

APPENDIX I

**FEDERAL CELL FACILITY CONSTRUCTION QUALITY ASSURANCE / QUALITY
CONTROL MANUAL**

FEDERAL CELL CQA/QC MANUAL
TABLE 1 – CQA/QC ACTIVITIES

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WORK ELEMENT - DOCUMENT CONTROL**



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
1) SCOPE: This work element applies to all construction activities in the Federal Cell embankment.		
2) QC DOCUMENTATION APPROVAL: QC documentation shall be approved/rejected by the QC Supervisor and submitted to Quality Assurance.	Sign the reports indicating documentation is adequate, correct, and has been accepted by QC. Provide QA with copies of the documentation and obtain their signature on the documentation indicating QA acceptance. Ensure that corrective actions required by QA personnel are accomplished.	Review the documentation generated by QC. Report deficiencies to the QC Supervisor and Quality Assurance. Verify that corrective action has been taken (where required) and recorded on the QC documentation. Countersign reports indicating documentation is adequate, correct, and has been accepted by QA. Record findings on the Daily Quality Assurance Report.
3) QC DOCUMENTATION FILES: Original QC documents shall be maintained. A copy shall be saved into the electronic database.	After the QC documentation has been accepted by QA, a copy of the original shall be saved into the electronic database.	Periodically review the electronic database to ensure the correct documentation is being saved.
4) QA DOCUMENTATION FILES: Original QA documents shall be maintained. A copy shall be saved into the electronic database.	None	

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SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>5) SCOPE: This work element applies to the Federal Cell embankment.</p>		
<p>6) RUNON CONTROL DURING PROJECT: The perimeter berms shall be constructed to a minimum of three feet above the ground elevations (GL) shown in the engineering drawings. Berm material will be as specified in Specification 33. The first lift of material shall have an uncompacted thickness of no greater than 12 inches. There is no lift thickness specification for subsequent lifts. Elevations for the berms between the specified ground elevations shall be linearly interpreted between the shown elevations. The berms shall be a minimum of four feet wide at the top and shall be compacted to a minimum of 90 percent of a standard Proctor.</p>	<p>Verify that the required berms have been constructed to the specified dimension. Record any findings on the Daily Construction Report. Conduct laboratory classification (ASTM D2487) and Standard Proctor tests (ASTM D698) at a rate of one test per 5,000 linear feet of berm, with a minimum of one test per berm. Conduct one density test per 300 linear feet of the first lift and subsequent lifts of the berm to ensure that it meets specifications. Record density tests on the Field Density Test form.</p>	<p>Verify that berms have been tested and inspected by QC personnel and that appropriate density test have been conducted.</p>
<p>7) RUNOFF CONTROL DURING PROJECT: Berms shall be constructed around the outside Perimeter of waste placement areas to a height of three feet. This height is measured as the elevation above the as-built elevation of the liner protective cover. Berms shall be a minimum of three feet wide at the top. Berm material will be as specified in Specification 33. The first lift of material shall have an uncompacted thickness of no greater than 12 inches. There is no lift thickness specification for subsequent lifts. The berm will be constructed on top of the clay liner such that the berm is not in contact with native ground. The berm shall be constructed directly on top of clay liner or liner protective cover that has been compacted to at least 90 percent of a standard Proctor. A minimum distance of 10 feet shall be maintained between the toe of the berm and the toe of the waste. The berms shall be compacted to a minimum of 90 percent of a standard Proctor.</p>	<p>Verify that the required berms have been constructed to the specified dimension. Record any findings on the Daily Construction Report. Conduct laboratory classification (ASTM D2487) and Standard Proctor tests (ASTM D698) at a rate of one test per 5,000 linear feet of berm, with a minimum of one test per berm. Conduct one density test per 300 linear feet of the first lift and subsequent lifts of the berm to ensure that the specification is met. Record density tests on the Field Density Test form.</p>	<p>Verify that the berms have been tested and inspected to the correct criteria by QC personnel.</p> <p>Review documentation to verify that the weekly access ramp inspections have been performed.</p>

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Contact water shall be controlled inside the runoff control berm system. Contact water is defined as any storm water that falls within the runoff berm system in the active, unfinished portions of the embankment. Access ramps that cross runoff berms shall be constructed and maintained to prevent such runoff from leaving the lined portion of the embankment.

Storm runoff for up to a 10-year, 24-hour event that runs off from those portions of the embankment that have been completed to final cover design shall be managed and controlled to prevent such runoff from contacting contaminated waste material in the active unfinished portions of the embankment.

After the first lift of radon barrier material for an entire side slope area (i.e., from the toe of waste to the side slope breakover) has been pushed out to the design lift thickness the adjacent runoff berm for that side slope area may be removed. During placement of this first lift of radon barrier, there is no minimum offset to the runoff berm.

- 8) **MONTHLY BERM INSPECTION:** The berms are to be inspected monthly. Inspect for obvious damage to berms. Ensure berm height where roads cross berms.

Inspect the access ramps that cross runoff berms on a weekly basis for the presence of runoff control channels and document the inspection on the Daily Construction Report.

Inspect the berm on a monthly basis and document the inspection and any corrective actions taken (if required) on the Daily Construction Report. Marker posts indicating the required berm height should be placed at both sides of a road at the point where the road crosses the berm. This is to aid in identifying damage to the berm due to road traffic. Notify the Project Manager and review documentation to verify any noted damage and required repairs. After repairs are completed, re-inspect the berm. Continue this process until the berm meets specification.

Verify that the monthly berm inspections have been performed and properly documented. Verify proper installation of marker posts.

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<p>9) BERM MAINTENANCE: The runoff and runoff berms shall be surveyed and improved, as required, by September 1 of each year.</p> <p>To insure the minimum runoff berm height is maintained (per Specification 7), inspect and survey waste offsets (area between the toe of runoff berms and the toe of waste slopes), and remove any accumulated sediment, waste and/or soil materials, as required, by September 1 of each year.</p>	<p>Survey the berms at 100 foot intervals and key points (i.e., changes in direction of the berm). Notify the operations Manager of any noted damage and required repairs. After repairs are completed, re-inspect the berm. Continue this process until the berm meets specification.</p> <p>Inspect and survey the runoff berms and waste offsets at 100 foot intervals and key points (i.e., changes in direction). This can be performed in conjunction with the annual berm survey. Notify the Operations Manager of areas requiring removal of accumulated materials (cleaning). After cleaning is completed, re-inspect and re-survey, as needed, the waste offset(s). Continue this process until the runoff berms/waste offsets meet specification.</p>	<p>Verify that the berms are surveyed and improved, as required.</p> <p>Verify that waste offsets are inspected, surveyed and cleaned, as required.</p>
<p>10) MOVING OR BREACHING A RUNOFF CONTROL BERM: When moving or breaching a berm, the work must be authorized by the QC Supervisor prior to commencing work. A temporary breach of a berm may be accomplished without a temporary berm, provided the work is expected to be completed and the berm replaced the same day. A temporary berm will be designed to ensure runoff is contained within the cell and approved by the Engineering Manager.</p> <p>A berm may be partially or completely breached during cover construction (e.g., one or more of the requirements in the Runoff Control During Project specification above is no longer met) as long as runoff control is maintained from potentially contaminated areas to clean areas as approved by the Engineering Manager.</p>	<p>Review the work to be performed. Document the approval to move or breach a berm on the Breach of Berm form.</p> <p>Ensure runoff control is maintained to prevent potentially contaminated liquids running into clean areas and document on the Daily Construction Report.</p>	<p>Verify that the approval to move or breach a berm has been properly documented on the Breach of Berm form.</p> <p>Review Daily Construction Reports to ensure proper documentation.</p>
<p>11) NUCLEAR DENSITY/MOISTURE GAUGE CALIBRATION: Each nuclear density gauge shall have current calibration, performed in accordance with the manufacturer's specifications,</p>	<p>Check calibration labels to ensure equipment is calibrated prior to using.</p>	

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prior to use on the project.

12) SAMPLING LOCATIONS FOR LOTS: For sample locations chosen by random numbers, two random numbers shall be employed. The first number (X) shall be between zero and the largest east-west distance of the lot. The second number (Y) shall be between zero and the largest north-south distance of the lot. The test location will be located at X feet east and Y feet south of the north-west corner of the lot. For a linear lot (e.g. the intersection of lifts), a single random number shall be generated.

Generate random numbers for each lot by using a calculator or computer with a random number generator. Locate the test location within five feet of the location specified by the random numbers. If the sample location is outside the lot, generate two new random numbers.

Verify that the test sample locations are being chosen by random number.

13) TEST METHODS: All tests shall be performed in accordance with the test methods specified in Appendix B.

14) QA AUDITING: EnergySolutions shall contract with an independent firm to perform an annual audit of the CQA/QC program. The auditor shall:

Schedule times with the QA auditor to observe the specified testing. Cooperate with QA auditor in the review of QC documentation.

Cooperate with QA auditor in the review of QC documentation. Verify that a copy of the report has been submitted to the Director.

A. audit at least 15 percent of the CQA\QC documentation; and

B. observe QC procedures for field density/moisture tests, classification tests, Proctors, permeability tests, and surveying.

The audits must be coordinated so that field activities are audited. Each audit shall include observations of field activities that occur while the auditor is on-site. A copy of the auditor's report shall be submitted to the Director of the Division of Waste Management and Radiation Control (Director).

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<p>15) TEST FAILURE PROTOCOL: Unless otherwise specified in this Manual, any failing test shall be addressed as follows:</p> <ul style="list-style-type: none"> A. Document the failing test result in applicable QC records. B. Notify construction personnel of the failing test result and re-work as needed. C. After re-work is complete, re-test and document results. D. If the re-test results pass, approve the work. E. If the re-test results fail, require further re-work until passing results are achieved. F. Any circumstance where re-work is not desired or possible shall be documented on a Nonconformance Report (NCR). Any circumstance addressed via NCR in accordance with this specification requires Director notification and written approval prior to proceeding. The Director approval shall be obtained in accordance with Specification 23. 	<p>Document all failing tests and corrective actions for those failures. When applicable, obtain documentation of Director notification.</p>	<p>Ensure documentation is present for all failed tests. Review documentation and corrective actions. Notify Director as required. Provide QC with documentation of the Director notification.</p>
<p>16) QUALITY OF ROCK: Applies to the following cover materials.</p> <p>Federal Cell: Type A Filter Zone Rock, Type B Filter Zone Rock, Type A Rip Rap and Type B Rip Rap.</p> <p>The rock shall have a "Rock Quality" score of at least 50 based on the following tests: Specific Gravity (ASTM C128), Absorption (ASTM C127),</p>	<p>As described in NUREG-1623, Appendix F, perform at least one petrographic examination for each rock source prior to use in accordance with ASTM C295. If a combination of limestone, sandstone, and igneous rock is found for a source, percentages of each type of material shall be determined for scoring.</p> <p>Perform Na soundness, LA abrasion, absorption, and specific gravity testing at a rate of one set of tests per 10,000 cubic yards of rock with a minimum of four tests</p>	<p>Verify the frequency of laboratory quality control tests and compliance of test results.</p>

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Sodium Soundness (ASTM C88), and L.A. Abrasion (ASTM C131 or ASTM C535). The procedures for scoring "Rock Quality" are found in Appendix C

per embankment. Samples may be collected at the source location or from onsite stockpiles. Record the location of all collected samples in the Sampling Log.

17) QC PROCEDURES: Quality Control procedures to perform the actions described in this Manual are designated CL-QC-PR and maintained by document control. Other QC procedures are described in designated ASTM tests.

18) PRE-CONSTRUCTION DOCUMENTATION & COMMUNICATION: Prior to each construction phase, and at the beginning of each construction season for ongoing phases, construction personnel will review construction phase-specific drawings, specifications, and procedures. A pre-construction meeting will also discuss key personnel and requirements for the construction phase. The Director shall be invited 48 hours in advance to a pre-construction meeting. The construction phase-specific drawings shall be submitted to the Director in accordance with Specification 23 for review and approval at least 30 calendar days prior to construction.

Obtain documentation confirming that the construction phase-specific drawings have been approved by the Director.

Verify that the construction phase-specific drawings have been provided to the Director at least 30 calendar days prior to construction. Provide QC with documentation of Director approval.

As waste placement is ongoing, this pre-construction documentation & communication section is not applicable to waste placement. Waste placement will be completed in accordance with this Manual and approved engineering drawings listed in Groundwater Quality Discharge Permit UGW450005.

19) PROJECT MANAGER: The Project Manager shall be designated at the beginning of each construction phase. If not designated or not

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available, the Engineering Manager shall assume the role of the Project Manager.

20) NATIVE MATERIAL: Natural soil from areas surrounding the Clive Facility. Native material may be used as fill during waste placement or in the construction of liner and cover provided the material meets project specific specifications.

21) OFF-SITE FILL/BACKFILL MATERIAL: Fill or backfill material may consist of licensed waste, native material, or other materials from off-site sources.

Fill or backfill material from off-site sources shall conform to the following requirements:

- A. It shall consist of only natural soil and rock.
- B. It shall not exceed the Exempt limit of UAC R313-19-13(2)(a)(i)(B).
- C. It shall not contain any of the following:
 - 1. Biodegradable materials.
 - 2. Hazardous waste, including but not limited to listed or characteristic waste.
 - 3. Material regulated by any other State or Federal regulatory program.
- D. It shall only be used in the fill and waste portions of the Federal Cell embankment.
- E. The following records shall be maintained:
 - 1. The identity / location of the source(s) of the material.
 - 2. The volume and weight of the material.

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3. Documentation that the material meets the prohibitions of Specification 21.C.

22) **DIRECTOR EXEMPTION:** Any requirement within this Manual may be exempted by the Director of the Division of Waste Management and Radiation Control. Exemptions will be confirmed in writing.

23) **DIRECTOR NOTIFICATION AND APPROVAL:** EnergySolutions shall simultaneously copy the DWMRC, LLRW Section Manager on all Director notifications within this Manual. Unless otherwise stated in the specification all notifications will be in the form of a letter.

Request for Approval

EnergySolutions shall obtain Director approval for various work tasks included in this CQA/QC Manual. The pertinent specifications will state the scope and timeframe needed for Director's approval or denial.

A written Request for Approval (RFA) shall be submitted by EnergySolutions for work tasks requiring Director approval. Email is an acceptable form of submission for RFA matters, including responses by the Division. The RFA along with supporting documentation shall be sent to the Director, with simultaneous copies sent to the LLRW Section Manager and assigned staff. The heading of the RFA shall include a reference to the Specification number, the response timeframe goal (in State business days), and a description of the activity requiring approval. Additional details of the work activity, including the basis for the requested action shall be included in the body of the

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RFA. The response timeframes included in this CQA/QC manual are goals for Division responses to RFAs. The Division recognizes the importance of timely responses to specific RFA matters. The Director agrees to make reasonable efforts to respond to RFAs on or before the specified timeframes. Director approval of RFA matters is not automatic. If staff has not responded within the timeframe goal, or if other circumstances exist that require the need of urgent attention, EnergySolutions may escalate the matter to the LLRW Section Manager. If the LLRW Section Manager is not responsive, EnergySolutions may escalate the matter to the Director.

Designee for Director

For purposes of this CQA/QC Manual, EnergySolutions may treat an email or letter signed by Section Staff in response to a specific RFA as constituting formal Director approval.

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WORK ELEMENT - FOUNDATION PREPARATION**



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>24) SCOPE: This work element applies to the Federal Cell embankment.</p>		
<p>25) CLEARING AND GRUBBING: Remove vegetation, debris, organic, or deleterious material from areas to be excavated for construction of cells. Grubbing depth will depend on the type of vegetation, debris, organic, or deleterious material on the site. If the area is free of these materials then no clearing and grubbing will be necessary.</p>	<p>Inspect the area once clearing and grubbing has been completed. Record observations and corrective actions (where required) on the Daily Construction Report.</p>	<p>Verify and document that the clearing and grubbing has been inspected by QC.</p>
<p>26) EXCAVATION: Excavation shall be made to the lines, grades, and dimensions prescribed in the approved construction phase-specific drawings. Any over excavation shall be backfilled with native materials and compacted to 95 percent of Standard Proctor. The uncompacted lift thickness shall not exceed nine inches.</p>	<p>Observe the cell excavation. Record observations and corrective actions taken (where required) on the Daily Construction Report.</p> <p>In areas of over excavation, conduct in-place density tests of backfill at a rate of one test per lot and record the results on the Field Density Test form. A lot is defined as a maximum of 10,000 square feet of a lift of a specified type of material. Test locations shall be chosen on the basis of random numbers (described in Specification 12).</p> <ol style="list-style-type: none"> a. Approve lots which meet the specified compaction. b. Rework and retest lots not meeting the specified compaction. <p>Proctors shall be performed at a rate of one test per 100,000 square feet for each material type. At least one proctor shall be performed for each material type. Record the location of the sample on the Sampling Log.</p>	<p>Observe QC personnel to ensure that the tests and observations are being performed correctly. Verify that the tests are being performed at the correct frequency and that the documentation is being completed correctly.</p>
<p>27) SCARIFICATION AND COMPACTION: The foundation shall consist of either:</p> <ol style="list-style-type: none"> A. For in-situ sands: Inspect the surface for cracks. If cracking of the surface is 	<p>Inspect and verify the foundation meets the compaction specifications. Record observations and corrective actions on the Daily QC Report.</p> <p>Conduct in-place density tests at a rate of one test per lot and record the results on the Field Density Test form. A</p>	<p>Observe QC personnel to ensure that the tests and observations are being performed correctly. Verify that the tests are being performed at the correct frequency and that the documentation is being completed correctly.</p>

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<p>observed, then scarify the in-situ sands and compact to at least 95 percent of a Standard Proctor. If no cracking is observed, then scarification is not necessary prior to compacting to at least 95 percent of a Standard Proctor.</p> <p>B. For in-situ non-sandy soil: Scarify the in-situ soils to at least six inches and compact it to at least 95 percent of a Standard Proctor.</p>	<p>lot is defined as a maximum of 10,000 square feet of a lift of a specified type of material. Test locations shall be chosen on the basis of random numbers (described in Specification 12).</p>	
<p>28) FINAL GRADING: The foundation surface shall be smooth-drum rolled prior to clay liner placement. The foundation shall be free from surface debris, soft (wet) spots greater than three inches deep, and loose soil areas with a loose surface greater than three inches deep. Foundation shall be at or below design elevation.</p>	<p>Proctors shall be performed at a rate of one test per 100,000 square feet for each material type. At least one proctor shall be performed for each material type. Record the location of the sample on the Sampling Log.</p> <p>Survey the foundation on a 50 foot grid and at key points (i.e. embankment break lines). Final survey measurements will be documented and provided to the QC Supervisor and Quality Assurance.</p>	<p>Review the final survey data. Verify the frequency of the survey points.</p>
<p>29) UNSUITABLE MATERIAL: Remove unsuitable material as required. Unsuitable material is non-soil material or soil which cannot be reworked to meet the compaction criteria.</p>	<p>Define areas of unsuitable material and notify the Project Manager that such areas must be removed. Observe the areas once the unsuitable material has been removed. Report corrective actions (where required) on the Daily Construction Report.</p>	<p>Verify that the removal of unsuitable material has been properly documented.</p>
<p>30) FOUNDATION APPROVAL: Foundation areas shall be approved by the Engineering Manager (or designee). Prior to covering, the Engineering Manager (or designee) shall prepare a "Notice of Acceptance" indicating that the foundation areas meet the required specifications.</p> <p>The Engineering Manager may delegate Engineering Manager duties to a qualified designee provided that the Engineering Manager is responsible for and shall personally review, correct</p>	<p>Accompany the Engineering Manager (or designee) on a walk-through of the foundation area. Obtain the Notice of Acceptance from the Engineering Manager (or designee) before construction of the clay liner begins.</p>	<p>Confirm that QC has obtained the Notice of Acceptance.</p>

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when necessary and approve any work performed by a subordinate or associate on the Engineering Manager's behalf in accordance with Utah Code §§ 58-22-102(16) and -603(1)(b).

