EXHIBIT 6

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NewFields	CLIENT Lithium Nevada Corporation	PROJECT NO 475.0385.000
PROJECT: THACKER PASS PROJECT		
TITLE: TECHNICAL SPECIFICATIONS FOR EARTHWORKS MATERIALS AND CONSTRUCTION		**SPECIFICATION NO.** **1-0385-000-SP-EW-3**

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1. GENERAL

This specification defines the requirements for the earthwork construction activities for the Thacker Pass Project owned by Lithium Nevada Corporation. The specifications set forth in this document cover the quality of materials and workmanship for earthworks construction.

Any alternatives or exceptions to this specification shall be submitted in writing to the Owner or its designated representative(s)/agent(s) and shall be approved by the Engineer.

The Definition of Terms is provided in Specification No. 0-0385-000-SP-GEN-0.

2. CODES AND STANDARDS

All tests shall be performed in accordance with the current edition of the testing standards as indicated below.

2.1. American Association of State Highway and Transportation Officials (AASHTO):

- AASHTO T103-08: "Soundness of Aggregates by Freezing and Thawing (Procedure A Total Immersion in Water)", American Association of State Highway and Transportation Officials, Washington DC, www.transportation.org.
- AASHTO T104-99: "Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate", American Association of State Highway and Transportation Officials, Washington DC., www.transportation.org.

2.2. American Society for Testing and Materials (ASTM):

- ASTM C88/C88M-18: "Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM C117-17: "Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM C131/C131M-14: "Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM C136/C136M-14: "Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM C535-16: "Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D 1556/D1556M-15e1: "Standard Test Methods for Density and Unit Weight of Soil in Place by Sand-Cone Method", ASTM International, West Conshohocken, PA, www.astm.org.

- ASTM D1557-12e1: "Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort", ASTM International, West Conshohocken, PA, www.astm.org.
- WK63917 Reinstatement of D2434 – 68(2006): "Standard Test Method for Permeability of Granular Soils (Constant Head) (Withdrawn 2015)", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D4318-17e1: "Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D4644-16: "Standard Test Method for Slake Durability of Shales and Other Similar Weak Rocks", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D5030/D5030M-13a: "Standard Test Method for Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D6913/D6913M-17: "Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis", ASTM International, West Conshohocken, PA, www.astm.org.
- ASTM D6938-17a: "Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)", ASTM International, West Conshohocken, PA, www.astm.org.

2.3. United States Bureau of Reclamation (USBR):

- USBR 5605: "Determining Permeability and Settlement of Soils Containing Gravel, Fixed Wall Saturated Hydraulic Conductivity", U.S. Bureau of Reclamation, Washington, DC., usbr.gov.

2.4. United States Department of Transportation- Federal Highway Administration (USDOT-FHWA):

- USDOT FLH T 521: "Standard Method of Determining Riprap Gradation by Wolman Count", United States Department of Transportation- Federal Highway Administration, Washington, DC. highways.dot.gov

3. LANDSCAPE PRESERVATION

The Contractor shall exercise care at all times to preserve the natural landscape and shall conduct operations to prevent unnecessary damage, scarring or defacing of the natural surroundings in the vicinity of the Work. Movement of personnel and equipment within the Site disturbance, Site access roads, and easements provided for access to the Work shall be performed in a manner to prevent damage to the property and the environment. In no case shall the Contractor disturb any areas outside the limits of the Work as defined by the Owner.

4. DUST CONTROL

The General Contractor, for the duration of the contract, shall maintain all excavations, mass grading operations, haul roads, access roads, waste disposal areas, borrow areas, and all other work areas free from excessive dust as determined by the Owner. Industry accepted methods of dust control suitable for the area involved, such as sprinkling water from an approved source, will be permitted. Alternative methods for dust control shall be approved by the Owner.

5. WEATHER LIMITATIONS

Unless approved in the field by the Engineer, controlled fill shall not be constructed when the atmospheric temperature is at thirty-five (35) degrees Fahrenheit (F) and falling. When the temperature falls below thirty-five (35) degrees F, it shall be the responsibility of the General Contractor to protect all areas of completed surfaces against any detrimental effects by methods approved by the Engineer. Any areas that are damaged by freezing shall be removed or reconditioned, reshaped and re-compacted by the General Contractor in conformance with the requirements of this Specification. In no case shall frozen fill materials be incorporated into the mass grading operations nor shall fill be placed on frozen ground, snow or materials that have not been approved by the Inspector.

Overliner placement shall be suspended at no cost to the Owner if, in the opinion of the Engineer, the operation creates unsafe conditions due to moisture or ice build-up on the geomembrane, visibility becomes problematic or the quality of Work is being compromised. The General Contractor shall make sure material is not rutting or pumping under the construction traffic due to the excessive moisture. Materials shall not be placed on concentrations of snow or ice, nor shall concentrations of snow or ice be incorporated into the Overliner materials either prior to or during placement. Snow and ice shall be removed from the geomembrane surface prior to Overliner placement. The snow or ice shall be removed a sufficient distance from the geomembrane and Overliner material interface such that Construction Quality Assurance (CQA) personnel can examine the geomembrane conditions prior to Overliner placement. Frozen chunks in the Overliner material that could damage the geomembrane or add excessive moisture to the material once thawed are not allowed.

6. EARTHWORKS

This section presents the technical requirements for the earthworks construction for the Thacker Pass Project.

All equipment used by the General Contractor shall meet satisfactory conditions and comply with the Specifications with the approval of the Engineer. The Engineer reserves the right to request in writing a change in the required equipment or procedure of any work and the General Contractor shall comply.

