

ATTACHMENT A

TECHNICAL SPECIFICATIONS FOR

RECLAMATION OF WHITE MESA MILL FACILITY

BLANDING, UTAH

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1.0 SPECIAL PROVISIONS

1.1 Scope of Document

The following technical specifications have been prepared for reclamation and decommissioning of the Energy Fuels Resources (USA) Inc. ("EFRI"), White Mesa Uranium Mill Facility ("Mill") in Blanding, Utah. These technical specifications have been prepared for review and approval by the Utah Department of Environment Quality ("DEQ"), Division of Waste Management and Radiation Control ("DWMRC") and are submitted as an attachment to the Reclamation Plan. The design drawings for reclamation are attached and are designated as the "Drawings". The Construction Quality Assurance/Quality Control Plan ("CQA/QC Plan") referenced in this document is provided as Attachment B to the Reclamation Plan. The Technical Specifications have been written assuming tailings management Cells 2, 3, 4A, and 4B will receive tailings to the maximum permitted tailings elevations. Cell 2 is full and partially reclaimed. Cell 3 was used for tailings storage, but is currently only receiving mill waste. Cell 3 is partially full and partially reclaimed. Cell 4A is the only cell currently receiving tailings and is partially full. Cell 4B is used for evaporation of process solutions and has not been used for storage of tailings. The Technical Specifications have been written assuming Cell 4B will be used in the future for tailings storage.

These technical specifications have been written assuming (a) a contractor will conduct tailings impoundment reclamation under contract with EFRI and under EFRI's direction (b) the work quality will be checked with independent (third-party) construction quality assurance, and (c) the tailings management system comprised of Cells 2, 3, 4A, and 4B will receive tailings to the maximum permitted tailings elevations.

1.2 Definitions and Roles

Construction Quality Assurance (CQA) – A planned and systematic pattern of means and actions designed to assure adequate confidence that the materials or services meet contractual and regulatory requirements and will perform satisfactorily in service. CQA refers to means and

actions employed by the involved parties to assure conformity of the project work with the CQA/QC Plan, the Drawings, and the Technical Specifications.

Construction Quality Control (CQC) – Actions which provide a means to measure and regulate the characteristics of an item or service in relation to contractual and regulatory requirements. CQC refers to those actions taken by the Contractor, technicians, or other involved parties to verify that the materials and the workmanship meet the requirements of the CQA/QC Plan, the Drawings, and the Technical Specifications.

Technical Specifications – The document that prescribes the requirements and standards for the specific elements of the reclamation. The Technical Specifications will be prepared in final form prior to commencement of reclamation activities.

Drawings – The detailed project drawings to be used in conjunction with the Technical Specifications. The Drawings will be prepared in final form as construction drawings prior to reclamation.

Construction Project – The total authorized/approved reclamation project that requires several construction segments to complete.

Construction Segment – A portion of the total construction project involving a specific area or type of work. Several construction segments will likely take place simultaneously during reclamation.

Construction Task – A basic construction feature of a construction segment involving a specific construction activity.

ASTM Standards – The latest versions of the American Society for Testing and Materials specifications, procedures and methods.

For the Technical Specifications, EFRI is referred to as the **Owner**, with overall responsibility for closure, as well as site reclamation.

The on-site **Construction Manager** is responsible for the conduct, direction and supervision of all reclamation activities as detailed in the Drawings and Technical Specifications.

The **Design Engineer** is responsible for the design of the various elements of the reclamation project and for preparing the Drawings and Technical Specifications.

The **Contractor** is defined as the group (or groups) selected by the Owner and responsible for conducting the work tasks outlined in Section 1.3 under the direction of, and under contract with the Owner.

The **Surveyor** is a party, independent from the Owner or Contractor, who is responsible for surveying, documenting, and verifying the location of all significant components of the work.

The **CQA/QC Consultant** is a party, independent from the Owner or Contractor, who is responsible for observing, testing, and documenting the various activities comprising the Reclamation Project in accordance with the CQA/QC Plan, the Technical Specifications and the Drawings.

The **CQA Officer** will be responsible for overall implementation and management of the CQA/QC Plan for the reclamation project.

The **CQA Site Manager** will be appointed by the CQA Consultant to provide day-to-day, on-site oversight of the CQA/CQC activities. The CQA Site Manager could be an employee of the Owner or a third-party consultant.

The CQA Consultant will utilize various **QC Technicians** to assist the on-site CQA Site Manager to perform specific tasks throughout the project to verify the adequacy of construction materials and procedures.

The **Document Control Officer** will be appointed by the Construction Manager to assist with managing the various documents that will be produced throughout the project.

The **CQA Laboratory** is a party, independent from the Owner and Contractor, responsible for conducting tests of soils and other project materials in accordance with ASTM and other applicable standards in either an on-site or off-site laboratory.

The **DWMRC Project Manager** will represent the DWMRC's interests in the reclamation project.

The CQA/QC Plan (Attachment B of the Reclamation Plan) contains more detailed descriptions of the project roles.

1.3 Scope of Work

The work outlined in these Technical Specifications consists of execution of the following tasks associated with reclamation of the tailings management system and associated site reclamation.

- Preparation of borrow areas for material excavation by removal of vegetation; and stripping, salvaging, and stockpiling of topsoil;
- Preparation of material staging and stockpile areas by removal of vegetation; stripping, salvaging, and stockpiling of topsoil; and providing for storm water diversion and internal water collection;
- Removal of raffinates and PVC liner materials from Cell 1 and placement within the last active tailings cell;
- Construction of a clay-lined disposal cell along the Cell 1 containment dike for disposal of mill demolition debris and contaminated soils;
- Construction of a sedimentation basin in the location of Cell 1;
- Excavation of process area structure foundations, paved areas, concrete pads and roadways, and placement of these materials in the disposal cell;
- Excavation of contaminated subsoils from the process area, and placement in the last active tailings cell or the Cell 1 Disposal Area.
- Construction of the cover system over the tailings cells, with placement of topsoil and/or topsoil-gravel admixture over the disposal cell cover surface.
- Regrading and placement of topsoil over excavated areas, stockpile and staging areas, and other disturbed areas of the site.
- Establishment of vegetation on the disposal cell surface and surrounding reclaimed areas on site.

The Technical Specifications have been written assuming tailings management Cells 2, 3, 4A, and 4B will receive tailings to the maximum permitted tailings elevations. Cell 2 is full and partially reclaimed. Cell 3 was used for tailings storage, but is currently only receiving mill waste. Cell 3 is partially full and partially reclaimed. Cell 4A is the only cell currently receiving tailings and is partially full. Cell 4B is used for evaporation of process solutions and has not been used for storage of tailings. The Technical Specifications have been written assuming Cell 4B will be used in the future for tailings storage.

Work not included in these Technical Specifications consists of salvage of facility equipment, demolition of facility structures, groundwater monitoring and remediation, and post-reclamation performance monitoring.

1.4 Applicable Regulations and Standards

The work will be conducted to conform with applicable Federal, State, and County environmental and safety regulations, as well as applicable conditions in the Owner's radioactive materials license. Geotechnical testing procedures will follow applicable ASTM standards, as documented in the most current edition of standards in force at the start of work. Personnel safety procedures and monitoring will be conducted in accordance with the Owner's Radiation Protection Manual for Reclamation Activities and as directed by the Radiation Safety Officer ("RSO").

1.5 Permits

The work will be conducted under the Owner's existing radioactive materials license and State of Utah Air Quality Approval Order (DAQE-AN0112050018-11, issue date March 3, 2011). The Contractor will be responsible for applying for, and obtaining (permit fees included), all other necessary permits required to complete the work outlined in these Technical Specifications.

1.6 Inspection and Quality Assurance

In general, the QA/QC Plan details the Owner's organizational structure and responsibilities, qualifications of personnel, operating procedures and instructions, record keeping and document control, and quality control in the sampling procedure and outside laboratory. The Plan will adopt the existing quality assurance/quality control procedures utilized in compliance with the existing license.

The RSO (and approved assistants as needed) will conduct on-site training, and full-time personnel monitoring, and inspection of construction activities while the site reclamation work is in progress. The RSO (and assistants) will be independent representatives of and appointed by the Owner. The responsibilities and duties of the RSO shall be as outlined in the Owner's Protection Manual for Reclamation.

The CQA Site Manager (and approved assistants as needed) will provide on-site inspection of all construction activities and quality assurance testing outlined in these Technical Specifications and the CQA/QC Plan while the construction work is in progress. The CQA Site Manager and assistants will be independent representatives of and appointed by the Owner. The inspection and CQA testing conducted by the CQA Site Manager will be under the supervision of the Reclamation Project Manager. Inspection and CQA testing will include the tasks described in the CQA/QC Plan and listed below.

- a. Observation of construction practices and procedures for conformance with the Technical Specifications.
- b. Testing material characteristics to ensure that earthen materials used in the construction conform to the requirements in the Technical Specifications.
- c. Documentation of construction activities, test locations, samples, and test results.
- d. Notification of results from quality assurance testing to the Owner and the Contractor.
- e. Documentation of field design modifications or approved construction work that deviates from the Technical Specifications.

The CQA Site Manager will record the documentation outlined above on a daily basis. The Reclamation Project Manager will approve deviations from the Technical Specifications (if necessary), with notification to the Owner and DWMRC or other appropriate Utah state regulatory agency personnel. Quality control procedures have been developed for reclamation and presented in Attachment B of this Reclamation Plan. Procedures will be used for testing, sampling, and inspection functions.

1.7 Construction Documentation

During construction, the CQA Site Manager will record documentation of construction inspection work on a daily basis. Documentation will include the following items.

- a. Work performed by the Contractor.
- b. CQA testing and surveying work conducted.
- c. Discussions with the Owner and the Contractor.
- d. Key decisions, important communications, or design modifications.
- e. General comments including: weather conditions, work area surface conditions, and visitors to the site.

All earthwork test results will be documented on a daily basis, with a copy of the results given to the CQA Site Manager by the end of the following working day after the testing.

The CQA Site Manager or his representative will take photographs of key construction activities and critical items for documentation.

A final construction completion report, documenting the as-built conditions of the tailings impoundment reclamation components will be submitted to DWMRC at the end of construction.

This report will include the following items.

- a. All design modifications or changes to the Technical Specifications that were made during construction.
- b. An as-built layout of the facility prior to, and at the completion of reclamation construction.

- c. An as-built layout of other reclaimed areas of the site.
- d. Documentation of soil cleanup verification work (soil radiation survey and soil sampling and analyses) in areas of contaminated soil excavation.
- e. Documentation of the revegetation work (soil amendments, seed mix, and vegetation establishment).

1.8 Design Modifications

Design modifications (due to unanticipated site conditions or field improvements to the design) will be made following the protocol outlined below.

- a. Communication of modification with the Reclamation Project Manager.
- b. Submittal to, and review by, DWMRC for approval prior to implementation.
- c. Documentation of modification(s) in the construction completion report.

1.9 Environmental Requirements

The Contractor shall store materials, confine equipment, and maintain construction operations according to applicable laws, ordinances, or permits for the project site. Fuel, lubricating oils, and chemicals shall be stored and dispensed in such a manner as to prevent or contain spills and prevent said liquids from reaching local streams or groundwater. If quantities of fuel, lubricating oils or chemicals exceed the threshold quantities specified in Utah regulations, the Contractor shall prepare and follow a Spill Prevention Control and Countermeasures Plan (SPCCP), as prescribed in applicable Utah regulations. The Owner will approve said plan. Used lubricating oils shall be disposed of or recycled at an appropriate facility. The Contractor shall be responsible for disposal of all waste associated with the project work.

1.10 Water Management

The Contractor shall construct and maintain all temporary diversion and protective works required to divert storm water from around work areas. The Contractor shall furnish, install, maintain, and operate all equipment required to keep excavations and other work areas free from water in order to construct the facilities as specified.

Water required by the Contractor for dust suppression or soil-moisture conditioning will be obtained from the Owner.

1.11 Historical and Archeological Considerations

The Contractor shall immediately notify the Owner if materials of potential historical or archeological significance are discovered or uncovered. The Owner may stop work in a specific area until the materials can be evaluated for historical, cultural, or archeological significance. All materials determined to be of significance will be protected during the work, as determined by appropriate regulatory agencies, including removal or adjustment of work areas.

1.12 Health and Safety Requirements

Work outlined in these Technical Specifications will be conducted under the Owner's Radiation Protection Manual for Reclamation Activities, as directed by the RSO.

The Contractor shall suspend construction or demolition operations or implement necessary precautions whenever (in the opinion of the Reclamation Project Manager or RSO) unsatisfactory conditions exist due to rain, snow, wind, cold temperatures, excessive water, or unacceptable traction or bearing capacity conditions. The CQA Site Manager, Reclamation Project Manager, and RSO each have the authority to stop Contractor work if unsafe conditions or deviations from Technical Specifications are observed.

1.13 Personnel Monitoring

Programs currently in place for monitoring of exposures to employees will remain in effect throughout the time period during which tailings cell reclamation, mill decommissioning and clean up of windblown contamination are conducted. These programs will include personnel monitoring and the ongoing bioassay program. Access control will be maintained at the Restricted Area boundary to ensure employees and equipment are released from the site in accordance with the current License conditions. In general, no changes to the existing programs are expected and reclamation activities are not expected to increase exposure potential beyond

the current levels. The Owner will assign an employee to act as RSO responsible for assuring site workers comply with the Owner's Radiation Protection Manual for Reclamation Activities and the requirements set forth in the Owner's radioactive materials license.

1.14 Environmental Monitoring

Existing environmental monitoring programs will continue during the time period in which reclamation and decommissioning is conducted as applicable. This includes monitoring of surface and groundwater, airborne particulates, radon, soils and vegetation, according to the existing License conditions as applicable. As site features are reclaimed, monitoring programs for those features may cease. Any changes will be approved by DWMRC prior to the cessation of monitoring. In general, no changes to the extent of the existing programs are expected because reclamation activities are not expected to increase exposure potential beyond the current levels.

2.0 SITE CONDITIONS

2.1 Site Location

The White Mesa Mill site is located about 6 miles south of Blanding, Utah in San Juan County, along County Road 191.

2.2 Climate and Geology

The climate of southeastern Utah is classified as dry to arid continental. Although varying somewhat with elevation and terrain, the climate in the vicinity of the Mill can be considered as semi-arid with normal annual precipitation of about 13.3 inches. The mean annual relative humidity is about 44 percent and is normally highest in January and lowest in July. The average annual Class A pan evaporation rate is 68 inches (NOAA, 1977), with the largest evaporation rate typically occurring in July. (Denison, 2009)

The Mill is located within the Blanding Basin of the Colorado Plateau physiographic province. The average elevation of the site is approximately 5,600 ft (1,707 m) above mean sea level (amsl). Typical of large portions of the Colorado Plateau province, the rocks underlying the site are relatively undeformed. The site is underlain by unconsolidated alluvium and indurated sedimentary rocks consisting primarily of sandstone and shale. The alluvial materials consist mostly of aeolian silts and fine-grained aeolian sands with a thickness varying from a few feet to as much as 25 to 30 ft (7.6 to 9.1 m) across the site. The alluvium is underlain by the Dakota Sandstone and Burro Canyon Formation, which are sandstones having total thicknesses ranging from approximately 100 to 140 ft (31 to 43 m). (Denison, 2009)

2.3 Past Operations

The mill is a uranium/vanadium mill that was developed in the late 1970's by Energy Fuels Nuclear, Inc. ("EFN") as an outlet for the many small mines located in the Colorado Plateau and for the possibility of milling Arizona strip ores. Construction on the tailings area began on August 1, 1978. The Mill was operated by EFN from the initial start-up date of May 6, 1980 until the cessation of operations in 1983 and then intermittently under different ownership

through present-day. Denison (then named International Uranium (USA) Corporation), and its affiliates, purchased the assets of EFN in May 1997. Energy Fuels Resources (USA), Inc. purchased the facility in 2012 and is the current owner.

