soil material for the admix layer material is obtained offsite, inspection of the soil shall be conducted as it arrives at the construction site. For borrow areas containing non-uniform materials, unacceptable soil material shall be segregated as it is excavated. CQA Personnel shall observe segregation operations carefully and continuously to document that only suitable material is retained for liner construction. Changes in color or texture may be indicative of a change in soil type or soil moisture content. The soil shall be inspected for roots, stumps, large rocks, and other deleterious materials. No rocks greater than 50 mm (2 inches) will be allowed in the admix layer. This requirement will be satisfied by the SUBCONTRACTOR by screening the soil prior to admix preparation.

During mixing, CQA Personnel shall observe production and shall test the admix to document that the specified amount of bentonite is mixed uniformly with the natural soil, and that water is

uniformly added to the admix in the amount necessary to achieve the specified design. The bentonite content of the admix liner material shall be determined by belt scale measurements and sieve analysis.

A sufficient number of samples of the constituent materials and finished admix, as determined by the CQA Officer, shall be tested to document that material properties are within the ranges stated in the specifications. These tests shall include at least the following:

- Bentonite yield manufacturer's certificates – as indicated in Table 4-1.
- Remolded Permeability (Admix) – as indicated in Table 4-1. Additional permeability testing shall be performed whenever the base soil has < 20% passing the U.S. No. 200 Sieve by dry weight. For this testing, the base soil shall be mixed with 12% bentonite by dry weight and compacted to at least 85% saturation, as described in Specification 0600X-SP-C0067 at a moisture content 2% to 4% over optimum. If the permeability results are comparable to those with base soil containing > 20% fines, the base soil may be used. Otherwise, it shall be rejected.
- Specific gravity (base soil) – as indicated in Table 4-1.
- Soil density/moisture content relationships (Admix) – as indicated in Table 4-1.
- Maximum clod size (Admix) - Periodic visual monitoring.
- Particle size distribution (base soil and admix) (hydrometer and - #200 sieve) – as indicated in Table 4-1.
- Bentonite content of admix by belt scale measurements – as indicated in Table 4-1.
- Atterberg limits (Admix) – as indicated in Table 4-1.
- Natural water content (Admix) – as indicated in Table 4-1.
- Soil Density/Moisture Content Relationship (Admix) – as indicated in Table 4-1.

Samples will be collected and tested by CQA Personnel. Tests shall be conducted in accordance with the methods and procedures specified in Table 4-1. Testing shall be completed and compliance with the specifications established prior to any placement of admix material. Additional samples totaling at least 100 kg (200lb) shall be collected by the CQA Personnel and archived at the direction of the CONTRACTOR. The CONTRACTOR shall hold archive samples at their discretion. If the admix properties change due to changes in the base soil or other factors, the CONTRACTOR may change the acceptable moisture and density limits as required to achieve at least 85 percent saturation and assure a workable admix.

4.2.2 Test Fill

A test fill shall be constructed by the SUBCONTRACTOR to demonstrate the adequacy of the materials, design, equipment, and construction procedures proposed for the admix liner. The primary purpose of the test fill is to document that the specified soil density, moisture content, and permeability values can be achieved consistently in the full-scale facility with the full-scale compaction equipment and procedures.

So that the test fill will accurately represent the performance of the full-scale facility, the following requirements shall be followed:

- Construction of the test fill shall use the same soil material, design specifications, equipment, and procedures as proposed for the full-scale facility.
- The test fill shall be constructed at least four times wider than the widest piece of construction equipment to be used for the full-scale facility. This is done to ensure a sufficient area to conduct testing after a buffer area has been left along the edges of the test fill.
- The test fill shall be long enough to allow construction equipment to achieve normal operating speed before reaching the area that will be used for testing.
- The test fill shall be constructed with at least six lifts to evaluate the methodology used to tie lifts together.
- The test fill shall be constructed to allow determination of the relationship among density, moisture content, and permeability. Field variables can affect this relationship and must be carefully measured and controlled both in the test fill and during construction of the full-scale liner. As a minimum, the following shall be observed, sampled, tested, and documented by the CQA Personnel:
  - the compaction equipment type, configuration, and weight
  - the number of passes of the compaction equipment
  - the method used to breakdown clods before compaction and the maximum allowable clod size
  - the method used to control and adjust moisture content, including equilibration time, and the quantity of water to be used in any adjustment
  - the speed of the compaction equipment traveling over the liner
  - the uncompacted and compacted lift thicknesses
  - types of rutting (depths, widths, etc.).

- Relatively undisturbed samples of the test fill shall be collected using Shelby tubes for laboratory permeability tests. The Construction SUBCONTRACTOR will assist in collecting the Shelby tubes.

- Following collection of permeability samples, the holes shall be repaired and the methodology for repairing holes in the soil liner shall be evaluated by the CQA Officer. Holes less than or equal to 50 mm (2 in.) in diameter shall be repaired by backfilling with admix liner or bentonite chips, pellets, or powder in lifts no more than 150 mm (6 in.) thick and hand-tamping with a steel rod or other suitable device to firmly compact each lift. The methods and materials that will be used in the repair process shall be documented by the CQA Officer. Performance of repaired soil liner sections shall be equal to or exceed the performance of undisturbed liner sections. The resulting procedures shall be followed during repair of testing or sampling holes during full-scale liner construction.

- The test fill construction shall include the removal and replacement of a portion of the soil liner to evaluate the method proposed for repair of defective portions of the full-scale liner.

- A Sealed Double Ring Infiltrometer (SDRI) Test (ASTM D5093) shall be performed on the test fill to evaluate large-scale permeability. The SDRI shall be installed by CQA SUBCONTRACTOR, CQA Personnel shall direct installation of the equipment, perform the test, and evaluate the data with support from the SUBCONTRACTOR.

- Evaluation of layer bonding shall be determined by CQA Personnel using test pits to make visual observations. A minimum of two test pits shall be excavated in each test fill after test fill construction has been completed. The test pits shall be excavated entirely through the test fill using a backhoe, post hole digger or other approved method. Test pit locations shall be determined by the CQA STR and CQA Officer. Test pits will be completed by SUBCONTRACTOR.

The number and frequency of field and laboratory tests to be conducted during the test fill are listed below:

- Visual observation - continuous

- Field in-place moisture-density (nuclear) - 6 per lift per each of two passes (minimum) of the compactor for lifts 1 and 2. Continue testing after each two passes until there is no significant change in results

- Field in-place moisture-density (nuclear) - 6 per lift (minimum) lifts 3 to 6

- Field in-place moisture-density (rubber balloon or sand cone) - 1 for every lift (minimum)

- Laboratory permeability test, grain size and Atterburg limits of in-place admix - 1 for every lift (minimum)

- SDRI test - one per test fill

Additional tests may be conducted at the direction of the CQA Officer. Tests shall be conducted in accordance with the methods and procedures specified in Table 4-1. The CQA Officer shall compare the results of field and laboratory testing to the required specifications. Any failing tests shall be reported to the CONTRACTOR.

Additional test fills shall be constructed for each borrow source and whenever significant changes occur in the liner material, equipment, or procedures used to construct the soil liner.

4.2.3 Construction

Low-permeability admix liner shall be constructed by using the materials equipment and procedures used in the test fill and as documented by CQA Personnel. Criteria to be used for determining the acceptability of the liner shall be as identified in the project specifications. The CQA process for admix liner are intended to accomplish three objectives:

1. Ensure that the admix liner materials are suitable.
2. Ensure that the admix liner materials are properly placed and compacted.
3. Ensure that the completed liner is properly protected.

Subgrade preparation shall be observed for compliance with the specifications. On the floor of the trench, the subgrade shall be compacted to at least 90% of modified Proctor dry density (ASTM D1557), and in place density shall be measured at the frequency listed in Table 4-1. On the sideslopes of the landfill, the subgrade will be prepared by removing loose material, watering, and track walking. These activities shall be visually observed, but no testing is required. However, compaction and testing will be required if fill is required to bring the subgrade elevations up to design grades at the frequency listed in Table 4-1.

To document that proper construction practices are followed, CQA Personnel shall continuously observe the liner material placement and compaction process. During material spreading, the following shall be documented:

- Area to be covered is lightly scarified and moisture conditioned to facilitate bonding.
- Liner material is spread adequately to obtain complete coverage and the specified loose lift thickness;
- Equipment used to transport material does not affect lower material that was previously scarified.
- Oversize clods in the liner material are discarded or reduced in size;
- Soil moisture content is adjusted appropriately in the event of a significant prolonged rain or drought during construction;

- When required, water is adequately spread and incorporated to obtain full penetration through clods and uniform distribution;

- Significant water loss and desiccation cracking before and after compaction are prevented through the use of water application, covering, or other appropriate methods.

- At tie-in locations, any dry, cracked, or otherwise unsuitable areas of the existing admix is removed

During the soil liner compaction process, the following shall be documented:

- Compaction equipment is of the same type, configuration, and weight as used in the test fill;

- The equipment speed and number of passes for compaction is the same as used in the test fill;

- Coverage by compaction equipment is uniform, especially at compacted fill edges, in equipment turnaround areas, and at the tops and bottoms of slopes;

- The specified soil density, water content, and permeability throughout each completed lift is achieved. This will be determined by laboratory and field testing;

- Permeability values obtained for undisturbed soil liner samples are consistent with values obtained for undisturbed samples from the test fill. Undisturbed sample locations are staggered from lift to lift so holes do not align vertically;

- Penetrations or holes resulting from the collection of undisturbed soil samples or the use of density or moisture probes are repaired using the same materials and methods used for repairs on the test fill. CQA personnel shall repair all holes resulting from sampling or testing activities;

- Repaired sections are tied-in with undisturbed sections of the liner;

- Compacted lifts are tied together by scarifying the top of each lift, if necessary, with appropriate equipment prior to applying the following lift;

- Newly placed material is thoroughly kneaded into existing admix at tie-in locations;

- Sufficient liner strength to maintain stable sidewalls and to supply a stable base for supporting overlying materials is maintained while achieving the minimum specified density. This shall be monitored with moisture-density testing in accordance with the procedures listed in Table 4-1. In place field density tests and moisture content tests shall be conducted at a frequency as listed in Table 4-1. Additional tests may be conducted as directed by the CQA Officer. If a nuclear density gauge is used to measure the in-place density of the admix, then at least one rubber balloon or sand cone density test shall be conducted per day to confirm the results of the nuclear gauge. Moisture content measured with the nuclear gauge shall be validated by collecting a minimum of one sample per day for laboratory

moisture determination. ASTM D4643 (microwave moisture content) may be used, provided that a reliable correlation between oven dried (ASTM D 2216) and microwave results is established. If this approach is used, a minimum of one oven dried test shall be performed daily for verifying the correlation;

- Protective covers to prevent desiccation of liner material after completion of the liner are placed in a timely manner where necessary; overbuilding the liner can be considered protective cover and

- Equipment traffic is routed and controlled such that accidental damage of installed portions of the soil liner is prevented.

Climatic conditions shall be considered when construction methods are chosen. Construction methods may be restricted on work performed during and just after a rainfall, during very hot or windy conditions, or during freezing weather. For example, more compactive effort must sometimes be applied to achieve the same density as soil temperature falls. In very dry weather, the surface water content of each compacted fill layer can be altered in a short time by drying, making continuous watering and blending necessary. Atmospheric conditions shall be observed and recorded by CQA Personnel, and appropriate actions shall be taken when unsuitable weather conditions exist.

At locations where the field testing indicates that moisture contents or densities are outside the acceptable limits of the specifications, the failing area shall be reworked or removed and replaced. These areas shall be retested and the repair process repeated as necessary until passing results are achieved.

Shelby tube samples of the in place soil liner shall be obtained at a minimum frequency as listed in Table 4-1 for material placed. The testing frequency shall be increased if the admix material changes significantly. At any time, additional samples may be obtained at the discretion of the CQA Officer. At least one sample shall be taken from a corner area. Laboratory permeability tests shall be conducted on these samples to document compliance with the specifications.

The CQA Officer shall monitor on a periodic basis the soil liner surface for desiccation and irregularities to document compliance with the specifications. The completed liner shall be protected from desiccation, erosion, and freezing immediately following completion of the uppermost lift.

4.2.4 Post Construction

Immediately before placement of any geomembrane, the soil liner shall be inspected for cracks, holes, defects, or any other features that may increase its permeability. Defective areas shall be repaired. If the underlying foundation is defective (e.g., soft or wet), then this material shall be removed and the resultant volume replaced. Excavated areas of the soil liner shall be repaired by the method demonstrated during test fill construction; inspection shall document that there is continuity between the repaired and undisturbed areas.

Special attention shall be paid to the final inspections of the sump area, sidewall and bottom slopes, liner coverage, and liner thickness. The CQA Officer shall coordinate with the CQA Surveyor to confirm that minimum design thicknesses and grades are achieved prior to placement of any additional material over the soil liner.

4.3 GRAVEL DRAINAGE LAYERS

The requirements for the gravel drainage layers are described in 0600X-SP-C0069, Cell Construction, of the Specifications. The CQA Personnel shall perform the following activities:

4.3.1 Pre-Construction

Samples of the drainage layer gravel and the sump gravel shall be obtained at the borrow source pit or stockpile. Samples shall be obtained and tested to document compliance with the specifications at a frequency as listed in Table 4-1. Tests shall consist of the following:

- Grain size
- Permeability
- Slake durability
- Carbonate Content

Tests shall be conducted in accordance with the methods and procedures specified in Table 4-1. Slake durability tests shall be conducted in simulated leachate as provided by the CONTRACTOR.

4.3.2 Construction

As the drainage material is delivered to the site and placed in the facility, the CQA Personnel shall perform the following activities:

- Visually observe the material for contamination by debris or deleterious material;
- Visually observe the material for uniformity;
- Sample the material for grain size and permeability tests at a frequency as listed in Table 4-1 for material delivered to the site;
- Observe the placement of the material to confirm minimum thickness under spreading and hauling equipment to prevent damage to the underlying liner materials and components of the leachate collection system; and
- Observe placement and compaction of the material around piping and risers in the sumps.

Tests shall be conducted in accordance with the methods and procedures specified in Table 4-1.

4.3.3 Post-Construction

The CQA Officer shall coordinate with the CQA Surveyor to document that minimum thicknesses and design grades in the gravel layer have been achieved prior to the placement of any additional materials over the top of the gravel.

4.4 OPERATIONS LAYER

The requirements for the operations layer are described in 0600X-SP-C0069, Cell Construction, of the Specifications. The CQA Personnel shall perform the following activities:

4.4.1 Pre-Construction

CQA Personnel shall obtain samples of the proposed operations layer material prior to placement in the landfill. Samples shall be obtained at a frequency as listed in Table 4-1 and tested to document that the material meets the gradation requirements in the specifications. Tests shall be conducted in accordance with the methods and procedures specified in Table 4-1.

4.4.2 Construction

During placement of the operations layer material, CQA Personnel shall observe the placement operations on a full-time basis and perform the following:

- Visually observe the material for contamination with debris or deleterious material;
- Visually observe the material for particle size;
- Sample the material for grain size tests at a frequency as listed in Table 4-1 for material placed in the facility;
- Observe the placement of the material to confirm minimum thickness under equipment to prevent damage to the underlying liner materials;
- Visually observe that the operations layer placement on the slopes is conducted in compliance with the procedures outlined in the specifications;
- Visually observe to detect any damage to the underlying liner materials; and
- Visually observe the moisture conditioning, placement, and compaction of the material placed adjacent to the primary slope riser pipes.

Tests shall be conducted in accordance with the methods and procedures specified in Table 4-1.

4.4.3 Post-Construction

The CQA Officer shall coordinate with the CQA Surveyor to confirm that minimum thicknesses and design grades in the operations layer have been achieved prior to the placement of any waste materials.

4.5 ANCHOR TRENCH/VADOSE ZONE TRENCH/SIDE SLOPE RISER PIPE TRENCH

The requirements for the anchor trenches and side slope riser pipe trenches are described in 0600X-SP-C0072, Sitework, of the Specifications. The CQA Personnel shall perform the following activities:

4.5.1 Pre-Construction

CQA Personnel shall obtain samples of the proposed backfill materials for anchor trenches, vadose zone trench and side slope riser pipe trenches prior to backfilling these trenches. Samples shall be obtained at a frequency as listed in Table 4-1 for each material or a minimum of one sample, whichever is greater, Samples shall be tested to confirm that the material meets the gradation requirements in the specifications. Tests shall be conducted in accordance with the methods and procedures specified in Table 4-1.

4.5.2 Construction

During placement of backfill in the anchor trenches, vadose zone trench and riser pipe trenches, CQA Personnel shall observe the placement operations on a periodic basis and perform the following:

- Visually observe the material for contamination with debris or deleterious material;
- Visually observe the material for particle size;
- Sample the material for grain size tests at the frequency listed in Table 4-1 for material placed;
- Visually observe that the material is moisture conditioned and compacted as specified;
- Visually observe that backfill around riser pipes does not contain voids;
- Observe the placement of the material to document minimum thickness under equipment to prevent damage to the underlying materials; and
- Visually observe to detect any damage to the underlying liner materials.