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WORK ELEMENT - CLAY LINER BORROW MATERIAL



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>31) SCOPE: This work element applies to the Federal Cell embankment.</p>		
<p>32) CLEARING AND GRUBBING: Remove vegetation, debris, organic, or deleterious material from areas to be used for borrow. Grubbing depth will depend on the type of vegetation, debris, organic, or deleterious material on the site. If the area is free of these materials then no clearing and grubbing will be necessary.</p>	<p>Inspect the area once clearing and grubbing has been completed. Record observations and corrective actions (where required) on the Daily Construction Report.</p>	<p>Verify that the clearing and grubbing has been inspected and recorded by QC.</p>
<p>33) MATERIAL: Satisfactory material shall be defined as CL or ML soils based on the Unified Soil Classification with at least 85 percent passing the No. 200 sieve (silt and clay), a plasticity index (PI) between 10 and 25, and a liquid limit (LL) between 30 and 50.</p>	<p>Perform laboratory classification tests (ASTM D 2487) at a rate of one test per lot prior to use of material in the clay liner. A lot is defined as a maximum of 5,000 cubic yards (compacted) of specified material type. Record the location of the classification sample on the Sampling Log.</p> <ul style="list-style-type: none"> a. Approve lots (which meet the specified classification) for use in the clay liner. b. Lots not meeting the specified classification cannot be used. 	<p>Verify the frequency of laboratory tests and compliance of test results.</p>
<p>34) PROTECTION: The clay borrow material shall be handled in such a manner as to prevent contamination with radioactive waste material or other deleterious material. Acceptable clay borrow material may contain up to five percent additional rocks (less than or equal to one inch) and sand above the content found in the classification test.</p>	<p>Visually check clay liner materials for contamination by foreign materials. If any foreign materials are identified, the percentage of foreign material shall either be estimated in accordance with ASTM D2488 or calculated in accordance with ASTM D2487. Document findings on the Daily Construction Report. Notify the Project Manager to have operations remove or rework clays which have been contaminated above the specified requirements. Re-inspect the clay liner material and document corrective actions (where required) on the Daily Construction Report.</p>	<p>Verify that the clay liner material is being inspected for contaminants and that the inspection and corrective actions (if required) are properly documented.</p>

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WORK ELEMENT - CLAY LINER BORROW MATERIAL



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>35) PROCESSING: These procedures may be used to provide suitable material for construction of the clay liner.</p> <p>A. If used, apply deflocculant at a rate determined by the Engineering Manager (based on test pad data). If used, the choice of deflocculant and the application rate shall be verified in the Clay Liner Test Pad.</p> <p>B. Mix the deflocculant thoroughly into the soils by tilling or similar action.</p>	<p>Measure the mixing areas and verify that the application rate of the deflocculant is equal to or greater than the rate determined by the Engineering Manager. Record the size of the mixing areas and the amount of deflocculant applied on the Embankment Construction Lift Approval Form.</p> <p>Observe the mixed clay and notify the Project Manager of areas which are not adequately mixed. Re-inspect after corrected. Document observations and corrective actions, if required, on the Daily Construction Report.</p>	<p>Verify that the size of the mixing areas and the amount of deflocculant applied has been properly documented.</p> <p>Verify that the clay is being inspected correctly and the inspection documented.</p>

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WORK ELEMENT - CLAY LINER TEST PAD**



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>36) SCOPE: This work element applies to the Federal Cell embankment.</p>		
<p>37) NOTICE OF TEST PAD CONSTRUCTION: In accordance with Specification 23 the clay liner test pad plan shall be approved by the Director. The clay liner test pad plan shall be provided to the Director at least 14 calendar days prior to test pad construction.</p> <p>The Director shall be notified 48 hours in advance of the start-up of test pad construction.</p>	<p>Obtain documentation confirming that the test pad plan has been approved by the Director.</p> <p>Obtain documentation confirming that the Director has been notified, as required.</p>	<p>Verify that the test pad has been provided to the Director at least 14 calendar days prior to construction of the test pad. Provide QC with documentation of Director approval.</p> <p>Notify the Director 48 hours in advance of the start-up of test pad construction. Provide QC with documentation of Director notification.</p>
<p>38) TEST PAD(S): A test pad with minimum dimensions of 60 feet by 75 feet will be constructed using the procedure outlined in the approved test pad plan.</p> <p>Prior to use of manually operated compaction equipment, a small test pad with minimum dimensions of five feet by five feet (sized appropriately for the equipment used) will be constructed. The purpose of this small test pad is to establish equipment and procedures for construction of clay liner in locations where large equipment is not practical (e.g. repairs). If manually operated compaction equipment is not used on the project, a small test pad is not required.</p> <p>A new clay liner test pad shall be constructed each time there is a change in specifications, construction procedures, unified soil classification, or types of equipment.</p> <p>Clay liner test pads are to be constructed and tested in accordance with the following specifications:</p>	<p>Observe the construction of test pads. Measure each test pad to ensure that it is constructed to at least the size required. Record the test pad size on the Embankment Construction Lift Approval Form.</p> <p>The large test pad shall be divided into three lots per lift (approximately 1,500 square feet per lot). Each lift of the small test pad shall equal a lot.</p>	<p>Observe the construction of the test pads. Verify that the test pad has been measured and is properly documented.</p>

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SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
A. Prior to compaction, conduct at least one classification and gradation test for each test pad.	Conduct classification and gradation tests (as described in Appendix B) at a rate of one of each type of test per test pad.	Verify the frequency of tests and compliance of test results.
B. Place the clay in at least three lifts with the first lift uncompacted thickness not exceeding twelve inches. Remaining lifts shall have a loose material thickness not exceeding nine inches for each lift.	Measure the lift thickness at a rate of one test per lot. Record thicknesses on the Embankment Construction Lift Approval Form.	Verify that the number of lifts and lift thicknesses has been documented. Verify that the clod size inspection has been performed and documented for each uncompacted lift thickness.
C. The clay material will have a dry clod size less than or equal to one inch.	Inspect the loose clay material during the unloading and spreading process for each uncompacted lift to ensure any dry clods that are present are less than or equal to one inch. Notify the Project Manager to have operations remove clods greater than one inch. Record inspection of the clod size on the Embankment Construction Lift Approval Form and re-inspect the uncompacted lift if necessary. Record any corrective actions performed on the Daily Construction Report.	Verify that the dry clod size inspection has been performed and documented, including corrective actions as necessary.
D. The clay is to be placed and compacted by equipment proposed for use during construction of the clay liner.	Record type of equipment used, and number of passes on the Embankment Construction Lift Approval Form.	Perform a minimum of one visual inspection per test pad.
E. The lifts of clay shall be bonded by providing a rough upper surface on the underlying layer of clay liner. The surface should have changes in grade of approximately one inch or more at a rate of two or more per linear foot.	Perform a visual inspection to verify that there are adequate changes in grade. Any areas of concern shall be verified by placing a straight edge at least two feet long on the surface and counting the number of points approximately one inch or more below the straight edge. Notify the Project Manager of any deficiencies. Re-inspect after the Project Manager has corrected deficiencies.	Verify the frequency of measurements and compliance of test results.
F. The clay is to be compacted to at least 95 percent of a standard Proctor with moisture content between one-half a percentage point		Verify the frequency of tests and compliance of test results.

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<p>below optimum and five percentage points over optimum. Compaction of the large test pad is to be accomplished by at least four passes of suitable compaction equipment.</p> <p>G. The clay is to be constructed to provide a permeability less than or equal to 1×10^{-6} cm/sec. Permeability testing on the bottom lift will be performed at the surface. Permeability testing on the second lift will be performed greater than or equal to two inches below the surface. Permeability testing on the third lift will be performed greater than or equal to four inches below the surface.</p> <p>H. The procedures used to construct the test pad shall be reviewed and approved by a Utah licensed Professional Engineer.</p> <p>I. In accordance with Specification 23 the test pad certification report shall be approved by the Director at least 14 calendar days from the time the certification report was submitted and prior to using the new test pad construction method.</p>	<p>Conduct in-place moisture-density tests at a rate of one test per lot, with a minimum of three tests per lift for large test pads and one test per lift on small test pads. The test location shall be chosen on the basis of random numbers (described in Specification 12). Record the test result on the Field Density Test form.</p> <ol style="list-style-type: none"> a. Approve lots which meet the specified moisture and compaction. b. Notify the Project Manager of lots not meeting the specified permeability to have the areas reworked. c. Retest (moisture/density and permeability) lots after rework has been completed. d. Any additional work under b. shall be included in the test pad construction method. <p>Conduct in-place permeability tests at a rate of one test per lot per lift. The permeability test shall be run within five feet of the moisture-density test (see Appendix B). Record the test result on the Field Permeability Test form.</p> <ol style="list-style-type: none"> a. Approve lots which meet the specified permeability. b. Notify the Project Manager of lots not meeting the specified permeability to have the areas reworked. c. Retest (moisture/density and permeability) lots after rework has been completed. d. Any additional work under b. shall be included in the test pad certification report. <p>Provide the Utah licensed Professional Engineer with copies of the documentation for the test pad for review and approval.</p> <p>Obtain documentation confirming that the test pad certification report has been approved by the Director.</p>	<p>Verify the frequency of tests and compliance of test results.</p> <p>Verify that proper approval has been obtained for the test pad and that the necessary construction procedure documents are in place for use during clay liner construction.</p> <p>Verify that the test pad certification report has been provided to the Director. Provide QC with documentation of Director approval.</p>

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WORK ELEMENT - CLAY LINER PLACEMENT**



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>39) SCOPE: This work element applies to the Federal Cell embankment.</p>		
<p>40) LIFT IDENTIFICATION: Each lift shall be given a unique lift identification number for testing and surveying purposes.</p>	<p>Assign a lift identification number to each lift. Use the lift identification number to identify all paper work for that lift.</p>	<p>Verify that a lift identification number has been assigned to each lift. Verify that the lift identification number is used on all paper work for that lift.</p>
<p>41) PLACEMENT: The clay liner will be prepared, placed, and compacted using equivalent type of equipment and mixing and compacting procedures that were approved in the test pad.</p> <p>If equipment used to prepare, place, and/or compact clay liner differs by make and/or model from the equipment identified in the approved test pad, equipment equivalency shall be determined and approved by a Utah licensed Professional Engineer prior to use. The Director shall be notified at least 48 hours in advance of implementing an equipment change and the Director shall approve the equivalency determination prior to use of the equivalent equipment. The Director approval shall be obtained in accordance with Specification 23.</p> <p>See Specification 33 for material specifications unless more restrictions were implemented during the test pad. The clay material shall have a dry clod or rock size less than or equal to one inch.</p>	<p>Observe the clay liner placement. Record the equipment and procedures used to place the clay liner and any corrective actions (where required) on the Embankment Construction Lift Approval Form.</p> <p>Obtain documentation of equipment equivalency. Obtain documentation that the Director has been notified and approved of an equipment equivalency determination.</p>	<p>Verify the equipment and procedures used to construct the clay liner have been documented.</p> <p>Verify that use of equivalent equipment has been approved by a Utah licensed Professional Engineer. Notify the Director 48 hours prior to using equipment that has been determined equivalent by a Utah licensed Professional Engineer. Provide QC with documentation of Director approval.</p>
	<p>Inspect the loose clay material during the unloading and spreading process for each uncompacted lift to ensure any dry clods or rocks that are present are less than or equal to one inch. Notify the Project Manager to have operations remove clods or rocks greater than one inch. Record inspection of the clod or rock size on the Embankment Construction Lift Approval Form. Re-inspect and record any corrective actions performed on the Daily Construction Report.</p>	<p>Verify that the clod or rock inspection has been performed and documented.</p>
<p>42) LIFT BONDING: The lifts of clay shall be bonded by providing a rough upper surface on the underlying lift. The surface should have changes in</p>	<p>Perform a visual inspection to verify that there are adequate changes in grade. Any areas of concern shall be verified by placing a straight edge at least two feet</p>	<p>Verify the frequency of measurements and compliance of test results.</p>

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grade of approximately one inch or more at a rate of two or more per linear foot.

long on the surface and counting the number of points approximately one inch or more below the straight edge. Notify the Project Manager of any deficiencies. Re-inspect the surface after corrective actions have been completed. Document any deficiencies and corrective actions taken on the Daily Construction Report.

43) LIFT THICKNESS: The first lift of material shall have an uncompacted thickness of no greater than 12 inches. For the remaining lifts, the loose lift thickness shall not exceed the lesser of the lift thickness used to construct the test pad or nine inches.

Verify that the required grading tolerance is achieved as follows:

Observe QC personnel to ensure that the measurements are being performed correctly. Verify that the measurements are being performed at the correct frequency and that the documentation is being completed. Verify that the inspection has been performed and documented for each uncompacted lift thickness.

A. Thickness for the lift will be established by installing grade poles on at least a 70-foot grid and at all control points. The grade poles must not be installed deeper than three inches into the underlying clay liner. The grade poles must be marked at the appropriate depth to establish the grade. After the grade for the lift has been checked and approved by QC personnel, the grade poles shall be removed.

- a. Ensure that the required frequency for placement of grade poles has been met.
- b. Compare soil level with the marked level on the grade poles.
- c. Visually check between poles for high or low spots.
- d. Define high out of specification areas and notify the Project Manager to rework those areas.
- e. Re-inspect areas reworked and approve areas meeting criteria.
- f. Continue "b" through "d" above until all areas meet criteria.
- g. Indicate areas meeting criteria on the Embankment Construction Lift Approval Form.

- OR -

- OR -

B. Survey to determine lift thickness using the same grid spacing described in Specification 43.A. Survey equipment shall have a tolerance no more than ± 0.1 foot.

- a. Verify survey equipment is within a tolerance of ± 0.1 foot.
- b. Verify correct set-up and operation of equipment.
- c. Visually check between survey points for high or low spots.
- d. Define high out of specification areas and notify the Project Manager to rework those areas.
- e. Document survey results on a survey report.

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<p>44) KEYING-IN: Segments of cell clay liner constructed at times more than 30 days apart from each other shall be keyed-in to each other by one of the following two methods:</p> <p>A. Key-in vertical steps no greater than nine inches and at least twice as wide as they are high.</p> <p style="text-align: center;">- OR -</p> <p>B. sloping the full thickness of old liner at a maximum slope of 5(H):1(V).</p> <p>The surface shall be maintained in accordance with Specification 47.</p>	<p>Verify that the new liner has been properly keyed-in to the existing liner. Record deficiencies on the Embankment Construction Lift Approval Form.</p>	<p>Verify that the keying-in of the liner has been documented.</p>
<p>45) COMPACTION: Clay liner material will be compacted to at least 95 percent of standard Proctor with moisture content between one-half of a percentage point below and five percentage points over optimum.</p>	<p>Conduct in-place moisture-density tests at a rate of one test per lot and record the results on the Field Density Test form. A lot is defined as 1,000 cubic yards (compacted) of a single lift. The test location shall be chosen on the basis of random numbers (described in Specification 12) and documented on the Lift Approval Form.</p> <p>Proctors shall be performed at a rate of one test per borrow lot. A borrow lot is defined as 5,000 cubic yards (compacted) or less of a specific material type. Record the location of the Proctor sample on the Sampling Log. Document results of the proctor on the Proctor Form.</p>	<p>Visually observe at least one lift being compacted and one in-place moisture-density test per project area per construction season. Verify that the tests are being performed at the correct frequency and that the documentation is being completed.</p>
<p>46) PERMEABILITY: Clay liner will have an in-place permeability less than or equal to 1×10^{-6} cm/sec.</p>	<p>Conduct in-place permeability tests at a rate of one test per lot and record the results on the Field Permeability Test form. A lot is defined as 2,000 cubic yards of compacted clay liner. The permeability test shall be run within five linear feet of a moisture density test location.</p> <p>a. Approve lots which meet the specified permeability.</p>	<p>Visually observe at least one in-place permeability test per project area per construction season. Verify that the tests are being performed at the correct frequency and that the documentation is being completed.</p>

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	<ul style="list-style-type: none"> b. Notify the Project Manager of lots not meeting the specified permeability to have the areas reworked. c. Retest (moisture/density and permeability) lots after rework has been completed. d. Restore all test areas to assure no leaks. 	
<p>47) LINER DRYING PREVENTION: Desiccation cracks shall not exceed one-fourth inch wide and three-inches deep in the clay liner. Areas with desiccation cracks exceeding this specification shall be identified as new lots to be reworked and shall be reported to the Director.</p>	<p>Observe the liner surface for drying and document results on the Daily Construction Report.</p> <p>Notify the Project Manager and QA of any desiccation cracks larger than specification identified in the clay liner.</p> <p>Clay liner with larger than specification desiccation cracks shall be reworked and retested in accordance with one of the following methods:</p> <ul style="list-style-type: none"> a. Scarify the in-place clay, moisture condition as needed, then recompact and retest the clay material in accordance with Specifications 41, 45, and 46. b. Excavate all material that has larger than specification desiccation cracks and replace with new clay in accordance with Specifications 40 through 46. 	<p>Verify that the liner is being inspected correctly and the inspection documented. Report discrepancies to the Director as required.</p>
<p>To prevent the clay liner from drying one (or more) of the following methods shall be employed:</p> <ul style="list-style-type: none"> A. Apply water to the clay liner surface on an as needed basis B. Cover the clay liner with nine inches of loose clay C. Cover the clay liner with at least one foot of loose liner protective cover material 	<p>Document methods used to prevent the clay liner from drying on the Daily Construction Report.</p>	<p>Verify methods used to prevent clay liner from drying have been documented.</p>