6.1. Control of Surface Water and Stormwater Runoff

During the construction period, the General Contractor will be responsible for constructing and maintaining any temporary ditches, channels, and/or sediment control features required to protect the Work and control surface water flows and sediment.

The General Contractor shall submit plans for temporary surface water runoff control to the Construction Manager for review and approval. The temporary surface water runoff control, including temporary and permanent berms, channels and any other control measures, shall be built according to the line and grade indicated on the plan submitted by the General Contractor and shall be maintained throughout the Work.

The General Contractor shall construct erosion control measures required to prevent significant transport of sediments from the stockpiles, construction areas, and other areas of the Work that may be subject to the effects of runoff.

The General Contractor shall provide equipment and perform all necessary work to maintain the areas of surface and groundwater collection to remove sediments from the water before it leaves the site. The General Contractor shall provide the temporary erosion control measures and make improvements immediately to these control measures if it is deemed necessary by the Owner or Engineer.

The General Contractor shall prevent all damage to the work areas due to drying, water runoff and sediment control.

The General Contractor shall remove all temporary installations of erosion control measures when they are no longer necessary and restore the areas affected by these measures.

The General Contractor shall be responsible for the damage that results from rainfall runoff and for failed erosion control measures.

6.2. Clear and Grub, and Growth Media Removal

The area within the disturbance limits of the Thacker Pass Project is a combination of native vegetated terrain that requires removal of vegetation and topsoil stripping, previously undisturbed area, storage of organic material, and storage piles of various rock and soil materials. No clearing and stripping shall occur in an area until the area has been approved by the Owner.

Based upon studies of site vegetation and topsoil thickness conditions, the average thickness of stripping of topsoil and grubbing of vegetation is anticipated to be twelve (12)-inches.

Clearing and stripping consists of cutting vegetation at the soil level, removing this material as well as branches and any other vegetation. The vegetation and surface topsoil materials, that are considered the root zone, shall be excavated, loaded, and hauled to a stockpile location

adjacent to the work area designated by the Owner. The limits of stripping shall generally extend approximately ten (10) feet outside of the Work activity areas as shown on the Drawings. Any clearing and stripping beyond the limits shown on the Drawings, or as required by the Engineer, shall be subject to the approval of the Owner.

Topsoil stockpiles shall be leveled, trimmed, and shaped to prevent the occurrence of ponding or concentrations of surface runoff and to provide a neat appearance. Finished slopes of the stockpiles shall be graded to 2.5H:1V (horizontal to vertical) for interim reclamation. All surface water runoff shall be directed to available natural drainage courses. The General Contractor shall use proper sediment control measures approved by the Construction Manager. Clearing and stripping will be carried out using whatever method is deemed necessary, providing it is consistent with producing an acceptable end result as determined by the Owner and the Engineer. Care is to be taken to minimize erosion and excessive sediment buildup.

After stripping of the required area, the surface shall be prepared as specified on the Drawings or in the Technical Specifications. Prior to any surface treatment on a stripped area, the Engineer shall be notified to inspect the stripped area and designate the method of treatment required for continuance of Work. A survey shall be taken of the area immediately prior to and immediately after stripping operations to determine quantities and/or for verification of lift/layer thickness to be placed after stripping is complete.

6.3. Over-excavation of Existing Surface Soils

After initial clearing and grubbing operations are completed, over-excavation of any softer soils to the contact of relatively firm soils or rock shall be performed only at the direction of the Engineer. If required, over-excavation shall be performed in embankment foundation areas and facility footprints. Confirmation of adequate sub-excavation and exposure of firm soils or rock shall be made by the Inspector subject to approval by the Engineer.

6.4. Surface Foundation Preparation and Compaction

Once the work area has been cleared and stripped to the satisfaction of the Engineer, the surface shall be prepared before any overlying materials are placed. All work areas shall be graded according to the limits shown on the Drawings. Areas of both cut and fill shall be required to bring the grading of the work area to the elevations specified in the Drawings.

The upper eight (8) inches of native soils (foundation preparation) beneath cut surfaces and areas to receive fill shall be scarified, moisture conditioned, and compacted to ninety (90) percent of the maximum dry density, within three (3) percent of optimum moisture content as determined by the Modified Proctor Density Test, ASTM D1557.

Scarification and compaction can be deleted in areas which intact bedrock is exposed at the surface. The Engineer may waive this requirement if the exposed surface soils without manipulating will provide a firm, non-yielding surface for fill placement, in which case the surface shall be moistened, lightly scarified, and the first layer of fill placed.

All boulders and cobbles that are located at the surface and/or partially exposed in a finish cut or fill area that could be detrimental to the overlying construction shall be removed as directed by the Engineer.

Areas of unsuitable material as determined by the Engineer or areas of pre-existing fill not compacted to the specifications shall be excavated to the limits designated by the Engineer and replaced with compacted Common Fill.

In cut areas where six (6) inches of material suitable for use as Liner Bedding material is encountered and approved by the Engineer, native soils shall be scarified; moisture conditioned and compacted to meet the requirements of Section 6.6.3 and for finished surface preparation as defined in Section 7.

The General Contractor is responsible for maintaining surfaces in a satisfactory condition after approval of the Engineer. The General Contractor shall protect the prepared surface from weather, construction equipment and other factors.

6.5. Excavations and Borrow Areas

6.5.1. General

Excavation methods, techniques, and procedures shall be developed with consideration to the nature of the materials to be excavated and shall include all precautions that are necessary to preserve, in an undisturbed condition, all areas outside the lines and grades shown on the Drawings or as required by the Engineer. Excavation, shaping, etc., shall be carried out by whatever method is considered most suitable, providing it is consistent with producing an acceptable result as determined by the Engineer. Excavations shall be graded to provide drainage and prevent ponding. For excavations that cannot be graded to drain, the General Contractor shall make provisions for the equipment and labor necessary to keep the excavations free of standing water.