2.4 Facilities Demolition

Demolition of equipment, structures, and associated facilities at the Mill site will be conducted according to applicable conditions of the radioactive materials license, the demolition plan for the facility, and the Owner's Radiation Protection Manual for Reclamation Activities. Facilities demolition is not included in this document.

2.5 Disposed Materials

Materials to be placed in the disposal and tailings cells consists of process waste materials, structural debris, underlying liner materials, and subsoils from planned site cleanup activities. Additional detail on each material type is outlined later in the Technical Specifications. The four major types of materials are outlined below:

- Raffinate Crystals – located in Cell 1
- Synthetic Liner – PVC liner from Cell 1
- Contaminated Soils - soils located in and around the Mill site with concentrations exceeding prescribed unity rule concentrations (see Section 6)
- Mill Debris – all equipment and structures from the demolition of the mill

2.6 Construction Materials

Construction materials for the disposal cell liner, cover system, and for erosion protection of the cover and discharge channel will include soils and aggregates from on-site and off-site sources. These materials are outlined below.

2.6.1 Liner Materials

The disposal cell will be constructed, prior to the placement of contaminated soils and mill demolition debris, with a compacted clay liner. The soils will be obtained from suitable materials stockpiled on site during cell construction.

2.6.2 Random Fill

Random fill will be used within the disposal cell and tailings cells, placed on and around mill material and debris and placed for the components of the cover system. Fill materials will be obtained from soils stockpiled on site.

2.6.3 Topsoil

Topsoil for the surface of the disposal cell and surrounding areas to be revegetated will be obtained from on-site stockpile areas.

2.6.4 Topsoil-Gravel Admixture

A mixture of gravel and topsoil will be used in select areas on the cover. The sources of rock are nearby commercial sources of alluvial gravel. Topsoil-gravel admixture shall meet the particle-size distribution requirements outlined in Section 8.

2.6.5 Riprap

A layer of riprap will be placed on the side slopes and on the perimeter apron of the disposal cell as well as within the discharge channel. The sources of riprap are nearby commercial sources of alluvial gravel and cobbles. Riprap shall meet the particle-size distribution and durability requirements outlined in Section 8, and shall meet requirements for rock durability outlined in NRC (1990) and Johnson (1999, 2002).

2.6.6 Filter Materials

Filter layer materials will be obtained from an off-site local commercial source or from select on-site borrow areas.

2.6.7 Granular Materials

Granular materials will be used for filter material and may also be used for subsurface fill for the cell base. These materials will be obtained from off-site commercial sources of alluvial sand and gravel.

2.7 Staging and Stockpile Areas

Areas on site identified as staging areas or stockpile locations will be approved by the Owner. These areas will be constructed and used in a manner consistent with the Owner's plans for storm water management. The Contractor shall maintain proper erosion control measures for stockpiles and may be required to cover piles in situations where precipitation is anticipated.

2.8 Access and Security

Access to the site will be controlled at gated entrances in the existing restricted area fencing. All gated entrances and security for the Mill property will be maintained by the Owner.

2.9 Utilities

Utilities on site will be maintained by the Owner outside of work areas (areas to be demolished or reclaimed). Utilities inside of work areas will be provided and maintained by the Contractor.

2.10 Sanitation Facilities

The Contractor, in accordance with the Owner's Radiation Protection Manual for Reclamation Activities, will maintain sanitation facilities required during construction.

3.0 WORK AREA PREPARATION

3.1 General

This section describes the preparation of site areas for reclamation. This work will be conducted according to applicable sections of the Owner's Radiation Protection Manual for Reclamation Activities.

3.2 Water Management

Preparation for work in the site area will include water management tasks outlined below.

- a. Removal of raffinate crystals from Cell 1.

Breaching of the Cell 1 dike for constructing the cell as a sedimentation basin. Re-routing runoff from the mill area and areas immediately north of the cell into the sedimentation basin for discharge onto the natural ground via the channel to be located at the southwest corner of the basin.

Diversion of clean area storm water runoff from work areas (where facilities demolition and material excavation will take place) and from the disposal cell footprint area.

Collection of storm water runoff from within the work areas and the disposal cell footprint for treatment and permitted discharge, or for disposed material compaction or dust control. The planned storage location for this affected storm water is the sedimentation pond.

Isolation of water used for processing operations associated with reclamation from storm water runoff. Water from processing operations or other contaminated water will not be used for disposal cell construction.

3.3 Cell Construction

A clay-lined disposal area will be constructed within Cell 1 for permanent disposal of contaminated material and debris from Mill site decommissioning. The disposal area will be

located immediately north of the existing dike between Cells 1 and 2. The disposal footprint area will be lined with a compacted clay liner prior to placement of contaminated materials and installation of the final reclamation cover. If there is not sufficient debris, rubble and contaminated soil to fill Cell 1 as designed, the footprint of Cell 1 can be reduced to decrease the horizontal dimension extending out from Cell 2 and the lateral extent of the disposed materials, to be closer to the base of the Cell 2 dike. If a design modification is required for Cell 1, it will be submitted to DWMRC for review and approval, and these Technical Specifications will be revised accordingly.

3.4 Soil Borrow Areas

Fill cover and liner materials for the disposal cell will be excavated from suitable materials stockpiled in identified borrow areas on site. Specific soil borrow areas will be selected based on haul distance to the disposal cell, ease of excavation of cover material, geotechnical characteristics, uniformity of the borrow material, and acceptable radiological and geochemical characteristics.

Borrow area preparation will consist of setup for storm water management (Section 3.2) and clearing and stripping (Section 3.5).

3.5 Clearing and Stripping

In work areas with vegetation, preparation work will include tasks outlined below.

3.5.1 Clearing

Clearing of vegetation and grubbing of roots will be in identified work areas. Clearing and grubbing shall not extend beyond 20 feet from the edge of the work area, unless as shown on the Drawings or as approved by the Reclamation Project Manager.

Vegetation from clearing and grubbing may be shredded or chipped to form mulch. Alternative methods of on-site or off-site disposal or burning of stripped vegetation shall be conducted only as approved by the Reclamation Project Manager.

3.5.2 Stripping

Stripping of salvageable topsoil (if present) shall be done within the entire work area. Stripping of topsoil shall not extend beyond 10 feet from the edge of the work area, unless approved by the Reclamation Project Manager. The depth of stripping of reclamation soil shall be based on the presence of suitable topsoil and approved by the Reclamation Project Manager. Water shall be applied to the areas of excavation and soil salvage to minimize dust generation.

Topsoil shall be stockpiled in approved areas. The final stockpile surface shall be graded and smoothed to minimize erosion and facilitate interim revegetation of the stockpile surfaces.

4.0 CELL 1 DISPOSAL AREA BASE CONSTRUCTION

4.1 General

This section outlines work associated with construction of the disposal cell base for receipt of materials (as described in Section 7.0) within Cell 1. The cell base will be constructed as shown on the Drawings and outlined in these Technical Specifications.

4.2 Materials Description

4.2.1 Subgrade Fill

The disposal cell footprint is likely to have an irregular surface from contaminated material excavation. Low areas of the excavated surface shall be filled with subgrade fill to form a smooth, competent foundation for clay liner construction (shown on the Drawings).

Subgrade fill will consist of off-site granular materials, or soils and weathered sedimentary rock from approved on-site excavation areas. Subgrade fill shall have a maximum size of 6 inches and shall be free from roots, branches, rubbish, and process area debris.

4.2.2 Clay Liner Material

Clay liner material shall have a maximum particle size of one inch, and shall be free from roots, branches, rubbish, and process area debris. Clay liner material shall have a minimum of 40 percent passing the No. 200 sieve and a minimum plasticity index (PI) of 15 percent.

4.3 Work Description

4.3.1 Foundation Preparation

The footprint of the disposal cell shall form a competent foundation for clay liner and cover construction. The surface of the disposal cell footprint shall be filled with subgrade fill (where required) in low areas to form a smooth, competent foundation for clay liner and cover construction. The final filled surface shall be compacted with approved construction equipment to provide a foundation surface with uniform density for clay liner placement.

4.3.2 Disposal Cell Foundation Area

The footprint of the disposal cell is established along the north side of the dike between Cells 1 and 2 (shown on the Drawings).

4.3.3 Subgrade Fill Placement

Subgrade fill (Section 4.2.1) shall be placed in lifts with a maximum loose thickness of 12 inches and compacted in excavated areas of the disposal cell footprint to meet desired grades and elevations for the disposal cell foundation.

4.3.4 Clay Liner Material Placement

Clay liner material (Section 4.2.2) shall be placed in lifts with a maximum loose thickness of 6 inches to form a continuous layer with a total minimum compacted layer thickness of 12 inches. Clay liner material shall be placed over the prepared subgrade surface of the disposal cell (Section 4.3.1).

Compaction of the clay liner material shall be done with a sheepsfoot or tamping-foot roller of sufficient weight to achieve the required compaction specifications. Compaction of the clay liner material shall not be achieved solely through the use of rubber-tired equipment.

If the moisture content of any layer of clay liner is outside of the allowable placement moisture content range specified (Section 4.4.2), the material shall be moistened and/or reworked with a harrow, scarifier, or other suitable equipment to a sufficient depth to provide relatively uniform moisture content and a satisfactory bonding surface before the next layer of clay material is placed. If the compacted surface of any layer of clay liner material is too wet (due to precipitation) for proper compaction of the fill material to be placed thereon, it shall be reworked with a harrow, scarifier or other suitable equipment to dry out the layer and reduce the moisture content to within the required limits, and re-compacted.

Clay liner construction shall minimize lenses, pockets, streaks or layers of material differing substantially in texture, gradation or moisture content from the surrounding material. Oversized material will be controlled through observation of placement by a qualified individual with

authority to stop work and reject material being placed and by culling oversized material from the fill.

No clay liner material will be placed when either the materials, or the underlying material, is frozen or when ambient temperatures do not permit the placement or compaction of the materials to the specified density without developing frost lenses in the fill.

Any holes in the clay liner material resulting from testing shall be repaired by hand by filling with clay fill, or by filling with bentonite powder which is hydrated to fully seal the hole.

4.4 Performance Standards and Testing

Lifts of material with tested dry densities less than the specified values will be reworked by the Contractor as necessary and re-compacted until the specified dry density is attained. Material that is too dry or too wet to permit bonding of layers during compaction will be reworked by the Contractor until the moisture content is within the specified limits.

4.4.1 Subgrade Testing

Subgrade fill shall be placed in lifts not exceeding 8 inches in loose thickness. Each lift shall be compacted to a minimum of 90 percent of standard Proctor (ASTM D698) density and within 3 percent of the optimum moisture content for the material.

Where required, checking of compaction of compacted subgrade fill and the final subgrade surface will consist of a minimum of one field density test per 1,000 cubic yards of material compacted. A minimum of two tests will be taken for each day that more than 150 cubic yards of material is placed. A minimum of one test per lift and at least one test for every full shift of compaction operations will be taken.

Field density tests will be compared with standard Proctor tests (ASTM D698 Method A or C). Where required, standard Proctor or Maximum Index Density tests will be conducted at a frequency of at least one test per 10,000 cubic yards of material compacted, or when material characteristics show significant variation.

Field density testing will be conducted with the sand cone test (ASTM D1556) or a nuclear density gauge (ASTM D6938, or as modified by the CQA Site Manager). Correlation of nuclear density gauge results will be by comparison with results from sand cone test(s) and laboratory testing for water content(s) using the oven drying method (ASTM D2216) on similar material.

4.4.2 Clay Liner Testing

Each lift of clay liner material shall be compacted to at least 95 percent of the maximum dry density for the material, as determined by the standard Proctor test (ASTM D698). During compaction, the material shall be within 2 percent of the optimum moisture content for the material, as determined by the standard Proctor test. If water addition is required to achieve this range of moisture contents, the added water shall be thoroughly mixed into the material prior to compaction.

Material specifications for the clay liner material will be confirmed by gradation testing conducted by approved personnel. Testing will consist of No. 200 sieve wash and maximum particle size testing (ASTM D422), and Atterberg limits testing (ASTM D4318) on samples of clay liner materials, at a frequency of at least one test per 2,000 cubic yards of fill placed, or when material characteristics show a significant variation.

Compaction of the clay liner material will be checked with a minimum of one field density test per 500 cubic yards of material compacted. A minimum of two tests will be taken for each day that more than 150 cubic yards of material is placed. A minimum of one test per lift and at least one test for every full shift of compaction operations will be taken.

Field density tests will be compared with standard Proctor tests (ASTM D698 Method A or C) on the same material. Standard Proctor tests will be conducted at a frequency of at least one test per 5,000 cubic yards of material compacted, or when material characteristics show significant variation.

Field density testing will be conducted with the sand cone test (ASTM D1556) or a nuclear density gauge (ASTM D6938, or as modified by the CQA Site Manager). Correlation of nuclear

density gauge results will be by comparison with results from sand cone test(s) and laboratory testing for water content(s) using the oven drying method (ASTM D2216) on similar material.

4.4.3 Grading Tolerances

The completed grading for the clay liner shall be within 1.0 foot (horizontally) of the lines as designed, and within 0.1 foot (vertically) of the elevations as designed. The final surfaces shall be smoothed to avoid abrupt changes in surface grade or areas of runoff concentration. The layer thicknesses shall meet the required minimum thicknesses.

5.0 DISCHARGE CHANNEL GRADING

5.1 General

This section outlines specifications for the work associated with excavating the discharge channel from Cell 1. Portions of the grading for the sedimentation basin may be in soil, while other areas may require rock excavation. Although the rock may be rippable, the Contractor should prepare for non-rippable rock in some of the excavation areas.

5.2 Work Description

5.2.1 Discharge Channel Excavation

The discharge channel shall be excavated to the slopes and grades and channel widths shown on the Drawings. Discharge channel excavation will include breaching of the dike on the west side of Cell 1. Riprap will not be required to armor the discharge channel where the channel is excavated into competent sedimentary rock, as verified in the field by the CQA Site Manager.

5.2.2 Grading Tolerances

Completed grading in soil for the sedimentation basin shall be within 1.0 foot (horizontally) of the lines as designed, and within 0.1 foot (vertically) of the elevations as designed. Final surfaces shall be smoothed to avoid abrupt changes in surface grade or areas of runoff concentration.