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<p>D. Cover the clay liner with six inches of clay compacted to a minimum of 90 percent of a standard proctor.</p> <p>Newly constructed liner will be covered in accordance with method B, C, or D above within 30 days of clay liner lift approval.</p> <p>Note: Placement of the next lift of clay liner or liner protective cover meets the requirements above.</p>	<p>Conduct in-place density tests at a rate of one test per lot and record the results on the Field Density Test form. A lot is defined as 1,000 cubic yards (compacted) of a single lift. The test location shall be chosen on the basis of random numbers (described in Specification 12) and documented on the Lift Approval Form.</p> <p>Proctors shall be performed at a rate of one test per borrow lot. A borrow lot is defined as 5,000 cubic yards (compacted) or less of a specific material type. Record the location of the Proctor sample on the Sampling Log. Document results of the proctor on the Proctor Form.</p> <p>Document that clay or protective cover soils have been placed over approved clay liner lifts within 30 days of lift approval.</p>	<p>Verify that density tests are being performed at the correct frequency and that the documentation is being completed</p>
<p>48) SNOW REMOVAL: When clay liner material is to be placed and the work area is covered with snow, the snow must be removed.</p>	<p>Observe that snow is removed. Inspect the clay liner for damage. Notify the Project Manager of any deficiencies/damage and re-inspect areas after repairs are completed. Record these corrective actions (where required) in the Daily Construction Report.</p>	<p>Verify that snow removal is being documented and the clay liner has been inspected.</p>
<p>49) COLD WEATHER PLACEMENT OF CLAY LINER: For purposes of this Manual, “frozen” is defined as a soil temperature of less than or equal to 27°F. Clay liner shall not be placed above frozen material. In addition, no frozen material shall be processed or placed.</p> <p>If the air temperature has dropped below 32°F since the last lift of clay liner was approved, one of the following three scenarios apply:</p>	<p>As needed, observe the area where clay liner is to be placed. If frozen material is observed, cease placement of clay liner. If frozen material is suspected, measure soil temperature. Document the stopping of placement in the Daily Construction Report.</p> <p>Review ambient air temperature records as measured at the site meteorological station. Document status of clay liner cover placement on the Daily Construction Report. Measure the liner/foundation temperature when</p>	<p>Verify that clay liner is tested as required (and the testing documented) during cold weather conditions.</p>

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<p>A. If less than 30 days have passed since the date of lift approval and the last lift of clay liner has been covered since the approval date with at least nine inches of loose clay or six inches of compacted clay, then the cover clay may be worked with no additional testing of the lower approved lift.</p> <p>B. If less than 30 days have passed since the date of lift approval and the last lift of clay liner has not been covered with at least nine inches of loose clay or six inches of compacted clay, then:</p> <ol style="list-style-type: none"> 1. Perform spring start-up testing as discussed below; or 2. Measure the liner/foundation temperature approximately one inch beneath the surface at a frequency of one measurement per lot (defined as no more than 100,000 square feet). If the temperature one inch beneath the surface is greater than 32°F, no additional actions are required. If the temperature one inch beneath the surface is less than 32°F and greater than 27°F, re-roll the surface with one pass of the same type of construction equipment (i.e., a compactor for intermediate lifts or a smooth drum roller for the final surface) and continue with liner construction. If the temperature 1 inch beneath the surface is less than or equal to 27°F, re-work and re-test density and permeability of the 	<p>triggered under B.2. of this specification, at the specified frequency. Clay temperature shall be measured between 6:00 AM and 8:00 AM on the day that clay liner will be placed. Temperature measurements shall include a location that is most likely to be coldest; i.e., if there is a portion of the liner that is shaded or at a low point. To ensure a stable reading, the temperature probe shall be left in place for at least two minutes prior to taking the reading.</p> <p>If the initial clay temperature measurement is less than or equal to 27°F, the affected area may be resampled before 8:30 AM the same day as follows:</p> <ol style="list-style-type: none"> a. Measure the liner/foundation temperature at a frequency of one measurement per lot (defined as no more than 10,000 square feet). b. Lots where the temperature is greater than 27°F do not require rework other than re-roll the surface with one pass of the same type of construction equipment; except that the lot where the initial temperature less than or equal to 27°F was measured shall be reworked regardless of resampling results. 	

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affected area after the clay temperature has risen above 27°F.

- C. If more than 30 days have passed since the date of lift approval, perform spring start-up testing.

50) SPRING START-UP: See Specification 49 for situations that trigger this specification.

For spring start-up testing, the surface lift is treated as protective cover, regardless of whether it was an approved lift of clay liner at one time or not. Excavate nine inches below the clay surface and re-test for density and permeability. Excavation for testing purposes may consist of removing the protective cover lift; or may be performed by ‘potholing’ only at the testing locations. Areas that have been ‘potholed’ for permeability testing shall be repaired by applying the same level of effort as prescribed by the approved test pad for liner construction.

Perform density and permeability testing at the frequencies outlined for liner construction in Specifications 43 through 46. This testing may be performed outside of the approved lift area so long as the area tested is representative of the clay in the approved lift area (i.e., was constructed at the same time and with the same method). Moisture testing is not required for spring start-up.

- a. Approve lots that meet specification. The protective cover lift may then be worked in place and tested to become the next lift of clay liner.
- b. For lots that do not meet specification, test the surface at successively deeper nine inch increments until a passing lift is found; remove all failing lot; re-work all failing lot; and re-test.

Document that repairs are completed to the same level of effort as required by the approved test pad for clay liner construction.

51) CONTAMINATION OF CLAY LINER: The clay liner material shall not become contaminated with radioactive soils or debris during construction. The in-place clay liner material may contain up to five percent additional rocks and sand above the content found in the classification test.

Prior to compaction, visually check the clay liner material for contamination by foreign materials in accordance with ASTM D2488. Remove or rework clay liner material that has been contaminated above the specified requirements. Document corrective actions (when required) on the Daily Construction Report.

Verify that the clay liner is being inspected for contaminants and that the inspection and corrective actions (if required) are properly documented.

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<p>52) FINAL GRADING: Final grading shall be at or above design elevations.</p>	<p>Survey on a 50 foot grid and at key points (i.e., embankment break lines). Final survey measurements will be documented and provided to the QC Supervisor and Quality Assurance.</p>	<p>Review the final survey data. Verify the frequency of the survey points.</p>
<p>53) HEAVY EQUIPMENT ON CLAY LINER: Heavy equipment travel will be minimized on top of the finished clay liner. Heavy equipment will not be operated on saturated clay liner.</p>	<p>Observe work on clay liner. Notify the Project Manager of problems with equipment on the clay liner. Re-inspect problem areas once corrected. Record corrective actions taken (where required) on the Daily Construction Report.</p>	<p>Verify that the work is being inspected.</p>
<p>54) DIRECTOR APPROVAL: In accordance with Specification 23 the Director shall approve documentation associated with completed clay liner. Documentation shall include all QC and QA records associated with clay liner construction, as well as photographs of the completed liner surface. In addition, 48 hour notification shall be provided to the Director prior to placement of soil material over the clay liner (waste or soil protective cover). However, Director approval of clay liner documentation is not required prior to placement of waste over the clay liner.</p>	<p>Notify Quality Assurance that the clay liner is prepared and ready for inspection by the Director. Obtain written authorization on the Liner Inspection Form from Quality Assurance that the clay liner has been inspected. Obtain documentation of Director notification from Quality Assurance.</p>	<p>Notify the Director that the clay liner is prepared and ready for inspection at least 48 hours prior to covering with soil protective cover material. Obtain written Director approval of the clay liner prior to the placement of material over clay liner (waste or soil protective cover). Provide QC with documentation of notification.</p>
<p>55) LINER PROTECTIVE COVER: At least one foot of compacted native soils, free of debris, shall be constructed on top of the clay liner. This layer is termed “Liner Protective Cover”. Contaminated equipment may be used to place Liner Protective Cover. Liner Protective Cover shall be constructed through one, or a combination, of the following methods:</p> <p>a. Clay liner placed in excess of clay liner design elevations may be considered part of the Liner Protective Cover.</p>	<p>Inspect, test and approve excess clay liner in accordance with Work Element “Clay Liner Placement”.</p>	<p>Verify that excess clay liner has been constructed and tested in accordance with Work Element “Clay Liner Placement”.</p>

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<p>b. Constructed Liner Protective Cover using native soils free of debris as follows:</p> <p>a. Soil material will be placed in lifts with a compacted average thickness not exceeding 12 inches.</p> <p>i. Thickness for the lift will be established by installing grade poles on at least a 70-foot grid and at all control points. The grade poles must not be installed deeper than three inches into the underlying clay liner. The grade poles must be marked at the appropriate depth to establish the grade. After the grade for the lift has been checked and approved by QC personnel, the grade poles shall be removed.</p> <p style="text-align: center;">- OR -</p> <p>ii. Survey to determine lift thickness using the same grid spacing described in Specification 43.A. Survey equipment shall have a tolerance no more than \pm 0.1 foot.</p> <p>b. Each lift shall be compacted to at least 90 percent of a standard Proctor. Moisture testing is not required.</p>	<p>Verify that the required grading tolerance is achieved as follows:</p> <p>a. Ensure that the required frequency for placement of grade poles has been met.</p> <p>b. Compare soil level with the marked level on the grade poles.</p> <p>c. Visually check between poles for high or low spots.</p> <p>d. Define high out of specification areas and notify the Project Manager to rework those areas.</p> <p>e. Re-inspect areas reworked and approve areas meeting criteria.</p> <p>f. Continue "b" through "d" above until all areas meet criteria.</p> <p>g. Indicate areas meeting criteria on the Embankment Construction Lift Approval Form.</p> <p style="text-align: center;">- OR -</p> <p>a. Verify survey equipment is within a tolerance of \pm 0.1 foot.</p> <p>b. Verify correct set-up and operation of equipment.</p> <p>c. Visually check between survey points for high or low spots.</p> <p>d. Define high out of specification areas and notify the Project Manager to rework those areas.</p> <p>e. Document survey results on a survey report.</p> <p>Conduct in-place density tests at a rate of one test per lot and record the results on the Field Density Test form. A lot is defined as 1,000 cubic yards (compacted) of a single lift. The test location shall be chosen on the basis of random numbers (described in Specification 12) and documented on the Lift Approval Form.</p>	<p>Observe QC personnel to ensure that the measurements are being performed correctly. Verify that the measurements are being performed at the correct frequency and that the documentation is being completed. Verify that the inspection has been performed and documented for each lift.</p> <p>Verify that the tests are being performed at the correct frequency and that the documentation is being completed.</p>

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Proctors shall be performed at a rate of one test per borrow lot. A borrow lot is defined as 5,000 cubic yards (compacted) or less of a specific material type. Record the location of the Proctor sample on the Sampling Log. Document results of the proctor on the Proctor Form.

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WORK ELEMENT – DEPLETED URANIUM WASTE PLACEMENT



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56) SCOPE: This work element applies to the Federal Cell Embankment.

57) DEFINITION OF WASTE:

Depleted Uranium Containers – Cylinders containing depleted uranium ranging from 11 to 12 Mg full. The cylinders with a 12-Mg capacity are 12 ft (3.7 m) long by 4 ft (1.2 m) in diameter. Most have a steel wall that is 5/16 in (0.79 cm) thick. Similar but slightly smaller cylinders with a capacity of 9 Mg are also managed. Drums containing depleted uranium have a gross volume of 55 gallons and from 0.6 to 1.0 Mg full.

58) DEPLETED URANIUM CONTAINER PLACEMENT: Depleted Uranium Containers shall be placed below ground surface level within the Federal Cell Embankment.

The maximum allowable load on the clay liner surface is less than 3,000 psf.

When CLSM is required as structural fill in a Depleted Uranium Engineering Review in order to meet the load specification, the first four feet of CLSM shall be placed around the depleted uranium containers within 14 calendar days of depleted uranium container disposal.

59) CLSM DESIGN SPECIFICATIONS:

CLSM shall have the following characteristics:

Have the Engineering Manager perform a Depleted Uranium Container Engineering Review. Ensure that the bearing pressure at the clay liner surface meets specification for the load associated with placement of depleted uranium containers.

Document the date of depleted uranium containers disposal and the date of the CLSM pour and include with the Lift Approval Form.

Confirm that the Depleted Uranium Container Engineering Review has been completed.

If CLSM is required to meet the load specification requirement, verify the first four feet of CLSM was placed around a depleted uranium container within 30 calendar days of depleted uranium containers disposal.

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<p>A. The design mix will be approved by the Engineering Manager prior to use in the cell area and meets the material specifications provided in Table 1 “Material Specifications for Portland Cement CLSM”.</p> <p>B. The CLSM passes a Slump Test (ASTM C143), Flow Consistency Test (ASTM D6103) or Efflux test (procedure provided in Appendix B of this Manual), as applicable. Passing criteria for each test is specified in Table 1 “Material Specifications for Portland Cement CLSM”.</p>	<p>For each day’s production, perform an initial screening test. Perform subsequent acceptance tests as required by lot size. The results of these tests and corrective actions, if any, shall be documented on the CLSM Testing Form.</p> <p>a. Initial screening tests shall be performed on the first load of CLSM for each day that CLSM is poured. This screening test shall be performed from the “front end” of the load. The initial screening test includes either a Flow Consistency Test (ASTM D6103) or Efflux test (procedure given in Appendix B. The results from this initial screening test shall indicate whether or not any adjustments need to be made at the batch plant to ensure loads meet design specifications.</p> <p>b. If adjustments are made to the load to produce a product that passes the testing requirements, perform initial screening testing on the subsequent two loads to verify that the batch plant adjustments are sufficient</p> <p>c. CLSM pouring shall only be authorized to proceed upon verification that the initial load (and subsequent two loads if the initial load failed) meets mix specifications.</p> <p>d. Acceptance tests shall be performed at a rate of one test per lot, with a minimum of one acceptance test performed for each CLSM pour. A lot is defined as 100 cubic yards of CLSM. Sampling for acceptance tests shall be performed in accordance with ASTM D5971 (“Practice for Sampling Freshly Mixed CLSM”). These acceptance tests shall be performed from a composite of two samples from near the middle of the load.</p> <p>1) Accept loads that meet specification.</p> <p>2) For loads with unsatisfactory results, accept the first part of the load and reject the remainder, or modify the load and/or pour techniques and retest.</p>	<p>Verify the frequency of measurements and compliance of test results.</p>

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<p>C. The CLSM shall have minimum 28-day strength of 150 pounds per square inch (psi) as determined by ASTM D4832. A minimum of three cylinders shall be cast for compressive strength testing.</p>	<p>Cast a minimum of three cylinders per 2,000 cubic yards of CLSM placed, with at least one set per lift for lifts smaller than 2,000 cubic yards. Perform compressive strength testing in accordance with ASTM D4832 at 28 days to ensure the minimum strength requirements are met. This test may be performed in-house or sent off-site to an AMRL certified laboratory. If the CLSM does not meet specification, evaluate why it failed and implement corrective actions to prevent recurrence. Record the reason for the failure and the corrective action on the Lift Approval Form.</p>	<p>Verify compressive strength testing is being performed at the correct frequency.</p>
<p>D. The CLSM shall have a wet unit weight in all cases of at least 100 lbs/ft³ as determined by ASTM D6023 “Standard Test Method for Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material (CLSM)”.</p>	<p>Conduct a unit weight test (ASTM D6023) in conjunction with sampling for compressive strength testing of Specification 59.C.</p>	<p>Verify unit weight testing is being performed at the correct frequency.</p>
<p>E. A load ticket shall be furnished for each truck of CLSM to be poured.</p>	<p>Obtain the load ticket for each truck load of CLSM and ensure the load meets the mix specifications provided in Table 1 “Material Specifications for Portland Cement CLSM” of this Manual. Reject any loads not meeting the mix specifications. Include the load ticket with the Lift Approval Form for the CLSM lift. During each CLSM pour, a QC Technician shall be present at or near the pour at all times and shall visually observe pour activities. Document discrepancies on the Daily Construction Report.</p>	<p>Verify that the load tickets have been obtained by QC personnel for each truck load of CLSM and that the load ticket has been checked against Table 1 “Material Specifications for Portland Cement CLSM”</p>
<p>60) SNOW REMOVAL: When depleted uranium containers are to be placed and the work area is covered with snow and/or ice, the snow and/or ice must be removed so that no more than one-quarter inch remains on the surface. Isolated individual</p>	<p>Observe that snow is removed. Inspect the waste lift for damage. Notify the Project Manager of deficiencies/damage. Construction may not continue without corrective action and re-inspection of deficiencies/damage. Record corrective action (where required) in the Daily Construction Report.</p>	<p>Verify that snow removal is being performed and documented and the waste lift has been inspected.</p>

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<p>clumps of snow and/or ice may be present, but shall be no larger than two-inches in diameter.</p> <p>61) CLSM POURS AROUND DEPLETED URANIUM CONTAINERS: In-filling of the placed depleted uranium containers with CLSM shall be maximized.</p> <p>Unless specifically exempted by the Director (e.g., ALARA considerations, contents already cemented, etc.), depleted uranium containers shall either have their lids removed or the lid shall be pierced with a hole size of at least eight square inches (i.e., two inch by four inch) to allow flow of CLSM into the container.</p>	<p>Ensure lids are removed or container are punctured. Holes shall be a minimum of eight square inches (i.e., two inch by four inch). If a container is exempted from this requirement, ensure a copy of the Director’s approval is within the records. Record results on the CLSM Inspection Form.</p>	<p>Review inspection results to ensure that adequate holes exist for containers where lids remain on the container. If a container is exempted, verify that Director approval has been obtained.</p>
<p>62) FINAL CLSM POUR SURFACE: The final CLSM surface will be a horizontal plane with no exposed containers that impedes contact with the surface area during proof rolling.</p>	<p>Visually inspect the final CLSM pour surface to ensure the area is acceptable for proof rolling.</p>	
<p>63) PROOF-ROLL TESTING: A proof roll test shall be performed on all CLSM lifts a minimum of three calendar days following completion of the CLSM pour and prior to placement of any lifts on top of the completed pour. The test shall consist of a loaded truck (rock truck, cement truck, or other vehicle of equal or greater wheel surface load) driving across the entire footprint of the completed CLSM pour.</p>	<p>Inspect the entire cured CLSM pour surface. Following inspection, direct the truck (rock truck, cement truck, or other vehicle of equal or greater wheel surface load) across the entire CLSM pour surface. Inspect the surface during rolling for any cracking or depressions resulting from the proof-rolling. Identify any surface cracks or depressions with a vertical displacement of one-half inch or greater, or cracks greater than ½-inch in depth. Mark these areas for repair or re-work. Document observations on the Lift Approval Form.</p> <p>Approve all lift areas not marked for repair or rework. For any areas with surface cracking or depressions with a vertical displacement of one-half inch or greater, or cracks greater than one-half inch in depth, one of the following methods shall be followed to remedy the</p>	<p>Review the documentation to ensure proof-roll testing is being performed and properly documented.</p> <p>Review the documentation to ensure rework, if required, has been performed and documented.</p>

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failed area(s):

- a. The area may be compacted and then re-poured. Following three days from the re-pour, perform another proof-roll test to evaluate if the repair was adequate; or
- b. Remove the CLSM from the marked area and replace it with new CLSM. Following three days from the re-pour, perform another proof-roll test of the area to evaluate if the repair was adequate. Repeat this process until satisfactory results are achieved; or
- c. Place a six-inch CLSM cap over the pour lift area after the area in question has been compacted. With the exception of edges at the perimeter of a lift, the six-inch cap shall extend a minimum of three feet past the damaged areas created during proof-rolling in each direction. Following a minimum of three calendar days, perform a proof-roll test of the six-inch cap area to evaluate if the cap was adequate. This process may also be repeated (i.e., placement of additional cap to a 12-inch cap) until satisfactory results are achieved.