No excavation beyond the lines and grades shown on the Drawings or as required by the Engineer shall be completed without the prior approval of the Engineer/Owner. The General Contractor shall protect and maintain all excavations until the adjacent placement or overlying placement of material has been completed. No Work is allowed outside of approved disturbance boundaries.

All earth materials, boulders, or detached pieces of solid rock less than one (1) cubic yard in volume shall be classified as common excavation. No additional allowance above the unit prices bid for rock fill placement shall be permitted for excavation of wet or frozen materials. All excavated material may be used as fill provided it meets the requirements for the class of material in which its use is intended as specified herein.

6.5.2. Rock Excavation

Rock excavation shall be classified as material that cannot be effectively loosened or broken down in a single pass by ripping with a late model tractor-mounted hydraulic ripper, equipped with one digging point of standard Manufacturer's design that is adequately sized for use with and propelled by a crawler-type tractor, rated at a minimum 410-net flywheel horsepower and operating in low gear. All boulders or detached pieces of solid rock in excess of one cubic yard in volume shall be classified as rock excavation. These materials may be used for fill if they meet the requirements for the class of materials in which its use is intended as specified herein.

The rock excavation pricing shall not take effect if the General Contractor can rip an average of 250 cubic yards per hour over a four (4) hour time period with a D10 dozer equipped with a single ripper shank.

The General Contractor shall notify and meet with the Construction Manager at the reported site of the rock excavation prior to starting the four (4) hour time period. No additional allowance above the unit prices bid for rock fill placement shall be permitted without prior written approval by the Construction Manager and the Engineer.

Based on the results of field exploration, bedrock is expected to be encountered within the depth of excavation at some areas of the project site. Areas to receive HDPE liner in which bedrock is encountered within the depth of the excavation shall be over-excavated a minimum depth of six (6)-inches below finished grade such that the Liner Bedding can be placed where shown on the Drawings. The rock surface shall be relatively smooth such that no rock asperities extend more than one (1) inch above the surrounding area. Over-excavation in excess of the six (6)-inches specified herein shall be at the expense of the General Contractor.

6.5.3. Borrow Activities

The General Contractor shall coordinate borrow activities with the Engineer and CQA to allow the sampling and testing of materials prior to their excavation. The General Contractor shall allow the Engineer adequate time to evaluate potential borrow materials. Materials from excavations within the works or borrow areas that meet the specified requirements for other construction materials shall be stockpiled or placed in fill areas as directed by the Engineer/Owner. Unsuitable or excess materials shall be hauled to designated waste or stockpile areas approved by the Owner.

The materials obtained from borrow pits or Owner-stockpiled material shall be selected to ensure that the gradation requirements for the various construction materials are achieved and that the materials are as homogeneous as possible. Care shall be taken to avoid cross-contaminating different types of materials.

On-site borrow areas shall be developed within the limits shown on the Drawings or as required by the Owner. Should the General Contractor wish to develop additional borrow sources, written approval shall be received from the Owner prior to proceeding. Approval by the Owner may require that subsurface investigations be carried out to obtain samples as are required by the Engineer to make an appropriate assessment of the suitability of the borrow materials in the area for the intended use.

Borrow pit operations shall be subject to the approval of the Owner and Engineer and shall avoid waste of any suitable construction material therein. Clearing and stripping of any borrow area is to be completed with all salvageable topsoil stockpiled in areas designated on the Drawings or as directed by the Owner. Each borrow area shall be developed with due consideration for drainage and runoff from the excavated surfaces not to cause erosion of the adjacent terrain. Each borrow area shall be excavated in near-horizontal layers and in such a manner that water will not collect and pond except as approved by the Owner. Before being abandoned, the sides of any borrow areas outside the Work area shall be brought to stable slopes not steeper than 2.5H:1V with slope intersections rounded and contoured to provide a natural, neatly graded appearance.

Care shall be taken to minimize and control the generation of dust as discussed in Section 4.

6.6. Fill Materials

Earthfill shall not be placed until the clearing and stripping; required foundation preparations have been completed; and the foundation has been inspected and approved by the Engineer; and any required surveys completed.

All material used for fill shall be loaded and hauled to the placement site, dumped, spread, and leveled to the specified layer thickness. Fill shall be moisture conditioned and compacted to form a dense integral fill in accordance with the Technical Specifications and as approved by the Engineer. Care shall be taken at all times to avoid segregation of the material being placed and, if required by the Engineer, all pockets of segregated or undesirable material shall be removed and replaced with material that matches the surrounding material. All oversize material shall be removed from the fill material either prior to it being placed or after it is dumped and spread but prior to compaction. No additional payment will be made to remove oversized materials unless the work is specifically identified as a payment item on the Schedule of Quantities.

For most construction conditions, the fill is to be constructed in near horizontal layers with each layer being completed over the full length and breadth of the zone before placement of

subsequent layers. Each zone shall be constructed with materials meeting the specified requirements and shall be free from lenses, pockets, and layers of materials that are substantially different in gradation from the surrounding material in the same zone, as determined by the Engineer.

Except in areas approved by the Engineer, where space is limited or as otherwise specified, fill shall be placed by routing the hauling and spreading units approximately parallel to the axis of fill. The hauling equipment shall be routed in such a manner that they do not follow in the same paths but spread their travel routes evenly over the surface of the fill to aid in compaction of the fill placed.