The completed grading in rock for the discharge channel and portions of the sedimentation basin shall be within 2.0 foot (horizontally) of the lines as designed, and within 0.5 foot (vertically) of the elevations as designed. The final excavated rock surfaces of the discharge channel will be below design grades and shall not be filled to make grade.

6.0 MILL DECOMMISSIONING

The following subsections describe decommissioning plans for the mill buildings and equipment, the mill site, and associated windblown contamination.

6.1 Mill Buildings and Equipment

The uranium and vanadium processing areas of the Mill, including all equipment, structures and support facilities, will be decommissioned by demolition and disposed of in tailings or buried on site as appropriate. All equipment, including tankage and piping, agitation equipment, process control instrumentation and switchgear, and contaminated structures will be cut up, removed and buried in tailings prior to final cover placement. Concrete structures and foundations will be broken up and removed. Concrete foundations may be left in place and covered with soil as appropriate.

Decommissioned areas will include the following:

- Coarse ore bin and associated equipment, conveyors and structures
- Grind circuit including semi-autogeneous grind (SAG) mill, screens, pumps and cyclones
- Three pulp storage leach tanks to the east of the mill building, including all tankage, agitation equipment, pumps and piping
- Seven leach tanks inside the main mill building, including all agitation equipment, pumps and piping
- The counter-current decantation (CCD) circuit including all thickeners and equipment, pumps and piping
- Uranium precipitation circuit, including all thickeners, pumps and piping
- Two yellow cake dryers and all mechanical and electrical support equipment, including uranium packaging equipment
- Clarifiers to the west of the mill building including the preleach thickener (PLT), clarifier, and claricone area

- The boiler and all ancillary equipment and buildings
- The entire vanadium precipitation, drying and fusion circuit
- All external tankage not included in the previous list including reagent tanks for the storage of acid, ammonia, kerosene, water, dry chemicals, etc. and the vanadium oxidation circuit
- The ammonium sulfate pad
- The uranium and vanadium solvent extraction (SX) circuit including all SX and reagent tankage, mixers and settlers, pumps and piping
- The SX building
- The mill building
- The alternate feed processing circuit
- The decontamination pads
- The office building
- The shop and warehouse building
- The sample plant building
- The reagent storage building

The sequence of demolition will proceed so as to allow the maximum use of support areas of the facility such as the office and shop areas. It is anticipated that all major structures and large equipment will be demolished using hydraulic shears. This equipment will expedite the process, provide proper sizing of the materials for transport and placement, and reduce personnel exposure to radiation and other safety hazards during the demolition. Uncontaminated or decontaminated equipment to be considered for salvage and remediation equipment will be released in accordance with the terms of License Condition 9.10 and NUREG 1575 Supplement 1, Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual

(MARSAME) (NRC, 2009) as appropriate and applicable. Contaminated soils from the Mill area will be disposed of in the tailings cells in accordance with Section 7.0.

6.2 Mill Site and Windblown Contamination

Areas with contamination around the Mill site are expected to be primarily surficial, except for the claricone and ammonium sulfate pad areas, and include the ore storage area and limited surface contamination of roads. Ore and alternate feed materials will have been previously removed from the ore stockpile area. Contaminated materials at the Mill site will be excavated and be disposed in Cell 1 in accordance with Section 7.0. The depth of excavation will vary depending on the extent of contamination and will be based on the criteria in Section 7.2.3, except for the claricone and ammonium pad areas which had removal depths and extents outlined in letters submitted by EFRI to the DWMRC on 10/26/12 and 12/23/13, respectively. All other 11e.(2) byproduct materials will be disposed in the tailings cells.

The Owner proposes to reclaim the Mill and surrounding land areas within the property boundary by excavating and placing wastes, demolition debris and contaminated soils into a fenced and controlled permanent disposal area. The permanent disposal area, the current restricted area, and the property boundary, are delineated in Drawing REC-1. The Owner proposes to survey and release all areas within the property boundary, excluding the Cell 1 Disposal Area and Cells 2, 3, 4A, and 4B, for unrestricted use.

Contaminants of concern are Ra-226, Th-230 and natural uranium (U-nat). The evaluation and remediation will be dictated by Ra-226, which is the contaminant with the most restrictive cleanup standard (based on the SENES Consultants, Inc. letter to EFRI dated August 15, 2012; this letter was provided as Attachment I to EFRI's Supporting Documentation for Response to Utah DWMRC Interrogatory 13/1 (SENES 2012)). The correlation between Ra-226 and the remaining two contaminants will be developed as outlined in subsequent sections of these Technical Specifications. Verification of the remediation will be established through a Wilcoxon Rank Sum (WRS) test between the study areas and local background areas. The procedure for verification will follow guidance from NUREG-1575 Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (NRC, 2000). The procedure will include:

- Scoping and characterization surveys: soil samples will be collected to develop a correlation between gamma radiation levels and the unity rule.
- Classification of land areas: to (MARSSIM) Class 1 through Class 3.
- Remediation of land areas driven by correlation-based prediction equation between gamma radiation and the unity rule for multiple radionuclides.
- Final Status Survey using the Wilcoxon Rank Sum (WRS) test with local background areas.

The procedure also follows the Data Quality Objective (DQO) process defined in the MARSSIM Guidance, as discussed in Section 6.6, and NUREG-1757 Volume 2 Consolidated Decommissioning Guidance, Characterization, Survey, and Determination of Radiological Criteria (NRC, 2006).

6.3 Scoping and Characterization Surveys

Areas contaminated through process activities or windblown contamination from the tailings areas will be remediated to meet applicable cleanup criteria for Ra-226, Th-230, and U-nat. Contaminated areas will be remediated such that the residual radionuclides remaining on the site, which are distinguishable from background, will not result in a dose that is greater than that which would result from the Ra-226 soil standard, that is, 5 pCi/g above background for the surface 15 cm soil layer and 15 pCi/g for the subsurface 15 cm soil layer, respectively as discussed in Section 6.6.3.3 and hereafter referred to as “5/15”.

An initial scoping survey for windblown contamination will be conducted based on analysis of pertinent past radiometric and land use information. Operational surveys of the areas surrounding the Mill and tailings area have indicated potential windblown contamination only to the north and east of the ore storage area, and to the southwest of Cell 3. The initial scoping survey will be conducted using calibrated gamma radiation instruments on 15 meter (15 m) transects. Additional surveys will be conducted in a halo, or buffer zone, around the projected impact area. The survey in the halo will be conducted using 25 m transects. Areas where no readings exceed 75 percent of the gamma radiation guideline value, as developed per Section 6.3.2, will be

classified as unaffected, and will not require remediation. Areas where one or more readings exceed the gamma radiation guideline value will be further investigated to determine whether or not remediation is required.

Prior to initiating cleanup of windblown contamination, a statistically-based soil sampling program will be conducted in an area within or outside the property boundary that is similar to the areas to be remediated, to determine the average background Ra-226 concentration, or concentrations, to be ultimately used for the cleanup. Similarity, or representativeness, will be determined based on geology, soil type and soil chemistry.

Soil cleanup verification will be accomplished by use of calibrated gamma radiation instruments. Multiple instruments will be maintained and calibrated to ensure availability and consistency during remediation efforts (Section 6.3.4).

6.3.1 Scoping and Characterization Survey for the Subsurface

The subsurface will only be investigated in areas where the historical site assessment (HSA) demonstrates the possibility of contamination below the 15 cm depth. This does not include areas of windblown contamination, or the ore storage area (unless also affected by an event demonstrated by the HSA). The method for the subsurface investigation will include boreholes where soil sampling and downhole gamma radiation investigations may occur. This method will be developed based on the HSA.

6.3.2 Gamma Radiation to Unity Rule Correlation

The Owner plans to use radiation measurement instrumentation for soil background analyses, unity rule – gamma radiation correlations, verification data, and sensitivity analyses. Soil background analyses will be completed using MARSSIM methods (NRC, 2000) for background reference areas.

Soil samples taken during characterization for correlation will be analyzed by a certified laboratory to determine the on-site correlation between the gamma radiation readings and the concentration of Ra-226, Th-230 and U-nat, in the samples. Samples will be taken from:

- Areas known to be contaminated with only processed uranium materials (i.e. tailings sand and windblown contamination)
- Areas in which it is suspected that unprocessed uranium materials (i.e. ore pad and windblown areas downwind of the ore pad) are present

The actual number of samples used will depend on the correlation of the results between gamma radiation readings and the unity rule as discussed below. Windblown contamination to the northeast of the Mill area is primarily associated with the unprocessed ore from the ore storage pad. The slightly larger windblown contamination area to the southwest of the Mill area is primarily associated with the processed tailings. A minimum of 35 samples of windblown tailings (to the southwest), and 15 samples of windblown unprocessed ore materials (to the northeast) will be collected.

Sufficient samples will be collected for developing prediction equations to calculate the linear regression lines and the corresponding upper and lower 95 percent confidence levels for each of the instruments. The upper one-sided 95 percent confidence limit will be used for the guideline value for correlation between gamma radiation readings and Ra-226 concentration. Because the unprocessed materials are expected to have proportionally higher values of uranium in relation to the Ra-226 and Th-230 content, the correlation to the gamma radiation readings are expected to be slightly different than readings from areas known to be contaminated with only processed materials. Areas expected to have contamination from both processed and unprocessed materials will be evaluated using the more conservative correlation, or will be excavated to the Ra-226 standard which should ensure that the uranium is removed.

The samples will be judgmentally selected with Ra-226 concentration at three different intervals related to the guideline value (5 pCi/g above background):

- 25 percent of the guideline value
- Approximately the guideline value
- Approximately twice the guideline value for the area of interest

This selection will maximize the precision of the correlation relationship at 5.0 pCi/g above background. Background Ra-226 concentrations have been gathered over a 16-year period at sample station BHV-3 located upwind and 5 miles west of the Mill. The Ra-226 background concentration from this sampling location is 0.93 pCi/g. This value and the concentrations of U-nat and Th-230 assumed in equilibrium with the Ra-226 will be used as an interim value for the background concentration used only in the initial planning for this project (e.g. use of historical knowledge for preliminary setting of verification sample sizes). Background locations for the verification test will have the three contaminants measured at multiple locations.

Because Ra-226 has short-lived radioactive decay products that are strong gamma radiation emitters (namely Pb-214 and Bi-214), gamma radiation surveys can be effective for characterizing soil Ra-226 distributions across large areas, including on relatively small spatial scales. The well-established, effective, and widely-used analytical approach for spatially comprehensive characterization of Ra-226 concentrations in surface soils involves spatially intensive gamma radiation surveys combined with the use of gamma radiation and soil Ra-226 concentration correlations.

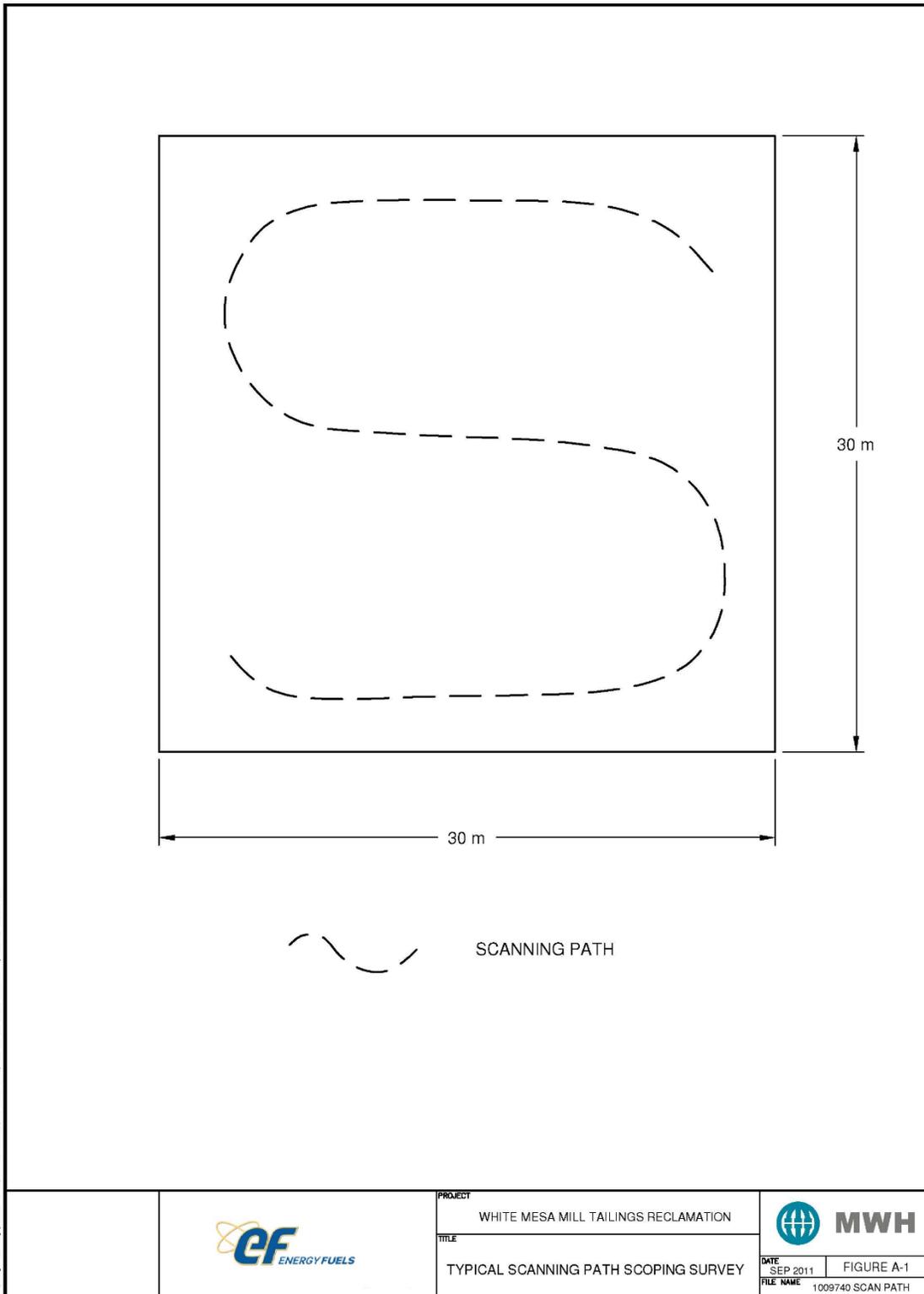
If a gamma radiation and Ra-226 concentration correlation is statistically significant, Ra-226 concentrations in surface soils can be predicted with reasonable accuracy based on gamma radiation readings collected at a high density of measurements across large areas. The same is true for other radionuclides, although correlative relationships tend to be less statistically significant and estimation uncertainty can be higher. The advantage of gamma radiation surveys is that a much higher density of measurements of terrestrial sources of gamma radiation is possible and when combined with gamma radiation/soil radionuclide correlation analysis, the approach produces a more comprehensive spatial characterization for comparisons against baseline conditions and evaluation of potential radiological contamination.