64) SIX-INCH CAP: A six-inch cap is required over repaired area as described in Specification 63. Areas poured with a CLSM cap shall still require a proof-rolling test (as described in Specification 63) to verify performance of the cap. With the exception of edges at the perimeter of a lift, the six inch cap shall extend a minimum of three feet in each direction past the edge of the area that requires a cap.

Visually inspect the CLSM pour area and identify the highest elevations that require a six-inch cap. Survey and document these designated elevations on the CLSM Inspection Form. Following completion of the six-inch cap, perform a final survey of the lift as required for determining lift thicknesses above. Document the survey on a survey report. Ensure that the thickness of the cap is six inches above all areas requiring a CLSM cap. Document the inspection and completion of the CLSM cap on the Lift Approval Form.

Review the documentation associated with the CLSM cap.

The six inch cap shall have minimum 28-day strength of 500 psi as determined by ASTM D4832.

Perform compressive strength testing of the CLSM used for caps at the rate of one test per 1,000 cubic yards of CLSM placed, with at least one test per lift. Test

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Table 1 specifications do not apply to the CLSM cap.

specimens/samples shall be collected in accordance with ASTM D5971. The samples shall then be tested in accordance with ASTM D4832. The test results are documented in the compressive strength report which is referenced on the Lift Approval Form. If the CLSM cap does not meet specification, evaluate why it failed and implement corrective actions to prevent recurrence. Document corrective actions on the Daily Construction Report.

Verify that compressive strength testing is performed at a rate of one per CLSM lift. Ensure that the compressive strength of the cap is greater than or equal to 500 psi.

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<p>65) SCOPE: This work element applies to the Federal Cell embankment.</p>		
<p>66) APPLICABILITY: This work element is applicable to fill placed and compacted with the CAT 826 compactor.</p>	<p>Document equipment used for compaction on the Lift Approval Form.</p>	
<p>67) DEFINITIONS:</p> <p><u>Machine Pass</u> is defined as movement of the compactor across an area of the lift in any direction, which also meets compaction criteria calculated by an algorithm in the compactor’s system. For example, movement of the compactor from south to north across the lift, which also meets compaction criteria calculated by an algorithm in the compactor’s system, constitutes one machine pass; the return trip from north to south, which also meets compaction criteria calculated by an algorithm in the compactor’s system, constitutes a second pass.</p> <p><u>Wheel Pass</u> is defined as movement of any of the compactor’s drums across an area of the lift, which also meets compaction criteria calculated by an algorithm in the compactor’s system. Since there are forward and rear drums on the CAT 826 compactor, each machine pass constitutes two wheel passes. The CCS compaction tracking system reports wheel passes.</p>		
<p>68) LINER PROTECTION: The compactor shall not be operated on the surface of finished clay liner or on the surface of the Liner Protective Cover directly over the clay liner. When operating on a slope that terminates on the surface of the Liner Protective Cover, the compactor shall be operated in a manner to prevent impact to the Liner Protective Cover.</p>	<p>When disposal and compaction is being performed on or adjacent to the first lift above the Liner Protective Cover, observe compactor operation for protection of the liner and Liner Protective Cover. Document observations, failures, and any corrective actions on the Daily Construction Report.</p>	

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When compacting near the toe of the slope, the compactor shall be operated parallel to the toe of the slope.		
69) LIFT IDENTIFICATION: Each lift shall be given a unique lift identification number.	Assign a lift identification number to each lift. Use the lift identification number to identify all paperwork for that lift.	Verify that a unique lift identification number has been assigned to each lift. Verify that the lift identification number is used on all paperwork for that lift.
70) LIFT ACCEPTANCE: At the time of acceptance, the date and time of lift approval shall be recorded.	Record the date and time of lift approval on the Lift Approval Form.	Verify that the date and time of lift approval is recorded on the Lift Approval Form.
No fill material will be disposed on a lift until the prior lift is approved.		
71) LIFT THICKNESS: The fill material will be placed in lifts with a compacted average thickness not exceeding 24 inches.	<p>Verify that the previous fill lift has been approved prior to fill disposal.</p> <p>Survey the mean elevation of the top of each lift by surveying at least five points over a 10,000 square foot area. Where practical, survey the corners and at least one spot in the middle. If the average thickness of these surveys exceeds 24 inches, notify the Project Manager to have lift reworked. The lift shall be re-surveyed with at least five more points per 10,000 square feet after it is reworked. Survey measurements will be documented on a survey report and forwarded to Quality Assurance. Lift thickness may also be verified via GPS.</p> <ol style="list-style-type: none"> a. Approve lifts with an average less than or equal to the specified lift thickness. b. Remove excess material from the thicker areas of the lift if the average lift thickness is greater than 24 inches, and re-compact lift in the areas where fills are removed. 	<p>Perform a monthly assessment of the survey documentation performed by the QC personnel to ensure that the measurements and observations are being performed correctly. Verify that the surveys are being performed at the correct frequency and that the documentation is being completed.</p> <p>Verify that the survey data has been received from the QC personnel and that the data meets thickness specifications.</p>
	- OR -	
	Download the CCS system report of beginning and ending lift elevations. For lifts that are not sloped, survey data may be used for beginning lift elevation. Lift thickness shall be reported using CCS in accordance	

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	with current operating procedure. When calculating the average lift thickness on a side slope, no point shall be more than 2.1 feet. If CCS is used to document lift thickness on the side slope, there shall be no white pixels shown in the lift. CCS data may be supplemented by GPS for areas where compactor coverage is inconclusive.	
72) LIFT AREA: Identify the dimensions and the location of the northwest corner of the lift. There is no minimum lift area for this work element.	Locate the northwest corner of each lift, and document the location and lift dimensions.	
73) CLASSIFICATIONS: Soil classification testing is not required for fill placed using this work element.		
74) TERRACING OF LIFTS: Lifts constructed at times more than 30 days apart from each other shall have at least one foot, measured horizontally, removed from the outer edge of the old lift (except for CLSM lifts). For compaction adjacent to CLSM surfaces, lift compaction will be conducted as close to the CLSM as the compactor can achieve.	Inspect the intersections between old and new lifts. Verify that the outer one foot of the old lift is being removed (except for CLSM lifts). Record any problems and corrective actions taken on the Daily Construction Report.	Verify that the required inspections are being performed and documented.
75) COMPACTION WITH CCS: When using the CCS system, each lift and lift interface shall be compacted by at least four machine passes with the CAT 826 compactor. The lift surface shall be firm and unyielding to the compactor’s weight. A minimum of 90 percent of the grid points reported for the lift by CCS shall exhibit adequate compaction and machine passes. Adequate compaction as well as meeting the minimum number of wheel passes is reported by CCS when each pixel turns green. Furthermore, a maximum of 56 square feet of non-green pixels may be adjacent to each other within the lift area limits. “Adjacent” means that two pixels share a common side; pixels	Document the CCS system report of compaction for each lift area. Compactive effort is reported by CCS on a roughly one foot x one foot grid; with each on-screen pixel representing one square foot. Ensure that the CCS reports a minimum of four machine passes (i.e., 8 wheel passes) for at least 90 percent of the grid points in the lift. Record this information on the Lift Approval Form. Perform a QC inspection of the compacted lift by observing the CCS control screen for evidence of uniform and adequate compaction. This condition is indicated by having a minimum of 90 percent of the screen green. Visually compare all adjacent non-green pixels against the 3.3 foot by 16.5 foot and 7.5 foot by 7.5 foot area legends on the system screen to ensure the	Perform a monthly assessment of the compaction documents generated by the QC technician.

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<p>that share only a common corner are not adjacent to each other.</p> <p>A. Additional compaction may be required if, after the minimum number of passes is complete, the minimum percentage of grid points do not exhibit adequate compaction, as reported by the CCS system.</p> <p>B. Evaluate the lift interface when compacting adjacent to an obstruction (e.g., a previously poured CSLM surface, irregular CLSM side slope, CWF caisson, etc.). Visually inspect for obstructions that may affect compaction data. More than 56 square feet of non-green adjacent pixels are permitted in this situation if QC visually observes and documents a minimum of six machine passes to within 12 inches of the obstruction.</p> <p>76) COMPACTION WITHOUT CCS: If the CCS system is not available to be used for compaction under this work element, the following requirements apply.</p> <p>A. Notice shall be provided to Director within 24 hours of beginning to approve lifts without CCS. This notice may be provided via email.</p> <p>B. Written notice shall be provided to Director no later than three calendar days (72 hours) after beginning to approve lifts without CCS. The written notice shall explain why CCS is down; an estimate of when CCS will be back online; a map of the areas being compacted without CCS; and a map of interim settlement</p>	<p>maximum number of adjacent pixels is not exceeded. Print the CCS report as a color image and include with the Lift Approval Form. Record QC inspection results on the Lift Approval Form.</p> <p>Perform a visual inspection of the obstruction/Soil interface. Identify areas of the obstruction that present an obstacle for the CAT 826 compactor. Visually observe the compactor operator make a minimum of six machine passes to within 12 inches of the obstruction. Document the observations on the Lift Approval form.</p>	<p>Notify Director within 24 hours of beginning to approve lifts without CCS. Provide QC with documentation of DRC notification.</p> <p>Provide written notice to Director no later than three calendar days after beginning to approve lifts without CCS. Provide QC with a documentation of written DRC notification. Note: Verbal and written notification may be submitted by the Engineering Manager, or designee, and then provided to Quality Assurance.</p>

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<p>monuments over the area being compacted without CCS.</p> <p>C. Compaction without CCS is limited to 10 calendar days per occurrence.</p> <p>D. Each lift and lift interface shall be compacted by at least six machine passes with the CAT 826 compactor. The lift surface shall be firm and unyielding to the compactor’s weight. Additional compaction may be required if, after the minimum number of passes is complete, any of the following are observed:</p> <ol style="list-style-type: none"> 1. The lift surface exhibits ruts or compression (excluding depressions caused by the tines of the compactor wheel) in excess of four inches; 2. The fill material exhibits pumping behavior, or has other indications of excess moisture content; or 3. The lift does not appear to be uniformly compacted. <p>77) SNOW REMOVAL: When fill material is to be placed and the work area is covered with snow and/or ice, the snow and/or ice must be removed so</p>	<p>Document that the minimum number of passes is completed for each lift area. Passes shall be counted by the QC technician or by using a GPS unit communicating with the GPS unit on the compactor.</p> <p>Perform a visual inspection of the compacted lift surface. If rutting or other indications of inadequate compaction are present, direct the equipment operator to complete additional passes until the situation is corrected. If additional passes are unable to correct the situation, moisture adjustment or other corrective actions may be needed and the lift shall not be approved until these actions are completed. Record any problems and corrective actions taken on the Daily Construction Report.</p> <p>Survey lift elevation and thickness in accordance with Specification 71, with the further requirement that the greater of the following number of points shall be surveyed per lift:</p> <ol style="list-style-type: none"> a. At least five points; or b. One point per 2,000 square feet of lift area. <p>Record the number of passes and visual inspection results on the Lift Approval Form.</p> <p>Observe that snow is removed. Inspect the fill lift for damage. Notify the Project Manager of deficiencies/damage. Construction may not continue</p>	<p>Review the compaction documents generated by the QC technician.</p> <p>Verify that snow removal is being performed and documented and the fill lift has been inspected.</p>

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that no more than one quarter inch remains on the surface. Isolated individual clumps of snow and/or ice may be present, but shall be no larger than two inches in diameter.

without corrective action and re-inspection of deficiencies/damage. Record corrective action (where required) in the Daily Construction Report.

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<p>78) SCOPE: This work element applies to the Federal Cell embankment.</p>		
<p>79) LIFT IDENTIFICATION: Each lift shall be given a unique designation for testing and surveying purposes.</p>	<p>Assign a lift identification number to each lift. Use the lift identification number to identify all paper work for that lift.</p>	<p>Verify that a unique lift identification number has been assigned to each lift. Verify that the lift identification number is used on all paper work for that lift.</p>
<p>80) LIFT ACCEPTANCE: At the time of acceptance, the date and time of lift approval shall be recorded.</p> <p>No fill material will be placed on a lift until the prior lift is approved.</p>	<p>The QC technician shall record the date and time of lift approval on the Lift Approval Form.</p>	<p>Verify that the date and time of lift approval is recorded on the Lift Approval Form.</p>
<p>81) LIFT THICKNESS: The waste material will be placed in lifts with a compacted average thickness not exceeding 12 inches.</p>	<p>Verify that the previous lift has been approved prior to placing more fill.</p> <p>Survey the mean elevation of the top of each lift by surveying at least five points over a 10,000 square foot area. Where practical, survey the corners and at least one spot in the middle. If the average thickness of these surveys exceeds 12 inches, notify the Project Manager to have operations rework the lift. The lift shall be re-surveyed with at least five more points per 10,000 square feet after it is reworked. Survey measurements will be documented and forwarded to Quality Assurance.</p>	<p>Verify the frequency of measurements and compliance of test results.</p>
<p>82) COMPACTION: Each lift shall be compacted to 90 percent of a standard Proctor.</p> <p>The moisture content of all lifts shall be equal to at least two percent and no greater than up to three percentage points above the optimum moisture.</p>	<p>Proctors shall be performed at a rate of one test per 15,000 cubic yards (compacted) or less of a specific material type.</p> <p>Conduct in-place moisture-density tests at a rate of one test per lot and record the results on the Field Density Test form. A lot is defined as 1,000 cubic yards (compacted) of a single lift. At least one test will be performed per lift. The test location shall be chosen on the basis of random numbers (described in Specification 12) and will be documented on the Lift Approval Form. Approve lots for compaction criteria where:</p>	<p>Verify the frequency of measurements and compliance of test results.</p>

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- a. material is observed to be properly compacted across the surface of the lot; and
- b. moisture/density test results meet moisture and compaction specifications.

For lots where the dry density reading from a nuclear gauge moisture/density test is less than or equal to the required percentage of the standard Proctor and/or moisture content is less than two percent or greater than three percentage points above optimum moisture:

Ensure that resolution of any reworked lots are properly accomplished and documented.

- a. Identify the lot(s) (including dimensions) requiring further compaction, and re-work the material. Re-test at the location previously tested. Test one more location in each re-worked lot. Identify the test location using the lot dimensions and random numbers (described in Specification 12).
 - 1) If the test results from both tests meet moisture/density requirements, approve the lot;
 - 2) If either test fails, repeat the above process until all tests at both locations meet moisture and compaction requirements.

- OR -

- b. If the lot is observed by the QC Technician to be adequately compacted, investigate the reason for the low density reading. If it is determined that the test results were improperly influenced, take two more density tests within five feet of the original test. **Note:** All tests are to be recorded on a Field Density Test form.

If the results from both tests meet moisture/density requirements, record both tests and approve the lot.

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	<p>If either test fails to meet moisture/density specifications – and the test results were not improperly influenced - follow instructions for a.2 above.</p>	
<p>83) TERRACING OF LIFTS: Lifts constructed at time more than 30 days apart from each other shall have at least three feet, measured horizontally, removed from the outer edge of the old lift.</p>	<p>Inspect the intersections of old and new lifts. Verify that the outer three feet of the old lifts are being removed (except for CLSM lifts). Document inspections on the Lift Approval Form. Record any problems on the Daily Construction Report.</p>	<p>Verify that the required inspections are being performed and documented.</p>
<p>84) FINAL GRADING BEFORE TEMPORARY COVER PLACEMENT: Top of fill elevations shall be at or below design elevations.</p>	<p>Survey the top lift of fill on a 50 foot grid and at key points (i.e., embankment break lines). Final survey measurements will be documented on a survey report and provided to the QC Supervisor and Quality Assurance.</p>	<p>Review the final survey data. Verify the frequency of the survey points.</p>
<p>A visual inspection is performed at the top of fill surface for any deficiencies (e.g., large rocks, etc.).</p>	<p>Perform the visual inspection. Notify the Project Manager of any deficiencies. Document inspection results on the Daily Construction Report and re-inspect deficiencies. If satisfactory, notify QA that the surface is ready for QA inspection.</p>	<p>Perform a visual inspection of the final elevation surface and provide written approval.</p>
<p>85) REGULATORY APPROVAL: In accordance with Specification 23 the Director shall approve the final surface before cover construction begins.</p>	<p>Obtain written authorization from Quality Assurance that the final surface has been inspected. Obtain documentation (e.g., notice of inspection, email, letter) confirming the Director inspection and approval.</p>	<p>Notify Director (by email) that the final surface is ready for inspection. Provide QC with documentation of Director inspection and approval.</p>

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<p>86) PRE-FINAL COVER SETTLEMENT MONUMENTS: Prior to cover construction, Interim settlement monuments will be constructed on top of the fill final surface. Interim settlement monuments shall consist of approximately 18-inch long #5 or greater rebar that is welded to a metal plate. The metal plate shall be approximately 18 inches square with a thickness of 3/16 inch to 1/4 inch. The metal plate shall be placed on the top of waste surface and secured by the temporary cover. Each monument shall be labeled, flagged, surveyed, and documented.</p>	<p>Inspect interim cover settlement monuments for compliance with the specification prior to installation.</p>	<p>Perform a surveillance of interim settlement monument installation activities.</p>
<p>87) INTERIM SETTLEMENT MONUMENT PLACEMENT: Interim settlement monuments shall be placed as close as practical to the locations of final cover settlement monuments identified in Figure 1.</p>	<p>Perform and document a post-construction survey of the location of the pre-final cover settlement monuments.</p>	<p>Verify that surveys have been performed and documented.</p>
<p>88) SURVEY REQUIREMENTS: Surveys shall be performed with GPS or approved equivalent equipment. Tolerance shall be no more than ± 0.1 foot.</p>	<p>Operate survey equipment in accordance with the manufacturer’s recommendations. Verify equipment accuracy with a known benchmark.</p>	
<p>89) SURVEY INTERVAL: The interim settlement monuments shall be surveyed within 30 days of temporary cover installation. New monuments shall be surveyed again during the months of January, March, May, July, September, and November. After at least one year of data has been obtained for a monument, it shall be surveyed semi-annually during the months of May and November until final cover construction begins. Weather conditions at the time of the survey and a discussion of the potential for frost to be present shall be documented in the survey report. Continue surveys</p>	<p>Perform and document the required surveys. Provide survey data to the Engineering Manager.</p>	<p>Verify that interim settlement monument surveys are completed and documented as required.</p>

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WORK ELEMENT – PRE-FINAL COVER SETTLEMENT MONITORING



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>until the conditions of Specification 91 are satisfied.</p> <p>90) INSPECTIONS: Monthly, inspect temporary cover for the presence of erosion gullies. If the inspection indicates that waste material is exposed due to erosion, the temporary cover shall be repaired in that area within seven calendar days.</p> <p>Annually by July 1 of each year, maintain the temporary cover surface. Maintenance shall consist of filling in and compacting any erosion gullies and, if necessary, re-grading to prevent ponding on the temporary cover.</p> <p>91) ANNUAL REPORTING: Survey data for interim settlement monuments shall be compiled and analyzed to evaluate total and differential settlement. This data and analysis shall be submitted to Director with the annual as-built report.</p> <p>Review and analysis of interim settlement monument data will include the following:</p> <ul style="list-style-type: none"> • A drawing identifying the location of each interim settlement monument, • Graphical or tabular presentation of the incremental settlement for each monument (how much each monument has moved since the last set of readings), • Graphical or tabular presentation of the total settlement for each monument, • Graphical or tabular presentation of the time rate of settlement for each monument (to include both the overall rate from the first data 	<p>Perform and document monthly inspections.</p> <p>Document maintenance activities. Document any areas requiring filling or re-grading.</p>	<p>Verify monthly inspections were completed and documented.</p> <p>Verify that annual temporary cover maintenance activities were completed and documented.</p>

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WORK ELEMENT – PRE-FINAL COVER SETTLEMENT MONITORING



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
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for the monument, and the incremental rates for each period),

- Graphical or tabular presentation of the differential settlement for each interim settlement monument with respect to the nearest adjacent interim settlement monument, and
- A discussion about the general nature of the observed settlement, and any areas of the landfill that are behaving in an anomalous manner.