Moisture conditioning is the operation required to increase or decrease the moisture content of material to within the specified limits. If moisture conditioning is necessary, it may be carried out by whatever method the General Contractor deems is suitable, provided it produces the moisture content specified in these Technical Specifications or designated by the Engineer. The General Contractor shall take the necessary measures to ensure that moisture is being distributed uniformly throughout each layer of material being placed immediately prior to compaction. Measures shall be adopted as are necessary to ensure that the designated moisture content is preserved after compaction until the overlying layer is placed.

All particles having dimensions that interfere with compaction in the fill as determined by the Engineer or CQA shall be removed from the zone in which they were placed either prior to or during compaction.

The rolling pattern for compaction of all zone boundaries or construction joints shall be such that the full number of roller passes required in one of the adjacent zones, or on one side of the construction joint, extends completely across the boundary or joint.

Minor deviations from the material properties and gradation limits specified in the following sections may be acceptable, subject to the review and approval of the Engineer.

6.6.1. Rockfill

Any material that cannot accurately be tested using a nuclear density gauge or sand cone shall be classified as rockfill. Rockfill may be obtained from excavations in areas of the facilities or borrow areas designated by the Construction Manager and approved by the Engineer. Rockfill can be placed as Common Fill in the base of the deeper fills and shall not be used in the upper two (2) feet of fills in areas that will receive Liner Bedding and concrete.

Material Properties - Rockfill may have a wide range of Unified Soil Classifications (USCS) and may contain significant variations in gradation and compaction properties. Rockfill shall have no particles larger than two-thirds (2/3) of the lift being placed, unless otherwise approved by the Engineer. Oversize materials shall be removed from the fill.

Placement Methods - Rockfill for mass grading operations shall be placed in lifts not to exceed four feet if compacted with mine haul trucks or twelve (12) inches in compacted thickness with standard construction equipment, unless authorized by the Engineer. The type of compaction equipment, and number of passes, shall be approved by the Engineer in writing based on an acceptable field fill compaction performance test.

Construction and monitoring of the field test may be performed per U.S. Army Corps of Engineers' guidelines for test fill construction unless otherwise approved by the Engineer. The test fill may be located so that it is incorporated within the limits of the compacted fill areas. The moisture content of the minus three-quarter (¾) inch material shall be within three (3) percent of optimum moisture prior to placement.

The data to be collected during construction of the test fill and submitted to the Engineer for approval shall include:

- Amount of settlement after every two (2) passes of ten (10) ton minimum (static drum weight) vibratory, smooth-drum roller compactor, or a loaded haul truck to a maximum of fifteen (15) passes
- Gradation and moisture content of in-place material.
- In-place fill density at completion of the test by bulk density or nuclear gauge methods (if applicable). If needed, a water replacement method test may be required to assess compaction for rockfill.

A curve showing change in settlement versus number of passes shall be produced from the data. This curve will be used to determine the required minimum number of passes for acceptable compaction. In general, the minimum number of passes will be that number to achieve eighty (80) percent of the total settlement obtained after ten (10) complete passes of the compaction equipment. Final determination by the Engineer of the lift thickness and minimum required passes will be based on review of the test data.

6.6.2. Common Fill

Common Fill will be placed in areas where the material is not required to be of uniform character and engineering properties. Common Fill shall consist of inorganic soil and rock materials from required excavations, mine waste, or borrow material from other sources as designated by the Construction Manager and approved by the Engineer. Common Fill can be used to within six (6)-inches of finished grade in areas of the facilities which receive Liner Bedding.

In areas to be covered with geomembrane and not designated to receive Liner Bedding material, the Common fill may extend to finished grade provided finished surface preparation is performed

and matches material specifications in accordance with the Liner Bedding requirements in Section 6.6.3 and for finished surface preparation as defined in Section 7.

Material Properties – Common Fill shall contain less than thirty (30) percent rock (materials above three-quarter (¾) inch size and up to eight (8) inch maximum rock size will have a wide range of Unified Soil Classifications and may contain significant variations in gradation and compaction properties. Common Fill shall be placed in areas where the material is not required to be of uniform character and engineering properties. Common Fill shall be free of roots, grass and other organic material and consist of inorganic soil and rock materials from required excavations, mine waste, or borrow material from other sources, as approved by the Engineer.

Materials shall be considered suitable for use as Common Fill provided they contain no particles larger than eight (8) inches nominal diameter (least dimension). Materials containing rock or cobbles, and gravel from required excavations may be used subject to the Engineer's approval and provided the rock be reasonably graded such that large void spaces do not result. The maximum size rock shall be no larger than two-thirds (2/3) the lift thickness. Furthermore, the anchor trench material shall consist of non-deleterious or consolidating materials that are two (2) inch minus.

Placement Methods - Common Fill shall be placed in twelve (12) inch maximum loose lifts and compacted to ninety-two (92) percent of the maximum dry density (ASTM D1557). The moisture content during compaction shall be maintained within three (3) percent of optimum moisture content (OMC) as determined in accordance with ASTM D1557.

Anchor trench backfill shall be compacted to a minimum of ninety (90) percent of ASTM D1557 maximum dry density, and care shall be taken to prevent any damage to the geomembrane. Except as necessary for construction, ballasting and the safety of the Works, geomembrane anchor trenches shall not be filled until approved by the Engineer.

Slight variations from the specified moisture range may be acceptable subject to the acceptance of the Engineer and provided the required relative compaction specifications are achieved. The Common Fill material shall be compacted with appropriate compaction equipment capable of achieving compaction through the full thickness of the lift layer. If the Common Fill placement and compaction utilizes ninety (90) ton or larger haul trucks, the lift thickness can be increased subject to the approval of the Engineer.