Fifteen soil samples will be collected in the restricted area to establish a correlation between the soil sampling analysis and the gamma radiation count. Additional measurement locations will be added, if necessary, to reach suitable precision, as defined in Section 6.6.3.7. The method that

will be used in an effort to develop statistically significant gamma radiation/soil radionuclide correlations is as follows:

1. At each correlation plot, a 100 m² (10 m x 10 m) plot for correlation measurements and soil sampling will be established with pin flags. A gamma radiation scan will be performed across each correlation plot (5 m transects at a detector height of 18 inches). The average gamma radiation reading (e.g. cpm) from scan data across each correlation plot will be calculated and recorded in the field logbook, or developed using data collected from the gamma radiation scan. See Figure A-1 for the scan path.
2. Within each 10 m x 10 m correlation plot nine sub-samples of surface soils, one in the center, and eight against the edges of the plot, will be collected across the plot (at a depth of 15 cm) and composited into a single sample to represent average soil radionuclide characteristics across the correlation plot. Composite surface soil samples from each correlation plot will be submitted to a qualified commercial laboratory for analysis of U-nat, Ra-226, Th-230, Th-232 (by Ra-228), and K-40. The correlation plot scanning and sampling design for each location is illustrated in Figure A-1.
3. The laboratory chain of custody/analysis request form to be submitted with composite correlation plot soil samples will specify the following requirements:
 - a. Thorough homogenization of each sample at the laboratory.
 - b. Ra-226 analysis by EPA Method 901.1, modified for soil samples, with sample counting to be performed at least 21 days after sealing in the counting tin to ensure full ingrowth of Rn-222 and its decay products. Analysis of K-40 will also be conducted with EPA method 901.1, as will analysis of Ra-228 (to determine Th-232 concentrations under the assumption of radiological equilibrium).
 - c. U-nat analysis by EPA Method 200.8 (ICP-MS) or equivalent, preferably with soil matrix digestion using EPA Method 3052 (microwave assisted acid digestion). EPA Method 3050B or equivalent digestive methods may alternatively be used; however, digestion will not be as complete.

- d. Th-230 analysis by EPA Method 200.8 (ICP-MS) or equivalent, preferably with soil matrix digestion using EPA Method 3052 (microwave assisted acid digestion). Ten percent of the correlation plot samples will also be analyzed for Th-230 by alpha spectroscopy.
4. Upon receiving soil analysis results from the laboratory, regression analysis will be performed to determine, based on paired data from all correlation plots, if significant statistical correlations exists between average gamma radiation readings and soil Ra-226, U-nat, Th-230, Th-232 by Ra-228 and K-40 concentrations.



6.3.3 Area Classification

The characterization and scoping surveys will be used to classify areas as either non-impacted or impacted areas. The impacted areas will be further classified into Classes 1-3 (NUREG-1575; NRC, 2000). The classification of the areas will determine the rigor required to survey and release the areas.

- Class 1 areas are areas which have, or had prior to remediation, a potential for radioactive contamination based on Mill operating history, or known contamination based on previous radiological surveys. Areas containing contamination in excess of the release criterion, specifically the Derived Concentration Guideline Level (DCGL) associated with the Wilcoxon Rank Sum Test ($DCGL_w$), established by the radium benchmark dose (RBD) approach in Section 6.6.3.3 prior to remediation should be classified as Class 1 areas. The concentration terms “ $DCGL_w$ ”, “release criterion”, and “unity rule”, have been used interchangeably throughout the remainder of these Technical Specifications. However, where a gamma radiation-based level is meant, the term “gamma guideline level” is used specifically.
- Class 2 areas are areas which have, or had prior to remediation, a potential for radioactive contamination or known radioactive contamination, but are not expected to exceed the $DCGL_w$.
- Class 3 areas are any impacted areas not expected to contain any residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the $DCGL_w$, based on Mill operating history and previous radiological surveys.

Table 6.1 - Final Status Survey Unit Classification for Land Areas

Survey Unit Classification		Statistical Test	Elevated Measurement Comparison	Sampling and/or Direct Measurements	Suggested Area (m ²)	Scanning
Impacted	Class 1	Yes	Yes	Systematic	2000	100% Coverage
	Class 2	Yes	Yes	Systematic	10,000	10-100% Systematic
	Class 3	Yes	Yes	Random	No limit	Judgmental
Non-Impacted		No	No	No	None	None

6.3.4 Remediation

Remediation will only occur in survey units that cannot pass the release criterion (DCGL_w). Remediation will consist of excavation of soils and placement in the tailing cells, as stated in Section 7.2.3. Remedial action support surveys will be conducted to guide the remediation. Remedial action support surveys will be conducted in a manner similar to the Final Status Surveys (FSSs), described in Sections 6.4 and 6.6, to ensure that the remedial action achieves the DCGL_w. Excavation will continue until the gamma radiation guideline value is achieved for surface soils.

Upon completion of remediation, gamma radiation surveys will be conducted on the excavated area and areas surrounding the excavation.

6.4 Final Status Surveys

Areas of the site will be released through the final status survey (FSS) process (see Section 6.6). Survey units will be released through FSS reports provided to DWMRC for each survey unit. Survey units that require remediation will undergo the FSS process after remediation. Survey units must meet the release criterion set forth in this section. Each survey unit that meets the release criterion will be released, pending DWMRC approval.

6.4.1 Release Criterion

Release criteria have been established and are discussed in more detail in Section 6.6.

6.4.2 Statistical Test

The WRS test will be performed using the background reference data set and the systematic sample data set from the survey unit under investigation. The background reference data set will be added to the unity rule (1) prior to the statistical test being completed. The two data sets will be derived using the weighted sum for multiple radionuclides set forth in MARSSIM (NRC, 2000):

For surface soils:

$$\frac{A \text{ (pCi/g Ra226)}}{5 \text{ (pCi/g)}} + \frac{B \text{ (pCi/g Unat)}}{545 \text{ (pCi/g)}} + \frac{C \text{ (pCi/g Th230)}}{46 \text{ (pCi/g)}} + 1$$

For subsurface soils:

$$\frac{A \text{ (pCi/g Ra226)}}{15 \text{ (pCi/g)}} + \frac{B \text{ (pCi/g Unat)}}{2908 \text{ (pCi/g)}} + \frac{C \text{ (pCi/g Th230)}}{142 \text{ (pCi/g)}} + 1$$

For instance, if the background reference area surface soil data set showed that one sample contained 2.2 pCi/g Ra-226, 2.2 pCi/g U-nat, and 2.0 pCi/g Th-230, the sample would be represented in the WRS data set as the following:

$$\frac{2.2 \text{ (pCi/g Ra226)}}{5 \text{ (pCi/g)}} + \frac{2.2 \text{ (pCi/g Unat)}}{545 \text{ (pCi/g)}} + \frac{2.0 \text{ (pCi/g Th230)}}{46 \text{ (pCi/g)}} + 1 = 1.49$$

Thus, 1.49 (unitless) for this particular background sample would be used in the WRS comparison data set for the background reference area to be compared to the survey unit data. If this sample were from the survey unit, the value would be 0.49 (unitless).

The WRS test will be performed on the survey unit and background reference area using the method in MARSSIM. For Class 1 to Class 3 survey units, the null hypothesis is that the survey unit exceeds the release criterion. If the null hypothesis is rejected, the mean for the survey unit does not exceed the DCGL_w, and no area exceeds the DCGL Elevated Measurement

Comparison ($DCGL_{EMC}$) then the survey unit is presumed to meet the release criterion and, pending DWMRC approval, released.

If an area in a survey unit exceeds the $DCGL_W$, the area of the contamination will be determined using a mixture of soil sampling and gamma radiation surveying.

A comparison to the EMC will be made to determine if the area presents a dose equal to, or lower than, the $DCGL_W$ scenario. This determination will be completed through the derivation of area factors based on the size of hypothetical areas of contamination. The area factor for a contaminated area will be multiplied by the $DCGL_W$ to determine the allowable contaminant concentration for that size of area, which still meets the unity rule. Area factors will be determined prior to FSS's and will be approved by DWMRC.

Areas of elevated activity that do not meet the $DCGL_{EMC}$ will be remediated.

6.5 Instrument Quality Assurance/Quality Control (QA/QC)

Field gamma radiation survey instrumentation will be sodium iodide (NaI) detectors. To the extent possible, the same instruments will be use throughout the characterization, remediation and final status survey. These instruments will be cross-calibrated to allow other identical instruments or similar instruments to be used. Individuals will be appropriately trained to use the selected instrumentation and the instrumentation will be suitable for its intended use. Instrumentation shall be operated in accordance with written procedures and manufacturers' manuals which will provide guidance to field personnel on the proper use and limitations of the instruments.

6.5.1 Calibration

The manufacturer's current calibration/maintenance records will be kept on site for review and inspection for all instruments used during the survey. Past calibration records will be retained for inclusion in the FSS report.

The records will include, at a minimum, the following:

- Equipment identification (name, model, and serial number)

- Manufacturer
- Date of calibration
- Calibration due date

Instrumentation must be maintained and calibrated to manufacturer's specifications to ensure that required traceability, sensitivity, accuracy, and precision of the equipment/instruments are maintained. Instruments will be maintained and calibrated in accordance with American National Standards Institute N323A (ANSI, 1997).

6.5.2 Source and Background Checks

Prior to and after daily use, instruments will be QC-checked by comparing the instrument's response to a designated gamma radiation source and to ambient background. Prior to commencement of field operations, a site reference location will be selected for the performance of these checks. Acceptable ranges (count rate) for each instrument will be established by performing a series of counts. The acceptable range will be ± 2 sigma of the mean of the series of counts. QC source checks will consist of one-minute integrated counts with the designated source position in a reproducible geometry, performed at the designated location. Background checks will be performed in an identical fashion with the source removed. Results of the background and QC checks will be recorded in a field logbook.

Instrument response to the designated QC check source will be plotted on control charts or in tabular form (spreadsheets) and evaluated against the average source and background readings established at the start of the field activities. A performance criterion of ± 2 sigma of this average will be used as an investigation action level, and a repeat of the measurement will be performed. A performance criterion of ± 3 sigma of this average will be used as a failure level requiring corrective action. Results exceeding this criterion will be investigated and appropriate corrections to instrument readings will be made if the response is affected by factors beyond personnel control, such as large humidity or temperature changes. The instrument(s) in question will be removed from service while investigations and corrective actions are in progress.

Instrument response to ambient background will be used to establish a mean background response for each instrument, to monitor gross fluctuations in background activity (e.g., from changes in barometric pressure and other, non-contaminant related causes), and to evaluate detector response. The background measurements are performed for the purpose of checking for detector contamination and electronic stability (especially cabling).

Instrument response to source checks are used to prove detector efficiency and electronics stability.

During QC checks, instruments shall be inspected for physical damage, current calibration and erroneous readings. The individual performing these tasks shall document the results in accordance with the instrument protocol within MARSSIM, as provided in Exhibit A-1. Instrumentation that does not meet the specified requirements of calibration, inspection, or response check will be removed from operation. If the instrument fails the QC response check, any data obtained to that point, but after the last successful QC check will be considered invalid due to potentially faulty instrumentation.

6.6 Data Quality Objectives

This plan was developed using guidance from MARSSIM to ensure surveys are conducted with the proper rigor, quality assurance, and statistical analysis to make proper decisions. A key step in the MARSSIM process is the development of DQOs. DQOs ensure collection of data of the right type, quality, and quantity to support decisions, the decommissioning process, and the achievement of the desired end state. The DQOs are outlined below, and include systematic processes to:

- 1) State the problem
- 2) Identify the goal of the characterization
- 3) Identify inputs to the decision
- 4) Define the study boundaries
- 5) Develop the decision rules/analytical approach

- 6) Define acceptable decision errors
- 7) Optimize the design

6.6.1 State the Problem

Ultimately, the mill will be decommissioned, the demolition and decommissioning waste disposed in the tailings cells, and the tailings system reclaimed as approved by DWMRC. The reclamation objective is to release the mill's land areas, other than the tailings area, for unrestricted use. Land areas may have radiological contamination from milling operations. The scanning procedure needs to identify and distinguish areas that can be released, from areas that must be remediated prior to being released. The data collected following excavation in remediation areas must also be suitable for use in the FSS to demonstrate that the clean-up criteria have been met.

6.6.2 Identify the Decisions

The decision process will be based on data from scoping and characterization surveys, gamma radiation correlation, remediation and final status surveys.

Survey and sampling data will be used to:

- 1) Assist in classification of survey units
- 2) Determine areas requiring remediation
- 3) Develop Final Status Surveys to verify that clean-up criterion has been met

6.6.3 Identify Inputs to the Decision

6.6.3.1 *Characterization and Scoping*

HSAs, scoping surveys, and characterization surveys will be used to determine the extent of the contamination as well as the presence of useable relationships/ratios between the radionuclides of background reference areas. The presence of useable relationships will be established in accordance with Section 4.5 of MARSSIM (NRC, 2000). Soil sampling will be conducted in the survey areas and samples will be analyzed for U-nat, Th-230 and Ra-226.

The background must be correctly characterized and a proper background reference area chosen to represent the background for the Mill soils. This will ensure that the soil will be cleaned up to the appropriate level. Goals of the characterization include selecting an appropriate background reference area(s) and appropriate background(s), and correctly comparing selected background(s) with the survey units. Multiple backgrounds may be selected for different survey units depending on the characterization and scoping surveys in conjunction with the HSA.

From MARSSIM Section 4.5, a site background reference area should have similar physical, chemical, geological, radiological, and biological characteristics as the survey unit being evaluated. Background reference areas are normally selected from non-impacted areas, but are not limited to natural areas undisturbed by human activities. In some situations, a reference area may be associated with the survey unit being evaluated, but cannot be potentially contaminated by site activities. For example, background measurements may be taken from core samples of a building or structure surface, pavement, or asphalt. The selected reference areas will be reviewed with DWMRC.

Systematic soil sampling will occur prior to the FSS, and samples will be analyzed for Ra-226, Th-230, and U-nat to determine background concentrations to be used for the cleanup. The soil sampling to determine the average background radionuclide concentrations to ultimately be used for the cleanup will be conducted prior to remediation. Background sampling will be conducted in a reference area within or outside of the property boundary that is similar to the area to be remediated.

Background reference areas will be chosen such that they are representative of the survey unit locations but are non-impacted from site operations. Representativeness shall be determined on the basis of geomorphology, geological, geochemical, and radiological, considerations.

6.6.3.2 Correlation

A correlation of the unity rule in the soil to the gamma radiation will be developed. This correlation will guide remediation and excavation. This correlation is explained in Section 6.3.2.

Remediation of the soil to meet the unity rule is described in Section 6.3.4. The final status survey reports will be the definitive source of information to describe the final impacts on the soil left by the Mill. The reports will detail how the cleanup met the Site Cleanup Criteria and show that each survey unit meets the cleanup criteria. The FSS reports will verify that the remediation has achieved the cleanup criteria.