92) TRANSITION TO FINAL COVER: If distortion is less than 0.007 foot/foot between adjacent interim settlement monuments, and each interim settlement monument has at least one year’s monitoring data; then final cover construction may proceed. The Engineering Manager shall make this evaluation from interim settlement data. If the criteria are met, a written report shall be prepared and forwarded to Director at least seven calendar days prior to removing the interim settlement monuments. Final cover construction shall be completed within three years of interim settlement monument removal over that specific area.

If an area is not approved for final cover construction by the end of the XXth year of the XX-year open cell period (as described in Groundwater Quality Discharge Permit UGW450005), an analysis of projected future distortions shall be performed and submitted to the Director. The analysis shall evaluate, at a minimum, potential settlement through the end of year XX of the open cell period. If the analysis indicates that the future distortions between any two adjacent monuments will be more than 0.007 foot/foot, then additional

Obtain documentation of Director notification at least seven calendar days prior to removing the interim settlement monuments.

Verify that QC has obtained documentation of Director notification.

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WORK ELEMENT – PRE-FINAL COVER SETTLEMENT MONITORING



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>engineering analyses will be done and a plan to stabilize settlement prior to final cover construction provided to the Director. The plan to stabilize settlement shall accomplish set goals prior to the open cell time limit.</p>		
<p>Immediately prior to placement of the first lift of radon barrier, the interim settlement monuments shall be removed and the temporary cover surface restored.</p>	<p>Inspect and document that all interim settlement monuments have been removed prior to final cover construction.</p>	<p>Verify that interim settlement monuments have been removed.</p>
<p>Top of temporary cover elevations shall be at or below design elevations. Additional clean debris-free soil material shall be placed; or excess temporary cover material shall be cut, as needed.</p>	<p>Survey and document the top of temporary cover surface on a 50 foot grid and at key points (i.e., embankment break lines) to confirm that the design elevations are not exceeded.</p>	<p>Verify that the temporary cover surface does not exceed design elevations.</p>
<p>When placing clean debris-free soil material for this purpose, the soil shall be placed in lifts with a compacted average thickness not exceeding 12 inches and compacted to 90 percent of a standard Proctor. If an area has settled more than 12 inches, bulk waste may be placed in accordance with the applicable work elements and specifications of this manual, so long as at least 1 foot of temporary cover is in place prior to radon barrier construction.</p>	<p>Document lift thickness and compaction for any temporary cover material placed to bring the temporary cover surface to design elevations.</p>	<p>Verify that documentation is complete.</p>
<p>Director shall be notified at least 48 hours in advance of the start-up of temporary cover removal in previously placed areas.</p>	<p>Obtain documentation of Director notification. Document the lift area and location on the Daily Construction Report.</p>	<p>Notify Director at least 48 hours in advance of temporary cover removal. Provide QC with documentation of Director notification.</p>

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - RADON BARRIER BORROW MATERIAL



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>93) SCOPE: This work element applies to the Federal Cell embankment.</p>		
<p>94) CLEARING AND GRUBBING: Remove vegetation, debris, organic, or deleterious material from areas to be used for borrow. Grubbing depth will depend on the type of vegetation, debris, organic, or deleterious material on the site. If the area is free of these materials then no clearing and grubbing will be necessary.</p>	<p>Inspect the area once clearing and grubbing has been completed. Record observations and corrective action (where required) on the Daily Construction Report.</p>	<p>Verify that the clearing and grubbing has been inspected and documented by QC.</p>
<p>95) MATERIAL--NATURAL CLAY MIXTURE: Satisfactory material shall meet the specifications as CL or ML soils based on the Unified Soil Classification System with at least 85 percent passing the No. 200 sieve (silt and clay), a plasticity index (PI) between 10 and 25, and a liquid limit (LL) between 30 and 50.</p>	<p>Perform laboratory classification tests (ASTM D 2487) at a rate of one test per lot prior to use of material in the radon barrier. A lot is defined as a maximum of 5,000 cubic yards (compacted) of specified material type. Record the location of the classification sample on the Sample Log.</p>	<p>Verify that the frequency of laboratory tests is in compliance with the specification.</p>
<p>96) PROTECTION: The borrow material will be handled in such manner as to prevent contamination with radioactive waste material or other deleterious material. Acceptable material may contain up to five percent additional rocks (less than or equal to one inch) and sand above the content found in the classification test.</p>	<p>Visually check radon barrier materials for contamination by foreign materials in accordance with ASTM D2488. Remove or rework clays that have been contaminated above the specified requirements. Document corrective actions (where required) on the Daily Construction Report.</p>	<p>Verify that the radon barrier is being inspected for contaminants and that the inspection and corrective actions (if required) are properly documented.</p>
<p>97) PROCESSING: These procedures may be used to provide suitable material for construction of the radon barrier.</p> <p style="margin-left: 40px;">A. If used, apply deflocculant at a rate determined by the Engineering Manager.</p>	<p>Measure the size of the mixing areas and verify that the application rate of the deflocculant is equal to or greater than the rate determined by the Engineering Manager. Record the size of the mixing areas and the amount of deflocculant applied on the Embankment Construction Lift Approval Form.</p>	<p>Verify that the size of the mixing areas and the amount of deflocculant applied has been properly documented.</p>

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B. Mix the deflocculant thoroughly into the soils by tilling, or similar action.

Observe the mixed clay and notify the Project Manager of areas which are adequately mixed.

Verify that the clay is being inspected correctly and documented by QC.

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - RADON BARRIER TEST PAD**



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>98) SCOPE: This work element applies to the Federal Cell embankment.</p>		
<p>99) NOTICE OF TEST PAD CONSTRUCTION: In accordance with Specification 23 the radon barrier test pad plan shall be approved by the Director. The radon barrier test pad plan shall be provided to the Director at least 14 calendar days prior to test pad construction.</p> <p>The Director shall be notified 48 hours in advance of the start-up of test pad construction.</p>	<p>Obtain documentation confirming that the test pad plan has been approved by the Director.</p>	<p>Verify that the test pad plan has been provided to the Director at least 14 calendar days prior to construction of the test pad. Provide QC with documentation of Director approval.</p>
	<p>Obtain documentation confirming that the Director has been notified as required.</p>	<p>Notify the Director at least 48 hours in advance of the start-up of test pad construction. Provide QC with documentation of Director notification.</p>
<p>100) TEST PAD(S): A test pad with minimum dimensions of 60 feet by 75 feet shall be constructed using the procedure approved in the test plan for construction of the radon barrier.</p> <p>Prior to use of manually operated compaction equipment, a small test pad with minimum dimensions of five feet by five feet (sized appropriately for the equipment used) shall be constructed. The purpose of this small test pad is to establish equipment and procedures for construction of radon barrier in locations where large equipment is not practical (e.g. repairs). If manually operated compaction equipment is not used on the project, a small test pad is not required.</p> <p>A new radon barrier test pad shall be constructed each time there is a change in specifications, construction procedures, unified soil classification, or types of equipment.</p>	<p>Observe the construction of test pads. Measure test pads to ensure that they are constructed to the size indicated. Record the test pad size on the Embankment Construction Lift Approval Form.</p> <p>The large test pad shall be divided into three lots per lift (approximately 1,500 square feet per lot). Each lift of the small test pad shall equal a lot.</p>	<p>Observe the construction of the test pads. Verify that the test pad has been measured and is properly documented.</p>

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WORK ELEMENT - RADON BARRIER TEST PAD**



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>Radon barrier test pads are to be constructed and tested in accordance with the following specifications:</p> <p>A. Prior to compaction, conduct at least one classification and gradation test for each test pad.</p> <p>B. Place the clay in at least three lifts with the first lift uncompacted thickness not exceeding twelve inches. Remaining lifts shall have a loose material thickness not exceeding nine inches for each lift.</p> <p>C. The clay material will have a dry clod size less than or equal to one inch.</p> <p>D. The clay is to be placed and compacted by equipment proposed for use during construction of the radon barrier.</p> <p>E. The lifts of clay shall be bonded by providing a rough upper surface on the underlying layer of radon barrier. The surface should have changes in grade of approximately one inch or more at a rate of two or more per linear foot.</p>	<p>Conduct classification and gradation tests (as described in Appendix B) at a rate of one of each type of test per test pad.</p> <p>Measure the lift thickness at a rate of one test per lot. Record thickness on the Embankment Construction Lift Approval Form.</p> <p>Inspect the loose clay material during the unloading and spreading process for each uncompacted lift to ensure any dry clods that are present are less than or equal to one inch. Notify the Project Manager to have operations remove clods greater than one inch. Record inspection of the dry clod size on the Embankment Construction Lift Approval Form and re-inspect the uncompacted lift if necessary. Record any corrective actions performed on the Daily Construction Report.</p> <p>Record type of equipment used, and number of passes on the Embankment Construction Lift Approval Form.</p> <p>Perform a visual inspection to verify that there are adequate changes in grade. Any areas of concern shall be verified by placing a straight edge at least two feet long on the surface and counting the number of points approximately one inch or more below the straight edge. Notify the Project Manager of any deficiencies. Re-inspect after the Project Manager has corrected deficiencies.</p>	<p>Verify the frequency of tests and compliance of test results.</p> <p>Verify that the number of lifts and lift thicknesses has been documented. Verify that the clod size inspection has been performed and documented for each uncompacted lift thickness.</p> <p>Verify that the dry clod size inspection has been performed and documented, including corrective actions as necessary.</p> <p>Perform a minimum of one visual inspection per test pad.</p> <p>Verify the frequency of measurements and compliance of test results.</p>

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WORK ELEMENT - RADON BARRIER TEST PAD**



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>F. The clay is to be compacted to at least 95 percent of a standard Proctor with moisture content between one-half a percentage point below optimum and five percentage points over optimum. Compaction of the large test pad is to be accomplished by at least four passes of suitable compaction equipment.</p>	<p>Conduct in-place moisture-density tests at a rate of one test per lot per lift. The test location shall be chosen on the basis of random numbers (described in Specification 12). Record the test result on the Field Density Test form.</p> <ol style="list-style-type: none"> a. Approve lots which meet the specified moisture and compaction. b. Notify the Project Manager of lots not meeting the specified moisture and compaction to have the areas reworked. c. Retest (moisture/density and permeability) lots after rework has been completed. d. Any additional work under b. shall be included in the test pad construction method. 	<p>Review documentation and verify the frequency of tests and compliance of test results.</p>
<p>G. The clay is to be constructed to provide a permeability of less than or equal to the specified permeability as indicated in specification 111 and as shown on the approved engineering drawings listed in Groundwater Quality Discharge Permit UGW450005. Permeability testing on the bottom lift will be performed at the surface. Permeability on the second lift will be performed greater than or equal to two inches below the surface. Permeability on the third lift will be performed greater than or equal to four inches below the surface.</p>	<p>Conduct in-place permeability tests at a rate of one test per lot per lift. The permeability test shall be run in close proximity to the moisture-density test. Record the test result on the Field Permeability Test form.</p> <ol style="list-style-type: none"> a. Approve lots that meet the specified permeability. b. Notify the Project Manager of lots not meeting the specified permeability to have the areas reworked. c. Retest (moisture/density and permeability) lots after rework has been completed. d. Any additional work under b. shall be included in the test pad construction method. 	<p>Verify the frequency of tests and compliance of test results.</p>
<p>H. The procedures used to construct the test pad shall be reviewed and approved by a Utah licensed Professional Engineer.</p>	<p>Provide the Utah licensed Professional Engineer with copies of the documentation for the test pad for review and approval.</p>	<p>Verify that proper approval has been obtained for the test pad and that the necessary construction procedure documents are in place for use during radon barrier construction.</p>
<p>I. In accordance with Specification 23 the approval of the test pad certification report by the Director shall be obtained at least 14</p>	<p>Obtain documentation confirming that the test pad certification report has been approved by the Director.</p>	<p>Verify that the test pad certification report has been provided to the Director. Provide QC with documentation of Director approval.</p>

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calendar days from the time the certification report was submitted and prior to using the new test pad construction method.

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<p>101) SCOPE: This work element applies to the Federal Cell embankment.</p>		
<p>102) NOTICE OF COVER CONSTRUCTION: The Director shall be notified of start-up for each phase of cover construction.</p>	<p>Obtain documentation of Director notification.</p>	<p>Notify the Director of start-up for each phase of cover construction. Provide QC documentation of Director notification.</p>
<p>103) PROJECT AREA: Radon barrier projects shall have a minimum total area of 300,000 square feet, unless otherwise approved in advance, in writing by Director. The Director approval shall be obtained in accordance with Specification 23. Placement of radon barrier shall be made to the lines, grades, and dimensions prescribed in the approved phase-specific plans. Radon barrier projects may continue over more than one construction season, so long as the specifications for cold weather placement and spring start-up are met (Specifications 116 and 117). A radon barrier project may consist of any number of lift areas. The project area shall be documented in phase-specific plan drawings.</p>		
<p>104) LIFT IDENTIFICATION: Each lift shall be given a unique lift identification number for testing and surveying purposes.</p>	<p>Assign a lift identification number to each lift. Use the lift identification number to identify all paper work for that lift.</p>	<p>Verify that a lift identification number has been assigned to each lift. Verify that the lift identification number is used on all paper work for that lift.</p>
<p>105) PLACEMENT: The radon barrier will be prepared, placed and compacted using equivalent type of equipment and mixing and compacting procedures that were approved in the test pad (Specification 100).</p> <p>If equipment used to prepare, place, and/or compact clay liner differs by make and/or model from the equipment identified in the approved test pad, equipment equivalency shall be determined and</p>	<p>Observe the radon barrier placement. Record the equipment and procedures used to place the radon barrier, along with any corrective actions (where required) on the Daily Construction Report.</p> <p>Obtain documentation of equipment equivalency.</p>	<p>Verify the equipment and procedures used to construct the radon barrier have been documented and that it is an equivalent type of equipment used to construct the test pad.</p> <p>Verify that use of equivalent equipment has been approved by a Utah licensed Professional Engineer.</p>

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<p>approved by a Utah licensed Professional Engineer prior to use. The Director shall be notified at least 48 hours in advance of implementing an equipment change and in accordance with Specification 23 the Director shall approve the equivalency determination prior to use of the equivalent equipment.</p> <p>The clay material shall have a dry clod size less than or equal to one inch.</p>	<p>Obtain documentation that the Director has been notified and approved of an equipment equivalency determination.</p> <p>Inspect the loose clay material during the unloading and spreading process for each uncompacted lift to ensure any dry clods that are present are less than or equal to one inch. Notify the Project Manager to have operations remove clods greater than one inch. Record inspection of the clod size on the Embankment Construction Lift Approval Form and re-inspect the uncompacted lift. Record any corrective actions performed on the Daily Construction Report.</p>	<p>Notify the Director 48 hours prior to using equipment that has been determined equivalent by a Utah licensed Professional Engineer. Provide QC with documentation of Director approval.</p> <p>Verify that the clod inspection has been performed and documented.</p>
<p>106) LIFT BONDING: The lifts shall be bonded by providing a rough upper surface on the underlying layer of radon barrier. The surface should have changes in grade of approximately one inch or more at a rate of two per linear foot.</p>	<p>Perform a visual inspection to verify that there are adequate changes in grade. Any areas of concern shall be verified by placing a straight edge at least two feet long on the surface and counting the number of points approximately one inch or more below the straight edge. Notify the Project Manager of any deficiencies. Re-inspect the surface after corrective actions have been completed. Document any deficiencies and corrective actions taken on the Daily Construction Report.</p>	<p>Verify the frequency of measurements and compliance of test results.</p>
<p>107) LIFT THICKNESS: The first lift of material shall have an uncompacted thickness of no greater than 12 inches. For the remaining lifts, the loose lift thickness shall not exceed the lesser of the lift thickness used to construct the test pad or nine inches.</p> <p>A. Thickness for the lift will be established by installing grade poles on at least a 70-foot grid</p>	<p>Verify that the required grading tolerance is achieved as follows:</p> <ol style="list-style-type: none"> a. Ensure that the required frequency for placement of grade poles has been met. b. Compare soil level with the marked level on the grade poles. c. Visually check between poles for high or low spots. d. Define out of specification areas and notify the Project Manager to rework those areas. 	<p>Verify the frequency of measurements and compliance of test results.</p>