Tests shall be conducted in accordance with the methods and procedures specified in Table 4-1.

4.5.3 Post-Construction

There are no specific post-construction requirements for anchor trench, vadose zone trench, side slope riser pipe trench backfill.

4.6 HDPE GEOMEMBRANE LINER

The requirements for the HDPE geomembrane liner are described in 0600X-SP-C0068, Cell Construction, of the Specifications. The CQA Personnel shall perform the following activities:

4.6.1 Preconstruction

Preconstruction activities for HDPE geomembrane liner include inspection of the raw materials, manufacturing operations, fabrication operations, and final product quality; observations related to transportation, handling, and storage of the membrane; observation of foundation preparation; and review of the personnel qualifications, training, and equipment to be used to install the HDPE geomembrane liner. In addition, CQA Personnel shall perform conformance and "fingerprinting" tests on samples of the HDPE liner material submitted by the geomembrane installer. These activities are discussed in the following subsections. "Fingerprinting" tests include specific gravity, melt index, and crystallinity. Samples of the geomembrane totaling at least 10 m^2 (~100 ft^2) shall be collected by the CQA personnel and archived by the CONTRACTOR.

4.6.1.1 HDPE Manufacture. Quality assurance requirements for the geomembrane manufacturer initially consist of evaluating the raw polymer materials. The resin supplier shall provide documentation with each shipment or production lot confirming that the raw materials comply with the manufacturers' product properties and performance requirements. The Manufacturer shall test each batch (lot) of resin to verify that the raw material meets or exceeds the specifications. The CQA Officer shall submit to the CONTRACTOR an inspection plan for the raw polymer materials in the manufacturer's facilities. The CQA Officer shall inspect the raw polymer materials only with CONTRACTOR's approval. Any source inspection activities shall be performed in compliance with the surveillance inspection procedures and non-conformances shall be documented on NCR forms and submitted to the CONTRACTOR for disposition and resolution.

CQA Personnel shall review testing results and other documentation submitted by the geomembrane Manufacturer for conformance to the specification requirements. Submittals from the Manufacturer include the following:

- 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;
- a copy of the quality control certificates issued by the Resin Supplier;

- reports on the tests conducted by the Manufacturer and the CQA Officer to confirm that the quality of the resin used to manufacture the geomembrane satisfies the specifications;

- a statement that no recycled polymer is added to the resin or that recycled polymer is clean and does not exceed 2% by weight, and does not include material that has seen previous service life;

- a properties sheet including properties listed in the specifications, measured using test methods indicated in the specifications, or equivalent;

- reports on the tests, including sampling procedures, conducted by the Manufacturer and/or the CQA Officer to confirm that the geomembrane meets the project specifications;

- a certification that property values given in the properties sheet are guaranteed by the Geomembrane Manufacturer.

4.6.1.2 Receiving Inspection and Conformance Testing. The CQA Personnel shall perform receiving inspection on geomembrane material in compliance with procedures, and nonconformances shall be documented on NCR forms and submitted to the CONTRACTOR for disposition and resolution. CQA Personnel shall also confirm that transportation, handling, and storage of geomembrane are performed in accordance with the specifications and manufacturer's instructions, and shall determine the condition of rolls of geomembrane upon delivery to the site.

CQA Personnel shall remove samples to be tested to determine conformance to the design specifications and the manufacturer's specifications. The properties which shall be tested include:

- Specific Gravity;
- Asperity height
- Tear
- Melt index;
- Carbon black content and dispersion;
- Thickness;
- Strength/elongation properties;
- Puncture resistance;
- Friction angle of the textured geomembrane vs. admix with soil liner material, textured geomembrane vs. geocomposite and geocomposite vs. operations layer (direct shear methods as specified by the ERDF Designer);
- Seam strength (if applicable).

Prior to shipment or after delivery of the rolls of geomembrane, CQA Personnel shall remove samples and forward them to the geosynthetics testing laboratory. Samples of geomembrane shall be taken across the entire width of the roll and shall not include the first three feet. Unless otherwise specified, samples shall be three feet long by the roll width. Samples shall be taken at a rate of one per lot or one per 5,000 square meters (~50,000 square feet), whichever results in

the greater number of tests, except that only two (2) friction angle tests will be performed per interface. Tests shall be completed in accordance with the methods and procedures specified in Table 4-2.

CQA Personnel shall examine results from laboratory conformance testing, shall document nonconformances on NCR forms, and shall notify the CONTRACTOR of any such nonconformance. Rolls of geomembrane which do not meet or exceed required specifications shall be rejected and brought to the attention of the CONTRACTOR.

4.6.1.3 Factory Fabrication. Sheets of geomembrane may be joined to form larger panels prior to delivery and installation at the landfill. CQA Personnel shall document that such fabrication activities are performed in accordance with the specifications, particularly that required materials, methods, and testing procedures are employed. CQA Personnel shall also review documentation submitted by the Fabricator, testing laboratories, and other parties as listed in the specifications. Nonconformances shall be documented on NCR forms. Geomembrane panels which do not meet or exceed required specifications shall be rejected and brought to the attention of the CONTRACTOR. Requirements for fabrication and testing are described in detail in the specifications and are summarized in the following paragraphs.

Unless otherwise approved, the fabrication of rolls of geomembrane into panels shall be performed by the geomembrane Manufacturer or Fabricator under controlled factory conditions. Seams shall meet or exceed the specifications required for field seams. Fabrication shall be performed by experienced personnel. Approved fabrication seaming processes are extrusion welding and fusion welding. Any proposed alternate processes must be submitted for approval by the CONTRACTOR. Details of the specific apparatus and methods to be used for seaming, shall be submitted for approval prior to use.

The SUBCONTRACTOR'S geomembrane Manufacturer or Fabricator shall allow the CQA Officer to visit the fabrication plant during the production of panels for this project in order to review the fabrication and quality control procedures.

Prior to shipment of fabricated panels to the site, the Fabricator shall provide written certification that quality control testing has been performed. Quality control certification shall include: panel numbers and complete identification features such as roll numbers, dimensions and fabrication methods, etc.; sampling and testing procedures including location and results of the testing; and documentation of the temperature and humidity conditions under which fabrication was performed. Quality control certificates shall be signed by an authorized representative of Fabricator.

4.6.1.4 Bedding Surface. CQA Personnel shall confirm that the surface upon which the geomembrane will be installed is suitably prepared and will not damage the geomembrane. Details of required observations are presented in the specifications and are summarized in the following paragraphs.

The geomembrane bedding layer shall be free of clods, rocks, sticks, sharp changes in grade, ruts greater than 1 inch, desiccation cracks, and standing water. Where the bedding surface is the low

permeability admix liner, methods shall be taken to prevent the soil liner surface from drying and cracking prior to installing the geomembrane. These methods may include the use of a temporary cover. Desiccation cracks larger than the limits listed in the specifications shall be repaired using approved methods as described in the Specifications.

The Geomembrane Installer shall inspect and provide written certification to the CONTRACTOR and the CQA Officer that the prepared surface under consideration is suitable for installation of the geomembrane.

After acceptance of the prepared surface, it shall be the Installer's responsibility to notify the CONTRACTOR and the CQA Officer of any deterioration in the prepared surface resulting from weather or other causes beyond the Installer's control. Repairs required to restore the surface as a result of such causes shall be made as directed by the CONTRACTOR. Any damage to the prepared surface caused by installation or other causes relating to performance of the work shall be the responsibility of the Geomembrane Installer.

4.6.2 Construction

Sheets of geomembrane will be welded together after they are placed in the trench to form a continuous moisture barrier. CQA Personnel shall document that the placement and seaming activities are performed in accordance with the specifications; particularly that required materials, methods, and testing procedures are employed. CQA Personnel shall also review documentation submitted by the Geomembrane Installer, testing laboratories, and other parties as listed in the specifications. Seams or repaired areas which do not pass the tests shall be repaired and retested as described in the specifications until a passing result is achieved. Requirements for geomembrane installation and testing are described in detail in the specifications and are summarized in the following subsections.

4.6.2.1 Placement of Geomembranes. Prior to placing geomembranes in the landfill, the Geomembrane Installer shall provide scale drawings showing the proposed placement pattern and field seam locations (including dimensions and details) to the CONTRACTOR and the CQA Officer for review. These drawings shall be submitted in a reproducible form.

Each field panel and field seam shall be given an identification code which is consistent with the proposed sequence of installation. A field panel is defined as the area of geomembrane which is to be cut and seamed in the field by the Installer. Unless otherwise directed, the Installer shall place the field panels in the sequence shown on the installation drawings.

On slopes or grades steeper than ten percent, seams shall be oriented down and not across the slope (no horizontal seams on side slopes). On the cell floor, no horizontal seam shall be less than 1.5 meters (five feet) from the top of the slope or other area of potential stress concentration. Seams shall not line up with leachate piping runs. The number of field seams shall be minimized in areas such as corners and odd-shaped geometric locations. In anchor trenches, the geomembrane shall be continuous through the trench, over the crest, and down the slope.

Geomembrane shall not be placed when ambient temperatures are less than 0°C (32°F) or more than 40°C (104°F) measured 300mm (12 inches) above the geomembrane. Placement shall not be attempted in rain or snow or under conditions of excessive fog or dew. Placement will not be permitted in areas of ponded water or in the presence of excessive winds.

Equipment used for placement shall not damage the geomembrane or the subgrade by handling, trafficking, leakage of hydrocarbons, or in other ways. Personnel working on the geomembrane shall not engage in any activities or wear footwear which could damage the geomembrane. Direct contact of any heavy mechanical equipment with the geomembrane shall not be allowed.

Panels shall be carefully unrolled according to the Manufacturer's and Fabricator's instructions, and in a manner that does not scratch or crimp the geomembrane. Panels shall be aligned to minimize wrinkles or "fishmouths", especially along the field seams. Adequate precautions (such as placement of sand bags) shall be taken to minimize the likelihood of wind uplift.

Any field panel or part of a field panel which becomes seriously damaged shall be replaced at the direction of the CQA Officer or CONTRACTOR. Minor damage, such as small wrinkles, crimps, etc., shall be repaired using approved procedures as described in the specifications. Damaged field panels which have been rejected for use shall be removed from the site.

4.6.2.1.1 Field Seaming of Geomembrane

Personnel

The Geomembrane Installer shall provide the CONTRACTOR and CQA Officer with a list of the Installer's proposed seaming personnel and their previous seaming experience. Seaming personnel shall be required to pass a seaming test prior to commencement of field seaming operations. The superintendent and lead welder foreman shall have experience seaming a minimum of 185,000 square meters (~1,991,000 square feet) of polyethylene geomembrane using the same type of seaming apparatus in use at the site. These individuals shall provide direct supervision over less experienced seamers. No field seaming shall take place without the superintendent or lead welder foreman being present (present means in the cell area).

Field Seaming Methods and Equipment

General: Only seaming methods and equipment which have been previously approved by the CONTRACTOR shall be used for field seaming of the geomembrane panels. Approved seaming methods are extrusion welding and single or dual track fusion welding. Fusion welding shall be utilized for tie-in seams between existing and new geomembrane. Seaming shall be a continuous process with a minimum of interruptions along any given seam. The Installer shall maintain at least two operable spare seaming units on site.

Where conditions warrant, the Installer may be allowed to use a temporary support surface between the geomembrane and the subgrade to achieve proper support conditions during seaming operations. The use of such support methods shall be subject to the approval of the

CQA Officer. The support shall not be left in place and shall be removed on completion of seaming.

Wherever possible, wrinkles or "fishmouths" shall be pulled out of the overlap area prior to seaming. Where this cannot be done, they shall be cut along the ridge of the wrinkle in order to achieve a flat surface. Such cuts shall be seamed. Where the overlap is inadequate, an oval or round patch of the same geomembrane, extending a minimum of 15 cm (six inches) beyond the cut in directions, shall be seamed onto the geomembrane.

Extrusion Welding Process: Extrusion welding apparatus shall be equipped with gauges to measure the temperature at the nozzle or the preheat temperature of the apparatus. The CQA Personnel shall monitor the extrudate and ambient temperature at appropriate intervals. The extruder shall be purged of heat-degraded extrudate at the beginning of each seaming sequence.

Artificially induced cooling of extrudate welds (using water or any other means) shall not be allowed. Sufficient time between welding and non-destructive testing shall be taken so that nondestructive testing procedures do not cause artificial cooling of the extrudate.

Fusion Welding Process: Fusion welding apparatus shall be automated, self-propelled devices which produce either a single seam or a double seam with an enclosed central air space. The apparatus shall be equipped with gauges which indicate the equipment temperatures during welding. For the seaming of cross-seams, the top and bottom edges of the cross-seam shall be ground to a smooth incline prior to seaming.

The CQA Personnel shall log ambient and seaming apparatus temperatures, as well as seaming apparatus speed for each seam.

Seam Overlap and Preparation: Prior to seaming, geomembrane rolls or panels shall be overlapped by a minimum of 76 mm (three inches) for extrusion welding and 127 mm (five inches) for fusion welding or as recommended by manufacturer. Procedures used to temporarily bond adjacent rolls together shall not result in damage to the geomembrane. If mechanical devices such as hot air leisters are used for temporary bonding, the air temperature at the nozzle of such equipment shall be controlled so as not to damage the geomembrane. Solvents or adhesives shall not be used.

Seams shall be aligned to create as smooth a surface as practicable with a minimum of wrinkles and "fishmouths". The area in the immediate vicinity of the seam shall be free of moisture, dust, dirt, debris, or any other foreign material and, if necessary, sheltered from wind and dust immediately prior to and during the seaming operation. If grinding is required along the seam, this shall be done according to the Manufacturer's recommendations, within one hour of the seaming operation and in a way which does not damage the geomembrane. This process also shall include cleaning the seam area with a brush or forced air immediately prior to seaming. Particular care shall be paid to the condition of existing geomembrane prior to tie-in with new geomembrane.

The CQA Personnel shall document geomembrane seam overlaps and preparation procedures.

Weather Conditions

In general, seaming shall not be attempted when ambient temperatures are below 0°C (32°F) or above 40°C (104°F) as measured 300mm (12 inches) above the liner. Below 0°C (32°F), seaming may be allowed provided that suitable precautions are taken and the Installer is able to certify in writing that seaming under these conditions will not cause any chemical or physical alteration to the geomembrane which may deleteriously affect its short- or long-term performance. Approval by the CONTRACTOR will be required to seam with ambient temperatures are below 0°C (32°F) or above 40°C (104°F) . Extrusion welding will require the geomembrane to be preheated by either the sun or the use of a hot air device, and the Installer shall take precautions that excessive cooling resulting from wind does not affect the seaming operation. CQA Personnel shall determine when preheating is required and whether wind affects may be deleterious to seaming operations.

Seaming shall not be performed during wet weather where the geomembrane is exposed to the elements.

Trial Seams

Trial seams shall be made to verify that adequate conditions exist for field seaming to proceed. Each seamer shall produce a trial seam at the beginning of each shift. Additional trial seams shall be made every four hours or, if a breakdown of the seaming equipment occurs, prior to resumption of seaming operations. This frequency may change at the discretion of the CQA Officer with approval of the CONTRACTOR. The CQA Personnel shall monitor and log the trial seam results.

Trial seams shall be made on pieces of geomembrane identical to the installed product measuring at least 0.6 meter (two feet) long by 0.3 meter (one foot) wide (after seaming) with the seam centered lengthwise and overlapped as required for the particular seaming process. Seaming shall be conducted in the trench near the area where production seaming will occur.

Six samples, each 25 mm (one inch) wide, shall be cut from the test seam and tested, 2 in shear and 4 in peel, using a tensiometer calibrated within the past 6-months. The samples shall not fail in the seam. If a seam failure occurs, then a second seam shall be produced and tested. If a second failure results, the apparatus or seamer shall be rejected and shall not be used for field seaming until any deficiencies have been corrected. This shall be verified by the production and successful testing of two consecutive trial seams.

4.6.2.1.2 Nondestructive Testing of Field Seams

General

Seams shall be nondestructively tested by the Installer over their full length to verify their continuity. It should be noted that this testing does not provide any information regarding seam strength. Nondestructive testing shall be performed concurrently with field seaming using the equipment and procedures described below. Testing equipment and procedures other than those

given below shall be subject to approval by the CONTRACTOR prior to their use. Any seam which fails the nondestructive test shall be repaired in accordance with approved procedures as described in the Specifications. Repairs shall be retested to determine the success of the repair.