6.6.3.3 Site Cleanup Criteria

The DCGLs for Ra-226 are set at 5 pCi/g for the surface 15 cm soil layer and 15 pCi/g for the subsurface 15 cm soil layer, respectively (hereafter referred to as “5/15”) (See Attachment D for further discussion).

The DCGLs for radionuclides other than Ra-226 are derived from doses calculated for Ra-226 at 5/15 using the same exposure scenarios as were used to estimate the dose from Ra-226 at 5/15. This is referred to as the radium benchmark dose (RBD).

Generally, elevation of U-nat and Th-230 concentrations relative to Ra-226 is unexpected since the contaminated materials will either be ore (which are at or near secular equilibrium) or tailings where U-nat is reduced relative to the other uranium decay series radionuclides of interest. Possible exceptions are:

- Areas with raffinate crystals which may have higher Th-230 concentrations compared to Ra-226 concentrations
- Areas of spilled yellowcake product near the mill where U-nat may be elevated relative to Ra-226

The RBD approach was applied as described in Attachment D. The RESRAD (Version 6.5) code (Yu et al. 2001) was used to implement the RBD approach. As described in NUREG-1569 as Appendix E (NRC 2003, a Guidance document for NRC Commission Staff on the Radium Benchmark Dose Approach), NRC considers the RESRAD code as an acceptable code for application of the Ra-226 benchmark dose approach. In brief, radionuclides at their respective DCGLs result in the same benchmark dose as the Ra-226 DCGL.

The DCGLs for the radionuclides of interest for the surface and subsurface layers were calculated and are provided in Table 6.2. The scenario is for a rancher with the doses determined using the RESRAD Version 6.5 model. The default RESRAD dietary and inhalation data which apply for the adult are carefully selected from literature and are already considered to represent conservative parameter values. Details on the calculation of DCGL's are provided in Attachment D.

Table 6.2 - DCGL above background

DCGL (pCi/gram) above background		
Radionuclide	Surface	Subsurface
Ra-226	5	15
U-nat	545	2908
Th-230	46	142

Since there is more than one radionuclide of concern, the criteria for unrestricted use is applied using the unity rule such that the RBD is never exceeded.

In the equations below, the numerator is determined by subtracting the local background from the sample analysis following remediation. It is possible that the background may vary between survey units due to variation in soil types.

The unity rules are:

For surface soil:

$$\frac{A \text{ (pCi/g Ra226)}}{5 \text{ (pCi/g)}} + \frac{B \text{ (pCi/g Unat)}}{545 \text{ (pCi/g)}} + \frac{C \text{ (pCi/g Th230)}}{46 \text{ (pCi/g)}} \leq 1$$

For subsurface soil:

$$\frac{A \text{ (pCi/g Ra226)}}{15 \text{ (pCi/g)}} + \frac{B \text{ (pCi/g Unat)}}{2908 \text{ (pCi/g)}} + \frac{C \text{ (pCi/g Th230)}}{142 \text{ (pCi/g)}} \leq 1$$

MARSSIM requires that the median concentration in a survey unit be demonstrably lower than the DCGL_w following remediation. This is accomplished with a WRS test between soil concentrations in the survey unit and appropriate background reference locations. For the WRS test, the actual concentrations are used for the survey unit rather than using the incremental concentrations, discussed previously in Section 6.4.2.

6.6.3.4 Gamma Radiation Surveys

Gamma radiation surveys will be conducted with a GPS-integrated system using 2-inch by 2-inch sodium iodide (NaI) detectors or the equivalent. Statistical correlations will be developed between the radiological soil sample analysis and the gamma radiation count rate. See Section 6.4.2 for the method for development and use of the gamma radiation correlation.

With the GPS-integrated method, high density gamma radiation scanning surveys will be done using the Ludlum 44-10 detectors at a height of 18 inches above the ground. The surveyor speed will be approximately 0.5 m/s.

For Class 1 survey units, transects will be 5 m apart and gamma radiation scanning surveys will continue up to 20 m outside the excavation with averages calculated on each 10-m by 10-m block. Class 1 survey units will scanned at a density to ensure that 95 percent of the 10-m by 10-m blocks have at least 20 gamma radiation measurements for blocks in and adjacent to the excavation areas with measurements in at least three of the four quadrants of the 10-m by 10-m block.

The remainder of the survey area outside the remediation area will be classified as Class 2 and will be surveyed at 10 m transects. The requirement for the remainder of the survey area, Class 2, will be that 95 percent of the blocks have at least 10 gamma radiation measurements.

The Class 3 area will include the buffer areas outside the area of contamination, and this area will be surveyed with planned transects of 50 m. Twenty percent or more of the 10-m by 10-m blocks will have at least 10 gamma radiation measurements.

The mean, median, and standard deviation of the 10-m by 10-m averages will be calculated by survey unit for data logged during the scanning surveys.

6.6.3.5 Gamma Radiation Guideline Level

The average gamma radiation count rate will be established over the 10-m by 10-m blocks. A correlation will be established between the gamma radiation level and the unity rule using co-located gamma radiation and soil concentration measurements. The gamma radiation guideline value will be the gamma radiation counts that equate to 0.8 (80 percent of unity rule) from the correlation equation. Locations where the gamma radiation guideline is exceeded will have additional gamma radiation surveys and potentially additional excavation before verification sampling.

6.6.3.6 Selection of Verification Samples

Following completion of excavation, if necessary, verification sampling will be carried out for each survey unit to allow a WRS test with background samples to confirm that the compliance criteria has been met. Ten sampling blocks will be determined from a random sampling approach for each survey unit. Following the final status gamma radiation survey, a minimum of 15 blocks in the survey unit will be measured to confirm the gamma radiation guideline level. For these 15 samples, the five 10- by 10-m blocks with the highest average gamma radiation will be sampled along with another 10 sample blocks randomly selected from the area.

The soil samples from the 10 randomly selected locations will be assessed to determine if the mean concentration in the survey unit is statistically below the unity rule with an alpha error of 0.05 using the MARSSIM WRS test.

The number of samples may be increased per Section 6.6.8.

6.6.3.7 Revision of Correlation

The verification sample measurements (soil analysis and mean gamma radiation counts) will be compared to the correlation to determine if the correlation is statistically valid. The correlation will be updated with the verification measurements if there is less than a 95 percent probability

(p-value of 0.05) that the random verification data is less than $DCGL_W$. Verification measurements (soil sample and mean gamma radiation counts) will be taken with the same method as the correlation measurements.

6.6.3.7.1 Reporting

For each survey unit, the following will be reported:

1. Number of blocks remediated during remediation phase.
2. Number of blocks with subsequent remediation initiated by gamma radiation measurement.
3. Gamma radiation coverage compliance (i.e. percentage of blocks meeting number of measurement criteria).
4. Mean gamma radiation level averaged over the 10-m by 10-m blocks.
5. Mean and range of predicted unity rules based on gamma radiation survey.
6. Mean and range of measured unity rules based on verification sampling.

6.6.3.8 Field Data

The objectives of the survey and sampling activities are to identify the concentrations of residual radioactive material in the survey units so that the unity rule can be evaluated. This information will allow a determination of whether a survey unit is likely to be suitable for release. The average soil concentrations will be evaluated to verify that each radiological $DCGL_W$ is met.

6.6.4 Define the Study Boundaries

The soil in the restricted area will be surveyed for radiological contamination of U-nat, Th-230, and Ra-226. This does not include the tailings cells and unrestricted areas. Survey units will be established in the unrestricted area if, during the survey of the restricted area, contamination is found at the boundary of the restricted area or if there is reason to believe contamination is present in the unrestricted area.

6.6.5 Develop the Decision Rules/Analytical Approach

If soils exhibit widespread contamination above the $DCGL_w$, then removal of the soil will be necessary or the EMC process will need to be followed to ensure that areas of contamination will not exceed the $DCGL_w$ following excavation.

6.6.6 Define Acceptable Decision Errors

6.6.6.1 Statistical Tests

The WRS test will be used to compare background reference areas to survey units in the MARSSIM framework for the FSS reporting. The WRS test is a nonparametric test used to test for a difference in values between two populations; that is, one data population is hypothesized to consist of higher average values than the other data population.

MARSSIM suggests using the WRS test in cases where the contaminant is present in background at a significant fraction of the $DCGL_w$. Since the $DCGL$ is 5 pCi/g for Ra-226 and the background is in the order of 1 pCi/g or more for Ra-226, the WRS test is the preferred test.

The soil concentrations from the 10 randomly selected locations as defined in Section 6.6.3.6 will be assessed with the WRS test to determine if the median concentration in the survey unit is statistically below the unity rule with an alpha error of 0.05 using the MARSSIM WRS test.

6.6.6.2 Hypothesis

The decisions necessary to determine compliance with the soil cleanup criteria are based on precise statistical statements called hypotheses, which are tested using the data from the survey unit.

Null Hypotheses - The situation that is presumed to exist is expressed as the null hypothesis (H_0), which states “*the median concentration in the survey unit exceeds the median concentration in the background reference area by more than the $DCGL$.*”

Alternative Hypotheses - For a given H_0 , there is a specified alternative hypothesis (H_a), which is an expression of what is believed to be the situation if the null hypothesis is not true. The H_a

states “*the median concentration in the survey unit does not exceed the median concentration in the background reference area by more than the DCGL.*”

These hypotheses were chosen for the following two reasons: (1) the burden of proof is placed on the H_A and, (2) the survey unit will not be released until proven to meet the cleanup criterion. In order to pass the WRS using the above H_0 , the median concentration of the systematic samples in the survey unit must be less than the $DCGL_W$ above background.

6.6.6.3 Error Types

Decision errors help to determine the number of samples required. Generally, more samples are required to generate lower decision errors (i.e., the fewer samples, the larger the uncertainty).

The statistical acceptability decisions are designed to avoid two kinds of errors:

- Releasing a survey unit which requires additional remediation
- Remediating a survey unit which is already below the $DCGL_W$

Two possible error types are associated with such decisions, Type I and Type II, which are described below.

Type I – which is also referred to as a false positive, occurs when H_0 is rejected when it is actually true. The probability of a Type I error is usually denoted by α . This error could result in higher potential doses to future site occupants than prescribed by the dose-based criterion. The maximum Type I error rate has been set at $\alpha = 0.05$ (there is less than 5 percent chance of error).

Type II - which is referred to as a false negative, occurs when H_0 is not rejected when it is actually false. The probability of a Type II error is usually denoted by β . Consequences of Type II errors include unnecessary remediation expense and project delays. The Type II error rate has been set at $\beta=0.10$ (there is less than 10 percent chance of error).

Statistical correlations will be developed between the unity rule and the gamma radiation measurements. The unity rule will be determined from measurement data for incremental concentrations at each sample location. The correlation between the unity rule and the gamma

radiation measurement at the sample location will produce a prediction equation. MARSSIM requires that the mean concentration in a survey unit be demonstrably lower than criteria following remediation but does not require all sampling units, in this case the 10-m by 10-m areas, to be lower than the criteria. The precision goal for the relationship will be that the mean prediction uncertainty for the survey unit will be +/- 0.2 when the predicted unity rule is equal to “1”.

Protocols will be in place to ensure decision errors are kept to a minimum. For example, instrument quality assurance checks will be required and minimum detectable concentrations (MDCs) will be met.

The gamma radiation survey will be limited by the MDC for the 2-inch x 2-inch sodium iodide (NaI) detector which is approximately 104 Bq/Kg (2.8 pCi/gram) for Ra-226, MARSSIM Table 6.7. This MDC is dependent on the background which may raise or lower the MDC (NRC, 2000).

Table 6.3. Reported MDC’s from MARSSIM Table 6.7

Nuclide	MDC (Bq/kg)	MDC (pCi/gram)
U-Nat	2960	80
Th-230	78,400	2100
Ra-226 (with decay products in equilibrium)	104	2.8

6.6.7 Relative Shift and Number of Samples

The target decision errors are 0.05 and 0.10 for α and β , respectively. The major contributor to the unity rule is Ra-226 since the criterion is much lower for Ra-226 compared to U-nat and Th-230. The lower bound of the gray region (LBGR) has been set to 0.8 as Ra-226 has a typical concentration that is only about 25 percent of the LBGR and the uncertainty will likely be of this order.

The preliminary estimate is that a relative shift of 2.0 based on the LBGR of 0.8 and an uncertainty of twice the background concentration. Using Table 5.3 of MARSSIM (NRC, 2000), the required number of samples is 8.

Should any area exceed the $DCGL_{EMC}$ or large areas exceed the $DCGL_W$, remediation of the affected areas would be completed prior to resampling.

6.6.8 Optimize the Design

Initially, gamma radiation scans will be conducted in the restricted areas of the Mill site. The data from these scans will be reviewed to determine the location of any hotspots. These hotspot locations will be sampled to determine the activity concentrations of U-nat, Th-230, and Ra-226. A prediction equation of the unity rule will provide the basis for scanning large areas effectively to direct focused remediation and to ensure that the cleanup criterion is met.

The statistical test (WRS test) could fail to show that the mean is below the criterion due to the initial number of verification samples, since there may be insufficient samples to achieve the desired decision error rates given the characteristics of the survey unit. In cases where data suggest that the concentration is below the criterion (e.g., the mean bases), additional samples would reduce the decision error and potentially allow the survey unit to pass. In this case, the mean and variability of the 10 randomly selected measurements will be used to determine MARSSIM's relative shift with the lower bound of the gray region equal to 0.8 of the unity rule. The α error will be set to 5 percent and the β error set to 10 percent to determine the required total number of samples. These samples would be collected and the WRS repeated on the larger data set.

6.7 Soil Sampling

6.7.1 Laboratory Approval

All samples will be analyzed for radionuclide activity concentration (pCi/g). All analyses will be performed by a DWMRC-approved/certified laboratory and a DOE-certified, or National Environmental Laboratory Accreditation Program (NELAP)-certified laboratory. The laboratory

will analyze method blanks, matrix spike samples, laboratory control samples and replicates. Typical required detection levels will be less than or equal to one tenth of the DCGL for each radionuclide.

6.7.2 Data Validation

Laboratory analytical results from the final status survey will be validated and will be reviewed by the data validator for the following:

- Data completeness/sample integrity
- Holding times
- Calibration
- Alpha spectroscopy tracer analysis
- Laboratory and field blanks
- Laboratory control samples
- Laboratory and field duplicates
- Alpha spectroscopy matrix spikes
- Quantitation and detection limits
- Alpha spectroscopy chemical separation specificity
- Gamma radiation spectroscopy target radionuclide list identification
- Secular equilibrium verification, and result verification

Review of these parameters checks the quality of the data with respect to:

- Precision – which is a measure of the reproducibility of an analysis under a given set of conditions. Precision will be evaluated through a review of field duplicate and laboratory duplicate samples.
- Accuracy – which is a measure of the bias that exists in a measurement system. Accuracy will be evaluated through a review of laboratory control samples, matrix spike samples, method blanks, and tracer recoveries.

- Representativeness – which is a measure of the degree to which the sampling data accurately and precisely represent site conditions. Representativeness will be evaluated through a review of raw data and through a comparison of whether the proposed scoping survey was implemented.
- Comparability – which is a measure of the degree of confidence with which two data sets can be compared to each other. Comparability will be evaluated through an assessment of whether appropriate and acceptable analytical methods were used.
- Completeness – which is a measure of the amount of valid data obtained.