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<p>and at all control points (at a minimum, each corner of the area; also at break lines). The grade poles must not be installed deeper than three inches into the underlying clay radon barrier. The grade poles must be marked at the appropriate depth to establish the grade. After the grade for the lift has been checked and approved by QC personnel, the grade poles shall be removed.</p> <p style="text-align: center;">- OR -</p> <p>B. Survey to determine lift thickness. Survey equipment shall have a tolerance no more than \pm 0.1 foot.</p>	<p>e. Review areas reworked and approve areas meeting criteria.</p> <p>f. Continue "b" through "d" above until all areas meet criteria.</p> <p>g. Indicate areas meeting criteria in the Embankment Construction Lift Approval Form.</p> <p style="text-align: center;">- OR -</p> <p>a. Verify survey equipment is within a tolerance of \pm 0.1 foot,</p> <p>b. Verify correct set-up and operation of equipment,</p> <p>c. Document survey results on a survey report.</p>	
<p>108) KEYING-IN: Segments of cell radon barrier constructed at times more than 30 days apart than each other shall be keyed-in to each other by one of the following methods:</p> <p>A. Key-in vertical steps no greater than nine inches and at least twice as wide as they are high.</p> <p style="text-align: center;">- OR -</p> <p>B. Slope the full thickness of old radon barrier at a maximum slope of 5:1.</p> <p>The surface shall be maintained in accordance with Specification 114.</p>	<p>Verify that the new liner has been properly keyed-in to the existing liner. Record deficiencies on the Embankment Construction Lift Approval Form.</p>	<p>Verify that the keying-in of the liner has been documented.</p>
<p>109) COMPACTION: Radon barrier material will be compacted to at least 95 percent of standard Proctor with moisture content between one-half a</p>	<p>Conduct in-place moisture-density tests at a rate of one test per lot and record the results on the Field Density Test form. A lot is defined as 500 cubic yards</p>	<p>Visually observe at least one in-place moisture-density test per project area. Verify that the tests are being</p>

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percentage point below optimum and five percentage points over optimum.	<p>(compacted) of a single lift. The test location shall be chosen on the basis of random numbers (described in Specification 12).</p> <p>a. Approve lots which meet the specified moisture and compaction.</p> <p>b. Rework and retest lots not meeting the specified moisture or compaction.</p> <p>Proctors shall be performed at a rate of one test per borrow lot. A borrow lot is defined as 3,000 cubic yards (compacted) or less of a specific material type. Record the location of the Proctor sample on the Sampling Log.</p>	performed at the correct frequency and that the documentation is being completed.
110) PERMEABILITY: The radon barrier shall have an in-place permeability of less than or equal to 1×10^{-6} cm/sec for the bottom layer. The radon barrier shall have an in-place permeability of less than or equal to 5×10^{-8} cm/sec for the final top foot.	<p>Conduct in-place permeability tests at a rate of one test per lot and record the results on the Field Permeability Test form. A lot is defined as 2,000 compacted cubic yards of 1×10^{-6} cm/sec radon barrier or 5×10^{-8} cm/sec radon barrier. The permeability test shall be run within five linear feet of a moisture-density test location.</p> <p>a. Approve lots which meet the specified permeability.</p> <p>b. Notify the Project Manager of lots not meeting the specified permeability to have the areas reworked.</p> <p>c. Retest (moisture/density and permeability) lots after rework has been completed.</p> <p>d. Restore all test areas to assure no leaks.</p>	Visually observe one lift being compacted per construction season.
111) LAYER THICKNESS: Construct the radon barrier for the Federal Cell embankment as shown on the approved engineering drawings listed in Groundwater Quality Discharge Permit UGW450005.		
112) TRANSITIONS BETWEEN RADON BARRIERS WITH DIFFERENT SPECIFIED PERMEABILITIES: The radon barrier with the higher permeability (i.e. the bottom radon barrier) shall be final graded to no greater than design	Survey the radon barrier surface on a 50 foot grid and at key points. Final survey measurements will be documented and provided to the QC Supervisor and Quality Assurance.	Review the final survey data. Verify the frequency of the survey points.

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<p>elevation and no less than 0.4 feet below design elevation. Survey on a 50 foot grid and key points (i.e., embankment break lines).</p>		
<p>113) RADON BARRIER DRYING PREVENTION: Desiccation cracks shall not exceed one-fourth inch wide and three-inches deep in the radon barrier. Areas with desiccation cracks exceeding this specification shall be identified as new lots to be reworked and shall be reported to the Director.</p>	<p>Observe the radon barrier surface for drying and document results on the Daily Construction Report.</p> <p>Notify the Project Manager and QA of any desiccation cracks larger than specification identified in the radon barrier.</p> <p>Radon barrier with larger than specification desiccation cracks shall be reworked and retested in accordance with one of the following methods:</p> <ol style="list-style-type: none"> a. Scarify the in-place clay, moisture condition as needed, then recompact and retest the clay material in accordance with Specifications 106, 110, and 111. b. Excavate all material with larger than specification desiccation cracks and replace with new clay in accordance with Specifications 105 through 111. 	<p>Verify that the radon barrier is being inspected correctly and the inspection documented. Report discrepancies to the Director as required.</p>
<p>To prevent the radon barrier from drying one (or more) of the following methods shall be employed:</p> <ol style="list-style-type: none"> A. Apply water to the radon barrier surface on an as needed basis B. Cover unfinished radon barrier with six inches of loose clay C. Cover finished radon barrier with 12 inches of the next design layer(s) or six inches of loose clay material. If clay material is used, remove loose clay prior to placing next design layer 	<p>Document methods used to prevent the radon barrier from drying on the Daily Construction Report.</p>	<p>Verify that the scheduling and methods used to prevent unfinished and finished radon barrier from drying have been documented.</p>

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<p>Unfinished or finished radon barrier will be covered in accordance with method B or C above within 30 days of the last activity for the lift.</p>	<p>Document that protective measures have been placed over unfinished and finished radon barrier lifts within 30 days of the last lift activity.</p>	
<p>114) SNOW REMOVAL: When radon barrier material is to be placed and the work area is covered with snow, the snow must be removed without damaging approved radon barrier.</p>	<p>Observe that snow is removed. Inspect radon barrier for damage. Notify the Project Manager of deficiencies/damage. Re-inspect after the Project Manager has corrected deficient/damaged areas. Record corrective actions (where required) in the Daily Construction Report.</p>	<p>Verify that snow removal is being documented and the radon barrier had been inspected.</p>
<p>115) COLD WEATHER PLACEMENT OF RADON BARRIER: For purposes of this Manual, “frozen” is defined as a soil temperature of less than or equal to 27°F. Radon barrier shall not be placed above frozen material. In addition, no frozen material shall be processed or placed.</p> <p>If the air temperature has dropped below 32°F since the last lift of radon barrier was approved, one of the following three scenarios apply:</p> <p>A. If less than 30 days have passed since the date of lift approval and the last lift of radon barrier has been covered since the approval date with at least nine inches of loose clay or six inches of compacted clay, then the cover clay may be worked with no additional testing of the lower approved lift.</p> <p>B. If less than 30 days have passed since the date of lift approval and the last lift of radon barrier has not been covered with at least nine inches of loose clay or six inches of compacted clay, then:</p>	<p>As needed, observe the area where radon barrier is to be placed. If frozen material is observed, cease placement of radon barrier. If frozen material is suspected, measure soil temperature. Record the stopping of placement in the Daily Construction Report.</p> <p>Review ambient air temperature records as measured at the site meteorological station. Document status of radon barrier cover placement on the Daily Construction Report. Measure radon barrier temperature when triggered under B.2. of this specification at the design frequency. Clay temperature shall be measured between 6:00 AM and 8:00 AM on the day that radon barrier will be placed. Temperature measurements shall include a location that is most likely to be coldest; i.e., if there is a portion of the radon barrier that is shaded or at a low point. To ensure a stable reading, the temperature probe shall be left in place for at least two minutes prior to taking the reading</p> <p>If the initial radon barrier temperature measurement is less than or equal to 27°F, the affected area may be resampled before 8:30 AM the same day as follows:</p>	

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - RADON BARRIER PLACEMENT**



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>1. Perform spring start-up testing as discussed in Specification 116; or</p> <p>2. Measure the radon barrier temperature approximately one inch beneath the surface at a frequency of one measurement per lot (defined as no more than 100,000 square feet). If the temperature one inch beneath the surface is greater than 27°F, re-roll the surface with one pass of the same type of construction equipment (i.e., a compactor for intermediate lifts or a smooth drum roller for the final surface) and continue with radon barrier construction. If the temperature one inch beneath the surface is less than or equal to 27°F, re-work and re-test density and permeability of the affected area after the clay temperature has risen above 27°F.</p> <p>C. If more than 30 days have passed since the date of lift approval, perform spring start-up testing.</p> <p>In addition, the final lift of 5×10^{-8} cm/sec radon barrier requires that the next design layer be placed over the radon barrier prior to the end of the work day when ambient temperatures will drop below 32 degrees Fahrenheit. If this protective cover is not applied prior to freezing conditions, an additional density test and permeability test shall be performed directly prior to covering the radon barrier final surface with the next design layer. This process must be repeated whenever any final surface material is not covered with the next design layer prior to overnight freezing conditions.</p> <p>116) SPRING START-UP: See Specification 115 for situations that trigger this specification.</p>	<p>a. Measure the radon barrier temperature at a frequency of one measurement per lot (defined as no more than 10,000 square feet).</p> <p>b. Lots where the temperature is greater than 27°F do not require rework; except that the lot where the initial temperature less than or equal to 27°F was measured shall be reworked regardless of resampling results.</p> <p>Perform an additional density test and permeability test on 5×10^{-8} cm/sec final surface that has been exposed to overnight freezing conditions prior to placement of the next design layer. If passing test results are achieved, but it is not possible to cover all of the exposed radon barrier material with the next design layer prior to the end of the workday, testing must be repeated for the exposed materials at a frequency of one test per 2,000 cubic yards of exposed material. This testing may be performed outside of the approved lift area so long as the area tested is representative of the clay in the approved lift area (i.e., was constructed at the same time and with the same method).</p>	<p>Verify that radon barrier is tested (and the testing documented) during cold weather conditions.</p>

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - RADON BARRIER PLACEMENT**



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>For spring start-up testing, the surface lift is treated as protective cover, regardless of whether it was an approved lift of radon barrier at one time or not. Excavate nine inches below the clay surface and re-test for density and permeability. Excavation for testing purposes may consist of removing the protective cover lift; or may be performed by ‘potholing’ only at the testing locations. Areas that have been ‘potholed’ for permeability shall be repaired by applying the same level of effort as prescribed by the approved test pad for radon barrier construction.</p>	<p>Perform density and permeability testing at frequencies of one test per lot size of 500 or 2,000 cubic yards, respectively. This testing may be performed outside of the approved lift area so long as the area tested is representative of the clay in the approved lift area (i.e., was constructed at the same time and with the same method). Moisture testing is not required for spring start-up.</p> <ol style="list-style-type: none"> a. Approve lots that meet specification. The protective cover lift may be worked in place and tested to become the next lift of radon barrier. b. For lots that do not meet specification, test the surface at successively deeper nine inch increments until a passing lift is found; remove all failing lots; re-work all failing lots; and re-test. <p>Document that repairs are completed to the same level of effort as required by the approved test pad for radon barrier construction.</p>	
<p>117) CONTAMINATION OF RADON BARRIER: The radon barrier material shall not become contaminated with radioactive soils or debris during construction. The in-place clay may contain up to five percent additional rocks (less than or equal to one inch) and sand above the content found in the classification test.</p>	<p>Visually check radon barrier for contamination by foreign materials in accordance with ASTM D2488. Remove or rework clays which have been contaminated above the specified requirements. Document corrective actions (where required) on the Daily Construction Report.</p>	<p>Verify that the radon barrier is being inspected for contaminants and that the inspection and corrective actions (if required) are properly documented</p>
<p>118) FINAL GRADING: Final grading shall be from design elevation to 0.2 feet above design elevation.</p>	<p>Survey the final grade surface of the radon barrier on a 50 foot grid and at key points (i.e., embankment break lines). Final survey measurements will be documented and provided to Quality Assurance.</p>	<p>Review the final survey data. Verify the frequency of the survey points.</p>
<p>119) EROSION CONTROL FOR EXPOSED SOIL: If Director-approved final elevation 5×10^{-8} cm/sec radon barrier soil surfaces are not covered</p>		

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - RADON BARRIER PLACEMENT**



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>by the next design layer within 30 days of lift approval, the following erosion control repair measures shall apply.</p> <p>Monthly, inspect exposed radon barrier soil surfaces for evidence of erosion. Rivulet or gullied areas wider than six inches or deeper than six inches require maintenance to fill the rivulet or gully and restore the area to design elevation. Soils imported as fill shall meet the requirements of Specification 96. Maintenance shall be performed within 30 calendar days when needed.</p> <p>Erosion control blankets, mats, or fiber mulch may be used, in accordance with the manufacturer's instructions, for erosion prevention.</p> <p>Director shall be notified at least 48 hours prior to deployment of erosion control blankets, mats, or fiber mulch. If used, such erosion control materials shall be removed prior to filter zone construction.</p>	<p>Perform monthly inspections. Document the inspection as well as associated maintenance activities on the Daily Construction Report.</p>	<p>Review documentation to verify that monthly inspections have been performed.</p>
<p>120) RADIOLOGICAL SAMPLING FOR EXPOSED SOIL: If Director-approved final elevation 5×10^{-8} cm/sec radon barrier soil surfaces are not covered by the next design layer within 30 days of final approval, the area shall be either:</p> <p>A. sampled and radiologically released in accordance with the Environmental Monitoring Plan; or</p> <p>B. have a minimum of six inches of clay removed and replaced prior to placement of the next design layer. Under this option, no environmental sampling is required.</p>	<p>Obtain documentation of Director notification.</p> <p>Coordinate sampling and analysis with environmental personnel. Attach a copy of the release report to the lift approval documentation.</p>	<p>Notify Director at least 48 hours prior to deployment of erosion control blankets, mats, or fiber mulch. Provide QC with documentation of Director notification.</p>

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - RADON BARRIER PLACEMENT**



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>121) HEAVY EQUIPMENT ON RADON BARRIER: Heavy equipment travel will be minimized on top of the finished radon barrier. Heavy equipment will not be operated on saturated radon barrier.</p>	<p>Observe work on radon barrier. Notify the Project Manager of problems with equipment on the radon barrier. Re-inspect radon barrier and record corrective actions taken (where required) on the Daily Construction Report.</p>	<p>Verify that the work is being inspected.</p>
<p>122) DIRECTOR APPROVAL: The Director shall approve documentation associated with completed radon barrier. Documentation shall include all QC and QA records associated with construction, as well as photographs of the completed surface. The Director approval shall be obtained in accordance with Specification 23. In addition, 48 hour notification shall be provided to the Director prior to placement of the next design layer over the finished radon barrier.</p>	<p>Notify Quality Assurance that the radon barrier is ready for inspection by the Director. Obtain written authorization on the Radon Barrier Inspection Form from Quality Assurance that the radon barrier has been inspected. Obtain documentation of Director notification. Confirm Director approval of the radon barrier documentation.</p>	<p>Provide written approval of the radon barrier. Notify the Director that the radon barrier is ready for inspection. Provide QC with documentation of Director notification.</p>

FEDERAL CELL CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – FROST PROTECTION LAYER PLACEMENT



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>123) SCOPE: This work element applies to the Federal Cell embankment.</p>		
<p>124) MATERIAL: The frost protection layer consists of well graded bank run borrow material as described in the approved engineering drawings listed in Groundwater Quality Discharge Permit UGW450005.</p>		
<p>125) GRADATION: Gradation of the frost protection layer bank run borrow material shall be 16” minus material.</p>	<p>Perform gradation testing, in accordance with ASTM D5519 or C136, at a rate of one test per 10,000 cubic yards with a minimum of four tests per embankment. Record the location of all samples in the Sample Log.</p> <p>If any deficiencies are identified in gradation testing, notify the Project Manager to have operations rework the material. After reworking (if necessary), retest the material and record corrective actions (where required) in the Daily Construction Report.</p>	<p>Verify the frequency of laboratory tests and compliance of test results.</p>
<p>126) PLACEMENT: Frost protection layer bank run borrow material will be placed over the radon barrier zone as specified on the approved engineering drawings. Bank run borrow material shall be handled in such a manner as to prevent segregation of finer materials.</p>	<p>Observe the placement of the frost protection layer bank run borrow material. Ensure that soil fines are not concentrated in localized areas. If soil fines are concentrated in localized areas, notify the Project Manager to have operations evenly distribute the fines or to remove them. Re-inspect after the Project Manager makes changes. Record observations and corrective actions (where required) in the Daily Construction Report.</p>	<p>Verify that QC personnel observe the placement of the frost protection layer such that fines are not concentrated in localized areas.</p>
<p>SNOW REMOVAL: When frost protection layer bank run borrow material is to be placed and the work area is covered with snow, the snow must be removed.</p>	<p>Observe that snow is removed. Inspect the bank run borrow material for damage. Advise the project manager of any deficiencies/damage. Record corrective actions (where required) in the Daily Construction Report.</p>	<p>Review the documentation and verify the depth specification from the approved engineering drawings is met. Verify that inspections were conducted.</p>

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – FROST PROTECTION LAYER PLACEMENT



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>127) FINAL GRADING: Thicknesses for the frost protection layer will be established by installing grade poles on at least a 70' grid and at all control points or by GPS survey. The grade poles must be marked at the appropriate depth to establish grade. After the grade has been checked and approved by QC personnel, the grade poles shall be removed.</p>	<p>Verify the required grade is achieved at all control points. Rework and re-verify areas not meeting the specified grade. Visually inspect for rock greater than 16" during lift placement. Mark oversized rock for removal and verify removal. Record observations and corrective actions (where required) in the Daily Construction Report</p>	<p>Review the documentation and verify the depth specification from the approved engineering drawings is met. Verify that inspections were conducted.</p>

FEDERAL CELL CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – FILTER ZONE (SIDE SLOPE)