Where CQA Personnel determine that seams cannot be nondestructively tested due to physical constraints, the seams shall be capped with the same geomembrane or double seamed. CQA Personnel shall observe the seaming and capping of such seams to assess their adequacy and determine whether additional action is required. Where such a seam is accessible for testing prior to final geomembrane deployment, testing shall be performed prior to deployment.

The non-destructive testing shall be conducted by the Installer and continuously monitored by CQA Personnel.

Vacuum Testing

For extrusion and single wedge fusion welded seams, seams shall be evaluated using vacuum box testing. The vacuum box shall consist of a rigid housing with a transparent viewing window on top and a soft, flexible gasket attached to the bottom of the housing. A port hole and valve assembly along with a calibrated vacuum gauge shall be provided at one end of the housing. The vacuum gauge shall be calibrated prior to initial use on the project and recalibrated on at least an annual basis, at the end of the project, or at the discretion of the CQA Officer. The Installer shall supply vacuum gauge calibrations to the CQA Officer for review prior to the start of testing. A steel vacuum tank and pump assembly complete with the necessary pressure controls, pipe connections, pressure hoses, and fittings shall be provided. A soapy solution and a method of dispensing the solution are also required.

The tests shall be performed according to ASTM D5641. To perform the test, the pressure in the vacuum tank shall be reduced to approximately 127 mm (five inches) of mercury. The soapy solution shall be applied to the test section and the vacuum box placed over the wetted area. The bleed valve shall then be closed and the vacuum valve opened. Once a tight seal has been established, the test section shall be visually examined for a period of not less than 10 seconds to determine whether bubbling of the soapy solution is occurring. The vacuum valve shall then be closed and the bleed valve opened. The vacuum box shall be removed and the process repeated on the next adjacent test section. A minimum 76 mm (three-inch) overlap shall be provided on test sections. Locations where bubbling of the soapy solution is observed shall be clearly marked for repairs to be performed in accordance with approved procedures as described in the Specifications. Repairs shall be retested.

The non-destructive testing shall be conducted by the Installer and continuously monitored by CQA Personnel.

Air Pressure Testing

This test method (ASTM D5820) shall apply only when the double hot wedge fusion seaming method is used to form the seam. The testing equipment shall consist of an air pump capable of generating and sustaining pressure of at least 276kPa (40psi) complete with a pressure gauge and

the necessary pressure hose, fittings, and connections. An approved pressure feed device such as a sharp hollow needle shall be provided to penetrate into the central air channel at one end of the seam. A second calibrated pressure gauge in 6.9kPa (1psi increments) capable of reading pressures up to 40psi shall be provided to detect any pressure loss at the opposite end of the seam from the pressure feed device. The pressure gauges shall be calibrated prior to initial use on the project and recalibrated on at least an annual basis, at the projects end or at the discretion of the CQA Officer. The Installer shall supply pressure gauge calibrations to the CQA Officer for review prior to the start of testing.

To perform the test, a section of the seam shall be sealed off at both ends. The pressure feed device shall be inserted into the air channel at one end of the sealed section, and the second pressure gauge shall be inserted into the opposite end of the air channel. If the seam is 13 mm (1/2-inch) wide, it shall be pressurized to a minimum pressure of 207 kPa (30 psi). The pressure valve shall be closed and the pressure monitored for a period of not less than 5 minutes. If a pressure loss greater than 14 kPa (2 psi) is observed at either end or if the required pressure cannot be reached, then the seam shall be rejected. If, in the judgment of the CQA Personnel, significant changes in temperature occur during the test (e.g., due to cloud cover), the test shall be repeated after the geomembrane has stabilized. Faulty areas along the seam shall be identified, repaired in accordance with approved procedures, and retested. Holes created during nondestructive testing shall be repaired in accordance with approved procedures as described in the Specifications upon completion of the test.

The non-destructive testing shall be conducted by the Installer and continuously monitored by CQA Personnel.

4.6.2.2 Destructive Testing of Field Seams. Destructive testing of field seams shall be performed at selected locations in order to verify that seams satisfy the strength requirements listed in the specifications. Sampling and testing shall be done concurrently with field seaming operations so that corrective action, if required, may be implemented as the work progresses. Samples shall be taken for testing so as to achieve a minimum average daily frequency as listed in Table 4-2. Sample locations shall be determined by CQA Personnel based on the required sampling frequency and seaming observations. The Installer shall not be informed in advance of the locations where the seam samples will be taken. Additional test locations may be required during seaming operations such as along tie-in seams with existing geomembranes. The necessity for such additional sampling and testing shall be determined by CQA Personnel, and extra testing shall be performed when there is cause to suspect the presence of excess crystallinity, contamination, offset welds, or any other potential defect. The CQA Officer may increase the minimum frequency of destructive testing as the work progresses based on the results of previous testing.

Samples shall be cut by the Installer under the observation of CQA Personnel. Samples may be cut prior to nondestructive seam testing. Each sample shall be numbered and identified. The sample number and location shall be recorded by CQA Personnel on the layout drawings.

The test sample shall measure approximately 300 mm (12 inches) wide by 1070 mm (42 inches) long with the seam centered lengthwise. Two 25mm (one-inch) wide strips shall then be cut, one

from either end of the sample. Both of these strips shall be tested by the Installer in the field using a tensiometer to determine the mode of failure in both peel and shear. The remaining portion of the sample shall be cut into three equal parts having a minimum length of 300 mm (12 inches). One sample shall be taken by CQA Personnel for destructive testing under laboratory conditions. One sample shall be given to the Installer to perform CQC testing. The third sample shall be kept in storage by the CONTRACTOR.

The area from which the test sample was cut shall be immediately repaired in accordance with approved procedures described in the Specifications. Seams created for these repairs shall be nondestructively tested in accordance with Section 4.6.2.1.2.

Neither of the field tests shall fail in the seams. The results of the laboratory testing by CQA Personnel shall in any case determine the acceptability of the field seam. The tests shall be performed in accordance with the methods listed in Table 4-2. The results of the laboratory destructive testing shall be made available to the Installer and CONTRACTOR by the CQA Officer not more than 24 hours after the samples have been received by the laboratory facility where the testing is to be performed.

Passing values for field testing are defined in specification 0600X-SP-C0068. Field testing shall meet these values for each test otherwise the seam will be considered failing.

A field seam shall only be considered acceptable when it is bounded by two destructive test locations which meet the seam strength requirements listed in the specifications, as well as passing the nondestructive tests described in Section 4.6.2.1.2. Whenever a sample fails a destructive test, whether that test is conducted by field tensiometer, CQA Laboratory or the Installer's laboratory, the following procedures shall be employed. The Installer shall have three options at his disposal as follows:

- The Installer may cap the failing seam between any two passed test locations; or

- The Installer may elect to trace the seam to two intermediate locations a minimum of 3 meters (10 feet) in either direction from the point of the failed test 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 CQA 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.

- Cap all seams welded by the machine that had the failing test.

The continuity of capped seams shall be verified by nondestructive testing in accordance with Section 4.6.2.1.2. In addition, if the total capped seam length exceeds 46 meters (150 feet), a destructive sample shall be taken for laboratory testing as described above.

The CQA Officer shall document actions taken in conjunction with destructive test failures.

4.6.2.3 Repairs. The entire geomembrane surface shall be examined by CQA Personnel in order to confirm that the geomembrane is free of any defects, holes, blisters, undispersed raw materials, or contamination by foreign matter. Particular attention shall be paid to existing geomembrane in tie-in areas. Whenever possible, the examination of the geomembrane surface shall be done prior to any seaming in that area. If necessary, the geomembrane surface shall be cleaned by the Installer so that it is free of dust, mud, or any other materials which may inhibit a thorough examination of the surface. Any suspect areas shall be clearly marked by CQA Personnel and nondestructively tested by the Installer in accordance with Section 4.6.2.1.2. Any location which fails to pass the nondestructive testing or from where a destructive test sample has been removed shall be repaired using one of the procedures described below.

Small tears, wrinkles, scratches, or pinholes shall be repaired by the Installer using spot welding, seaming, or patching, as appropriate. Large holes and tears, undispersed raw materials, and any areas which have been contaminated by foreign matter shall be repaired by the Installer using patches or by capping the area. All damage that fully penetrates the layers shall be repaired with a patch. Patches shall be round or oval in shape, shall consist of the same geomembrane material, and shall extend a minimum of 150 mm (6 inches) beyond the edge of the defect in all directions. Temporary bonding methods used to hold patches in place prior to seaming shall be approved methods only. Geomembrane surfaces to be patched shall be abraded in accordance with the specifications. Surfaces shall be clean and dry at the time the repair work is performed. Repair seaming shall be performed using approved extrusion welding methods and equipment.

Repairs shall be nondestructively tested using the appropriate methods described in Section 4.6.2.1.2. Unless additional destructive testing is required as described in Section 4.6.2.2, repairs which pass the nondestructive test shall be accepted as being adequate. Any repairs which fail the nondestructive test shall not be accepted, and the Installer shall perform the necessary remedial work and retest the repaired area until it passes the nondestructive testing criteria.

Upon completion of field seaming and testing, and prior to any placement of materials on top of the geomembrane, CQA Personnel shall identify any large wrinkles or "fishmouths" which may have been built into the geomembrane. Any such features shall be cut out, repaired, and tested by the Installer.

In any given area, no work shall proceed with any materials which may cover the geomembrane until repairs in that area have been successfully made. As the work progresses, CQA Personnel shall document locations requiring repair work and shall confirm that repairs have been successfully made.

4.6.2.4 Materials in Contact with Geomembrane. The requirements of this section are intended only to minimize the risk of geomembrane damage during installation on existing surfaces or during placement of overlying materials. The construction and material specifications shall govern the adequacy of construction using these overlying materials. Installer shall not perform any cutting, testing or work on top of the geomembrane. All generators shall be kept off geomembrane.

The installation of geomembrane on rough surfaces such as concrete shall be carefully performed so as to prevent any damage to the geomembrane. The Installer, with prior approval from the CONTRACTOR, may elect to use a remnant piece of geosynthetic material as a temporary "rub-sheet" beneath the geomembrane to act as a cushion. Foreign objects and particles in excess of the maximum size allowed in the material specifications shall be removed from the bedding surface prior to geomembrane placement.

Placement of materials on top of the geomembrane shall not be allowed when the ambient temperature is below 0°C (32°F) or above 40°C (104°F).

Equipment used for placing and compacting overlying soil materials shall not be driven directly on to any geosynthetic material. A minimum thickness of 0.3 meter (one foot) of material shall be maintained between the geomembrane and the low contact pressure bulldozer or light motor grader used to place granular materials. No sharp turning of the spreading equipment will be allowed on the initial 300mm (12 inches) cover. No heavy rubber-tired vehicles shall be allowed in areas underlain by geomembrane until a minimum of 0.9 meter (3 feet) of soil cover material has been placed, with the exception that a light grader may be used on the 0.3 meter (one-foot) cover for fine grading and trimming operations. However, the weight of the equipment may not exceed (5psi) as measured on the geomembrane surface. Equipment shall be observed by the CQA Personnel during placement to document that no leakage of hydrocarbons occurs, particularly on top of the geomembrane.

Placement of soil materials on top of the geomembrane shall not be allowed within 15 meters (50 feet) of any unseamed edge of geomembrane until field seaming of that edge is complete. This is required to allow sufficient room to work out any large wrinkles or "fishmouths" prior to seaming.

The placement of cover materials shall be done with caution and in a manner which is least likely to cause wrinkles in, or damage to, the geomembrane. The CQA Personnel shall monitor the placement of cover materials over the geomembrane on a regular basis.

4.6.3 Post-Construction

Site Clean-up

Upon completion of work in any given area, CQA Personnel shall examine that area to determine whether waste and extraneous materials have been removed and that the area has been left in a satisfactorily clean condition to allow placement of materials on top of the geomembrane.

Completion of Work

The installation of the geomembrane shall be considered as complete when: (1) required deployment, field seaming, testing, repairs, retesting, and site clean-up have been completed by the Installer; (2) the Installer has submitted the required quality control certificates and work/inspection records to the CONTRACTOR; and (3) the CONTRACTOR and the CQA

Subcontractor are satisfied that the geomembrane has been installed in accordance with the plans and specifications.

4.7 LEACHATE COLLECTION SYSTEM (LCS)

The requirements for the leachate collection system (LCS) are described in the following sections of the Specifications (most current revisions):

Section Title	New Section No.
Geotextiles	0600X-SP-C0068
Geocomposites	0600X-SP-C0068
HDPE Pipe and Flatstock	0600X-SP-M0029
Leachate System	0600X-SP-C0069
Leachate Pumps	0600X-SP-M0030
Crest Pad Piping	0600X-SP-M0029
Crest Pad Valves	0600X-SP-M0029
Meters, General	0600X-SP-M0029
Electrical Distribution System, Underground	0600X-SP-E0024
Electrical Work, Interior	0600X-SP-E0024

The CQA Personnel shall perform the following activities:

4.7.1 Pre-Construction

CQA Personnel shall inspect leachate collection system materials, equipment, and components when they are delivered to the site to confirm that they conform to the design criteria and specifications. Receiving inspection shall be performed in compliance with the procedures specified in the CQAP and SUBCONTRACTOR's CQC Plan, with the exception that nonconformances shall be documented on NCR forms and submitted to the CONTRACTOR for disposition and resolution. In general, activities performed by CQA Personnel shall include the following:

- Inspect materials upon arrival at the site to confirm conformance to the specifications;
- Inspect piping components to confirm (from appearance and shipping documents) that they are constructed of materials as listed in the plans, specifications, and procurement documents and that they are not damaged. Take measurements to confirm that pipe is of specified size and wall thickness and that perforations are sized and spaced as specified;
- Observe and test to confirm that sand and gravel materials conform to the specifications are of the proper size and gradation, and do not contain unacceptable types of materials. Testing requirements for the drainage layers are outlined in Section 4.3;
- Inspect to confirm that prefabricated structures are as specified in the design. Such items include, but are not limited to, non-HDPE piping systems, prefabricated HDPE components, electrical equipment, and monitoring equipment. Inspection shall include visual observation

of any corrosion-resistant coatings to document that they are present and without flaw. The CONTRACTOR shall be informed of the acceptance status of all such items prior to installation; and

- Witness, inspect and document LCS equipment, system components, and mechanical/electrical equipment identified in the Acceptance Test Procedures (Appendix A) to confirm they meet specification requirements. Acceptance Tests (AT) shall be performed by the Construction SUBCONTRACTOR.

4.7.2 Construction

4.7.2.1 Pipe Network Installation. The HDPE pipe network shall be placed according to the design. CQA monitoring activities shall include:

- Review of construction subcontractor's submittals concerning joining methods and type of perforations;
- Review of manufacturer's certification to document that the HDPE pipe meets the specifications;
- Visually observe that the geonet and geotextile layers are placed over the geomembrane prior to pipe installation;
- Observe and measure to confirm that the pipes are placed at specified locations and in specified configurations, and that pipe grades are as specified;
- Verify that the internal cleanliness of HDPE pipe is maintained.
- Visually observe that pipes are joined together and perforated in accordance with the approved procedures. Visual inspection of the carrier pipe is not required when double containment pipe is joined using the double butt fusion process (the pipes will be pressure tested);
- Observe that the placement of any filter or backfill materials around the pipe proceeds as shown on the plans;
- Witness, review, and document testing of HDPE piping prior to being buried or covered with liner;
- Observe that backfilling and compaction are completed as specified and that, in the process, the pipe network is not damaged.

4.7.2.2 Drainage Layer. Inspection of the drainage layer shall include:

- Testing the material to confirm that it has the specified particle size and is free from excessive amounts of fines or organic materials (See Section 4.3);

- Measuring the thickness and observing coverage of each drainage layer as it is placed in the LCS (coordinate with CQA Surveyor); and

- Surveying the completed layer to document that specified slopes and grades are obtained (coordinate with CQA Surveyor).

Placement of the drainage layers shall not damage any component of the underlying composite liner or the piping.

4.7.2.3 Geotextile, Geocomposite, and Geonet

Manufacture

The geotextile, geocomposite, and geonet manufacturers shall provide a list of guaranteed properties for the type of geotextile, geocomposite, or geonet to be delivered. The manufacturers shall also provide written certification signed by a responsible party that the materials actually delivered have properties which meet or exceed the guaranteed values.

Rolls of geotextile, geocomposite, and geonet shall be marked or tagged with the following information:

- manufacturer's name,
- product identification,
- lot number,
- roll number, and
- roll dimensions.

If any special handling of the materials is required, it shall be so marked, e.g., "This Side Up" or "This Side Against Geonet".