6.8 Employee Health and Safety

Programs currently in place for monitoring of exposures to employees will remain in effect throughout the time period during which tailings cell reclamation, mill decommissioning and clean up of windblown contamination are conducted. This will include personal monitoring and the ongoing bioassay program. Access control will be maintained at the Restricted Area boundary to ensure employees and equipment are released from the site in accordance with the current License conditions. In general, no changes to the existing programs are expected and reclamation activities are not expected to increase exposure potential beyond current levels.

6.9 Environment Monitoring

Existing environmental monitoring programs will continue during the time period in which reclamation and decommissioning is conducted. This includes monitoring of surface and groundwater, airborne particulates, radon, soils and vegetation according to the existing License conditions. In general, no changes to the existing programs are expected and reclamation activities are not expected to increase exposure potential beyond current levels.

6.10 Quality Assurance

In general, the QA/QC Plan details the Owner's organizational structure and responsibilities, personnel qualifications, operating procedures and instructions, record keeping and document control, sampling procedures and outside laboratory testing.

7.0 MATERIAL DISPOSAL

7.1 General

This section outlines work associated with placement of materials in the disposal cell area within Cell 1 and tailings cells (Cells 2 through 4).

7.2 Materials Description

The types of materials to be disposed of are outlined below.

7.2.1 Raffinate Crystals

After the residual liquid in Cell 1 has been evaporated, the raffinate crystals from Cell 1 will be excavated and disposed in one of the tailings disposal cells. The crystals are likely to have granular consistency, with larger crystal masses that may require breaking down for loading and transport (using the loading equipment).

7.2.2 Synthetic Liner

The existing PVC liner in Cell 1 will be removed and disposed of in one of the tailings disposal cells.

7.2.3 Contaminated Soils

During remediation, soils located in and around the Mill site that exceed the soil cleanup guideline value will be placed in one of the tailings disposal cells. Soils excavated from Cell 1 to meet design grades or exceed the soil cleanup guideline value shall be placed in one of the tailings disposal cells.

7.2.4 Mill Debris

The Mill debris will include equipment, such as tankage and piping, agitation equipment, process control instrumentation and switchgear, and contaminated structures (including concrete structures and foundations). Mill debris will be placed in the disposal area in Cell 1 (disposal cell).

7.3 Work Description

Materials to be disposed in the cells will be spread over the working surface as much as possible to provide relatively uniform settlement and consolidation. In the disposal cell, a minimum of one foot of soil will be placed over the clay liner prior to placing any debris.

7.3.1 Raffinate Crystals

Raffinate crystals will be removed from Cell 1 and transported to the tailings cells. Placement of the crystals will be performed as a granular fill, with large-sized material broken to minus 6-inch size. Voids around large material will be filled with finer material. Actual placement procedures will be evaluated by the CQA Officer during construction as crystal materials are placed in the cells and modified with the agreement of the DWMRC.

7.3.2 Synthetic Liner

The PVC liner will be cut, folded (when necessary), removed from Cell 1, and transported to the tailings cells. The liner material will be spread as flat as practical over the designated area. After placement, the liner will be covered as soon as possible with at least one foot of soil, crystals or other materials for protection against wind uplift, as approved by the CQA Site Manager.

7.3.3 Contaminated Soils

The extent of contamination of the Mill site will be determined by gamma radiation scanning and the A correlation developed between gamma survey readings and the unity rule concentrations (Section 6). Gamma survey readings will be used to define cleanup areas and confirm cleanup. Soil sampling will be conducted to verify that the cleanup results meet soil cleanup guideline values.

Where surveys indicate the above criteria have not been achieved, the soil will be removed to meet the criteria. Soil excavated from Cell 1 will be transported to one of the tailings cells.

7.3.4 Mill Debris

Debris will be spread across the bottom of the disposal cell to avoid nesting and to reduce the volume of voids present in the disposed mass. Stockpiled soils and/or other approved materials will be placed over and into the debris in a sufficient lift thickness to fill the voids between the debris pieces. The CQA Site Manager will approve the use of materials other than stockpiled soils for filling voids.

7.3.5 Material Sizing and Preparation

Demolition debris to be placed in the disposal area of Cell 1 will consist of equipment and structural material from facilities demolition. Demolition procedures are outlined in the Appendix B to the Reclamation Plan (Preliminary Mill Decommissioning Plan). Because of the wide variety in shape and size of demolition debris, material of odd shapes will be cut or dismantled to facilitate handling, loading, transport, and placement in the disposal cell. The maximum size of dismantled or cut materials will not exceed 20 feet in the longest dimension and a maximum volume of 30 cubic feet. Smaller dimensions may be necessary for loading, handling, hauling, and placement of material.

7.3.6 Incompressible Debris

Material that is not compressible (steel columns and beams, concrete, and other solid material) will be reduced in size for loading, hauling, and placement in the disposal cell. Incompressible debris shall be placed, oriented, or spread in a manner that minimizes void spaces below, between, and above these materials. Incompressible debris shall be placed on and covered with soils or similar materials (Section 7.2.3). Incompressible debris such as steel members shall be placed in the disposal cell with the longest dimension oriented horizontally.

Thick-walled pipe, conduit, tanks, vats, pressure vessels, and other hollow materials that cannot be crushed or dismantled shall be transported to the planned location within the disposal cell and oriented for filling and burial. The voids on the inside of the item will be filled with contaminated soil, clean fill soil, or grout (controlled low-strength material or flowable fill). Contaminated soil (Section 7.2.3) or clean fill will be placed outside of the items and compacted

with standard compaction equipment (where possible) or hand-operated equipment to the compaction requirements in Section 7.4. Several lifts of compacted contaminated soil or clean fill may be necessary to fill around and cover these items.

For debris where internal voids cannot practically be filled with soil, a grouting program will be initiated to pump controlled low strength material (CLSM, flowable fill) into the voids. Debris will be grouped together and characterized as materials that will require grouting, so that a significant volume of debris can be grouted in a single action, rather than grouting individual lengths of pipe. Pipe sections could be stacked horizontally, or cut short enough to stand vertically in a safe manner. Grout will fill the voids within the grouped debris with a soil berm or trench used to contain the grout laterally around the perimeter of the selected debris.

If CLSM is required for the grouting of voids that cannot be filled with soil, the mix design for the grout will mimic, as closely as possible, the strength and hydraulic properties of the contaminated soil that will also be used for filling voids within the debris. The unconfined compressive strength of the CLSM will be between 30 and 150 psi, and unit weights will be approximately 100 to 120 pcf.

7.3.7 Compressible Debris

Materials that are compressible (such as thin-walled piping and thin-walled tanks) will be flattened or crushed in a designated staging area or in the disposal cell. Flattening or crushing will be done with a hydraulic excavator bucket or other attachments, or with a dozer or other steel-tracked equipment.

These materials shall be placed in the disposal cell and spread to form a lift with a maximum thickness of two feet. Placement shall be done in a manner resulting in materials lying flat and minimizing void spaces. Pipe shall be cut into lengths of approximately 10 feet or less for disposal. Pipe larger than 12 inches in diameter shall be longitudinally split or cut, or filled with grout.

7.3.8 Organic Debris

Organic materials (such as wood and paper) will be placed in the disposal cell in maximum lifts of 12 inches and mixed with the soil and other incompressible debris during placement to prevent pockets of organic material from being created. Organics mixed with soil for spreading will be limited to 30 percent by volume of the mixture.

7.3.9 Soils and Similar Materials

Soils and soil-like materials to be placed in the disposal cell will be from on-site areas identified by the Owner for excavation. Soil or soil-like material will be placed and compacted over each lift of debris (Section 7.2.4) or other materials in lifts not to exceed 2 feet in loose thickness and compacted prior to placement of additional lifts. Soils will also be used for interim soil cover to minimize exposure of demolition materials and other materials to air and meteoric water.

7.4 Performance Standards and Testing

7.4.1 Material Compaction – Debris Lifts

During construction, the compaction requirements for the raffinate crystals will be evaluated based on field conditions, material quantities, and compaction equipment. The compaction requirements will be determined by the CQA Site Manager and the Construction Manager or a designated representative, with the agreement of the Owner.

Each lift of debris (up to 2 feet thick) will be covered with soil (Section 7.3.9) (up to 2 feet in loose thickness). Each lift of soil or similar material will be compacted with a minimum of 6 passes with vibratory compaction equipment. The number of passes shall be confirmed with the actual compaction equipment on site with a field test section to establish a correlation between the field compaction method and 80 percent of maximum dry density for the soil, as determined by the standard Proctor test (ASTM D698).

The CQA Technicians will monitor and approve debris placement. In areas where voids are observed during placement, the Contractor shall re-excavate the area, fill any voids encountered with soil and recompact the materials, or grout the voids. The CQA Site Manager will

recommend implementation of a grouting program where voids, either within a debris mass, or within a vessel, cannot be properly filled with soil using conventional equipment.

7.4.2 Material Compaction – Final Disposed Material Surface

The upper 12 inches of the final disposed material surface shall be compacted to 90 percent of the maximum dry density for the material, as determined by the standard Proctor test (ASTM D698).

7.4.3 Testing Frequency

Field density tests shall be compared with standard Proctor tests (ASTM D698 Method A or C) on the same material. Standard Proctor tests shall be conducted at a frequency of at least one test per 5,000 cubic yards of material compacted, or when material characteristics show significant variation.

Field density testing may be conducted with the sand cone test (ASTM D1556) or a nuclear density gauge (ASTM D6938, or as modified by the CQA Site Manager). Correlation of nuclear density gauge results shall be by comparison with results from sand cone test(s) and laboratory testing for water content(s) using the oven drying method (ASTM D2216) on similar material.

The frequency of the field density and moisture tests will be not less than one test per 2,000 cubic yards of compacted soil. A minimum of two tests will be taken for each day that more than 150 cubic yards of material is placed. A minimum of one test per lift and at least one test for every full shift of compaction operations will be taken.

7.4.4 Final Slope and Grades

The final disposed material surface shall have maximum side slopes of 5:1 (H:V) and a top surface sloping in the directions and grades shown on the Drawings. The side slopes and top surface shall be free from abrupt changes in grade or areas of runoff concentration. The final disposed material surface shall be compacted with approved construction equipment to form a smooth surface with uniform density for subsequent cover placement.

8.0 COVER CONSTRUCTION

8.1 General

This section outlines work associated with construction of the cell cover system. A multi-layered earthen cover will be placed over tailings Cells 2, 3 and 4A and a portion of Cell 1 used for disposal of contaminated materials (the Cell 1 Disposal Area).

8.2 Materials Description

8.2.1 Random Fill

The random fill for the interim fill, compacted cover, and growth medium layers will consist of on-site stockpiled soils from areas designated by the Owner. Random fill, except for the interim fill, shall have a maximum particle size of 6 inches, and a minimum of 10 percent passing the No. 200 sieve. Oversized material will be controlled through selective excavation at the stockpiles and through the utilization of a grader, bulldozer or other equipment to cull or break down oversized materials.

The source of these materials will be on-site stockpiles from previous cell construction activities. On-site stockpiles shall be approved for specific use by the Construction Manager and Design Engineer prior to use.

8.2.2 Organic Matter Amendment

Composted biosolids will be used to amend the physical and chemical properties of the random fill used to construct the growth medium layer (Section 8.3.7). Composted biosolids will be added to the upper 6 inches of the growth medium layer at a rate of 10 tons/acre.

8.2.3 Topsoil-Gravel Admixture

Gravel will be mixed with topsoil and placed on portions of the cover on Cells 2, 3, 4A, and 4B top surfaces (as shown on the Drawings) as the erosion protection layer. Topsoil-gravel admixture material shall be free from roots, branches, rubbish, and debris.

The gravel portion of the topsoil-gravel admixture will consist of granular materials from approved off-site areas. The gravel portion of the topsoil-gravel admixture shall have a maximum particle size of 1 inch.

The topsoil portion of the topsoil-gravel admixture will consist of select material from the on-site topsoil borrow area (Section 3.4). The mixture shall be 25 percent gravel by weight.

8.2.4 Riprap

Riprap will be placed along the toe of the disposal cell and the tailings cells (as shown on the Drawings). Riprap will consist of granular materials from approved off-site sources. Riprap shall be a screened product, free from roots, branches, rubbish, and debris.

Riprap shall meet NRC long-term durability requirements (a rock quality designation of 65 or more; Johnson, 2002). For a rock quality designation of 70 or higher, the particle-size specifications below shall be used. If actual rock quality designation is between 65 and 69, oversizing will be required.

Designated gradations for the riprap will be as specified on the Drawings. Riprap will be imported from off-site.

- Side Slope riprap shall have a minimum D_{50} as listed below and a minimum layer thickness of 1.5 times the D_{50} or the D_{100} of the riprap, whichever is greater:
 - 1.7 in. for non-accumulating flow side slopes
 - 5.3 in. for Cell 4A and Cell 4B southern side slopes
 - 5.3 in. for Cell 1 Disposal Area side slope
- Riprap used in the rock aprons shall have a minimum D_{50} as listed below and a minimum layer thickness of 1.5 times the D_{50} or the D_{100} of the riprap, whichever is greater
 - 3.4 in. for Rock Apron A

- 10.6 in. for Rock Apron B

- 9.0 in. for Rock Apron C

8.2.5 Filter Material

Filter material shall be free from roots, branches, rubbish, and debris. The filter material shall meet the gradation specifications in Table 8.1.

Table 8.1 – Filter Material Gradation

Sieve Size	Percent Passing, By Weight
3-inch	100
No. 4	70-100
No. 20	40-60
No. 200	0-5

8.2.6 Topsoil

Topsoil will consist of select material from the designated, on-site topsoil borrow area (Section 3.4).

8.3 Work Description

The Contractor will place cover materials based on a schedule determined by the Owner and the Owner’s analysis of settlement data, piezometer data and equipment mobility considerations. Settlement monitoring points will be established and monitored in accordance with Sections 8.3.1 to 8.3.3 and the Settlement Monitoring Plan approved by DWMRC for the site.

Cover construction shall minimize lenses, pockets, or layers of material differing substantially in texture, gradation or moisture content from the surrounding material. Oversized material will be controlled through selective excavation of stockpiled material, observation of placement by a qualified individual with authority to stop work and reject material being placed and by culling oversized material from the fill.

If the compacted surface of any layer of fill is too dry or smooth to bond properly with the layer of material to be placed thereon, it will be moistened and/or reworked with suitable equipment to a sufficient depth to provide relatively uniform moisture content and a satisfactory bonding surface before the next succeeding layer of fill is placed. If the compacted surface of any layer of fill in-place is too wet, due to precipitation, for proper compaction of the fill material to be placed thereon, the material will be reworked to reduce the moisture content to the specified range and recompact.

No material will be placed when either the material being compacted, or the underlying material, is frozen or when ambient temperatures do not permit the placement or compaction of the materials to the specified density, without developing frost lenses in the fill.