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
128) SCOPE: This work element applies to the Federal Cell embankment side slope.		
129) FILTER ZONE PERMEABILITY: The filter zone rock on the Federal cell embankment will have a minimum permeability of 3.5 cm/sec.	<p>Perform permeability testing at a rate of one test per 10,000 cubic yards placed. Record the location of all samples in the "Sampling Log".</p> <p>a. Approve rock for use in the filter zone which meets the specified permeability.</p> <p>b. Rock not meeting the specified permeability cannot be used.</p>	<p>Verify the frequency of laboratory tests and compliance of test results.</p>
130) GRADATION: Federal Cell embankment rock gradation shall be as specified on currently approved engineering drawings listed in Groundwater Quality Discharge Permit UGW450005.	<p>If filter zone rock material is to be stockpiled, perform gradation testing at a rate of one test per 10,000 cubic yards stockpiled. If filter zone rock material is transferred directly to the cell from the production plant, perform at least one gradation test per source per day material is placed, or at least one test per 10,000 cubic yards. A minimum of four tests is necessary over the entire embankment.</p> <p>In addition, perform a minimum of one test per change in soil type by ASTM D2488. Record the location of all samples in the Sampling Log.</p> <p>If any deficiencies are identified in gradation testing, notify the Project Manager to have operations rework the material. After reworking (if necessary), retest the material and record corrective actions (where required) in the Daily Construction Report.</p>	<p>Verify the frequency of laboratory quality control tests and compliance of test results.</p>
131) PLACEMENT: Filter zone material will be placed over the frost protection layer. The thickness of the filter zone layer for the Federal Cell embankment shall be as specified on currently approved engineering drawings listed in Groundwater Quality Discharge Permit	<p>Observe the placement of the filter zone material. Ensure that the filter zone is uniform in appearance with no soil fines or rock concentrated in localized areas. If the filter zone is not uniform in appearance, notify the Project Manager to have operations evenly distribute the filter zone material. Re-inspect the filter zone material</p>	<p>Review documentation and verify that QC personnel observe the placement of the filter zone material such that it is uniform in appearance.</p>

FEDERAL CELL CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – FILTER ZONE (SIDE SLOPE)



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
UGW450005. Filter zone material shall be handled in such a manner as to prevent the segregation of finer materials.	and record corrective actions (where required) in the Daily Construction Report.	
132) SNOW REMOVAL: When filter zone material is to be placed and the work area is covered with snow, the snow must be removed.	Observe that snow is removed. Inspect the filter zone for damage. Notify the Project Manager of any deficiencies/damage. Re-inspect the filter zone and record corrective actions (where required) in the Daily Construction Report.	Verify that snow removal is being documented and the filter zone has been inspected.
133) FINAL GRADING: Thickness for the lift will be established by installing grade poles on at least a 50' grid and at all control points. The grade poles shall consist of PVC pipe (approximately ½-inch diameter) with surveyor's ribbon (or other distinguishable markings) attached to the appropriate lift thickness. The poles shall be held in place by placing the filter rock adjacent to the base of the grade pole to secure it in a vertical position (long axis of the grade pole perpendicular to the radon barrier surface). With the grade pole marked at the appropriate thickness and secured at the appropriate locations, the filter rock may be placed throughout the project area. The base of the grade poles shall rest on the surface of the radon barrier and therefore will not damage the radon barrier surface. After the grade has been checked and approved by QC personnel, the grade poles shall be removed from the filter zone.	<p>Verify that the grade poles are marked at the appropriate depth to establish grade for the layer that will be placed.</p> <p>Verify the required grade is achieved at all control points throughout the placed filter rock in the project area. Confirm that the in-place thickness of the filter zone material is between 90 percent and 125 percent of the design thickness. Rework and re-verify areas not meeting the specified grade. Ensure all grade poles have been removed following verification of grade. Document all inspections and corrective actions, where required, on the Daily Construction Report.</p>	<p>Observe the installation of some of the grade poles to ensure that the installation method has been followed and verify that the grade poles have not penetrated or damaged the surface of the radon barrier.</p> <p>Review documentation for final grading.</p>

FEDERAL CELL CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - ROCK EROSION BARRIER (SIDE SLOPE)



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>134) SCOPE: This work element applies to the Federal Cell embankment side slope.</p>		
<p>135) GRADATION: Gradation of the rock erosion material shall be as specified on the currently approved engineering drawings listed in Groundwater Quality Discharge Permit UGW450005.</p>	<p>In addition to rock quality scoring, perform gradation testing, in accordance with ASTM D5519 or C136, at a rate of one test per 10,000 cubic yards with a minimum of four tests per embankment. Record the location of all samples in the Sampling Log.</p> <p>If any deficiencies are identified in gradation testing, notify the Project Manager to have operations rework the material. After reworking (if necessary), retest the material and record corrective actions (where required) in the Daily Construction Report.</p>	<p>Verify the frequency of laboratory quality control tests and compliance of test results.</p>
<p>136) PLACEMENT: Rock erosion material will be placed over the filter zone. Thickness of rock erosion barrier for the Federal Cell embankment shall be as described in the currently approved engineering drawings listed in Groundwater Quality Discharge Permit UGW450005. Rock erosion material shall be handled in such a manner as to prevent segregation of finer materials.</p>	<p>Observe the placement of the rock. Ensure that soil fines are not concentrated in localized areas. If soil fines are concentrated in localized areas, notify the Project Manager to have operations evenly distribute the fines or to remove them. Re-inspect after the Project Manager makes changes. Record corrective actions (where required) in the Daily Construction Report.</p>	<p>Verify that QC personnel observe the placement of the rock erosion material such that soil fines are not concentrated in localized areas.</p>
<p>137) SNOW REMOVAL: When rock erosion barrier material is to be placed and the work area is covered with snow, the snow must be removed.</p>	<p>Observe that snow is removed. Inspect the rock erosion barrier for damage. Notify the Project Manager of any deficiencies. Re-inspect and record corrective actions (where required) in the Daily Construction Report.</p>	<p>Verify that snow removal is being documented and the rock erosion barrier has been inspected.</p>
<p>138) FINAL GRADING: Thickness for the lift will be established by installing grade poles on at least a 70 foot grid and at all control points or by GPS survey. The grade poles shall consist of PVC pipe (approximately one-half inch diameter) with surveyor ribbon (or other distinguishable markings). The grade poles must be marked at the appropriate depth to establish grade. After the grade</p>	<p>Verify the required grade is achieved at all control points. Confirm that the in-place thickness of the rock erosion barrier is between 90 percent and 125 percent of the design thickness. Notify the Project Manager of areas not meeting the specified grade. Re-verify after rework has been completed. Document all inspections and corrective actions (where required) on the Daily Construction Report.</p>	<p>Review the documentation for final grading.</p>

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - ROCK EROSION BARRIER (SIDE SLOPE)



SPECIFICATION

QUALITY CONTROL

QUALITY ASSURANCE

has been checked and approved by QC personnel, the grade poles shall be removed.

139) NOTICE OF COVER CONSTRUCTION:
Provide written notice of the completion of cover construction to the Director within 30 days of completion of each phase of cover construction in the "cut and cover" operation.

Obtain documentation of Director notification.

Within 30 days of completion of each phase of cover construction, notify the Director of completion of cover construction. Provide QC with documentation of Director notification. **Note:** The Engineering Manager, or designee, may notify the Director and provide Quality Assurance documentation of the notification.

FEDERAL CELL CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – EVAPORATIVE ZONE LAYER PLACEMENT (TOP SLOPE)



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>140) SCOPE: This work element applies to the Federal Cell embankment top slope.</p> <p>MATERIAL: Satisfactory Unit 4 clay material shall be defined as CL, ML or CL-ML soils based on the Unified Soil Classification.</p>	<p>Perform laboratory classification tests at a rate of one test per lot prior to use of material. A lot is defined as a maximum of 5,000 cubic yards (placed) of specified material type. Record the location of the classification sample on the Sample Log.</p>	<p>Verify the frequency of laboratory tests and compliance of test results.</p>
<p>141) PLACEMENT: Evaporative zone layer material will be placed over the frost protection zone layer as specified on currently approved engineering drawings listed in Groundwater Quality Discharge Permit UGW450005.</p>	<p>.</p>	<p>.</p>
<p>142) CONTAMINATION OF EVAPORATIVE ZONE MATERIAL: Evaporative zone material shall not become contaminated with radioactive soils or debris during construction. The in-place clay may contain up to 5 percent additional rocks and sand above the content found in the classification test.</p> <p>LIFT THICKNESS: The evaporative zone material may be placed in a single lift or multiple lifts, without a maximum loose lift thickness. Thickness for the lift will be established by installing grade poles on at least a 70-foot grid and at all control points. The grade poles must be marked at the appropriate depth to establish the grade. After the grade for the lift has been checked and approved by QC personnel, the grade poles shall be removed.</p>	<p>Visually check evaporative zone material for contamination by foreign materials in accordance with ASTM D2488. Remove or rework material which has been contaminated above the specified requirements. Document corrective actions (where required) on the Daily Construction Report.</p> <p>Verify that the required grading tolerance is achieved as follows:</p> <ol style="list-style-type: none"> a. Ensure that the required frequency for placement of grade poles has been met. b. Compare soil level with the marked level on the grade poles. c. Visually check between poles for high or low spots. d. Define out of specification areas and advise the project manager to rework those areas. e. Review areas reworked and approve areas meeting criteria. f. Continue "b" through "d" above until all areas meet criteria. 	<p>Verify that the evaporative zone material is being inspected for contaminants and that the inspection and corrective actions (if required) are properly documented.</p> <p>Verify the frequency of laboratory tests and compliance of test results.</p>

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – EVAPORATIVE ZONE LAYER PLACEMENT (TOP SLOPE)



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
	g. Indicate areas meeting criteria in the “Embankment Construction Lift Approval Form”..	
- OR -	- OR -	
Perform a survey using GPS to determine lift thickness.	a. Verify GPS equipment calibration, b. Verify correct set-up and operation of GPS equipment.	
There is not a compaction (density) requirement for the evaporative zone layer.		
143) LIFT BONDING: The lifts of evaporative material shall be bonded by providing a rough upper surface on the underlying layer of evaporative material. The surface should have changes in grade of approximately one inch or more at a rate of two per linear foot.	Verify that there are adequate changes in grade by placing a straight edge at least two feet long on the surface. Count the number of points approximately one inch or more below the straight edge.	Verify the frequency of measurements and compliance of test results.
SNOW REMOVAL: When evaporative zone material is to be placed and the work area is covered with snow, the snow must be removed.	Observe that snow is removed. Inspect the evaporative zone for damage. Advise the project manager of any deficiencies/damage. Record corrective actions (where required) in the Daily Construction Report.	Verify that snow removal is being documented and the evaporative zone has been inspected.
FINAL GRADING: Final grade shall be from design elevation to 0.2 feet above design elevation.	Survey the final grade surface of the evaporative zone on a 50 foot grid and at key points (i.e., embankment break lines). Final survey measurements will be documented in the survey report and provided to Quality Assurance.	Review the final survey data. Verify the frequency of the survey points.

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – SURFACE ZONE LAYER MATERIAL PREPARATION (TOP SLOPE)



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>144) SCOPE: This work element applies to the Federal Cell embankment top slope.</p>		
<p>145) MATERIAL: The surface zone layer material shall be Satisfactory Unit 4 Material defined as CL, ML, and CL-ML soils based on the Unified Soil Classification.</p> <p>Gravel admixture shall meet the requirements of the Quality of Rock specification as described in Specification 16. The gravel admixture shall be well graded gravel with 100% passing a 3” screen and less than 10% passing a 0.75” screen</p>	<p>Perform laboratory classification tests at a rate of 1 test per lot prior to use of material. A lot is defined as a maximum of 5,000 cubic yards (placed) of specified material type. Record the location of the classification sample on the Sample Log.</p> <p>Perform gradation testing (ASTM C136 or D2487) at a frequency of 1 test per 5,000 cubic yards of gravel. In addition, perform a minimum of one gradation test (ASTM C136 or D2487) per change in soil type. Record observations and corrective actions (where required) in the Daily Construction Report.</p>	<p>Verify the frequency of laboratory tests and compliance of test results.</p> <p>Verify the frequency of laboratory tests and compliance of test results.</p>
<p>146) PROTECTION: The surface material shall be handled in such a manner as to prevent contamination with radioactive waste material or other deleterious material.</p>	<p>Visually check surface materials for contamination by foreign materials. Remove surface materials which have been contaminated above the specified requirements. Document corrective actions (where required) on the Daily Construction Report.</p>	<p>Verify that the surface layer material is being inspected for contaminants and that corrective actions (if required) are properly documented.</p>
<p>147) PROCESSING These procedures may be used to provide suitable material for construction of the surface layer.</p> <ol style="list-style-type: none"> 1. Apply gravel to surface material at a rate determined by the Engineering Manager to arrive at a volumetric mixture of 15% ±3% gravel for application to the Embankment’s top slope. 2. Apply gravel to surface material at a rate determined by the Engineering Manager to arrive at a volumetric mixture of 50% ±3% gravel for application to the Embankment’s side slope. 3. Mix the gravel into the soils to obtain a uniform appearance by tilling or similar action 	<p>Measure the mixing areas and verify that the application rate of the gravel is equal to the rate determined by the Engineering Manager. Record the size of the mixing areas and the amount of gravel applied on the Embankment Construction Lift Approval Form.</p>	<p>Verify that the size of the mixing areas and the amount of gravel applied has been properly documented and meets specification</p>

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – SURFACE ZONE LAYER MATERIAL PLACEMENT (TOP SLOPE)



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>148) SCOPE: This work element applies to the Federal Cell embankment top slope.</p>		
<p>149) MATERIAL: Surface zone layer material shall be prepared according to Specifications 144 to 147 in Work Element – Surface Zone Layer Material Preparation.</p>		
<p>150) PLACEMENT: Surface zone layer material will be placed over the evaporative zone layer as specified on currently approved engineering drawings listed in Groundwater Quality Discharge Permit UGW450005. Surface zone layer material shall be handled in such a manner as to prevent contamination from waste material and segregation of finer materials.</p>		
<p>151) CONTAMINATION OF SURFACE ZONE MATERIAL Surface zone material shall not become contaminated with radioactive soils or debris during construction. The in-place clay may contain up to five percent additional rocks and sand above the content found in the classification test.</p>	<p>Visually check surface zone material for contamination by foreign materials in accordance with ASTM D2488. Remove or rework material which has been contaminated above the specified requirements. Document corrective actions (where required) on the Daily Construction Report.</p>	<p>Verify that the surface zone material is being inspected for contaminants and that the inspection and corrective actions (if required) are properly documented.</p>
<p>152) LIFT THICKNESS: The surface material may be placed in a single lift or multiple lifts, without a maximum loose lift thickness. Thickness for the lift will be established by installing grade poles on at least a 70-foot grid and at all control points.</p>	<p>Verify that the required grading tolerance is achieved as follows:</p> <ol style="list-style-type: none"> a. Ensure that the required frequency for placement of grade poles has been met. b. Compare soil level with the marked level on the grade poles. c. Visually check between poles for high or low spots. d. Define out of areas and advise the project manager to rework those areas. e. Review areas reworked and approve areas meeting criteria. f. Continue "b" through "d" above until all areas meet criteria. 	<p>Verify the frequency of tests and compliance of test results.</p>

FEDERAL CELL CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – SURFACE ZONE LAYER MATERIAL PLACEMENT (TOP SLOPE)



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
	g. Indicate areas meeting criteria in the “Embankment Construction Lift Approval Form”	
- OR -	- OR -	
Perform a survey using GPS to determine lift thickness.	a. Verify GPS equipment calibration, b. Verify correct set-up and operation of GPS equipment.	
153) SNOW REMOVAL: When surface zone layer material is to be placed and the work area is covered with snow, the snow must be removed.	Observe that snow is removed. Inspect the surface zone layer material for damage. Advise the project manager of any deficiencies/damage. Record corrective actions (where required) in the Daily Construction Report.	Verify that snow removal is being documented and the surface zone layer material has been inspected
154) FINAL GRADE: Final grade shall be from design elevation to 0.2 ft above design elevation.	Survey the final grade surface of the evaporative zone on a 50 ft grid and at key points (i.e., embankment break lines). Final survey measurements will be documented in the survey report and provided to Quality Assurance.	Review the final survey data. Verify the frequency of the survey points.
155) SEEDING: The surface zone layer material shall be seeded with an approved seed mixture and at an application rate defined by the Engineering Manager.	Observe the seeding process. Ensure full coverage is attained. Advise the project manager of any deficiencies in coverage. Record the application rate and any observations/corrections on the Daily Construction Report.	Review the Daily Construction Report and verify that seeding meets the criterion provided by the Engineering Manager.
156) NOTICE OF COVER CONSTRUCTION: Provide written notice of the completion of cover construction to the Director within 30 days of completion of each phase of cover construction in the "cut and cover" operation.	Obtain documentation of Director notification.	Within 30 days of completion of each phase of cover construction, notify the Director of completion of cover construction. Provide QC with documentation of Director notification. Note: The Engineering Manager, or designee, may notify the Director and provide Quality Assurance documentation of the notification.

FEDERAL CELL CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – DRAINAGE DITCH IMPORTED BORROW



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>157) SCOPE: This work element applies to the Federal Cell embankment ditch.</p>		
<p>158) CLEARING AND GRUBBING: Remove vegetation, debris, organic, or deleterious material from areas to be used for borrow. Grubbing depth will depend on the type of vegetation, debris, organic, or deleterious material on the site. If the area is free of these materials then no clearing and grubbing will be necessary.</p>	<p>Inspect the area once clearing and grubbing has been completed. Record observations and corrective actions (where required) on the Daily Construction Report.</p>	<p>Verify that the clearing and grubbing has been inspected by QC.</p>
<p>159) MATERIAL: The imported borrow shall be classified as CL or ML soils by ASTM D-2487.</p>	<p>Perform laboratory classification tests at a rate of one test per lot prior to use of material in the road. A lot is defined as a maximum of 5,000 cubic yards (compacted) of specified material type. Record the location of the classification sample on the Sampling Log.</p> <ol style="list-style-type: none"> a. Approve lots which meet the specified classification. b. Lots not meeting the specified classification cannot be used. 	<p>Verify the frequency of laboratory tests and compliance of test results.</p>
<p>160) LIFT THICKNESS: Drainage ditch borrow material shall be placed in lifts with an uncompacted thickness of less than or equal to nine inches.</p> <p>A. Thickness for the lift will be established by installing grade poles on at least a 50-foot grid lengthwise and at all control points. The grade poles must be marked at the appropriate depth to establish the grade. After the grade has been checked and approved by QC personnel, the grade poles shall be removed.</p>	<p>Verify that the required grading is achieved as follows:</p> <ol style="list-style-type: none"> a. Ensure that the required frequency for placement of grade poles has been met. b. Compare soil level with the marked level on the grade poles. c. Visually check between poles for high or low spots. d. Define those areas that are high out of specification and advise the Project Manager to re-work those areas. e. Review areas re-worked and approve areas meeting criteria. f. Continue “b” through “d” above until all areas meet criteria. g. Indicate areas meeting criteria in the “Embankment Construction Lift Approval Form”. 	<p>Verify the frequency of measurements and compliance of test results.</p>

FEDERAL CELL CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – DRAINAGE DITCH IMPORTED BORROW



SPECIFICATION

QUALITY CONTROL

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- OR -

- B. Survey to determine lift thickness on at least a 50-foot grid lengthwise and at all control points. Survey equipment shall have a tolerance no more than ± 0.1 foot.