6.6.3. Liner Bedding

Material Properties - Liner Bedding material shall consist primarily of a finer-grained material primarily used to provide suitable bedding for geomembrane deployment and installation.

The material gradation shall be as follows and meet the following grading requirements as determined by ASTM D6913, unless otherwise approved by the Engineer:

Sieve Size (square openings)	Percent Passing (by dry weight)
2-inch	100
No. 4	25-100
No. 200	0-100

No minimum Atterberg limits requirements are specified for Liner Bedding materials.

Placement Methods – If the existing materials do not meet the requirements of this specification, Liner Bedding will be sourced from local borrow areas or stockpiles and placed in a single lift, moisture conditioned to within three (3) percent of OMC and compacted to at least ninety (90) percent of the maximum dry density as determined by ASTM D1557.

Smooth drum finishing rollers shall be used to achieve the specified compaction. The areas that are inaccessible to large compaction equipment shall be compacted using jumping jack, plate compactors or other compaction methods approved by the Engineer. Any particles projected up from the surface greater than ¾" shall be removed by hand or other methods approved by the Engineer that achieve a smooth compacted surface.

The General Contractor shall protect the finished surface of the Liner Bedding from weather damage between placement activity and coverage by the Geomembrane Installation.

If moisture accumulates under the Geomembrane before or after welding the panels and softens the Liner Bedding layer, the geomembrane shall be removed, and the Liner Bedding shall be repaired to comply with the Specifications.

If any area of Liner Bedding does not comply with the requirements of the Specifications and is not approved by the Engineer, it shall be considered in nonconformance and the General Contractor shall be required to rework the area until acceptable. Subgrade requirements for geosynthetic installation are discussed further in Section 7.

6.6.4. Select Gravel

Material Properties - Select gravel shall be a processed or natural clean gravel material containing nonplastic fines. The select gravel shall consist of materials composed of hard, durable stone particles free from organic material and generally free of thin, flat, and elongated pieces.

The select gravel shall generally conform to the following graduation requirements as determined by ASTM C136 and C117.

Sieve Size (square openings)	Percent Passing (by dry weight)
1-inch	100
3/4-inch	50-100
No. 4	0-10
No. 40	0-5
Non-plastic per ASTM D4318	

The select gravel material shall be nonplastic when tested in accordance with ASTM D4318.

The percent of wear when subject to the Los Angeles abrasion test (ASTM C131, 500 revolutions) shall be no greater than forty (40).

Where geotextile is encapsulating the select gravel it shall consist of a nonwoven, needle punched, polypropylene fabric meeting the requirements of latest revision to Specification 3-0378-000-SP-GT-A.

Placement Methods – Select Gravel material shall be placed with minimal compaction by mechanical means in order to maintain transmissivity and porosity of the material and to avoid damage to the geomembrane and geotextile material during placement.

6.6.5. Overliner

Material Properties - The Overliner will be native materials produced from an onsite borrow source or based on availability, Coarse Gangue material, processed and generated through a crushing and screening operation. The Overliner material shall consist of a sandy gravel material. The materials shall be composed of hard, durable stone particles reasonably free from thin, flat, and elongated pieces.

The material shall meet the following gradation limits unless otherwise approved by the Engineer:

Sieve Size (square openings)	Percent Passing (by dry weight)
1.5 - inch	90-100
1/2 - inch	40-80
1/4 - inch	20-60
No. 200	0-10
Non-plastic per ASTM D4318	

The in-place Overliner material shall meet the grading and consistency requirements as determined in accordance with ASTM C117 and ASTM D6913. The Overliner material shall be non-plastic when tested in accordance with ASTM D4318.

The Overliner materials shall have a targeted coefficient of permeability of 1 x 10^{-4} cm/s or greater when tested in accordance with USBR 5605 - Amended with an applied stress of 32 ksf. The target permeability for the Overliner is two orders of magnitude faster than the overlying tailings material with a minimum limit of one order of magnitude faster than the overlying tailings.

Material used for Overliner may be approved by the Engineer by visual inspection if the rock is determined to be sound and durable. However, if in the Engineer's opinion, the material is marginal or unacceptable, the Engineer may require one or more of the following laboratory tests on representative samples of the material in order to assess the quality of the material.

Overliner Material Laboratory Tests

Test Description	Test Method	Specification Requirement
Los Angeles Abrasion	ASTM C 535	50% Loss Maximum (after 500 revolutions)
Sodium Sulfate or Magnesium Sulfate Soundness	AASHTO T 104 or ASTM C88	10% Maximum Loss (after 5 cycles)
Soundness by Freezing and Thawing	AASHTO T 103	10% Maximum Loss (after 12 cycles)
Slake Durability	ASTM 4644	Classification as Type 1

Placement Methods – Overliner shall be placed to the lines and grade shown on the Drawings. Proposed equipment and placement methods shall be outlined in the General Contractor's proposal to the Owner. Proposed equipment and placement methods to minimize compaction of the Overliner materials shall also be outlined in the General Contractor's proposal to the Owner.

Before placing the Overliner, the General Contractor shall verify by a visual inspection that all geosynthetic material installed in the area is free from perforations, wrinkles, scratches and other damage. The Engineer shall inspect the geosynthetic material to verify that it is ready to receive the Overliner.

Overliner material shall be placed directly on the geomembrane and around piping with extreme care to prevent damage. This is generally done by hauling and placing the material on the geomembrane in a single lift with haulage units that exert less than 80 psi of ground pressure.