Shipment, Handling, and Storage

The geotextile and geocomposite material shall be protected from ultraviolet light exposure, precipitation or inundation by water, mud, dirt, dust, puncture, cutting, and any other damaging or deleterious conditions. Geotextile and geocomposite rolls shall be shipped and stored in relatively opaque and watertight wrappings. Geotextile and geocomposites shall not be exposed to precipitation prior to being installed. Wrappings protecting geotextile and geocomposite rolls shall be removed less than one hour prior to unrolling the material. After the wrapping has been removed, a geotextile shall not be exposed to sunlight for more than 14 days (guaranteed by the geotextile manufacturer).

Geonet rolls shall be covered in polyethylene sheet or otherwise protected against dust and dirt during shipping and storage. The covering shall be removed less than one hour before placement. CQA Personnel shall document that geonets are free of dirt and dust just before installation. If the geonets are judged dirty or dusty, they shall be washed by the Installer prior to installation.

Conformance Testing

Prior to shipment or after delivery of the geotextile, geocomposite, and geonet, CQA Personnel shall remove samples and forward them to an approved geosynthetic 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 5,000 square meters (~50,000 square feet), whichever results in the greater number of tests, except that only two (2) friction angle tests on each interface will be performed. Samples shall be taken across the entire width of the roll and shall not include the first 0.9 meter (three feet). Unless otherwise specified, samples shall be 0.9 meter (three 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 geotextiles:

- Mass per unit area;
- Grab strength;
- Tear strength;
- Burst strength;
- Puncture strength;
- Thickness;
- Permittivity (filter applications); and
- Apparent opening size (AOS) (filter applications).

As a minimum, the following tests shall be performed on geonets:

- Polymer specific gravity;
- Thickness; and
- Mass per unit area.

As a minimum, two sets of the following tests shall be performed on finished geocomposites:

- Friction angle with operations layer, and
- Friction angle with textured geomembrane
- Ply adhesion
- Transmissivity

Tests shall be conducted in accordance with the procedures listed in Table 4-2. CQA Personnel shall examine all results from laboratory conformance testing and shall report any nonconformance to the CQA Officer and the CONTRACTOR. Testing and acceptance of geotextiles and geonets for geocomposites shall be completed prior to geocomposite fabrication.

Installation

The geosynthetics Installer shall handle geotextiles, geocomposites, and geonets in such a manner that they are not damaged. On slopes, the geocomposite material shall be securely anchored in the anchor trench and then rolled down the slope in such a manner as to continually

keep the geocomposite sheet in tension. In the presence of wind, geotextiles, geocomposites, and geonets shall be weighted with sandbags or the equivalent. Such sandbags shall be installed during placement and shall remain until replaced with earth cover material. Geotextiles, geonets, and geocomposites shall be cut using approved cutters only. Special care shall be taken to protect other materials from damage which could be caused by the cutting of the geotextile, geocomposite, and geonet materials. The Installer shall take any necessary precautions to prevent damage to underlying layers during placement of the geotextile, geocomposites, or the geonet. During placement of geotextile and geocomposite materials, care shall be taken not to entrap stones, sandbags, excessive dust, or moisture that could damage the geosynthetic material, clog drains or filters, or that might hamper subsequent seaming. Geotextiles and geocomposites shall not be dragged across textured geomembranes.

CQA Personnel shall visually examine the entire surface of the geotextile and geocomposite layers after installation to confirm that no potentially harmful foreign objects, such as needles, are present. In addition, the CQA Personnel may undertake a sweep of the entire geotextile surface using a metal detector, to determine the presence of any such items.

During placement of geonets, care shall be taken not to entrap dirt or excessive dust that could cause clogging of the drainage system, and stones that could damage the adjacent geomembrane. If dirt or excessive dust is entrapped in the geonet, it shall be hosed clean prior to placement of the next material on top of it. In this regard, care should be taken with the handling of sandbags, to prevent rupture or damage. Care shall be taken not to leave tools in the geonet. CQA personnel shall confirm that all geonet is covered with geotextile on the same day it is deployed.

Seams

Geotextiles shall be continuously sewn (i.e., spot sewing is not allowed) with a chain stitch.

Geotextiles shall be overlapped a minimum76 mm (three inches) prior to seaming. No horizontal seams shall be allowed on side slopes (i.e., seams shall be along, not across, the slope) provided rolls can be manufactured of sufficient length, except as part of a patch. On the landfill floor, no horizontal seam shall be less than 0.9 meter (three feet) from the toe of the slope or other area of potential stress concentrations, unless otherwise authorized. When entering and exiting a seam, the stitches shall overlap to prevent unraveling.

Any sewing shall be done using polymeric thread with chemical resistance properties equal to or exceeding those of the geotextile. The Manufacturer shall provide written certification that the thread complies with the specifications.

Adjacent geonets shall be joined according to the specifications. As a minimum, the following requirements shall be met:

- Adjacent rolls shall be overlapped by at least 100 mm (four inches);

- Overlaps shall be secured by spot welding or tying with strings, plastic fasteners, or polymer braid. Tying devices shall be white or yellow for easy inspection. Metallic devices are not allowed;

- Side edges of panels shall be spot welded or tied every 1.5 meters (five feet) along the slope and floor of the landfill, and every 150 mm (six inches) in the anchor trenches;

- End to end seams shall be spot welded or tied in two rows. Each row shall be joined at 150 mm (six inches) intervals. The rows shall be 76 mm (3 inches) apart, with joining locations staggered.

CQA Personnel shall visually examine both the geotextile and geonet seams to document that the above requirements have been met.

Repair

Holes or tears in the geotextile shall be repaired as follows. A patch made from the same geotextile shall be double seamed into place, with each seam 6.9 to 19 mm (1/4 to 3/4 inch) apart and no closer than 25 mm (1 inch) from any edge. Care shall be taken to remove any soil or other material which may have penetrated the torn geotextile.

Holes or tears in the geonet shall be repaired by placing a patch extending 0.6 meter (two feet) beyond the edges of the hole or tear. Ribs in the patch shall be parallel to ribs in the existing geonet. The patch shall be secured to the original geonet by spot welding or tying every 150 mm (six inches) using tying devices as indicated above. If the hole or tear width across the roll is more than 50 percent the width of the roll, the damaged area shall be cut out and the two portions of the geonet shall be joined as described in the specifications.

Holes, tears, or unbonded areas in geocomposites shall be repaired by first removing the damaged area. Geocomposite damage greater than 4 sq ft shall require removal of full roll width of damaged area.

CQA Personnel shall visually observe and document geotextile, geocomposite, and geonet repair procedures.

Soil Placement

Soil shall not be placed in direct contact with geonets.

The Installer shall place soil materials on top of geotextiles or geocomposites in such a manner that there is:

- no damage to the geotextile, geocomposite, or underlying layers;
- minimal slippage of the geotextile or geocomposite on the underlying layers; and
- no excess tensile stresses in the geotextile or geocomposite.

CQA Personnel shall visually observe that the above conditions are satisfied.

LCS System Equipment and Components

Electrical System and Pump Controls

The electrical system which controls the leachate pumps shall be checked for proper installation and operation. The SUBCONTRACTOR'S QC activities are described in the pertinent sections of the specifications. CQA Personnel shall perform the following activities:

- Receipt inspections of electrical components (verify UL, listings, etc.);
- Review construction subcontractor's submittals and proposed equipment to document compliance with the specifications;
- Verify and document final tagging, labeling, and marking of the electrical systems (i.e. breaker, outlets, disconnects, switches, etc.);
- Perform or review component checks of resistance, grounding, and load prior to complete system check.

Pumps, Piping, Meters, and Valves

The pumps, piping, instruments (such as the flow meters), and valves that are included in the leachate collection (removal and transfer) system shall be examined and tested at the system level for conformance to the specifications and proper performance. CQA Personnel shall perform the following activities in conjunction with these items:

- Review construction subcontractor's submittals and equipment deliveries to the site to verify conformance with the specifications;
- Review the results of subcontractor's acceptance testing of the piping system;
- Verify and document final tagging, labeling, and marking of the electrical systems (i.e. breaker, outlets, disconnects, switches, etc.);
- Review system performance checks to confirm operation in accordance with the specifications;
- Review the complete leachate removal system performance using the installed pumps as described in the specifications.

Acceptance Test Procedures

CQA Personnel will observe and record the results of the Acceptance Test Procedures (ATPs). The ATPs will be performed by the SUBCONTRACTOR to demonstrate that the installed

pumps, piping, instrumentation, and electrical system components function as intended by the design. An example ATP is included in Appendix A.

4.7.3 Post-Construction

The post-construction inspection of the LCS shall include observations to confirm that systems and components have been installed in the proper locations and according to the design drawings, Construction Specifications, and Manufacturer's specifications.

5.0 DOCUMENTATION

This section describes the documentation required during construction of ERDF Cells 7 through 10.

5.1 DAILY REPORTS

Daily reports shall be completed by each of the CQA Personnel when they are on site. CQA Personnel shall be assigned field books which will be labeled with a unique number issued by the CQA Officer. The field CQA Personnel shall record field observations and the results of field tests either in their assigned field book or on standard field data sheets. After each book is filled (or at the end of the project), the field book shall be returned to the CQA Officer and routed to the project files. CQA Officer shall keep a log of field logbooks issued, returned, and completed. Log books shall be completed and maintained in accordance with CONTRACTOR's expectations.

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

- Job Name
- Job Number
- Date
- Name
- Weather conditions
- Page number (if pages are not prenumbered)

The remaining individual entries shall 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 shall be noted in the field book.

Entries in the field book shall 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 subcontractors;

- Descriptions of areas being observed, inspected, and documented;
- Description 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, field CQA Personnel shall summarize the day's activities on a daily field monitoring report form. The field report shall include a information of the day's work activities, tests and observations that were made, descriptions of the adequacy of the work performed, and highlight any unresolved issues that must be addressed by the CQA Officer or CQA Personnel the following day. In addition, the summary report shall reference the field book number and page numbers that cover that day's activities. The summary field reports shall be turned into the CQA Officer at the end of each day.

The daily field monitoring report shall be filled out in a triplicate form. The individual initiating the report shall attach three copies of his field book notes for that day. The three copies shall be distributed as follows:

- Original shall be filed in field office.
- One copy transmitted to the ERC Quality Services Manager. (WCH)
- One copy transmitted to the project quality records in compliance with the documentation requirements of the QAPD. (WCH)

The CQA Officer shall review and initial each summary field report before distributing to the project quality records and the CONTRACTOR.

5.2 INSPECTION DATA SHEETS

Observations, results of field and laboratory tests performed on site or off site shall be recorded on an inspection data sheet. At a minimum, each inspection data sheet shall include the following information:

- Unique identifying sheet number for cross-referencing and document control;
- Description of the inspection activity;

- Location of the inspection activity and location from which the sample was obtained;
- Type of inspection activity and/or procedure used (reference to standard method when appropriate);
- Recorded observation or test data, together with necessary calculations;
- Results of the inspection activity (e.g. pass/fail) and comparison with specification requirements;
- Identification of personnel involved in the inspection activity; and
- Signature of the CQA Personnel performing the activity and concurrence by the CQA Officer.

5.3 NONCONFORMANCE REPORTING

A nonconformance is considered to be a deficiency in characteristics, documentation, or procedures that renders the quality of an item or activity unacceptable or indeterminate. If a deficiency cannot be repaired or replaced to the satisfaction of CQA Personnel within the guidelines established by this CQAP, then such a deficiency shall be considered a nonconformance and shall be documented in accordance with the CONTRACTOR NCR procedure (QA-1-1.6) and referred to the CONTRACTOR for disposition and initiation of corrective action processes. Nonconforming situations shall be brought to the attention of the CQA Officer, CQA STR, and WCH Quality Services Manager for concurrence prior to initiation of the NCR. These individuals and others as directed by the CONTRACTOR shall participate in NCR disposition, resolution, and corrective action processes. Documentation relating to NCR situations shall be retained in the project quality.

5.4 DESIGN CHANGES AND CLARIFICATIONS

Requests for changes to the specifications or drawings shall be referred to the CQA STR and initiated on Field Change Request (FCR), Field Change Notice (FCN) forms, or other form provided by the CONTRACTOR. Forms shall be completed in accordance with standard WCH procedures. Design changes shall be approved by the CONTRACTOR prior to implementation.

Requests for modifications to the CQAP shall be made by memorandum to the CONTRACTOR with copies to the CQA Officer.

If during the course of construction questions arise regarding interpretation of the plans and/or specifications, the CONTRACTOR shall be contacted by the CQA Officer. Any clarification of the drawings shall be documented by memorandum or telecon records, and routed to the SUBCONTRACTOR, CONTRACTOR. The memorandum or telecon shall also be routed to the project files for record.

5.5 PROGRESS REPORTS

The CQA Officer shall prepare a summary progress report each week, or at time intervals established at the pre-construction meeting. As a minimum, this report shall 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 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 specifications and/or drawings;
- References to the specifications or drawings defining the acceptance criteria for each inspected characteristic;
- A summary of inspection and test results, failures, and retests;
- A summary of construction situations, deficiencies, and/or defects occurring during progress reporting period;
- A summary of other problem resolutions and dispositions; and
- The signature of the CQA Officer.

5.6 FINAL DOCUMENTATION

Daily inspection summary reports, field logbooks, inspection sheets, data sheets, problem identification and corrective measures reports, acceptance reports, deviations from design and material specifications (with justifying documentation), NCRs, FCRs, FCNs, photographic records, progress reports, drawings, drawing revisions, and other documentation shall be retained as permanent project quality records in compliance with the CQA SUBCONTRACTOR's Quality Assurance Program. At the completion of the project, a final summary report that incorporates the above information, along with as-built drawings, shall be prepared by the CQA Officer and submitted to the CONTRACTOR. The as-built drawings, which will be generated by a licensed land surveyor licensed in the State of Washington and retained by the SUBCONTRACTOR, shall include scale drawings depicting depths, plan dimensions, elevations, and fill thicknesses. The report shall include documentation of each construction component monitored by CQA Personnel and shall certify that the facility was constructed in accordance with the Permitting Agency-Approved CQAP, Technical Specifications, and

Drawings. The report shall be sealed by a professional engineer registered in the State of Washington.

5.7 STORAGE OF RECORDS

During the construction of ERDF cells, the CQA Officer shall be responsible for CQA documents. This includes the CQA Officer's copy of the design criteria, plans, procedures, and specifications; the CQAP; and the originals of the data sheets and reports. Completed documents shall be routed to the project quality records in compliance with those sections of the CQA SUBCONTRACTOR's Quality Assurance Program which address project QA records management, including maintenance of a records index, access control, and duplicate records requirements. Working copies shall be retained at the field office to the extent necessary to properly support ongoing activities. Records shall be submitted to the CONTRACTOR in accordance with Exhibit I.

6.0 REFERENCES

ASTM, 2006, *2006 Annual Book of ASTM Standards*, American Society for Testing and Materials, Philadelphia, Pennsylvania

Volume 4.08: Soil and Rock:

C136 Method for Sieve Analysis of Fine and Coarse Aggregates

D422 Method for Particle-Size Analysis of Soils

D792 Test Method for Specific Gravity of Soil

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

D1004 Standard Test Method for Initial Tear Resistance (Graves Tear) of Plastic Film and Sheeting

D1140 Test Method for Amount of Material in Soils Finer than the No. 200 (0.075mm) Sieve

D1204 Test Method for Linear Dimensional Changes of Nonridgid Thermoplastic Sheeting for Film at Elevated Temperature

D1238 Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer

D1505 Standard Test Method for Density of Plastics by the Density-Gradient Technique

D1556 Density of Soil in Place by the Sand-Cone Method

D1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3) (2,700 kN-mm^3)

Dl603 Standard Test Method for Carbon Black Content in Olefin Plastics

D1777 Standard Test Method for Measuring Thickness of Textile Materials

D2167 Density and Unit Weight of Soil in Place by the Rubber Balloon Method

D2216 Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock

D2434 Test Method for Permeability of Granular Soils (Constant Head)

D2663 Standard Test Methods for Carbon Black - Dispersion in Rubber

D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

D3015 Standard Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds

D3042 Standard Test Method for Insoluble Residue in Carbonate Aggregates

D3786 Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method

D4218 Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique

D4318 Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

D4355 Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)

D4491 Standard Test Methods for Water Permeability of Geotextiles by Permittivity

D4533 Standard Test Method for Trapezoid Tearing Strength of Geotextiles

D4632 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

D4643 Standard Test Method for Determination of Water Content of Soil by the Microwave Oven Method

D4644 Test Method for Slake Durability of Shales and Similar Weak Rocks

D4716 Standard Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products

D4751 Standard Test Method for Determining Apparent Opening Size

D4833 Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

D5084 Test Method for Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

D5093 Test Method for Field Measurement of Infiltration Rate Using a Double-Ring Infiltrometer with a Sealed Inner Ring

D5199 Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes

D5261 Standard Test Method for Measuring Mass per Unit Area of Geotextiles

D5321 Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method

D5397 Evaluation of Stress Crack Resistance of Polyolefin Geomembrane Using Notched Constant Tension Load Test (Appendix A, Single Point)

D5596 Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics

D5641 Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber

D5820 Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes

D5890 Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners

D5891 Standard Test Method for Fluid Loss of Clay Mineral Component of Geosynthetic Clay Liners

D5994 Test Method for Measuring Core Thickness of Textured Geomembrane

D6392 Standard Method for Determining the Integrity of Nonreinforced Geomembane Seams Produced Using Thermo-Fusion Methods

D6693 Standard Test Method for Determining Tensile Properties of Non-reinforced Polyethylene and Non-reinforced Flexible Polyproylene Geomembranes

D7005 Determining the Bonds Strength (Ply Adhesion) of Geocomposites

GRIGM-12 Asperity Height (Asperity Measurement) of Textured Geomembranes Using a Depth Gauge

API 13A, API Specification for Oil-Well Drilling-Fluid Materials

Ecology, 1994, *Dangerous Waste Regulations*, WAC 173-303, Washington State Department of Ecology, Olympia, Washington

EPA/600/R-93/182, EPA, Technical Guidance Document, Quality Assurance and Quality Control for Waste Containment Facilities, 2nd Edition, Waste Containment Facilities, ASCE Press, 2007

EPA, 1994, *Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities*, 40 CFR 264, U.S. Environmental Protection Agency, Washington, D.C.