8.3.1 Monitoring Interim Cover Settlement

The existing settlement monitoring points located within tailings disposal cells will be maintained by extending them through additional fill placement. For areas without settlement monitoring points, settlement monitoring points will be installed to monitor settlement of the interim cover surface and will be constructed as specified in the DWMRC approved Settlement Monitoring Plan. Settlement data will be collected and analyzed; and the reclamation techniques and schedule will be adjusted accordingly.

8.3.2 Monitoring Final Cover Settlement

8.3.3 After placement of final cover material, settlement plates will be extended or will be installed to monitor settlement of the final cover surface. The settlement plates will be constructed as specified in the DWMRC approved Settlement Monitoring Plan.
Monitoring Settlement Points

Settlement monument placement and data collection will be made in accordance with the DWMRC approved Settlement Monitoring Plan.

8.3.4 Interim Fill Layer

The interim fill layer will have a minimum thickness of 2.5 feet and will be placed over the tailings surface to form a stable working platform for subsequent controlled fill placement. This

interim fill layer will be placed by pushing random fill material across the tailings such that the underlying tailings are displaced as little as possible. Interim fill will be placed in lifts of 12-inch maximum loose thickness to form a uniform subsoil layer for the cover system. A rough surface will be maintained on the surface of each lift.

8.3.5 Compacted Cover Layer

The compacted cover layer shall be constructed of random fill placed in lifts with a maximum loose thickness of 12 inches to form a continuous layer with a total minimum compacted layer thickness of 36 to 48 inches, as indicated in the Drawings. A rough surface will be maintained on the surface of each lift.

8.3.6 Growth Medium Layer

The growth medium layer shall be constructed of random fill placed to a minimum of 42 inches thick, above the compacted cover layer in lifts of 18-inch maximum loose thickness. If oversized material is observed during the excavation of fill material, it will be removed, as far as practicable, before it is placed in the fill. A rough surface will be maintained on the surface of all but the uppermost lift.

8.3.7 Organic Matter Amendment

Composted biosolids will be applied prior to the placement of the erosion protection layer (topsoil or the topsoil-gravel admixture). Composted biosolids will be uniformly spread over the surface of the growth medium layer and mixed to a depth of 6 inches.

8.3.8 Erosion Protection Layer: Topsoil-Gravel Admixture

The topsoil and the gravel admixture shall be 75 percent topsoil - 25 percent gravel admixture (by weight). The mixture shall be prepared (mixed) prior to transport to the placement areas. Gradation samples will be collected at the point of placement to verify the mixture's content. The CQA Site manager will approve the Contractor's proposed method of mixing based on the gradation results during initial placement.

The mixture shall be placed in one loose lift to form a uniform layer with a final thickness of 6 inches on the slope surfaces of the disposal cell (shown on the Drawings). The topsoil-gravel admixture shall be spread with tracked equipment.

The erosion protection layer will not be amended for organic matter or nutrients to avoid the stimulation of undesirable weedy species.

Following placement of the topsoil-gravel admixture erosion protection layer, the area shall be harrowed to reduce any compaction that may have occurred during placement of the cover and to create an uneven surface for optimum seedbed conditions.

8.3.9 Erosion Protection Layer: Topsoil

Topsoil (Section 8.2.6) shall be placed in one loose lift to form a uniform layer with a final thickness of 6 inches on the top and side slope surfaces of the disposal cell (shown on the Drawings). The topsoil shall be spread with tracked equipment.

The erosion protection layer will not be amended for organic matter or nutrients to avoid the stimulation of undesirable weedy species.

Following placement of the topsoil layer, the area will be harrowed to reduce any compaction that may have occurred during placement of the cover and to create an uneven surface for optimum seedbed conditions.

8.3.10 Riprap and Filter Material Placement

The side slopes of the reclaimed cover will be protected by rock surfacing. Riprap (Section 8.2.4) and filter material (Section 8.2.5) shall be placed in one or more lifts to the depths outlined in the Drawings and using the methods outlined below. The Drawings show the location of riprap with the size and thickness requirements for the various side slopes and aprons.

Filter material and riprap shall be handled, loaded, transported, stockpiled, and placed in a manner that minimizes segregation. Riprap and filter material shall be placed in or near its final location by dumping, then spread with a small dozer, the bucket of a trackhoe, or other suitable equipment. Riprap and filter material shall be placed and spread in a manner that minimizes

displacement of underlying cover soils, natural soils, or filter material. Each layer of riprap and filter material shall be track-walked with a small dozer, tamped with the bucket of a trackhoe, or densified by other approved methods.

Placement of the riprap will avoid accumulation of riprap sizes less than the minimum D_{50} size and nesting of the larger sized rock. The riprap layer will be compacted by at least two passes by a dozer, tamping with the bucket of a trackhoe, or equivalent methods in order to key in the rock particles for stability. The completed layer of filter material shall be well-graded in particle-size distribution and free from pockets of smaller material and free from large voids or loose areas.

8.4 Performance Standard and Testing

8.4.1 Compacted Cover Layer Testing

Each lift of the compacted cover layer shall be compacted to at least 95 percent of the maximum dry density for the material, as determined by the standard Proctor test (ASTM D698). Water contents shall be adjusted, as needed, to meet the density requirements.

Material specifications for the random fill material shall be confirmed by gradation testing conducted by approved personnel. Testing shall consist of No. 200 sieve wash and particle-size distribution testing (ASTM D422) at a frequency of at least one test per 2,000 cubic yards of fill placed, or when material characteristics show a significant variation.

Checking of compaction shall consist of a minimum of one field density test per 500 cubic yards of material compacted. A minimum of two tests shall be taken for each day that more than 150 cubic yards of material is placed. A minimum of one test per lift and at least one test for every full shift of compaction operations will be taken.

Field density tests shall be compared with standard Proctor tests (ASTM D698 Method A or C) on the same material. Standard Proctor tests shall be conducted at a frequency of at least one test per 5,000 cubic yards of material compacted, or when material characteristics show significant variation.

Field density testing may be conducted with the sand cone test (ASTM D1556) or a nuclear density gauge (ASTM D6938, or as modified by the CQA Site Manager). Correlation of nuclear density gauge results shall be by comparison with results from sand cone test(s) and laboratory testing for water content(s) using the oven drying method (ASTM D2216) on similar material.

8.4.2 Growth Medium Layer Testing

Each lift of the growth medium layer shall be compacted to at least 85 percent of the maximum dry density for the material, as determined by the standard Proctor test (ASTM D698). Water contents shall be adjusted, as needed, to meet the density requirements.

Material specifications for the random fill for water storage layer shall be confirmed by gradation testing conducted by approved personnel. Testing shall consist of No. 200 sieve wash and particle-size distribution testing (ASTM D422) at a frequency of at least one test per 2,000 cubic yards of fill placed, or when material characteristics show a significant variation.

The frequency of the field density tests will be not less than one test per 2,000 cubic yards of compacted fill. A minimum of two tests will be taken for each day that more than 150 cubic yards of material is placed. A minimum of one test per lift and at least one test for every full shift of compaction operations will be taken.

Field density tests shall be compared with standard Proctor tests (ASTM D698 Method A or C) on the same material. Standard Proctor tests shall be conducted at a frequency of at least one test per 10,000 cubic yards of material compacted, or when material characteristics show significant variation.

Field density testing may be conducted with the sand cone test (ASTM D1556) or a nuclear density gauge (ASTM D6938, or as modified by the CQA Site Manager). Correlation of nuclear density gauge results shall be by comparison with results from sand cone test(s) and laboratory testing for water content(s) using the oven drying method (ASTM D2216) on similar material.

8.4.3 Topsoil-Gravel Admixture Testing

The gradation specifications for the topsoil-gravel admixture (Section 8.2.3) shall be confirmed by gradation testing, on samples collected from the point of placement (on the topdeck). Testing shall consist of particle-size distribution testing (ASTM D422) at a frequency of at least one test per 2,000 cubic yards of mixture placed, or when the characteristics of the mixture show a significant variation. The CQA Site Manager may choose to increase the frequency of testing at the beginning of placement to evaluate the mixing method proposed by the Contractor.

Topsoil-gravel admixture thickness will be controlled through the establishment of grade stakes placed on a 200 x 200 foot grid on the top of the cells and by a 100 x 100 foot grid on the cell slopes. Physical checks of topsoil-gravel admixture depth will be accomplished through the use of hand dug test pits at the center of each grid in addition to monitoring the depth indicated on the grade stakes.

8.4.4 Riprap Testing

Material specifications for the riprap shall be confirmed by gradation testing conducted by the CQA Technician. Testing shall consist of particle-size distribution testing (ASTM D422) at a frequency of at least one test per 2,000 cubic yards of rock delivered to the site, or when rock characteristics show a significant variation.

Rock layer thickness will be controlled through the establishment of grade stakes placed on a 200 x 200 foot grid on the top of the cells and by a 100 x 100 foot grid on the cell slopes. Physical checks of riprap depth will be accomplished through the use of hand dug test pits at the center of each grid in addition to monitoring the depth indicated on the grade stakes.

The durability of the riprap shall be verified by durability tests outlined in Section 8.4.7.

8.4.5 Filter Material Testing

Material specifications for filter material (Section 8.2.5) shall be confirmed by gradation testing conducted by CQA Technician. Testing shall consist of No. 200 sieve wash and maximum

particle size testing (ASTM D422) at a frequency of at least one test per 10,000 cubic yards of fill placed, or when material characteristics show a significant variation.

Filter layer thickness will be established during construction with grade stakes placed on a grid or centerline and offset pattern and layer thickness marks on each grade stake. The minimum thickness of the layer will be verified by spot checking of layer thickness by hand excavation in selected locations.

8.4.6 Rock Durability Testing

For riprap materials, each load of material will be visually checked against standard piles for gradation prior to transport to the tailings piles. Prior to delivery of any riprap materials to the site, rock durability tests will be performed for each gradation to be used. Test series for riprap durability will include specific gravity, absorption, sodium soundness and LA abrasion. During construction, additional test series and gradations will be performed for each type of riprap when approximately one-third (1/3) and two-thirds (2/3) of the total volume of each type have been produced or delivered. For any type of riprap where the volume is greater than 30,000 cubic yards, a test series and gradations will be performed for each additional 10,000 cubic yards of riprap produced or delivered.

8.5 Surface Slopes and Grades

The final cover surface shall have maximum side slopes of 5:1 (H:V) and a top surface sloping in the direction and grade shown on the Drawings. The side slopes and top surface shall be free from abrupt changes in grade or areas of runoff concentration. The perimeter apron at the toe of the side slopes shall have the dimensions as shown on the Drawings.

8.6 Grading Tolerances

The completed cover surface shall be constructed to within 1.0 foot (horizontally) of the lines as designed, and within 0.1 foot (vertically) of the elevations as designed. The final surface of the subsoil zone shall be smoothed to avoid abrupt changes in surface grade. The layer thicknesses shall meet the required minimum thicknesses.

The completed riprap shall be placed to within 5.0 foot (horizontally) of the layout as designed, and within 0.5 foot (vertically) of the elevations as designed. The rock layer thicknesses shall meet the minimum requirements.

9.0 REVEGETATION

9.1 General

Following topsoil placement, the cover surface and other areas disturbed during reclamation work will be revegetated. This section outlines the requirements for vegetation establishment where required. This section may be revised as necessary based on field requirements and soil nutrient analyses at the time of revegetation.

9.2 Materials Description

The soil amendments, seed mixture, and erosion control materials for revegetation are outlined below. Submittals for each of the following products shall be provided to the Owner for approval prior to use of such products.

9.2.1 Soil Amendments

The proposed application rate may be adjusted up or down based on soil chemical analysis that is conducted prior to placement of the water storage layer.

Composted biosolids shall be added at a rate of 10 tons/acre and uniformly spread over the surface of the water storage layer and mixed to a depth of 15 cm. This treatment will be applied after the water storage layer is in-place and before placement of the erosion protection layer.

9.2.2 Seed Mix

Species selection for the seed mixture was based on native vegetation found in the area as well as soil and climatic conditions of the Mill site. Changes to the seed mixture will be as approved by the Owner. The seed mixture in Table 9.1 shall be used on all seeded areas.

Table 9.1. Species and seeding rates proposed for Mill site.

Scientific Name	Common Name	Varietal Name	Native/ Introduced	Seeding Rate (lbs PLS/acre) [†]	Seeding Rate (# seeds/ft ²)
Grasses					
<i>Pascopyrum smithii</i>	Western wheatgrass	Arriba	Native	3.0	7.9
<i>Pseudoroegneria spicata</i>	Bluebunch wheatgrass	Goldar	Native	3.0	9.6
<i>Elymus trachycaulus</i>	Slender wheatgrass	San Luis	Native	2.0	6.2
<i>Elymus lanceolatus</i>	Streambank wheatgrass	Sodar	Native	2.0	7.3
<i>Elymus elymoides</i>	Squirreltail bottlebrush	Toe Jam	Native	2.0	8.8
<i>Thinopyrum intermedium</i>	Pubescent wheatgrass	Luna	Introduced [‡]	1.0	1.8
<i>Achnatherum hymenoides</i>	Indian ricegrass	Paloma	Native	4.0	14.7
<i>Poa secunda</i>	Sandberg bluegrass	Canbar	Native	0.5	11.4
<i>Festuca ovina</i>	Sheep fescue	Covar	Introduced [‡]	1.0	11.5
<i>Bouteloua gracilis</i>	Blue grama	Hachita	Native	1.0	16.5
<i>Hilaria jamesii</i>	Galleta	Viva	Native	2.0	7.3
Forbs					
<i>Achillea millefolium</i> , variety <i>occidentalis</i>	Common yarrow	VNS*	Native	0.5	32
<i>Artemisia ludoviciana</i>	White sage	VNS	Native	0.5	45
Shrubs					
<i>Atriplex canescens</i>	Fourwing saltbush	Wytana	Native	3.0	3.4
<i>Ericameria nauseosa</i>	Rubber rabbitbrush	VNS	Native	0.5	4.6
Total				26.5	188

[†]Seeding rate is for broadcast seed and presented as pounds of pure live seed per acre (lbs PLS/acre).

[‡]Introduced refers to species that have been 'introduced' from another geographic region, typically outside of North America. Also referred to as 'exotic' species.

*VNS=Variety Not Specified and seed source will be from sites that are climatically similar to White Mesa.

Seed shall be purchased as pounds of pure live seed and will be certified by the Utah State Department of Agriculture and Food. Certification will verify that the seed is correctly identified and genetically pure. Once the seed is obtained, seed labels will be checked to determine the percent PLS and the date that the seed was tested for percent purity and percent germination. If the test date is greater than 6 months old, the seed will be tested again before being accepted.

9.2.3 Erosion Control Materials

Wood fiber mulch will consist of specially prepared wood fibers and will not be produced from recycled material such as sawdust, paper, cardboard, or residue from pulp and paper plants. The

fibers will be dyed an appropriate color, with non-toxic, water-soluble dye to facilitate visual metering during application. Wood-fiber mulch will be supplied in packages and each package will be marked by the manufacturer to show the air-dry weight.