The material shall be spread with a low ground pressure crawler-type tractor or equivalent that exerts less than 20 psi of ground pressure. The material shall be placed at a minimum loose thickness such that the compacted lift thickness is not less than the design thickness shown on the drawings (General Contractor to determine allowance for settlement). At no time shall equipment operate directly on the surface of the geomembrane.

Special attention shall be taken when being placed over the Corrugated Polyethylene (CPe) and High Density Polyethylene (HDPE) pipe. All oversized material that may damage the pipework or geomembrane will be removed by whatever means necessary to ensure there is no damage. Because of the thickness of the Overliner and the potential crushing of the collector pipes and damage of the geomembrane, vehicle traffic on the Overliner shall be as minimal as possible and shall be restricted to roadways and other main access ways. Overliner thickness within roadways shall be maintained at least four (4) feet above the geomembrane surface. A minimum cover equal to 2-feet over the top of the CPe pipe shall be maintained at all times.

Placement equipment and procedures shall minimize compaction of the Overliner material and watering shall be limited to thickened access roads. Increased thicknesses of material shall be required in areas with large diameter piping to prevent crushing from haulage vehicle traffic. Haulage equipment may also necessitate increased cover material thickness within haulage

Placement of Overliner at angles of approximately forty five (45) degrees from normal is acceptable, provided the material is placed from the bottom up. Placement of Overliner parallel to the contours and across the slope is not acceptable. Placement of Overliner shall be performed in accordance with the Design Drawings and Technical Specifications in a manner which maintains the integrity of the geomembrane and allows placement of the collection pipe as shown on the drawings. A written placement procedure with proposed methods and equipment to be used shall be developed and provided to the Engineer for review and approval prior to Overliner placement on steep slopes.

The General Contractor shall not place fill materials at such times that, in the opinion of the Engineer, conditions for such operations are unsatisfactory due to precipitation, low temperatures or any other reasons. As ambient air temperature increases, wrinkles in the HDPE geomembrane will develop due to thermal expansion of the geomembrane. Placement of Overliner will cease if the wrinkles become large enough to fold over or it causes a crease to form when covered with Overliner material. Overliner material shall be placed during the cooler times of the day or during the evening when the geomembrane lays relatively flat. To minimize the effect of wrinkles, the Overliner shall be placed in an uphill direction and /or parallel to the contours. At no time, shall conditions result in movement/slippage of the Overliner materials that could potentially cause geomembrane or pipe damage.

The thickness of the Overliner shall be verified by the Engineer and areas with deficient amounts of material shall be reworked to comply with the Specifications. Overliner placement around the perimeter of the facility shall be as shown on the Drawings. Any damage to the geosynthetic material during installation shall be exposed by the General Contractor and repaired by the Geomembrane Lining Contractor. If overliner is placed at night, the General Contractor must develop an approved plan including adequate lighting.

The General Contractor shall supply a full-time laborer (one laborer per one dozer) to visually inspect one-hundred (100) percent of the Overliner placement.

6.6.6. Wearing Course

The roadway-wearing surface is to be constructed using select mine waste material. A source for the material will be provided by the Owner. Some removal of oversized rock will be required. Wearing Course shall generally conform to the following gradation requirements as determined by ASTM D6913 or as approved by the Engineer.

Material Properties - The Wearing Course materials shall consist of approved materials and shall meet the specified grading requirements as determined by ASTM D6913 or as approved by the Engineer.

Sieve Size (square openings)	Percent Passing (by dry weight)
3-inch	100
3/4-inch	50-90
No. 4	35-65
No. 16	15-40
No. 200	2-10

For optimal performance, the plasticity index for road surfacing materials shall be less than nine (9) as determined in accordance with ASTM D4318.

Placement Methods - Road wearing course materials shall be placed in lifts not to exceed six (6) inches in compacted thickness. Compaction of road wearing course material shall be to a minimum of ninety-five (95) percent relative compaction of ASTM D1557 maximum dry density or as approved by the Engineer. The moisture content shall be sufficient to obtain adequate density.

6.6.7. Pipe Bedding and Pipe Backfill

Material Properties - Pipe bedding and backfill material shall consist of materials with the following typical characteristics:

Sieve Size (square openings)	Percent Passing (by dry weight)	
	Pipe Backfill	Pipe Bedding
4 -inch	100	
3 -inch	90-100	
1-½ -inch	--	100
¾ -inch	70-100	90-100
No. 4	--	30-70
No. 40	10-50	--
No. 200	0-35	5-15
Plasticity Index	10 max	10 max

Pipe bedding and pipe backfill shall be free of organic material.

Placement Methods - The pipe embedment materials shall be stable, sufficiently workable for placement under the sides of the pipe to provide satisfactory haunching, and to be able to achieve soil compaction. The particle size of the material in contact with the pipe shall not exceed one (1) inch for pipes six (6) to sixteen (16) inches, and 1 ½ inches for larger pipes.

Backfilling shall be done as soon as possible after pipe or culvert installation. Suitable backfill, free from large lumps, clods, or rocks shall be placed alongside the structure in loose layers not exceeding eight (8) inches thick to provide a berm of compacted earth on each side of the pipe or structure (where applicable). The fill materials shall be a minimum of five (5) feet wide or the width of the pipe diameter/structure but no less than required to operate the appropriate compaction equipment.

Pipe bedding and backfill shall be placed one small layer at the time, and then spread uniformly each layer in such a matter so that no un-filled space or gaps remain in the placed material. Each eight (8) inch layer shall be moisture-conditioned near optimum, as required to facilitate compaction, and compacted to a minimum of ninety (90) percent of the maximum dry density as determined by ASTM D1557 or as directed by the Engineer.