WAC 173 216, State Waste Discharge Permit Program

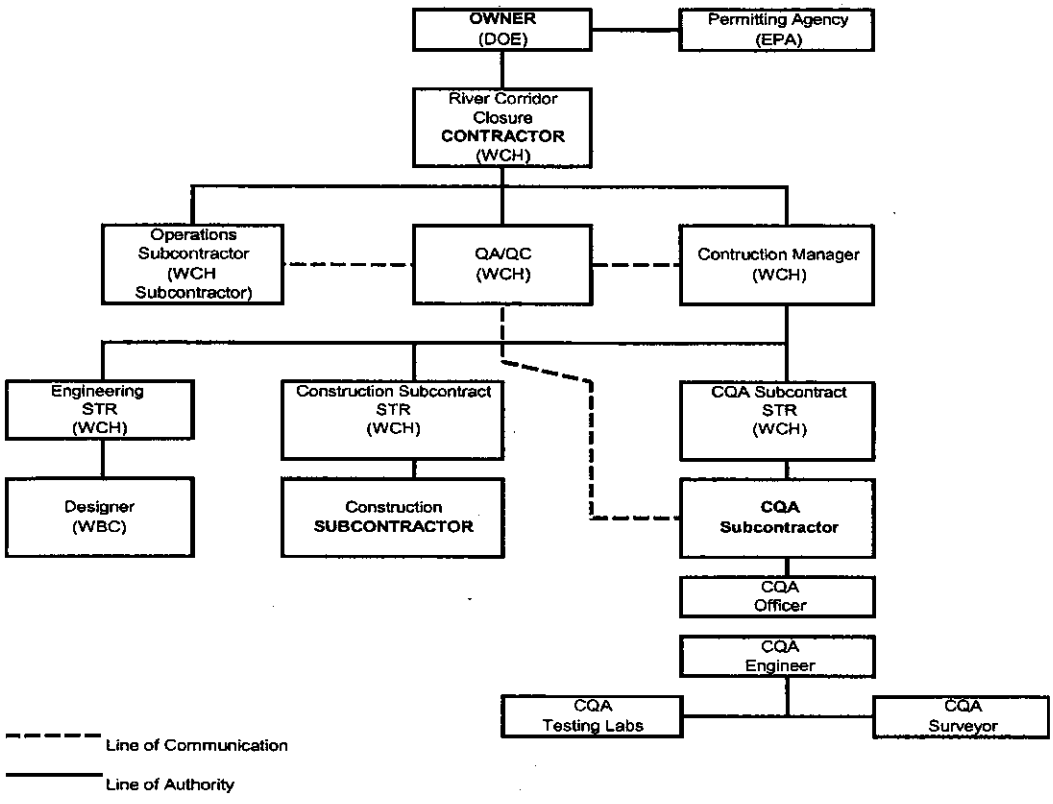
WAC 173 400, General Regulations for Air Pollution Sources

Washington DOT Standard Specification

WCH-51, *River Corridor Closure Contract Quality Assurance Program Description*, Washington Closure Hanford, LLC, Richland, Washington

FIGURES

FIGURE 1. ERDF CONSTRUCTION/QUALITY ASSURANCE ORGANIZATION



TABLES

TABLE 4-1. SOIL MINIMUM TESTING REQUIREMENTS

4-1.1 EARTHWORK

Phase	Material	Test and ASTM Number	Frequency
Pre-construction	Backfill	Grain Size Distribution (C136/D422)(1)	1 per 6,000 m^3 (7,848 cy)
		Atterberg Limits (D4318)	1 per 6,000 m^3 (7,818 cy) for soil with > 12% passing the No. 200 sieve
		Modified Proctor Compaction (D1557)	1 per 6,000 m^3 (7,848 cy)
	Subgrade(3)	In-Place Density (D2922)	1 per 900 m^3 (9,688 sf)
Construction	Fill, Roadway Top Course (2,3)	In-Place Density (D2922)	1 per 4,600 m^2 (49,514 sf) per lift
	Below Crest Pad Bldgs.(3)	In-Place Density (D2922)	2 per lift
	Vadose Zone Trench	In-Place Density (D2922)	1 per 100m (328ft) of trench

Notes:

(1) ASTM C136 shall be used when the amount of material passing the No. 200 sieve is less than 12% by weight. ASTM D422 shall be used when the fine soil fraction is greater than this value.

(2) Only applies to roadways within trench or passing over trench embankment.

(3) If ASTM D2922 is used at least one ASTM D1566 or ASTM D2167 shall be performed per shift.

4-1.2 ADMIX SOIL LINER

Phase	Material	Test and ASTM Number	Frequency
Pre-construction	Bentonite	Manufacturer's Certificates	1 per 450 metric tons (500 tons) delivered
	Admix	Recompacted Permeability (D5084)	1 per 15,000 m^3 (19,620 cy)
		Soil Density/Moisture Content Relationship (D698) and (D1557)	1 per 4,000 m^3 (5,132 cy)
		Atterberg Limits (D4318)	1 per 4,000 m^3 (5,132 cy)
		Natural Moisture Content (D2216)	1 per 800 m^3 (1,046 cy)
		Maximum Clod Size	Periodic Visual Monitoring
		Belt Scale Measurements	1 per 4,000 m^3 (5,132 cy)
	Base Soil	Particle Size Distribution/Hydrometer (D422)	1 per 8,000 m^3 (10,464 cy)
		Specific Gravity (D792)	1 per soil type
		USCS Classification (D2487)	1 per 8,000m^3 (10,464cy)
Test Fill	Admix	Visual Observation	Continuous
		In-place Moisture-Density (Nuclear, D2922)	6per lift
		In-Place Moisture-Density (Rubber Balloon, D2167) (Sand Cone, D1556)	1 per lift
		Permeability (D5084)	1 per lift
		SDRI (D5093)	1 per test fill

4-1.2 ADMIX SOIL LINER

Phase	Material	Test and ASTM Number	Frequency
Construction	Admix	In-Place Moisture-Density (Nuclear, D2922)	1 per 200 m^3 (262 cy)
		Rubber Balloon (D2167) or Sand Cone (D1556) Moisture-Density	1 per day, if nuclear gage is used.
		Shelby Tube for Permeability (D5084)	1 per 4,000 m^3 (5,232 cy), and at least 1 in a corner area
		Moisture Content (D2216 or D4643)	1 per day nuclear moisture test

4-1.3. GRAVEL DRAINAGE LAYERS

Phase	Material	Test and ASTM Number	Frequency
Pre-Construction	Borrow Source	Grain Size Distribution (C136)	1 per 4,000 m^3 (5,232 cy)
		Permeability (D2434)	1 per 4,000 m^3 (5,232 cy)
		Carbonate Content (D4373)	1 per 8,000 m^3 (10,464 cy)
		Slake Durability (D4644)	1 per 8,000 m^3 (10,464 cy)
		Standard Proctor (ASTM D698)	1 per 8,000 m^3 (10,464 cy)
Construction	Gravel, when delivered	Visual Observations	Continuous
		Grain Size Distribution (C136)	1 per 1,500 m^3 (1,962 cy)
		Permeability (D2434)	1 per 1,500 m^3 (1,962 cy)
		In-Place Density (ASTM D2922) (1)	1 per 8,000 m^3 (10,464 cy)

(1) Type B material only.

4-1.4 OPERATIONS LAYER

Phase	Material	Test and ASTM Number	Frequency
Pre-construction	Proposed Material	Grain Size Distribution (D422)	1 per 1,500 m^3 (1,962 cy)
		Standard Proctor (ASTM D698)	1 per 8,000 m^3 (10,464 cy)
Construction		Visual Observations	Continuous
		Grain Size Distribution (D422)	1 per 1,500 m^3 (1,962 cy)
		In-Place Density (D2922)	1 per 1,800 m^2 (19,375 sf)

4-1.5 ANCHOR TRENCH/SIDE SLOPE RISER PIPE TRENCH

Phase	Material	Test and ASTM Number	Frequency
Pre-Construction	Prior to backfilling	Grain Size Distribution (D422)	1 per 1,500 m^3 (1,962 cy)
Construction (1)		Visual Observations	Periodic
		Grain Size Distribution (D422)	1 per 1,500 m^3 (1,962 cy)

(1) Vadose zone trench addressed in 4.1.1

TABLE 4-2. GEOSYNTHETIC MATERIALS MINIMUM TESTING REQUIREMENTS

4-2.1. HDPE GEOMEMBRANE

Phase	Material	Test and ASTM Number	Frequency
Pre-Shipment (Before Shipping)	Resin	Manufacturer's Documentation Certification and QC Test Results	Every Lot
	Geomembrane	Manufacturing Plant Visit	During Production
		Manufacturer's Documentation, Certification and QC Test Results	Every Roll
Pre-Construction (Before Installing) (Note 1)	Geomembrane	Receiving Inspection	Every Roll
		Specific Gravity (D1505) Carbon Black Content (D1603 or D4218) Asperity Height (GRIGM-12) Tear (ASTM D1004) Melt Index (ASTM D1238) Carbon Black Dispersion (D5596) Thickness (D5199 or D5994) Yield Strength (D6693) Elongation at Yield (D6693) Break Strength (D6693) Elongation at Break (D6693) Puncture Resistance (D4833)	Every 5,000 m^2 (53,8200 sf) per Lot
		Friction Angle (Direct Shear – D5321) admix vs geomembrane	2 Tests Total
	Extrudate	Documentation and Certification	Every Resin Lot
	Installation Surface	Installer's Certification of a Suitable Installation Surface	Each Installation Surface
Construction	Geomembrane	Seam Overlap	Every Panel
		Trial Seams	Every 4 Hours per Welder per Machine
		Vacuum Test (D5641)	All Extrusion or Single Wedge Fusion Welds
		Air Pressure Test (D5820)	All Double Wedge Fusion Welds
		Seam Destructive Test (D6392) (5 peel/5 shear)	Min. Avg. of 1 per 150 m (492 ft) per Welder

4-2.2 GEOTEXTILE

Phase	Material	Test and ASTM Number	Frequency
Pre-Shipment (Before Shipping)	Geotextile and Thread	Manufacturer's Documentation, Certification, and QC Test Results	Every 5,000 m^2 (53,820 sf) per Lot
Pre-Construction (Before Installing) (Note 1)	Geotextile	Receiving Inspection	Every Roll
		Mass per Unit Area (D5261) Grab Strength (D4632) Tear Strength (D4533) Burst Strength (D3786) Puncture Strength (D4833) Thickness (D1777 or D5199) Filter Application Only Permittivity (D4491) Apparent Opening Size – AOS (D4751)	Every 5,000 m^2 (53,820 sf) per Lot

4-2.3. GEOCOMPOSITE

Phase	Material	Test and ASTM Number	Frequency
Pre-Fabrication (Before Bonding Geotextile to Geonet)	Geonet and Geotextile Components	Manufacturer's Documentation, Certification and QC Tests	Every 5,000 m^2 (53,820 sf) per Lot
		Passing Conformance Test Results for both the Geonet and the Geotextile	
Pre-Shipment (After Bonding, but Before Shipping)	Geocomposite	Manufacturer's Documentation, Certification and QC Test Results	
Pre-Construction (Note 1)	Geocomposite	Receiving Inspection	Every Roll
		Friction Angle (Direct Shear - D5321) Geocomposite vs. Textured HDPE Liner	2 Tests Total
		Friction Angle (Direct Shear - D5321) Geocomposite vs. Operations Layer	2 Tests Total
		Ply Adhesion (ASTM D7005)	Every 5,000m^2 (53,820 sf)
		Transmissivity (ASTM 4716)	

4-2.4 GEONET

Phase	Material	Test and ASTM Number	Frequency
Pre-Shipment (Before Shipping)	Geonet	Manufacturer's Documentation Certification and QC Tests	Every 5,000 m^2 (53,820 sf) per lot
Pre-Construction (Before Installing) (Note 1)	Geonet	Receiving Inspection	Every Roll
		Polymer Specific Gravity (D1505) Thickness (D1777 or D5199) Mass per Unit Area (D5261)	Every 5,000 m^2 (53,820 sf) per Lot

Notes:

1. Testing may be performed prior to shipment from factory.

TABLE 4-3. ERDF CONSTRUCTION HOLD POINTS

Phase	Activity	Hold Point	Proceed to Next Activity
Excavation	Surface	Before Covering Subject Portion with Next Layer	Passing results for density tests
			CQA review of subcontractor and CQA surveys
Soil Liner	Admix Placement	Before Placing in Cell	Passing test results for test fill and stockpiled admix
	Individual Lift or Final Surface	Before Covering Subject Portion with Next Layer	Passing results for all CQA tests and observation requirements
			CQA review of subcontractor and CQA surveys
HDPE Liner	Delivery	Before Shipping	Manufacturer's Documentation
			Acceptable Friction Angle test results vs. admix and geocomposite
	Installation	Before Installing	Passing conformance test results
		Before Covering Subject Portion with Next Layer	Installation records (CQA) review
			Visual inspection
			Seam survey data
Geotextile	Delivery	Before Shipping	Manufacturer's Documentation
	Installation	Before Installing	Passing conformance test results
		Before covering subject Portion with Next Layer	Visual Inspection of seaming
Geocomposite	Fabrication	Before Fabrication	Passing conformance test results for geotextile
			Passing conformance test results for geonet
	Delivery	Before Shipping	Manufacturer's Documentation
			Acceptable Friction Angle test results vs. HDPE liner and Operations Layer material.
	Installation	Before Installing	Passing conformance test results
		Before Covering Subject Portion with Next Layer	Visual Inspection of seaming
Drainage Gravel	Delivery	Before Shipping	Passing Pre-construction test results
	Installation	Before Covering subject Portion with Next Layer	Passing CQA test results CQA review of subcontractor and CQA surveys
Operations Layer	Installation	Before Installing	Passing CQA test results
		After Installing	CQA review of subcontractor and CQA surveys
Piping	Installation	Before Backfilling Trenches	Passing Pressure and Leak Test Results

APPENDIX A

ACCEPTANCE TEST PROCEDURES

PROJECT
ENVIRONMENTAL RESTORATION
DISPOSAL FACILITY CELLS 7 and 8

HANFORD SITE
RICHLAND, WASHINGTON

EXAMPLE ACCEPTANCE TEST PROCEDURES

Date

CONTENTS

ACCEPTANCE TEST PROCEDURE

ENVIRONMENTAL RESTORATION DISPOSAL FACILITY

1.0 PURPOSE OF THE ACCEPTANCE TEST

This acceptance test procedure (ATP) has been prepared to establish field testing procedures to demonstrate that the Electrical/Instrumentation and Piping/Mechanical systems for the Disposal Trench and Support Facilities function as intended by the design.