- OR -

- a. Verify survey equipment is within a tolerance of ± 0.1 foot.
- b. Verify correct set-up and operation of equipment.
- c. Visually check between survey points for high or low spots.
- d. Define high out of specification areas and notify the Project Manager to rework those areas.
- e. Document survey results on a survey report.

**FEDERAL CELL CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - DRAINAGE DITCHES**



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>161) SCOPE: This work element applies to the Federal Cell embankment.</p>		
<p>162) EXCAVATION: Excavation shall be made to the lines, grades, and dimensions prescribed in the approved phase-specific plans. Temporary (operational) ditches may be constructed to these phase-specific plans. Final design grade and dimensions (as shown in the approved engineering drawings listed in Groundwater Quality Discharge Permit UGW450005) are not required to be met before final closure of the Federal cell embankment.</p> <p>Prior Director approval in writing must be obtained before diverting ditches from the current approved design. The purpose and duration of diversion shall be specified in any request to do so. The Director approval shall be obtained in accordance with Specification 23.</p> <p>Any over excavation shall be backfilled with drainage ditch borrow material and compacted to 95 percent of standard Proctor. The uncompacted lift thickness shall not exceed nine inches.</p>	<p>Provide daily observation of the ditch excavation. Record observations and corrective actions (where required) on the Daily Construction Report.</p> <p>Obtain documentation confirming that the Director has approved the plans for diverting ditches</p> <p>In areas of over excavation, conduct in-place density test at a rate of one test per lot, with a minimum of one test per phase, and record the results on the Field Density Test form. A lot is defined as a maximum of 10,000 square feet of a single lift of a specified type of material. Test locations shall be chosen on the basis of random numbers (described in Specification 12).</p> <ol style="list-style-type: none"> a. Approve lots which meet the specified compaction. b. Rework and retest lots not meeting the specified compaction. <p>Proctors shall be performed at a rate of one test per 100,000 square feet for each material type. At least one proctor shall be performed for each material type. Record the location of the sample on the Sampling Log.</p>	<p>Verify daily observations and corrective actions have been documented.</p> <p>Verify that Director approvals have been obtained before diverting ditches. Provide QC with approval documentation.</p> <p>Verify the frequency of laboratory tests and compliance of test results.</p>

**FEDERAL CELL CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - DRAINAGE DITCHES**



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>163) FINAL GRADING: Smooth roll the excavated surface to prepare for filter zone material. Final grading of this surface shall be ± 0.1 of a foot.</p>	<p>Inspect the surface for smoothness. Survey the surface on a 50 foot grid and at key points (i.e., changes in direction of the ditch). Final survey measurements will be documented on the survey report and provided to Quality Assurance.</p>	<p>Review the final survey data. Verify the frequency of the survey points.</p>
<p>164) FILTER ZONE AND ROCK EROSION BARRIER: The filter zone and rock erosion barrier shall be constructed in accordance with Specifications 128 thru 138 as appropriate.</p>	<p>See Specifications 128 thru 138.</p>	<p>See Specifications 128 thru 138.</p>
<p>165) EROSION CONTROL FOR EXPOSED SOIL: If reviewed and approved drainage ditch soil surfaces are not covered by filter zone within 30 days of lift approval, the following erosion control repair measures shall apply.</p> <p>Monthly, inspect exposed drainage ditch soil surfaces for evidence of erosion. Rivulet or gullied areas wider than six inches or deeper than six inches require maintenance to fill the rivulet or gully and restore the area to design elevation. Maintenance shall be performed within 30 calendar days when needed, unless additional time is approved by Director.</p> <p>Erosion control blankets, mats, or fiber mulch may be used, in accordance with the manufacturer's instructions, for erosion prevention.</p> <p>Director shall be notified at least 48 hours prior to deployment of erosion control blankets, mats, or fiber mulch. If used, such erosion control materials shall be removed prior to filter zone or riprap construction.</p>	<p>Perform monthly inspections. Document the inspection as well as associated maintenance activities on the Daily Construction Report.</p> <p>Obtain documentation of Director notification</p>	<p>Review documentation to verify that monthly inspections have been performed.</p> <p>Notify Director at least 48 hours prior to deployment of erosion control blankets, mats, or fiber mulch. Provide QC with documentation of Director notification.</p>

FEDERAL CELL CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - DRAINAGE DITCHES



SPECIFICATION

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166) RADIOLOGICAL SAMPLING FOR EXPOSED SOIL: If reviewed and approved drainage ditch soil surfaces are not covered by filter zone or riprap within 30 days of lift approval, the area shall either

- A. be sampled and radiologically released in accordance with the Environmental Monitoring Plan; or
- B. have a minimum of six inches of ditch material removed and replaced prior to filter zone or riprap placement. Under this option, no environmental sampling is required.

Coordinate sampling and analysis with environmental personnel. Attach a copy of the release report to the lift approval documentation.

**FEDERAL CELL CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - INSPECTION ROAD**



SPECIFICATION

QUALITY CONTROL

QUALITY ASSURANCE

167) SCOPE: This work element applies to the Federal Cell embankment.

168) MATERIAL: The material used to construct the inspection road shall conform to a relevant UDOT roadbase specification and be approved in writing by a Utah licensed Professional Engineer prior to use.

169) SUBSURFACE PREPARATION: The subsurface will be scarified and re-compacted to at least 95 percent of a standard proctor (ASTM D698).

170) ROAD THICKNESS: The compacted road shall be 12 inches thick plus or minus 0.2 feet.

Obtain written material approval from a Utah licensed Professional Engineer. Perform or obtain laboratory gradation testing at a rate of one test per lot prior to use of material in the road. A lot is defined as a maximum of 3,000 cubic yards (compacted) of specified material type. Record, as needed, the location of the classification sample on the Sampling Log.

- a. Approve lots which meet the specified classification.
- b. Notify the Project Manager of lots not meeting the specified classification to have the areas reworked.
- c. Retest lots after rework has been completed.

Conduct in-place density tests at a rate of one test per lot and record the results on the Field Density Test form. A lot is defined as 200 cubic yards (compacted) of material. The test location shall be chosen on the basis of random numbers (described in Specification 12).

- a. Approve lots which meet the specified compaction.
- b. Notify the Project Manager of lots not meeting the specified compaction to have the areas reworked.
- c. Retest lots after rework has been completed.

Proctors shall be performed at a rate of one test per borrow lot. A borrow lot is defined as 3,000 cubic yards (compacted) or less of a specific material type. Record the location of the Proctor sample on the Sampling Log.

Measure the thickness of the road at both edges of the road at no greater than 50 foot intervals. Record the results on the Lift Approval Form.

- a. Approve lots which meet the specified thickness.
- b. Notify the Project Manager of lots not meeting the specified thickness to have the areas reworked.

Verify written material approval, the frequency of laboratory tests and compliance of test results.

Verify the frequency of tests and compliance of test results.

Verify the frequency of tests and compliance of test results.

FEDERAL CELL CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - INSPECTION ROAD



SPECIFICATION

QUALITY CONTROL

QUALITY ASSURANCE

171) COMPACTION: The road will be compacted to at least 95 percent of standard Proctor (ASTM D698).

c. Retest lots after rework has been completed.

Conduct in-place density tests at a rate of one test per lot and record the results on the Field Density Test form. A lot is defined as 200 cubic yards (compacted) of material. The test location shall be chosen on the basis of random numbers (described in Specification 12).

- a. Approve lots which meet the specified compaction.
- b. Notify the Project Manager of lots not meeting the specified compaction to have the areas reworked.
- c. Retest lots after rework has been completed.

Proctors shall be performed at a rate of one test per borrow lot. A borrow lot is defined as 3,000 cubic yards (compacted) or less of a specific material type. Record the location of the Proctor sample on the Sampling Log.

Verify the frequency of tests and compliance of test results.

FEDERAL CELL CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - PERMANENT CHAIN LINK FENCES



SPECIFICATION

QUALITY CONTROL

QUALITY ASSURANCE

172) SCOPE: This work element applies to the Federal Cell embankment.

173) MATERIALS: All burial embankments and waste storage areas, including immediately adjacent drainage structures, shall be controlled areas, surrounded by six-foot high, chain link fence. All permanent fences shall be chain link, six feet high, topped with three strand barbed wire, top tension wire and twisted selvedge.

Zinc coated chain link fence shall meet the requirements of ASTM A392 with Class I coating. Aluminum Coated fence fabric shall meet the requirements of ASTM A491.

Fence Fabric: Fence fabric shall be made of 0.148 inch or larger diameter wire. The fabric shall have twisted selvedge.

Wire and Ties: Tension wires shall be 0.177 inch or larger diameter spiral type. Ring ties for tying fabric to supporting members shall be made of 0.148 inch or larger diameter wire. Wire ties for tying fabric to support members shall be made of 0.12 inch or larger diameter wire. Ties to line posts shall be made of 0.192 inch or larger diameter wire. All wire shall have Class II coating as specified by ASTM A116.

Barbed Wire: Barbed wire on zinc coated fence shall meet the requirements of ASTM A121, including a Class I zinc coating. Barbed wire shall be made of 0.099 inch or larger diameter wire with 0.080 inch or larger diameter wire four point barbs on five inch centers. When aluminum or aluminum coated fence is used, aluminum coated barbed wire shall be used meeting the requirements of ASTM A0491. The

Obtain a copy of the manufacture's specification for the materials to be used in the construction of the fence. Verify that the materials meet the required specifications. Document materials acceptance on the Daily Construction Report.

Verify that the materials to be used in the construction of the fence have been approved and documented.

FEDERAL CELL CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - PERMANENT CHAIN LINK FENCES



SPECIFICATION

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support arm on the fence for the barbed wire shall be capable of supporting a 200 pound vertical load at the end of the arm without permanent deflection.

Posts: Line posts may be "H" section or pipe. The minimum strength requirements are as follows:

- A. Load at top: 600 lbs.
- B. Maximum Moment: 1200 ft-lbs.
- C. Maximum permanent set: 0.010 in.

"H" posts shall be coated in accordance with the requirements of ASTM A123. Pipe posts shall conform to the requirements of ASTM A120 (Schedule 40) for zinc coated pipe. All pipe posts shall be fitted with a weather resistant tip, designed to fit securely over the post, and carry an apron around the outside of the post.

Fittings: Fittings shall be malleable cast iron or pressed steel and be coated in accordance to ASTM A123.

Gates: Gate posts and frames shall be constructed of the sizes shown on the approved plans for the various gate dimensions. The corners of the gate frame shall be fastened together with pressed steel or malleable iron corner ells riveted or welded in accordance with the plans. Welded steel gate frames shall be galvanized after fabrication in accordance with the provision of ASTM A123. Chain link fence fabric for covering the gate frames shall be the same as required for the fence. Each gate shall be furnished complete with necessary galvanized

**FEDERAL CELL CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - PERMANENT CHAIN LINK FENCES**



SPECIFICATION

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hinged, latch, and drop bar locking device for the type of gate used on the project.

174) INSTALLATION: The steel posts shall be set true to line and grade in concrete bases. The distances between posts shall be uniform and not exceeding 10 feet. Fence corners and ends shall be constructed in accordance with Detail A on sheet L9 of the approved engineering drawings listed in Groundwater Quality Discharge Permit UGW450005. Gates shall be constructed in accordance with Detail B on sheet L9 of the approved engineering drawings.

A minimum of six inches of concrete shall be provided below the bottom of each post. End posts, pull posts, corner posts, and gate posts shall have a concrete base at least 12 inches in diameter. Bases for line posts shall be at least 10 inches in diameter.

Pull posts shall be provided at 500 feet maximum intervals. Changes in line of 30 degrees or more shall be considered as corners.

The fabric shall be stretched taut, and securely fastened to the posts. Fastening to end, gate, corner, and pull posts shall be with stretcher bars and metal bands, spaced at one foot intervals. The fabric shall be cut and each span fastened independently at all pull and corner posts. Fastening to line posts shall be with tie wire, metal bands, or other approved method at 14 inch intervals. The top edge of fabric shall be attached to the top rail or tension cable at approximately 24 inch intervals. The bottom edge of the fabric should be installed within one inch of the ground surface. The bottom tension wire is required and shall be attached to the fabric with tie

Verify that the fence is constructed in the location shown on the plans and in accordance with sheet L9. Document any problems in the Daily Construction Report.

Spot check the depth and diameter of the post holes to verify that the holes meet the required specification. Document any problems in the Daily Construction Report.

Inspect the fence for proper placement of pull and corner posts. Document any problems in the Daily Construction Report.

Inspect the fencing fabric to verify that it has been installed in accordance with the specifications. Document any problems in the Daily Construction Report.

Verify that the fence has been inspected and problems have been properly documented.

**FEDERAL CELL CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - PERMANENT CHAIN LINK FENCES**



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wires at 24 inch intervals and shall be secured to the end or pull posts with brace bands.

**FEDERAL CELL CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – SETTLEMENT MONITORING**



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>175) SCOPE: This work element applies to the Federal Cell embankment.</p>		
<p>176) SETTLEMENT MONUMENTS: Settlement monuments shall consist of approximately four-foot long #5 or greater rebar that is welded to a metal plate. The metal plate shall be approximately 18 inches square with a thickness of 3/16 inch to 1/4 inch. The rebar shall be sized to extend no more than six inches above the rock erosion barrier surface. The settlement plate shall be placed on top of the final approved radon barrier and then secured by the rock cover layers as they are built. Each monument shall be permanently labeled, flagged, and documented on a reference drawing.</p>	<p>Inspect settlement monuments for compliance with the specification prior to installation. Observe installation to ensure that the radon barrier is not damaged.</p>	<p>Perform a surveillance of monument installation activities.</p>
<p>177) SETTLEMENT MONUMENT PLACEMENT: Settlement monuments shall be placed at the locations identified on Figure 1.</p>	<p>Perform and document a post-construction survey of the placed settlement monument.</p>	<p>Verify that surveys have been performed and documented.</p>
<p>178) SURVEY REQUIREMENTS: Surveys shall be performed with GPS or approved equivalent equipment. Tolerance shall be no more than ± 0.1 feet.</p>	<p>Calibrate and operate survey equipment in accordance with the manufacturer’s recommendations</p>	
<p>179) SURVEY INTERVAL: Settlement monuments shall be set and surveyed for initial location within 30 days of the completion of final cover construction. New monuments shall be surveyed again at 2, 4, and 12 months (± 10 calendar days) after the initial survey. Thereafter, monuments shall be surveyed once annually between October 1 and December 31 until a minimum of five years after initial placement. Weather conditions at the time of the survey and a discussion of the potential for frost to be present shall be documented in the survey report.</p>	<p>Perform and document the required surveys in a survey report. Provide survey data to the Engineering Manager.</p>	<p>Verify that monument surveys are completed and documented as required.</p>

**FEDERAL CELL CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – SETTLEMENT MONITORING**



SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>During the annual survey, perform a visual inspection of the completed cover to evaluate potential areas of settlement that may not be captured by the settlement monument network.</p>	<p>Perform and document the required surveys in a survey report. Provide survey data to the Engineering Manager.</p> <p>Document observations made during the inspection, and denote areas where differential settlement may be occurring. Provide documentation to the Engineering Manager.</p>	<p>Verify that new monument surveys are completed and documented as required.</p>
<p>180) REPORTING: Settlement monitoring data shall be summarized and evaluated in the annual as-built report for the embankment.</p> <p>Calculate total and differential settlement for each settlement monument against the most recent measurement and against the baseline monument location.</p> <p>Total settlement of more than 1.5 feet at any settlement monument or differential settlement of more than 1.0 percent slope between adjacent monuments shall be reported to and evaluated by the Engineering Manager within 30 days of measurement and discussed in the annual as-built report.</p> <p>Any failure in the settlement monuments shall be documented. A replacement monument shall be reset as close as possible to the previous location, surveyed, and documented.</p>	<p>Provide settlement monitoring data to the Engineering Manager.</p>	<p>Perform a surveillance of visual inspection activities.</p>

**FEDERAL CELL CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – ANNUAL AS-BUILT REPORT**



SPECIFICATION

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181) SCOPE: This work element applies to the Federal Cell embankment.

182) AERIAL SURVEY REQUIREMENTS: An aerial survey of all areas within 100 feet of Section 32 shall be performed within three months prior to the Annual As-built Report submittal.

The aerial survey shall be performed by a registered land surveyor.

Survey control points shall be identified in the survey report.

Survey tolerance shall not exceed ± 0.75 ft. Actual tolerance of the survey shall be stated in the report.

183) ANNUAL AS-BUILT VOLUMES: Calculate embankment volumes from the aerial survey data using AutoCAD or approved equivalent equipment.

As required in I.H.6 of Groundwater Quality Discharge Permit UGW450005, provide plan view and cross-sections of the as-built embankment(s) based on the aerial survey data. Include in each cross-section the profile of the maximum authorized waste elevation. Also include in each cross-section the elevation profile of the top of the uppermost approved waste lift (as of the time the lift was approved). Provide a clear key to each cross-section to define the meaning of each symbol and line used.

For each embankment, report the design capacity, capacity used to date, and remaining capacity, including overburden. Compare remaining capacity

FEDERAL CELL CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – ANNUAL AS-BUILT REPORT



SPECIFICATION

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with the surety reserve capacity for each embankment. Report any volume of waste that is placed over the design top of waste.

FEDERAL CELL CQA/QC MANUAL

TABLE 1

MATERIAL SPECIFICATIONS FOR PORTLAND CEMENT CLSM

PROPERTY	TEST METHOD	MINIMUM	MAXIMUM	FREQUENCY
WET UNIT WEIGHT	ASTM D6023	100 lbs/ft ³	None	One Test/2,000 Cubic Yards/Lift
SLUMP -OR- FLOW -OR- FLOW CONSISTENCY	EnergySolutions Slump Test (Appendix B) EnergySolutions Efflux Test (Appendix B) Flow Consistency (ASTM D6103)	Eight inches NA Eight inches	None 26 seconds None	One Test/100 Cubic Yards/Lift One Test/100 Cubic Yards/Lift One Test/100 Cubic Yards/Lift
28 DAY COMPRESSIVE STRENGTH	ASTM D4832	150 psi	None	One Test/2,000 Cubic Yards Placed at 28 days
CEMENT	None	50 lbs for each cubic yard of CLSM	None	Inspect each load ticket prior to pour
POZZOLAN	None	None	375 lbs for each cubic yard of CLSM	Inspect each load ticket prior to pour
AGGREGATE SIZE	Gradation Test Certificate from Batch Plant ASTM C117 ASTM C136	<u>Percent Passing</u> <u>Sieve</u> 100 3/8" 60 #8	<u>Percent Passing</u> <u>Sieve</u> 30 200	One certification per day if material is received from exterior batch plant or One test per stockpile if material is received from onsite batch plant. Gradation certificate shall be received by QC Technician prior to pouring any CLSM