If it is necessary to construct a haul or other vehicle road over the pipe trench, the Engineer shall be consulted prior to the initiation of trench construction for specification modification to achieve structure sufficient for such traffic loading.

Backfill shall be placed symmetrically on each side of the structure. The backfill differential on either side of the pipe shall not exceed eight (8) inches or one quarter (1/4) of the diameter of the structure (whichever is less).

Prior to adding each new layer of loose backfill material until a minimum twelve (12) inches of cover is obtained, an inspection shall be made of the inside of the structure for local or unequal deformation caused by the backfilling operation. Only hand-operated tamping equipment shall be allowed within vertical planes three (3) feet beyond the horizontal projection of the outside surfaces of the structure (or as recommended by the pipe/structure manufacturer/designer). No heavy earthmoving equipment shall be permitted over the structure until a minimum of 150 percent of the largest buried pipe diameter of compacted fill has been placed over the top of the structure (or the minimum cover recommended by the pipe manufacturer/designer). In no case shall the minimum compacted structural cover be less than twelve (12) inches.

Backfill material shall not be placed against any concrete foundation, abutment, wing wall, or culvert until the concrete has been in place at least seven (7) days or the compressive strength of the concrete is seventy five (75) percent of the required twenty eight (28) day strength. On structures that are not permanently supported laterally and that cannot tolerate horizontal movement, internal bracing or support should be placed during backfill operations.

The General Contractor shall place backfill material by methods which have been approved by the Engineer prior to pipe backfill placement. The proposed method provided to the Engineer shall demonstrate that equipment used will not disturb or damage the pipe during placement and compaction of the pipe backfill.

6.6.8. Filter Sand

Material Properties Filter sand shall consist of either native material sourced from an onsite borrow source, imported or a processed using a crushing and/or screening operation. Common Fill material used to construct the embankment near the Filter Diaphragm and Filter Layer will indicate the required physical properties for the Filter Sand material and will be specified by the Engineer at the time of placement. The Filter Sand shall have a maximum plasticity index of 5 as determined by ASTM D4318.

Laboratory testing shall be completed on all Filter Sand sources prior to placement.

Placement Methods – The Filter Sand material shall be placed, moisture conditioned and compacted in accordance with the Pipe Bedding requirements under Section 6.6.7.

6.6.9. Riprap

Material Properties - Riprap shall be hard, angular, durable and reasonably well graded rock and shall be free of overburden, spoil, organic or any other deleterious material. Rounded stone is

not acceptable. The riprap shall generally conform to the following gradation requirements as determined by USDOT FLH T521 (Wolman Count). The stone shall have a minimum specific gravity of 2.5. The riprap stone shall be such that its greatest dimension is not greater than three times its least dimension.

Riprap D_{50} = 4 inches

Sieve Size	% Passing	Typical Stone Mass
8 in.	100	
6 in.	70-100	10 lbs.
4 in.	50-70	3 lbs.
2 in.	2-15	0.5 lbs.

Riprap D_{50} = 6 inches

Sieve Size	Percent Passing (%)	Typical Stone Mass
12 in.	100	
9 in.	70-100	35 lbs.
6 in.	50-70	10 lbs.
2 in.	2-10	0.5 lbs.

Riprap D_{50} = 9 inches

Sieve Size	% Passing	Typical Stone Mass
18 in.	100	
15 in.	70-100	165 lbs.
9 in.	50-70	35 lbs.
6 in.	35-55	10 lbs.
3 in.	2-10	1.3 lbs.

Riprap D_{50} = 12 inches

Sieve Size	% Passing	Typical Stone Mass
24 in.	100	
21 in.	70-100	440 lbs.
18 in.	50-70	275 lbs.
12 in.	35-55	88 lbs.
4 in.	2-10	3 lbs.

Riprap D_{50} = 24 inches

Sieve Size	% Passing	Typical Stone Mass
48 in.	100	
36 in.	70-100	2,200 lbs.
30 in.	50-70	1,280 lbs.
24 in.	35-55	650 lbs.
8 in.	2-10	10 lbs.

Minor deviations from the above may be acceptable, subject to the review and approval of the Engineer. Material used for riprap may be approved by the Engineer by visual inspection if the rock is determined to be sound and durable. However, if in the Engineers opinion, the material is marginal or unacceptable, the Engineer may require the General Contractor to have performed one or more of the following laboratory tests on representative samples of the riprap in order to assess the quality of the riprap material.

Riprap Laboratory Tests

Test Description	Test Method	Specification Requirement
Los Angeles Abrasion	ASTM C 535	50% Loss Maximum (after 500 revolutions)
Sodium Sulfate or Magnesium Sulfate Soundness	AASHTO T 104 or ASTM C88	10% Maximum Loss (after 5 cycles)
Soundness by Freezing and Thawing	AASHTO T 103	10% Maximum Loss (after 12 cycles)
Slake Durability	ASTM 4644	Classification as Type 1

Placement Methods - Surfaces and piping to be protected by riprap shall be dressed to a smooth surface. All soft or objectionable material shall be removed as directed by the Engineer and replaced with an approved material. Materials underlying the riprap shall be placed in accordance with each material's specific placement specifications.

The riprap shall be placed as shown on the Drawings or as required by the Engineer in a manner that will produce a reasonably well graded mass of stone with the minimum practicable

percentage of voids and good stone interlocking/contact. The entire mass of stone shall be placed in reasonable conformance with the lines, grades, and thicknesses shown on the Drawings. Riprap shall be placed to its full thickness during a single operation and in such a manner as to avoid damaging or displacing the underlying bedding material or geotextile. The riprap minimum thickness shall be two (2) times the specified D_{50}, unless otherwise specified on the Drawings.