2.0 REFERENCE DRAWINGS AND SPECIFICATIONS

2.1 DRAWINGS

Drawing Number	Drawing Title
0600X-DD-G0026	Title, Location & Hanford Area Maps
0600X-DD-G0027	Drawing List
0600X-DD-G0028	Symbols
0600X-DD-G0029	Abbreviations
0600X-DD-C0258	Overall Site Plan
0600X-DD-C0259	Construction Limits and Fence Location Cells 7 & 8
0600X-DD-C0260	Construction Limits and Fence Location Cells 9 & 10
0600X-DD-C0261	Coordinate Table
0600X-DD-C0262	Fence Details
0600X-DD-C0263	Sign Details
0600X-DD-C0264	Reserve for Future Use
0600X-DD-C0265	Existing Topography
0600X-DD-C0266	Project Office Trailer Placement
0600X-DD-C0267	Subgrade & Cell Berm Contours – Cells 7 & 8
0600X-DD-C0268	Subgrade & Cell Berm Contours – Cells 9 & 10
0600X-DD-C0269	Subgrade Survey Control – Cells 7 & 8
0600X-DD-C0270	Subgrade Survey Control – Cells 9 & 10
0600X-DD-C0271	Admix Layer Contours – Cells 7 & 8
0600X-DD-C0272	Admix Layer Contours – Cells 9 & 10
0600X-DD-C0273	Secondary Drainage Layer Contours – Cells 7 & 8
0600X-DD-C0274	Secondary Drainage Layer Contours – Cells 9 & 10
0600X-DD-C0275	Primary Drainage Layer Contours – Cells 7 & 8
0600X-DD-C0276	Primary Drainage Layer Contours – Cells 9 & 10
0600X-DD-C0277	Operations Layer Contours – Cells 7 & 8
0600X-DD-C0278	Operations Layer Contours – Cells 9 & 10
0600X-DD-C0279	Civil Sections
0600X-DD-C0280	General Cross Sections

Drawing Number	Drawing Title
0600X-DD-C0281	Liner System Details – 1
0600X-DD-C0282	Liner System Details – 2
0600X-DD-C0283	Liner Termination Details - 1
0600X-DD-C0284	Liner Termination Details- 2
0600X-DD-C0285	Sump Layout Plan - Cell 7
0600X-DD-C0286	Sump Layout Plan - Cell 8
0600X-DD-C0287	Sump Layout Plan - Cell 9
0600X-DD-C0288	Sump Layout Plan - Cell 10
0600X-DD-C0289	Sump Details – 1
0600X-DD-C0290	Sump Details – 2
0600X-DD-C0291	In-Cell Leachate Piping Plan – Cells 7 & 8
0600X-DD-C0292	In-Cell Leachate Piping Plan – Cells 9 & 10
0600X-DD-C0293	Crest Pad Plan and Elevation
0600X-DD-C0294	Yard Piping Plan – Cells 7 & 8
0600X-DD-C0295	Yard Piping Plan – Cells 9 & 10
0600X-DD-C0296	Reserve for Details
0600X-DD-C0297	Stockpile Plans – Cells 7 & 8
0600X-DD-C0298	Stockpile Plans Cells 9 & 10
0600X-DD-C0299	Vadose Zone Monitoring System
0600X-DD-C0300	Vadose Zone Monitoring System Details
0600X-DD-C0301	Access Road Plan and Profiles
0600X-DD-C0302	Access Road Plan and Profiles
0600X-DD-C0303	Reserve for Future Details
0600X-DD-C0304	Access Blvd Details
0600X-DD-C0305	Reserve for Future Details
0600X-DD-C0306	Reserve for Future Details
0600X-DD-C0307	Reserve for Future Details
0600X-DD-C0308	Test Pits and Boring Locations
0600X-DD-C0309	Soil Boring Logs 1
0600X-DD-C0310	Soil Boring Logs 2
0600X-DD-C0311	Soil Boring Logs 3
0600X-DD-C0312	Soil Test Pit Logs 1
0600X-DD-C0313	Soil Test Pit Logs 2
0600X-DD-C0314	Reserve for Future Details
0600X-DD-C0315	Soil Test Pit Logs -3
0600X-DD-C0316	Crest Pad Bldg Structural Plans and Sections
0600X-DD-C0317	Structural Details – 1
0600X-DD-C0318	Structural Details – 2
0600X-DD-C0319	Reserve for Future Details
0600X-DD-A0014	Crest Pad Bldg – Plans and Elevations
0600X-DD-A0015	Architectural Details – 1
0600X-DD-A0016	Architectural Details – 2
0600X-DD-A0017	Finish Schedules

Drawing Number	Drawing Title
0600X-DD-E0104	Electrical Symbols
0600X-DD-E0105	Electrical Abbreviations and General Notes
0600X-DD-E0106	Electrical Details – 1
0600X-DD-E0107	Electrical Details – 2
0600X-DD-E0108	Reserve for Future Details
0600X-DD-E0109	Electrical Cable and Raceway Schedule
0600X-DD-E00110	Electrical Cable and Raceway Schedule
0600X-DD-E00111	Electrical Site Plan – Cells 7 & 8
0600X-DD-E00112	Electrical Site Plan – Cells 9 & 10
0600X-DD-E00113	Electrical One-Line Switchgear
0600X-DD-E00114	MCC One-Line Diagrams
0600X-DD-E00115	Reserved for Future Details
0600X-DD-E00116	MCC Details
0600X-DD-E00117	Electrical Schedules
0600X-DD-E00118	Control Schematics – 1
0600X-DD-E00119	Control Schematics – 2
0600X-DD-E00120	Control Schematics – 3
0600X-DD-E00121	Control Schematics – 4
0600X-DD-E00122	Control Schematics – 5
0600X-DD-E00123	Crest Pad Electrical Power Plan
0600X-DD-E00124	Crest Pad Electrical Lighting Plan
0600X-DD-M0022	Piping Details
0600X-DD-M0023	Mechanical Schedules
0600X-DD-M0024	Mechanical Details – 1
0600X-DD-M0025	Mechanical Schedules
0600X-DD-M0026	Reserve for Future Details
0600X-DD-M0027	Crest Pad Details – 1
0600X-DD-M0028	Crest Pad Details – 2
0600X-DD-M0029	Reserve for Future Details

2.2 SPECIFICATIONS

Specification Number	Specification Title
0600X-SP-G0037	Quality Control Requirements
0600X-SP-G0038	Supplier Quality Assurance Requirements
0600X-SP-A0024	Coatings & Finishes
0600X-SP-C0067	Cell Construction- Admix Layer
0600X-SP-C0068	Cell Construction- Geosynthetics
0600X-SP-C0069	Cell Construction- Leachate Collection Systems and Lysimeters
0600X-SP-C0070	Reinforced Concrete
0600X-SP-C0071	Crest Pad Building
0600X-SP-C0072	Site Work
0600X-SP-C0073	Metals
0600X-SP-E0024	Electrical Work
0600X-SP-M0029	Pipe, Valves & Specials
0600X-SP-M0030	Leachate Pumps

3.0 RESPONSIBILITIES

Each company or organization participating in the conduct of this ATP will designate personnel to assume the responsibilities and duties as defined herein for their respective roles. The names of these designees shall be provided to the Recorder for listing on the Recorder's copy of the Test Execution Sheet prior to the performance of any part of this ATP.

3.1 (CONTRACTOR) WASHINGTON CLOSURE HANFORD (WCH)

3.1.1 Designate a Test Director.

3.1.2 Act as liaison between the participants in acceptance testing.

3.1.3 Establish and distribute the testing schedule.

3.1.4 Schedule and conduct a pre-ATP meeting with test participants prior to start of testing.

3.1.5 Notify all persons performing and witnessing the test prior to the start of testing.

3.1.6 Notify all concerned parties when a change is made in the testing schedule.

3.1.7 Sign Test Execution Sheet when ATP is approved and accepted.

3.1.8 Take necessary action to clear exceptions to the ATP.

3.1.9 Sign Exception Sheet when exception has been resolved.

3.1.10 Provide a distribution list for the approved and accepted ATP.

3.2 TEST DIRECTOR

3.2.1 Coordinate acceptance testing.

3.2.2 Distribute documents including completed ATP, exceptions, resolutions and approvals.

3.2.3 Confirm that field testing and inspection of the system or portion of the system to be tested has been completed.

3.2.4 Stop any test which, in the judgment of the Director, may cause damage to the system until the test procedure has been revised.

3.2.5 Obtain revisions to the ATP, as necessary, to comply with authorized field changes or to accommodate existing field conditions.

3.2.6 Evaluate recorded data, discrepancies, and exceptions.

3.2.7 Obtain from the CONTRACTOR any information related to this ATP or changes necessary to clear or resolve objections.

3.2.8 Sign Test Execution Sheet when ATP has been completed.

3.2.9 Sign Exception Sheet when retest has been executed and accepted.

3.3 WITNESSES

Witnesses shall be provided as directed by the CONTRACTOR.

3.3.1 Witness the tests.

3.3.2 Evaluate results of testing.

3.3.3 Assist the Test Director when requested.

3.3.4 Sign Test Execution Sheet as a Witness.

3.3.5 Sign Exception Sheet as a Witness when retest has been executed and accepted.

3.4 RECORDER

The Recorder will be provided by the WCH'subcontracted Quality Assurance Engineer.

3.4.1 Prepare Test Data Forms to record ATP data and observations.

3.4.2 Record names of all designated personnel on Recorder's copy of ATP prior to start of testing.

3.4.3 Observe tests and record test data.

3.4.4 Sign the Test Execution Sheet as the Recorder.

3.4.5 On the Exception Sheet, record objections or exceptions and test activities which are not performed.

3.4.6 Orally notify the Test Director at the time an objection is made.

3.4.7 Assign page numbers to all test data sheets and Exception Sheets, after ATP is complete. Submit the completed ATP documents to the CONTRACTOR.

3.5 CONSTRUCTION SUBCONTRACTOR

3.5.1 Organize and perform this acceptance test under coordination of the Test Director.

3.5.2 Confirm that all equipment required for performing this test will be available at the start of testing.

3.5.3 Provide equipment required for performing this acceptance test, unless designated by these procedures as being supplied by others.

3.5.4 Provide lock and tag materials and personnel to perform ATP.

3.5.5 Request in writing from the CONTRACTOR those services, materials, or equipment that have been designated as being supplied by the CONTRACTOR or others.

3.5.6 Sign the Test Execution Sheet when the ATP has been completed.

3.5.7 Sign the Exception Sheet when the retest has been completed and accepted.

3.6 OCCUPATIONAL SAFETY AND HEALTH

Individuals shall carry out their assigned work in a safe manner to protect themselves and others from undue hazards and to prevent damage to property and environment. Performance of test activities shall always include safety and health aspects as delineated in the most current version

of the Federal Occupational Safety and Health Administration/Washington Industrial Safety and Health Act (OSHA/WISHA) safety health codes and standards.

4.0 ACCEPTANCE TEST PROCEDURE CHANGE CONTROL

Acceptance testing shall be conducted in accordance with the steps and requirements specified in this procedure. Any required changes must be authorized in accordance with approved change control procedures for this project and promptly accomplished. Procedure changes during testing must be approved by the CONTRACTOR, quality assurance, and the subcontracted quality assurance engineer (via initials). The recorder shall note these changes as exceptions (see Section 5.2), provided that these changes do not affect safety and health. The changes shall be noted in the final acceptance test report.

5.0 RECORDING AND RESOLVING EXCEPTIONS

5.1 GENERAL

Exceptions to the ATP are sequentially numbered and recorded on individual Exception Sheets. This enables case-by-case resolution, recording, approval, and distribution of each exception.

5.2 RECORDING

5.2.1 Number each exception sequentially as it occurs and record it on an Exception Sheet.

5.2.2 Enter name and organization of objecting party for each exception.

5.2.3 Describe the exception.

5.2.4 Record the action taken to resolve each exception. Include test results as applicable. Repeat the process as necessary until exception has been resolved.

5.2.5 When action taken results in an acceptable retest, sign and date the Exception Sheet.

6.0 TEST CONDITIONS AND EOUIPMENT REOUIRED

6.1 GENERAL

The following conditions shall exist at the start of the acceptance testing for that portion of the system being tested.

6.1.1 Systems being tested have been inspected for workmanship and for compliance with design.

6.1.2 Continuity tests have been performed on portions of the electrical system being tested.

6.1.3 Power is available to components of systems being tested.

6.1.4 Continuity tests of instrumentation wiring have been performed in accordance with the latest revision of the construction Specifications.

6.1.5 All test instruments have a valid calibration stamp attached that indicates a calibration traceable to the National Institute of Standards and Technology.

6.1.6 Personnel responsible for directing, witnessing and performing the tests described in this ATP are familiar with the equipment to be tested, have reviewed the vendor information pertaining to the operation of the equipment, and are familiar with the requirements of this acceptance test procedure.

6.1.7 Values used to simulate process inputs (such as water levels Dl, D2, D3, D4, etc. - See Figure 1) and alarm conditions for execution of ATP have been provided.

6.2 EQUIPMENT REQUIRED

The Construction SUBCONTRACTOR shall supply all test equipment unless otherwise noted. Test equipment shall include electrical equipment, pressure gages, tapes or rods, and other measuring apparatus to perform the acceptance tests. Test equipment shall have suitable range and accuracy for the parameter being measured. All ancillary equipment such as jumpers, valves, piping, and similar items shall also be provided by the Construction SUBCONTRACTOR. All test equipment shall be approved by the Test Director prior to use.

7.0 TRANSDUCERS AND METER/CONTROLLERS IN LANDFILL SUMPS

This procedure will demonstrate the correct functioning of the level transducers and the associated meter/controllers. See Figure 1 for definitions of water levels and associated pumps and relays. Verify that the level transducers have been calibrated prior to installation.

7.1 PRIMARY

7.1.1 Pump the primary sump to below the low water level Dl, Remove power to the pump in the sumps by opening the associated circuit breakers.

7.1.2 Verify that the relays associated with the high water levels (D2 and D4) in the primary sump are "off" (de-energized) and the relay associated with the low water levels (D1 and D3) in the primary sump are "on" (energized).

7.1.3 Verify pressure transducer out put in relation to foot of water head pressure. Provided table of output to feet of head.

7.1.3 Add water in increments as directed by the Test Director to primary sump via the secondary slope riser pipe. Record the volume of water added to the sump. Wait 2 minutes after each increment of water, and record the primary sump level meter reading. Verify that the primary sump level meter reading increases as water is added.

7.1.4 Continue adding water in increments and observe that the low water level relay is de-energized when the level is DS and that the high water level relay is energized when the level is DS Stop filling the sump.

8.0 LEACHATE PUMP TESTS

This procedure will demonstrate the correct functioning of the high capacity and low capacity leachate pumps and associated controls. See Figure 1 for definitions of water levels and associated pumps. For each of the leachate pumps, measure the phase currents prior to beginning pumping tests. Record this information on the top of the appropriate test data forms. Verify that motor overload devices are sized correctly.

8.1 INITIAL CONDITIONS FOR PUMP TESTS

Prior to testing pumps, verify that the relay associated with the high water levels for the leachate storage tanks is de-energized, that the valves in the manholes for the leachate piping system are open, and that any water in the manholes is below the flood switches.

8.1.1 Primary Sump

This testing should begin with water in the primary sump above level D4. Verify the following conditions on the control panel:

a. High water level relays are energized.
b. Low water level relays are de-energized.
c. Pump failure lights for the primary low capacity and high capacity submersible pumps are on.
d. The roof alarm light is on.
e. The panel lights associated with the high water relays are on, and the panel lights associated with the low water relays are off.

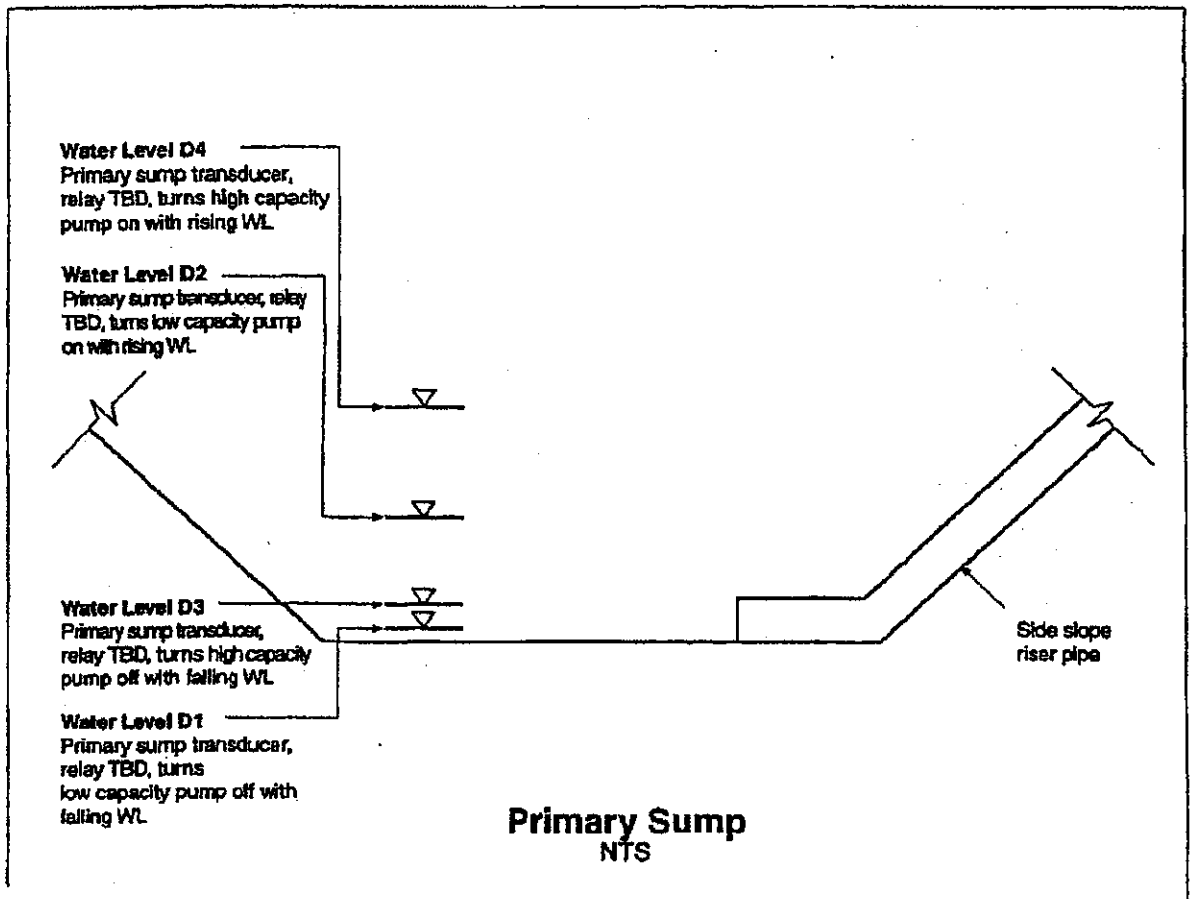


Figure 1. Water Level Definitions.