A tackifier will be used with the wood-fiber mulch to improve adhesion. The tackifier will be a biodegradable organic formulation processed specifically for the adhesive binding of mulch. In addition, the tackifier will uniformly disperse when mixed with water and will not be detrimental to the homogeneous properties of the mulch slurry.

9.3 Work Description

Revegetation efforts shall be directed at all reclaimed and disturbed areas. The goal of the revegetation plan is to ensure that a self-sustaining vegetative community is established.

9.4 Soil Amendment Application

Following final placement and grading of the frost barrier layer, amendments will be applied as discussed in Section 9.2.1. Inorganic sources of nitrogen, phosphorus, and potassium will not be applied to the soil because composted biosolids will provide all the macronutrients required for long-term sustainability.

9.5 Growth Zone Preparation

A favorable seedbed shall be prepared on the topsoil layer or topsoil-rock mixture, prior to seeding operations. The soil shall be loose and friable so as to maximize contact with the seed. The soil will be tilled, following site contours with a disc or harrow (or similar approved equipment) to a maximum depth of 6 inches. The depth of valleys and the height of ridges caused by the final tillage operations are not to exceed 3 inches.

9.6 Seed Application

Seeding will follow the application of soil amendments and seedbed preparation, by broadcast spreading method. This procedure will use a centrifugal type broadcaster (or similar implement),

also called an end gate seeder. The broadcasters will have a minimum effective spreading width of 20 feet. Seed will be applied in two separate passes. One-half of the seed will be spread in one direction and the other half of seed will be spread in a perpendicular direction. This will ensure that seed distribution across the site is highly uniform and also provide the opportunity to adjust the seeding rate if the specified rate is not being achieved. Seeding will not occur if wind speeds exceed 10 mph.

Immediately following seeding, the area will be lightly harrowed to provide seed coverage and to maximize seed-soil contact. Broadcast seed shall be harrowed into the soil to a depth of 0.25 to 0.75 inches.

Seeding will take place as soon as practical after the cover system is in place. Successful seeding in southeastern Utah can occur either in late fall (e.g. October) as a dormant seeding, with germination and establishment occurring the following spring or can be conducted in June, prior to the summer monsoon season. Timing for seeding will depend upon the construction schedule for the cover system.

9.7 Erosion Control Material Application

Mulch will be applied immediately following seeding. A weed-free, wood-fiber mulch shall be applied to the seeded area at a minimum rate of 1.5 tons/acre. The wood-fiber mulch will be applied by means of hydraulic equipment that utilizes water as the carrying agent. A continuous agitator action, that keeps the mulching material and approved additives in uniform suspension, will be maintained throughout the distribution cycle.

The pump pressure will be capable of maintaining a continuous non-fluctuating stream of slurry. The slurry distribution lines will be large enough to prevent stoppage and the discharge line will be equipped with a set of hydraulic spray nozzles that will provide even distribution of the mulch slurry to the seedbed. Mulching will not be done in the presence of free surface water resulting from rains, melting snow, or other causes. Tackifier may be added either during the manufacturing of the mulch or incorporated during mulch application.

9.8 Performance Standard and Testing

The following section describes performance-based criteria for successful revegetation.

9.8.1 Seeding Rates

Prior to seeding, a known area will be covered with a tarp and seed will be distributed using the broadcaster and simulating conditions that would exist under actual seeding conditions. Seed will then be collected and weighed to determine actual seeding rate in terms of pounds per acre. This process will be repeated until the specified seeding rate is obtained.

During the seeding process, the seeding rate will be verified at least once by comparing pounds of seed applied to the size of the area seeded.

9.8.2 Erosion Control

The cover shall be inspected two times per year for eroded areas. Any area that has experienced erosion shall be backfilled and reseeded. Erosion control materials shall also be reapplied over reseeded areas.

9.8.3 Weed Control

Weed management will be conducted on the Mill site by identifying the presence of any noxious weeds during annual vegetation surveys and developing a weed control plan that is specific to the species that are present (Table 9.2). Noxious weed control is species-dependent and both method and timing will vary from species to species.

Table 9.2. Noxious weed species.

Scientific Name	Common Name
Utah State—Listed Noxious Weeds	
<i>Acroptilon repens</i>	Russian knapweed
<i>Cardaria spp.</i>	Whitetop (all species)
<i>Carduus nutans</i>	Musk thistle
<i>Centaurea diffusa</i>	Diffuse knapweed
<i>Centaurea solstitialis</i>	Yellow star thistle
<i>Centaurea stoebe ssp. micranthos</i>	Spotted knapweed
<i>Centaurea virgate ssp. Squarrosa</i>	Squarrose knapweed
<i>Cirsium arvense</i>	Canada thistle
<i>Convolvulus spp.</i>	Bindweed (all species)
<i>Cynodon dactylon</i>	Bermuda grass
<i>Elymus repens</i>	Quackgrass
<i>Euphorbia esula</i>	Leafy spurge
<i>Isatis tinctoria</i>	Dyer’s woad
<i>Lepidium latifolium</i>	Broadleaf pepperweed
<i>Lythrum salicaria</i>	Purple loosestrife
<i>Onopordum acanthium</i>	Scotch thistle
<i>Sorghum almum</i>	Perennial sorghum (all species)
<i>Taeniatherum caput-medusae</i>	Medusahead
San Juan County—Listed Noxious Weeds	
<i>Aegilops cylindrical</i>	Jointed goatgrass
<i>Alhagi maurorum</i>	Camelthorn
<i>Asclepias subverticillata</i>	Western whorled milkweed
<i>Solanum elaeagnifolium</i>	Silverleaf nightshade
<i>Solanum rostratum</i>	Buffalobur

Each survey will identify noxious weed populations and locate these populations on a map using a set of symbols to identify species, size of the infestation, and density of the population. The effectiveness of control methods will be documented in each annual survey. In addition, immediately adjacent off-site properties will be visually surveyed to a distance of 100 feet. Inspections will be conducted by personnel familiar with the identification of noxious weeds in the area and based on Utah’s Noxious Weed List.

The selected control methods will be based on the type, size, and location of the mapped noxious weeds. The treated area(s) will be monitored and re-inspected annually for new weed introductions and to evaluate the success of the control methods. Prevention is the highest priority weed management practice on non-infested lands; therefore protecting weed-free plant communities is the most economical and efficient land management practice. Prevention is best accomplished by ensuring that new weed species seed or vegetative reproductive plant parts of weeds are not introduced into new areas, and by early detection of any new weed species before they begin to spread.

Control methods may include chemical or mechanical approaches. The optimum method or methods for weed management vary depending on a number of site-specific variables such as associated vegetation, weed type, stage of growth, and severity of the weed infestation.

Chemical Control

Chemical control consists mostly of selective and non-selective herbicides. Considerations for chemical controls include: herbicide selection, timing of application, target weed, desirable plant species being grown or that will be planted, number of applications per year and number of years a particular species will need to be treated for desired control. Also important are the health and safety factors involved, and the need to consider undesirable impacts. The use of herbicides will be in compliance with all Federal and State laws on proper use, storage, and disposal. The chemical application will be done by a licensed contractor in accordance with all applicable laws and regulations and all label instructions will be strictly followed. Applications of herbicides will not be permitted when the instructions on the herbicide label indicate conditions that are not optimal.

Mechanical Control

Mechanical control is the physical removal of weeds from the soil and includes tilling, mowing, and pulling undesirable plant species. Tillage is most effective prior to seeding and establishment of desirable vegetation. The tillage method of weed control can be effective in eliminating noxious perennial weeds when repeated at short intervals (every 1-2 weeks) throughout the growing season. Tillage has the drawback of indiscriminately impacting all vegetation interspersed with weeds in established areas and can eliminate competitive, desirable vegetation leaving behind a prime seedbed for weeds to reinvade. Mowing can be an effective method for controlling the spread of an infestation and preventing the formation and dispersal of seeds. Mowing is most effective on weeds which spread solely or primarily by seed. In order to achieve this, mowing must be repeated at least twice during the growing season prior to, or shortly after bloom. Also, even the most intense mowing treatment will not kill hardy perennial weeds. Additional considerations will be made when selecting control treatments when specific situations arise regarding type, size, and location of weed infestations. Examples of this are perennial versus biennial, broadleaf versus grasses, noxious weeds interspersed with desirable vegetation, large monoculture patches, or small patches requiring spot treatment.

Treatment windows schedules, based on the control methods chosen and the noxious weeds present, will be established for each treatment area. The best time to treat perennial noxious weeds is in the spring or fall during their active growth phase. Different species will have different optimum treatment times even with the same type of control. Perennial weeds usually grow vegetatively in the spring, flower and seed in late spring and early summer, enter dormancy during the summer and actively grow again in the fall. The treatment windows selected will depend on the species present and control methods selected.

The final preparatory step is to determine the priority for areas to be treated. Prioritization ensures that the most important areas are dealt with at the most effective times. Important areas of concern include areas that may transport weed seeds. These areas include ditches, roadsides, and land equipment storage sites. Large monoculture patches are of concern wherever they occur

and will always be high priority. Also, small patches of weeds will be treated to prevent expansion of weed populations.

Once the treatment plan is implemented, detailed records will be kept, and success or failure of treatment will be recorded so as to eliminate unsuccessful treatments.

9.8.4 Vegetation Establishment Performance

The following Revegetation Acceptance Goals/Criteria have been adapted from the Monticello Site and will be used at the Mill site to determine reclamation success.

Revegetation Acceptance Goal/Criteria:

Criterion 1 Species Composition

- a. The vegetative cover (the percentage of ground surface covered by live plants) shall be composed of a minimum of five perennial grass species (at least four listed as native), one perennial forb species, and two shrub species listed in Table 9.1.

Criterion 2 Vegetative Cover

- a. Attain a minimum vegetative cover percentage of 40 percent.
- b. Individual grass and forb species listed in Table 9.1 that are used to achieve the cover criteria shall have a minimum relative cover (the cover of a plant species expressed as a percentage of total vegetative cover) of 4 percent and a maximum relative cover of 40 percent.
- c. Individual species not listed in Table 9.1 may be accepted as part of the cover criteria if it is demonstrated that the species is native or adapted to the area and is a desirable component of the reclaimed project site.
- d. Species not listed in Table 9.1, including annual weeds or other undesirable species such as those listed in Table 9.2, shall not count toward the minimum vegetative cover requirement. Every attempt shall be made to minimize establishment of all noxious weeds.

- e. Reclaimed areas shall be free of state- and county-listed noxious weeds (Table 9.2).
- f. The vegetative cover shall be self-regenerating and permanent. Self-regeneration shall be demonstrated by evidence of reproduction, such as tillers and seed production.

Criterion 3 Shrub Density

- a. A minimum shrub density of 500 stems per acre.
- b. Shrubs shall be healthy and have survived at least two complete growing seasons before being evaluated against success criteria.

Plant cover will be measured annually on the tailing cells for a minimum of ten years or until the revegetation goals stated above are achieved. Cover will be measured by the point method, using a vegetation sighting scope mounted on an adjustable tripod with a level. Cover will be measured for each species encountered, as well as litter, rock, and bareground. Cover measurements will be made along a minimum of ten randomly placed transects on each tailing cell that are 100 feet long. A total of 100 points will be sited at one-foot intervals along each transect to collect cover data in the categories of live vegetation, litter, rock, and bareground. Sample adequacy will be determined for each tailing cell using the following formula that identifies the minimum number of samples that are necessary to estimate the population mean at a 90 percent level of confidence. Total live vegetation cover will be used to calculate sample adequacy.

$$n = \frac{t^2 s^2}{(.10x)^2}$$

Where: n = minimum number of samples required to meet sample adequacy requirements
 s² = variance
 t² = 1.64 for 90% confidence
 x = sample mean

Shrub density will be measured in belt transects placed on either side of the cover transects. All shrubs will be counted within a three-foot wide strip or belt transect along each side of the transect used for point cover measurements, resulting in a belt transect that is six-feet wide and 100 feet long.

In addition to the above cover sampling, annual observations will be made of overall plant community health and sustainability. Overall health will be based on plant vigor, presence of annual weeds, and signs of plant deficiencies or toxicities. Plant community sustainability will be based on observations of reproduction, including both vegetative reproduction, such as tillering, and seed production.

If revegetated areas are not making satisfactory progress in meeting revegetation goals outlined above, then remedial actions will be implemented as needed. These actions may include fertilization/soil amendments, reseeding, weed control, and/or erosion control depending upon the cause of the problem that may exist and the best remediation approach to ensure plant community success.

10.0 REFERENCES

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Exhibit A-1: Daily QA/QC Checks

1.0 INTRODUCTION

A background count rate and reliability check using a check source shall be performed daily, prior to use, when the detector/scaler is used for counting. Background count rates and source checks shall be input on a control chart after developing of the mean and standard deviation (sigma) as discussed below.

2.0 QC CONTROL CHARTING

Select a background location such as an office or other location where background gamma radiation gamma values are not expected to vary. Take ten 30-second count readings and record them on Form 1. Using the ten readings, calculate the mean, sigma, and 2 sigma). These results shall also be recorded on Form 1.

Daily, prior to use, and at the end of surveys, perform a 30-second background and source count at the same location and in the same configuration as the acceptable ranges were developed. If the background or source check result exceeds a difference of two standard deviations, (2s or 2 sigma) from the mean, as shown on Figure 2, the Instrument Control Chart, re-count the background or source, log the results, and enter the new data on the Instrument Control Chart. Two successive background or source check counts outside the 2s Instrument Control Chart range indicates possible problems with the detector/electronics.

Values between $\pm 2s$ of the mean net counts generally indicate normal operation of the instrument. Values outside the mean $\pm 2s$ will occur with a frequency of less than 5 percent. Values greater than 3s from the mean will occur with a frequency of less than one percent and should be investigated. Two consecutive measurements outside 3s indicate problems with equipment and require adjustments and/or repairs as necessary. The scaler shall be removed from service and immediate notification shall be made to the RSO or designee prior to counting any samples.

Calibrations shall be checked whenever a significant change or repair is made to the measurement system, or when changes are detected as a result of check source measurements.

Control charts shall be maintained to indicate instrument operability and/or malfunction problems on a daily basis when instruments are in use. Use the attached control chart. Control charts should be kept for both background counts and counts with a check source, such as a 5 μCi Cs-137 source.

FORM 1: CALCULATION OF INSTRUMENT STANDARD DEVIATION

Date of 1st Instrument Use	Count 1	Count 2	Count 3	Count 4	Count 5	Count 6	Count 7
	Count 8	Count 9	Count 10	Sample Mean (λ)	Sample Standard Deviation (σ)	Lower Control Limit ($\lambda-2s$)	Upper Control Limit ($\lambda+2s$)

$$\lambda = \frac{1}{10} \sum_{i=1}^{10} n_i$$

Where λ is the mean of the counts, and n is the 30 second count rate

$$s = \sqrt{\frac{\sum_{i=1}^m (n_i - \lambda)^2}{9}}$$

Where σ is the standard deviation, λ is the mean of the counts, and n is the 30 second count rate