8.2 PRIMARY LEACHATE PUMPS

8.2.1 The switches on the control panel for the pumps should be in the "off" position.

8.2.2 Turn the switch for the low capacity pump to the "hand" position. Verify by observation (sight, sound, pipe vibrations, and/or transducer readings) that water is being pumped from the sump, and verify that the associated "pump run" light is on.

8.2.3 Turn the switch for the high capacity pump to the "hand" position. Verify by observation (sight. sound, pipe vibrations, and/or transducer readings) that water is being pumped from the sump, and verify that the associated "pump run" light is on.

8.2.4 Run the primary leachate pumps until the primary sump is drained below high water level D2.

8.2.5 Turn the primary leachate pump switches on the motor controller to "automatic" position. Add water to primary sump until the water reaches level D2.

8.2.6 Verify that the low capacity pump starts automatically and that the pump run light is on. Verify by observation that water is being pumped from the sump. Allow the pump to continue running in the "automatic" mode.

8.2.7 Resume or continue adding water to the primary sump until the water reaches the high capacity pump high water level (D4).

8.2.8 Verify that the high capacity pump starts automatically and that the pump run light is on. Verify by observation that water is being pumped from the sump.

8.2.9 Continue pumping both the high capacity and low capacity pumps in the automatic mode.

8.2.10 While the pumps are running, connect across the high-tank switch electrical terminals using a jumper, to simulate high water level in the storage tanks. Verify that the pumps are automatically stopped and that the roof alarm is initiated. Remove the jumper and re-initiate the automatic operation.

8.2.11 Verify that when the water level in the sump reaches low levels (water levels Dl and D3), the appropriate relays are energized, and both primary sump pumps are automatically shut off.

9.0 LEACHATE STORAGE AND TRANSFER SYSTEM

9.1 MANHOLE FLOOD ALARM SWITCHES

Demonstrate that when activated, each alarm switch will close the appropriate motor-operated valves in the manholes and will shut-off the pumps in the landfill.

9.2 FLOOD SWITCH

Demonstrate that when activated, each flood switch will close the appropriate motor- operated valve.

10.0TEST EXECUTION SHEET

TEST EXECUTION SHEET

TEST NO. _____

ITEM _____

NUMBER OF EXCEPTIONS (ATTACH) _____

SUMMARY OF EXEPTIONS, ACTIONS TAKEN, AND RESULTS: _____

_____

_____

_____

_____

_____

_____

APPROVED:

_____	_____
FDPM	Date
_____	_____
Test Director	Date
_____	_____
Witness Name / Organization	Date
_____	_____
Witness Name / Organization	Date
_____	_____
Construction Subcontractor / Organization	Date
_____	_____
Other / Organization	Date
_____	_____
Recorder / Organization	Date

11.0 EXCEPTION SHEET

EXCEPTION SHEET

EXCEPTION NUMBER. _____ SHEET _____ OF _____

DATE _____

EXCEPTIONS BY: _____
NAME

_____
ORGANIZATION

DESCRIPTION: _____

_____

_____

_____

ACTION TAKEN: _____

_____

_____

_____

APPROVED:

_____ _____
FDPM Date

_____ _____
Test Director Date

_____ _____
Witness Name / Organization Date

_____ _____
Witness Name / Organization Date

_____ _____
Construction Subcontractor / Organization Date

_____ _____
Other / Organization Date

_____ _____
Recorder / Organization Date

REVIEW COMMENT RECORD

Document Reviewed: 90% Design Analysis Variance Report (DAVR)
90% Technical Specifications (15 specifications)
90% Drawings (87 Drawings)
90% CQA Plan

Reviewers(s): Dave Einan, EPA and Rod Lobos, EPA
(Verbal comments were provided to WCH during the 8/16/07 review meeting. Comments and resolutions were documented in Meeting Minutes dated 8/23/07, CCN 136039. Electronic copies of the Meeting Minutes were provided to DOE and EPA.

Revision(s)/Rev. #: D (ref. CCN 134732) Reviewing Department: Waste Operations Engineering/Construction Review Date: August 16, 2007

Item	Reference Number (Section, Figure, Table, Page)	Comment	Comment Type		Resolution
			Major	Minor	
1	DAVR Section 4.1 Leachate Transmission Pipeline	Include the velocity and the flow capacity calculations for the liquids traveling in the leachate conveyance line.		X	Transmission pipeline flow and velocity calcs are included in Calc. No. 0600-SR-G0524-M-01 and 0600-SR-G0524-M-02.
2	DAVR Section 4.2 Leachate Pump Capacity Spec. No. 0600X-SP-M0030	> The pump size needs to be stated in the mechanical section of the DAVR. > Include pump head calculations. > The type of stainless steel used for the pumps was discussed and the recommendation was that the same type of stainless should be consistent with was used in previous cells.		X	> For "open conditions" the peak drainage was calculated to be 85 gpm. However, 140 gpm pump will be specified to keep cells 7 through 10 consistent with cells 1 through 6. The DAVR and Spec No. 0600X-SP-M0030, Section 2.2.3 were revised to specify 140-gpm pumps for the high capacity pumps. > Pump head calcs are included in Calculation No: 0600-SR-G0524-M-03. > Verified that stainless steel spec for pumps is used in Spec. No. 0600X-SP-M0030, Section 2.2.1.c was consistent with latest spec used in previous cells.
3	DAVR Calc. No. 0600-SR-G0524-M-02	The title blocks on the pages behind the Calc No. 0600-SR-G0524-M-02 cover sheet are incorrectly labeled 0600-SR-G0524-M-03.		X	The title blocks were revised to show the correct Calc. No.

REVIEW COMMENT RECORD

Item	Reference Number (Section, Figure, Table, Page)	Comment	Comment Type		Resolution
			Major	Minor	
4	DAVR Sections 1.1 Leachate Pump Design	Why referencing the IDF HELP modeling instead of referring to the DAVR for ERDF Cells 5 & 6? Specifically: > Using 18-inches of bare ground as compared to 16-inches for the evaporative zone depth. > Clarifying the use of USDA classifications in the HELP model vs. USCS classifications. > Clarifying the use of using loamy fine sand compared to sandy loam in the operations layer. > The individual who tends to the Hanford Weather Station is Ken Burk.		X	> Weaver Boos referenced the IDF HELP modeling where there was a reference to items like the installation quality in the HELP model, for instance a "good" installation is the standard practice when CQA is used on a project. Additionally, Weaver Boos tried to match the performance of the material layers specific to ERDF, and many times this translated to the same information used at IDF. An example of this is the meteorological data. Section 1.1 was revised to minimize references to IDF HELP modeling. > The HELP modeling was rerun using 16-inches for evaporative zone depth. > USDA soil types have more classifications as compared to USCS even though the material properties are generally the same. For instance a classification of SM (USCS) corresponds to a USDA classification of LS, LFS, SL, and FSL. Revised references to soil types by showing **both** USDA and USCS classifications. > For the Operations Layer, WBC selected the HELP model soil type with the "saturated hydraulic conductivity" that was similar to the field material that will be used for the Operations Layer.
5	Spec No. 0600X-SP-M0029	Specification for removing internal beads on the HDPE fusion welded pipe housing pumps or transducers was not included in the specification.		X	Removal of internal beads from HDPE fusion welded pipes on the side slopes and sumps housing pumps and transducers was added to Spec No. 0600X-SP-M0029, Section 3.2.n.

REVIEW COMMENT RECORD

Item	Reference Number (Section, Figure, Table, Page)	Comment	Comment Type		Resolution
			Major	Minor	
6	CQA Plan	Miscellaneous test revisions: > Page 13 of 0600X-QA-G0004, Section 4.1.1 first paragraph. > Page 14 of 0600X-QA-G0004, Section 4.1.2 first paragraph. > Page 25 of 0600X-QA-G0004, Section 4.6.1 last paragraph. > Page 27 of 0600X-QA-G0004, Section 4.6.1.4 second paragraph. > Page 28 of 0600X-QA-G0004, Section 4.6.2.1 third paragraph. > Page 29 of 0600X-QA-G0004, Section 4.6.2.1.1 first paragraph. > Page 33 of 0600X-QA-G0004, Section 4.6.2.2 fourth paragraph. > Page 34 of 0600X-QA-G0004, Section 4.6.2.3 last paragraph. > Page 53 of 0600X-QA-G0004, Figure 1 (this related to the addition of "CQA Officer" in the project's chain of authority/communication figure). > Page 55 of 0600X-QA-G0004, Table 4-1 (this related to English/metric conversions)		X	> The text revisions were incorporated in to the CQA Plan. > The CQA Officer was inserted between the CQA Subcontractor and the CQA Engineer on the organization chart in the CQA Plan, CQA Scope of Work, and Construction Scope of Work. > The English conversions were revised to more closely match (less rounding) the metric frequencies.
7	Electrical Drawings	EPA indicated that they would like additional time to review the one-line electrical drawings to understand the shutdown signaling process.		X	A meeting was held on August 27, 2007 with EPA, DOE, WCH, and the Electrical Engineer to review the electrical drawings Comments and and comment resolutions from this meeting are documented in the Meeting Minutes dated August 27, 2007, CCN 135405.
8	Air Monitor Relocation	Provide an updated coordinate list on the Drawings for the new location for the air monitoring stations relocated at ERDF		X	Drawing Nos. 0600X-DD-0261 and 0600X-DD-C0259 show the new coordinates.
19	Geomembrane Seams	The geomembrane shouldn't have horizontal seams on the 3:1 sideslopes.		X	Spec. No. 0600X-SP-C0068, Section 3.4.2 and the CQA Plan, Section 4.6.2.1 were revised to specify no horizontal seams on the sideslopes

WEAVER
BOOS
CONSULTANTS
LLC
GEO-ENVIRONMENTAL ENGINEERS
AND SCIENTISTS

136039

Memorandum

PROJECT NO.: 2186-351-11

DATE: **August 23, 2007**

TO: **Bill Borlaug**

CC: **Tom Kinsenwether**

FROM: **John Briest**

RE: **ERDF Cells 7 through 10 progress meeting with EPA.**

ERDF Progress Meeting Cells 7 -10, WCH contract 0600X-SC-G0524. August 16, 2007

Attendees: Owen Robertson (DOE-RL), Dave Einan (EPA), Rod Lobos (EPA), Ashur Michael (WCH), Bill Borlaug (WCH), Tom Kinsenwether (WCH), John Briest (WBC)

The meeting began with everyone introducing themselves.

- Rod began going through his comments regarding the DAVR. For the HELP model Rod questioned the references to IDF instead of referring to the DAVR for ERDF Cells 5 & 6. Specifically he had questions relating to:
  - Using 18-inches of bare ground as compared to 16-inches for the evaporative zone depth.
  - Clarifying the use of USDA classifications in the HELP model vs. USCS classifications.
  - Clarifying the use of using loamy fine sand compared to sandy loam in the operations layer.
  - The individual who tends to the Hanford Weather Station is Ken Burk.

A discussion followed regarding these questions. Specifically references to the IDF were used where there was a reference to items like the installation quality in the HELP model , for instance a "good" installation is the state of practice when CQA is used on a project. Additionally, WBC tried to match the performance of the material layers specific to ERDF, and many times this translated to the same information used at IDF. An example of this is the meteorological data. The soil types were discussed in detail. It was noted that the USDA soil types have more classifications as compared to USCS even though the material properties are generally the same.

For instance a classification of SM (USCS) corresponds to a USDA classification of LS, LFS, SL, and FSL. WBC indicated that they work to match the "saturated hydraulic conductivity" with the field material.

- Dave asked that the DAVR needs to state the pump size in the mechanical section of the DAVR. The pump will be 140 gpm (high flow). Dave also indicated that he would like to see a velocity and the flow capacity of liquids traveling in the leachate conveyance line. This information should be included in the DAVR calculations.

A discussion followed regarding the pump size. For "open conditions" the peak drainage was 85 gpm, and it was decided to keep the 140 gpm pump to keep cells 7 through 10 consistent with cells 1 through 6. Dave asked that a pump head calculation be included in the DAVR. These changes will affect Mechanical calculations M-01 and specification M0030.

The type of stainless steel used for the pumps was discussed and the recommendation was that the same type of stainless should be consistent with was used in previous cells.

Additionally the Acceptance Test Procedures document (ATP) was briefly discussed. It was noted that a draft ATP was included in the documents. The purpose of this was to give the construction subcontractor an example to use with the intent that the subcontractor would incorporate many of the additions/modifications which have occurred in Cells 1 through 6.

- Dave noted that there were two M-03 calculations.
- Dave indicated that there was no specification for bead removal on butt fused pipe in Specification M0029 and should be added.
- Dave noted the following text revisions in the SOW:
  - Page 13 of 0600X-QA-G0004, Section 4.1.1 first paragraph.
  - Page 14 of 0600X-QA-G0004, Section 4.1.2 first paragraph.
  - Page 25 of 0600X-QA-G0004, Section 4.6.1 last paragraph.
  - Page 27 of 0600X-QA-G0004, Section 4.6.1.4 second paragraph.
  - Page 28 of 0600X-QA-G0004, Section 4.6.2.1 third paragraph.
  - Page 29 of 0600X-QA-G0004, Section 4.6.2.1.1 first paragraph.
  - Page 33 of 0600X-QA-G0004, Section 4.6.2.2 fourth paragraph.
  - Page 34 of 0600X-QA-G0004, Section 4.6.2.3 last paragraph.
  - Page 53 of 0600X-QA-G0004, Figure 1 (this related to the addition of "CQA Officer" in the project's chain of authority/communication figure).
  - Page 55 of 0600X-QA-G0004, Table 4-1 (this related to English/metric conversions).

- Dave indicated that he would like to go through the one-line electrical drawings, such that he could understand the shutdown signaling process. Dave was planning on being off the week of August 20th, but indicated he was available on Monday August 27. Bill indicated he would set up a meeting with WBC's electrical engineer for that day.
- Dave asked that an updated coordinate list be inserted regarding the air monitoring stations at ERDF.
- Dave asked that no horizontal seams be on the sideslope for geomembrane. For instance the gemomembrane seams should run down the slope and not across.

REVIEW COMMENT RECORD

Document Reviewed: 90% Drawing Nos. 0600X-DD-E0118, -E0119, -E0120, -E0121, 0600X-DD-M0022, -M0027

Reviewers(s): Dave Einan, EPA
(Verbal comments were provided to WCH during 9/4/07 review meeting. Comments and resolutions were documented in Meeting Minutes dated 9/6/07, CCN 135429. Electronic copies of the Meeting Minutes were provided to DOE and EPA.

Revision(s)/Rev. #: E Reviewing Department: Waste Operations Engineering/Construction Review Date: September 4, 2007

Item	Reference Number (Section, Figure, Table, Page)	Comment	Comment Type		Resolution
			Major	Minor	
1	0600X-DD-E0118 Ladder Rungs 12, 39	Determine the purpose of the 24 HOUR TIMER on rung 39 and the "TIMER TM1" on rung 12.		X	The timer is used to send a signal to start the high capacity pump (Pump P-1) once per day. Pump P-1 will start and operate if the leachate level in the primary sump is above the shut off level for Pump P-1. Once started, Pump P-1 will pump until the leachate level in the primary sump reaches the shut off level for Pump P-1. If the leachate level in the primary sump is below the Pump P-1 shut off level, Pump P-1 will not start. The leachate levels in the sumps are determined by transducers located in the sumps. If the transducers do not operate properly, the pumps will not operate properly.
2	0600X-DD-E0118 Ladder Rungs 27, 30, 33, 47	Symbol is difficult to read to determine if TR1, TR2, TR3, and TR4 are normally open or closed. Verify that these timers are normally open.		X	Symbol was revised to be easier to read. The symbols shown for TR1, TR2, TR3, and TR4 **are normally open**.

REVIEW COMMENT RECORD

Item	Reference Number (Section, Figure, Table, Page)	Comment	Comment Type		Resolution
			Major	Minor	
3	0600X-DD-E0118 Ladder Rungs 28, 31, 34	Clarify Note 3 reference to Drawing No. 0600X-DD-E-120.		X	Drawings 0600X-DD-E0118 and 0600X-DD-E0120 were revised to clarify that the signal from the Signet Flowmeter will used to determine if leachate is being pumped and whether there is a loss of flow.
4	0600X-DD-E0118 Ladder Rungs 37, 38	"P3 FAILURE" callout should be on Ladder Rung 38 and "P2 FAILURE" callout should be on Ladder Rung 38. Correct the rung references.		X	Line number references were checked and the drawings revised to show the appropriate references and callouts.
5	0600X-DD-E0118 Ladder Rung 49	The end of this ladder rung refers back to itself (Ladder Rung 49), delete "49" and move "CR15" circuit closer to end of Rung 49.		X	Drawing was revised to incorporate the comments.
6	0600X-DD-E0118 Ladder Rung 4	The end of this ladder rung refers back to itself (Ladder Rung 49), delete "49" and move "CR15" circuit closer to end of Rung 49.		X	Drawing was revised to incorporate the comments.
7	0600X-DD-E0118 Ladder Rung 25	Ladder Rung 25 is not labeled.		X	The bottom Ladder Rung 24 (rung with the power supply) was renumbered as Rung 25.
8	0600X-DD-E0118 Ladder Rung 49A	The end of this rung references "0.5,6.5". This reference is not consistent with the rung numbering. Add Rung "A" and "6A" to the Ladder and revise end of Rung 49A to reference "A,6A".		X	Drawing was revised to incorporate the comments.
9	0600X-DD-M0022 Section B	The callout to the valve should say note 3 instead of note 4.		X	Drawing was revised to incorporate the comments.
10	0600X-DD-M0027 Detail 1	The Section A callout on the secondary riser pipe is not accurate and should be deleted.		X	Drawing was revised to incorporate the comments.

WCH Washington Closure Hanford

Meeting Minutes

135429

SUBJECT DESIGN REVIEW COMMENTS ON ERDF CELLS 7-10 ELECTRICAL DRAWINGS

TO Distribution

FROM W.A. Borlaug

DATE September 6, 2007

ATTENDEES	DISTRIBUTION
O.C. Robertson, DOE-RL, A3-04	Attendees
D.R. Einan, EPA, B1-46	A.R. Michael, H4-20
T.F. Kisenwether, H4-20	S.R. Grozescu, H4-10
W.A. Borlaug, H4-20	B.J. Howard, T2-05
	J. Laws, T2-05
	J. Briest, Weaver Boos
	R.E. Merriman, Benegas Engineering
	Document Control H4-11

A meeting on the above subject was held on September 4, 2007 (2:00 pm – 3:00 pm), at EPA's Office, Richland, WA.

Dave Einan, EPA provided comments on the leachate system control schematics (Drawing Nos. 0600X-DD-E0118, 060X-DD-E0119, 0600X-DD-E0120, and 0600X-DD-E0121) and the mechanical drawings. Follow-up actions for WCH are listed below:

A. Items Needing Clarification:

A.1 Drawing No. 0600X-DD-E0118, Ladder Rungs 12 and 39: Determine the purpose of the 24 HOUR TIMER(TM) on rung 39 and the "TIMER TM1" on rung 12.

A.2 Drawing No. 0600X-DD-E0118, Ladder Rungs 27, 30, 33, and 47: Symbol is difficult to read to determine if TR1, TR2, TR3, and TR4 are normally open or closed. Verify that these timers are normally open.

A.3 Drawing No. 0600X-DD-E0118, Ladder Rungs 28, 31, and 34: Clarify [3] reference to Drawing No. 0600X-DD-E-120.

B. Corrections to the Drawings:

B.1 Drawing No. 0600X-DD-E0118, Ladder Rungs 37 and 38: "P3 FAILURE" callout should be on Ladder Rung 38 and "P2 FAILURE" callout should be on Ladder Rung 38. Correct the rung references.

B.2 Drawing No. 0600X-DD-E0118, Ladder Rung 49: The end of this ladder rung refers back to itself (Ladder Rung 49), delete "49" and move "CR15" circuit closer to end of Rung 49.

B.3 Drawing No. 0600X-DD-E0118, Ladder Rung 4: Correct the end of the rung reference from "17,44" to "17,42".

B.4 Drawing No. 0600X-DD-E0118, Ladder Rung 25 is not shown.

B.5 Drawing No. 0600X-DD-E0118, Ladder Rung 49A: The end of this rung references "0.5,6.5". This reference is not consistent with the rung numbering. Add Rung "A" and "6A" to the Ladder and revise end of Rung 49A to reference "A,6A".

B.6 Drawing No. 0600X-DD-M0022, Section B: The callout to the valve should say note 3 instead of note 4.

B.7 Drawing No. 0600X-DD-M0027, Detail 1: The Section A callout on the secondary riser pipe is not accurate and should be deleted.

WCH Responses:

A.1 Drawing No. 0600X-DD-E0118, the timer is used to send a signal to start the high capacity pump (Pump P-1) once per day. Pump P-1 will start and operate if the leachate level in the primary sump is above the shut off level for Pump P-1. Once started, Pump P-1 will pump until the leachate level in the primary sump reaches the shut off level for Pump P-1. If the leachate level in the primary sump is below the Pump P-1 shut off level, Pump P-1 will not start. The leachate levels in the sumps are determined by transducers located in the sumps. If the transducers do not operate properly, the pumps will not operate properly.

A.2 Drawing No. 0600X-DD-E0118, Ladder Rungs 27, 30, 33, and 47: The symbols shown for TR1, TR2, TR3, and TR4 **are normally open**.

A.3 Drawings 0600X-DD-E0118 and 0600X-DD-E0120 will be revised to clarify that the signal from the Signet Flowmeter will used to determine if leachate is being pumped and whether there is a loss of flow.

B.1 Line number references will be checked and the drawings revised to incorporate revisions.

B.2 Drawing will be revised to incorporate the comments.

B.3 Drawing will be revised to incorporate the comments.

B.4 Drawing No. 0600X-DD-E0118, the bottom Ladder Rung 24 (rung with the power supply) will be renumbered as Rung 25.

B.5 Drawing will be revised to incorporate the comments.

B.6 Drawing will be revised to incorporate the comments.

B.7 Drawing will be revised to incorporate the comments.

Responses continued:

A.2 Low Flow or Loss of Flow shall trigger illumination of an alarm light and shall shut off the pump. Drawing 0600X-DD-E0118 will be revised to include this control.

A.3 The "Current Alarm" callout describes the electronic instrument used compare the current delivered by the transducers and then set the points to start and stop the pumps. Cells 1&2 use current meters. Cells 3&4 and 5&6 use an analog input module connected to a PLC to compare the current delivered by the transducers. The PLC is used to program the start and stop points for the pumps. Drawing 0600X-DD-E0118 will be revised to remove the current alarm callout.

B.1 Line number references will be checked and the drawings revised to incorporate revisions.

B.2 Drawing will be revised to incorporate the comments.

B.3 Drawing will be revised to incorporate the comments.

B.4 Drawing will be revised to incorporate the comments.

REVIEW COMMENT RECORD

Dave Einan, EPA
(Verbal comments were provided to WCH during 8/2707 review meeting. Comments and resolutions were documented in Meeting Minutes dated 8/27/07, CCN 135405. Electronic copies of the Meeting Minutes were provided to DOE and EPA.

Document Reviewed: 90% Drawing Nos. 0600X-DD-E0118, -E0119, -E0120, -E0121
90% Specification No. 0600X-SP-E0024

Reviewers(s):

Revision(s)/Rev. #: D (ref. CCN 134732) Reviewing Department: Waste Operations Engineering/Construction Review Date: August 27, 2007

Item	Reference Number (Section, Figure, Table, Page)	Comment	Comment Type		Resolution
			Major	Minor	
1	0600X-SP-E0024	Leachate pump start/stop levels and basis for selecting level set points		X	The pumps specified for Cells 7-10 match the pump head and capacities specified for Cells 5&6. The pump start/stop levels were set to match Cells 5&6. A table and figure were added to Specification No. 0600X-SP-E0024 to specify pump start/stop levels.
2	0600X-DD-E0118	Low Flow/Loss of Flow actions (i.e. illuminate warning light, shut off pump)		X	Drawing 0600X-DD-E0118 was revised to trigger illumination of an alarm light and shut off the pump for Low Flow or Loss of Flow.
3	0600X-DD-E0118	"Current Alarm" callout on leachate level primary sump low capacity pump controller		X	The "Current Alarm" callout describes the electronic instrument used compare the current delivered by the transducers and set the levels to start and stop the leachate pumps. Cells 1&2 use current meters. Cells 3&4 and 5&6 use an analog input module connected to a PLC to compare the current delivered by the transducers. The PLC is used to program the start and stop points for the pumps. Drawing 0600X-DD-E0118 was revised to remove the current alarm callout.

REVIEW COMMENT RECORD

Item	Reference Number (Section, Figure, Table, Page)	Comment	Comment Type		Resolution
			Major	Minor	
4	0600X-DD-E0118	Check line number references on schematic ladders		X	Line number references were checked and the drawings revised to incorporate revisions.
5	0600X-DD-E0118	Callout for note 3 on ladder line Nos. 31 and 34 should match the callout shown under NOTES		X	Drawing was revised to incorporate the comments.
6	0600X-DD-E0119	Add nameplate call out no. (12) for data logger on the Trench Control Panel		X	Drawing was revised to incorporate the comments.
7	0600X-DD-E0119	Add name plate no. 13 to the NAMEPLATE SCHEDULE		X	Drawing was revised to incorporate the comments.

WCH Washington Closure Hanford

Meeting Minutes

135405

SUBJECT DESIGN REVIEW COMMENTS ON ERDF CELLS 7-10 ELECTRICAL DRAWINGS

TO Distribution

FROM W.A. Borlaug

DATE August 27, 2007

ATTENDEES	DISTRIBUTION
O.C. Robertson, DOE-RL	Attendees
D.R. Einan, EPA	A.R. Michael, H4-20
R.E. Merriman, Benegas Engineering	S.R. Grozescu, H4-10
T.F. Kisenwether, H4-20	B.J. Howard, T2-05
W.A. Borlaug, H4-20	J. Laws, T2-05
	Document Control H4-11

A meeting on the above subject was held on August ~~21~~ 27, 2007 (2:00 pm – 3:30 pm), at WCH's Office, 2620 Fermi, Conf. Room D200.

The leachate system control schematics (Drawing Nos. 0600X-DD-E0118, 060X-DD-E0119, 0600X-DD-E0120, and 0600X-DD-E0121) were reviewed by the attendees to verify system alarms and pump interlocks. Follow-up actions for WCH are listed below:

A. Items Needing Clarification

A.1 Leachate pump start/stop levels and basis for selecting level set points

A.2 Low Flow/Loss of Flow actions (i.e. illuminate warning light, shut off pump)

A.3 "Current Alarm" callout on leachate level primary sump low capacity pump controller

B. Corrections to the Drawings:

B.1 Check line number references on schematic ladders (0600X-DD-E0118)

B.2 Callout for note 3 on ladder line Nos. 31 and 34 should match the callout shown under NOTES (0600X-DD-E0118)

B.3 Add nameplate call out no. (12) for data logger on the Trench Control Panel (0600X-DD-E0119)

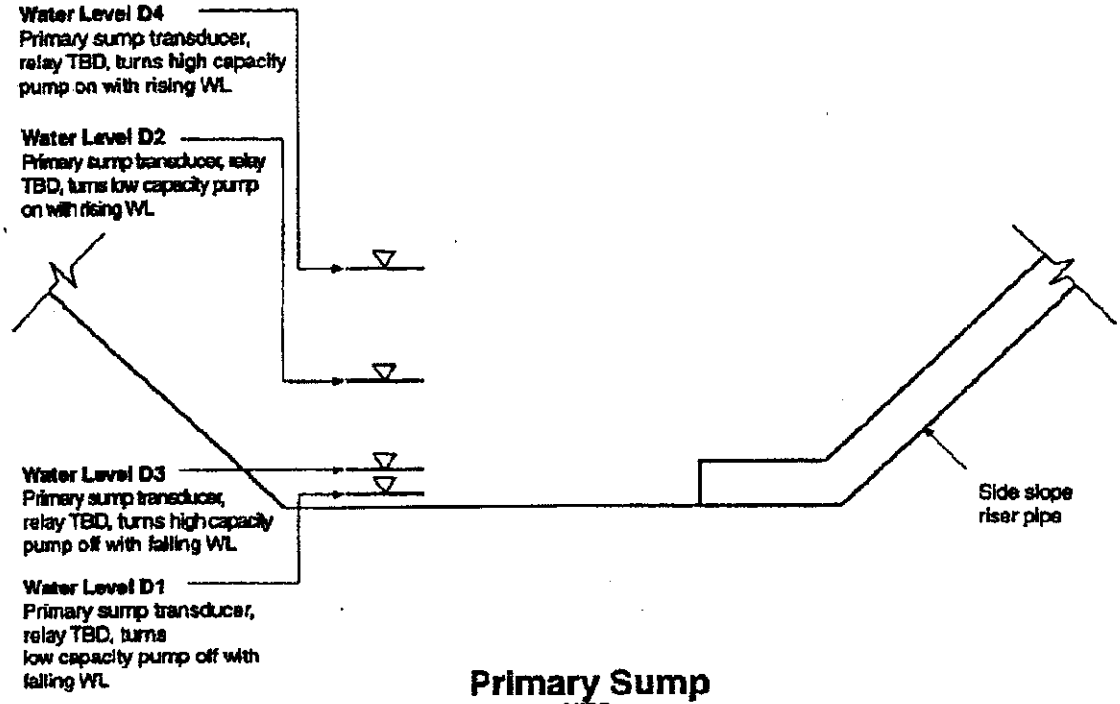
B.4 Add name plate no. 13 to the NAMEPLATE SCHEDULE (0600X-DD-E0119)

WCH Responses:

A.1 The pumps specified for Cells 7-10 match the pump head and capacities specified for Cells 5&6. The pump start/stop levels will be set to match Cells 5&6. The following table and figure were added to Specification No. 0600X-SP-E0024:

Responses continued:

Pump ID	Description	Function	Water Level	Level Above Sump Floor (ft)
Pump-1	Primary Sump High Capacity Pump	Pump Start	D4	2.00
Pump-1	Primary Sump High Capacity Pump	Pump Stop	D3	1.20
Pump-2	Primary Sump Low Capacity Pump	Pump Start	D2	1.30
Pump-2	Primary Sump Low Capacity Pump	Pump Stop	D1	0.80
Pump-2	Secondary Sump Low Capacity Pump	Pump Start	D2	1.30
Pump-2	Secondary Sump Low Capacity Pump	Pump Stop	D1	0.80



Primary Sump
NTS

Guidance for setting the levels is explained in the Design Concepts for Operations of the Environmental Restoration Disposal Facility, March 1996 (CCN 028840):

- D1 – Low Capacity Pump Stop: Level is based on minimum water level required for normal pump operation.
- D3 –High Capacity Pump Stop: Level is based on guidance to stop at a point when the low capacity pump can handle flow, assumed to be below the start point of low capacity pump.
- D2 - Low Capacity Pump Start: Guidance recommends 0.9 feet. However, operational requirement to minimize unnecessary cycling (start at 0.9' and stop at 0.8') sets the level to ~1.3 feet.
- D4 - High Capacity Pump Start: Level is based on recommended start range 1.5 feet to 6.0 feet and unnecessary cycling.

Responses continued:

A.2 Low Flow or Loss of Flow shall trigger illumination of an alarm light and shall shut off the pump. Drawing 0600X-DD-E0118 will be revised to include this control.

A.3 The "Current Alarm" callout describes the electronic instrument used compare the current delivered by the transducers and then set the points to start and stop the pumps. Cells 1&2 use current meters. Cells 3&4 and 5&6 use an analog input module connected to a PLC to compare the current delivered by the transducers. The PLC is used to program the start and stop points for the pumps. Drawing 0600X-DD-E0118 will be revised to remove the current alarm callout.

B.1 Line number references will be checked and the drawings revised to incorporate revisions.

B.2 Drawing will be revised to incorporate the comments.

B.3 Drawing will be revised to incorporate the comments.

B.4 Drawing will be revised to incorporate the comments.