The larger stones shall be well distributed and the materials shall be placed and distributed so that there will be no large accumulations of either the larger or the smaller size stones. Hand placing or rearranging of individual stones by mechanical equipment may be required to achieve the results specified.

6.6.10. Structural Tailings

Material Properties – Structural Tailings will be delivered and stacked in the CTFS from the Process Plant. The structural tailings will consist of clay tailings material.

Placement Methods - Structural Tailings shall be placed in the areas shown on the Drawings and free of organic and other deleterious material, in twelve (12)-inch loose lifts or as determined to be acceptable by the Engineer after testing trials are completed at the start of operations. This material shall be dried or moisture conditioned to within six percent of optimum moisture content and compacted to ninety-five (95) percent relative compaction of the maximum dry density as determined by ASTM D1557 unless otherwise approved by the Engineer. Slight variations from the specified moisture range, as determined during the start of operations, may be acceptable subject to acceptance by the Engineer and provided the required compacted densities are achieved. If oversize materials are encountered during fill placement, such as waste rock placed for roads, the Engineer should be consulted on oversize placement methodology. Oversized material is 8-inch diameter or greater.

The material shall be compacted with equipment capable of achieving compaction through the full thickness of the lift layer. Placement shall be performed in such a manner that material placed is not rutting, pumping or exhibiting excessively deflection during compaction under haul traffic loading. If the surface exhibits excessive deflection, the material in the area of question may require stabilization using a combination of moisture reduction through active drying and re-compaction, selective placement of rocky material and re-compaction, or other means of stabilization.

6.6.11. Non-Structural Tailings

Material Properties – Non-Structural Tailings will be delivered and stacked in the CTFS from the Process Plant. The non-structural zone is designated primarily for placement of the salts and also for clay tailings with higher moisture contents than is allowed to achieve 95 percent compaction

in the structural zone. The density requirement in the non-structural zone is lower than required for the structural zone.

Placement Methods – Non-Structural Tailings shall be placed in the areas shown on the Drawings and free of organic and other deleterious material, in twelve (12)-inch loose lifts or as determined to be acceptable by the Engineer after testing trials are completed at the start of operations. This material shall be air dried if needed to within 12 percent of the optimum moisture content and compacted to approximately 85 percent relative compaction of the maximum dry density as determined by ASTM D1557 unless otherwise approved by the Engineer. The target moisture content range is within twelve percent of optimum moisture content however slight variations from the specified moisture range may be acceptable subject to acceptance by the Engineer and provided the required compacted densities are achieved. If oversize materials are encountered during fill placement, the Engineer should be consulted on oversize placement methodology. Oversized material is 8-inch diameter or greater.

The fill material shall be compacted with equipment capable of achieving compaction through the full thickness of the lift layer. If the surface exhibits excessive deflection, the material in the area of question may require stabilization using a combination of moisture reduction through active drying and re-compaction, selective placement and blending with drier material and re-compaction, or other means of stabilization as approved by the Engineer.

6.6.12. Chimney Drain

Material Properties – Chimney Drain material will be native sand materials produced from an onsite borrow source or sand material from the Coarse Gangue Stockpile. The targeted coefficient of permeability for Chimney Drain material is 1×10^{-4} cm/s or greater when tested in accordance with ASTM D2434 and USBR 5605 - Amended with an applied stress of 32 ksf. The target permeability for the Chimney Drain is two orders of magnitude faster than the adjacent tailings material with a minimum limit of one order of magnitude faster than the overlying tailings.

Placement Methods – Chimney Drain construction shall be performed concurrent with tailings placement by placing the material between the Structural and Non-Structural Tailings Zones as shown on the Drawings. This material shall be compacted to approximately 85 percent relative compaction of the maximum dry density as determined by ASTM D1557. Tailings or other contaminates shall be removed from the surface of the Chimney Sand prior to placing the subsequent layer of sand. The sand layer is shall be a minimum of 3 feet thick and shall be routinely surveyed during construction to confirm the thickness and determine the extents of the sand layer.

6.6.13. Low Hydraulic Conductivity Soil Layer (LHCSL)

On-site existing native LHCSL shall be used as shown on the Drawings.

Material Properties - LHCSL material shall consist of soils containing enough silt and clay to achieve a permeability of 1 x 10^{-6} cm/s as determined by ASTM D5084 when properly moisture conditioned and compacted in accordance with the required placement methods.

The material gradation shall be as follows unless otherwise approved by the Engineer:

Sieve Size (square openings)	Percent Passing (by dry weight)
3-inch	100
No. 4	60-100
No. 200	20 - 100
Plasticity Index ≥ 20 (ASTM D4318)	

The material shall have a plasticity index greater than 20 as determined by ASTM D4318 unless otherwise approved by the Engineer.

Placement Methods - LHCSL is to be placed in two six (6) inch thick compacted lifts to form a minimum twelve (12) inch thick compacted layer. Each lift shall be compacted to a minimum of ninety five (95) percent of maximum dry density (as determined by ASTM D1557) and moisture content between two percent below optimum moisture content and three percent above optimum moisture content as determined by ASTM D1557 unless otherwise approved by the Engineer. The permeability shall be no greater than 1 x 10^{-6} cm/sec as determined by ASTM D5084 or USBR 5600.

Slight variations from the specified material gradation, moisture content range and compaction requirements may be acceptable subject to the acceptance of the Engineer and provided it is demonstrated that the required permeability values are achieved.

Pad foot and sheepsfoot compactors and smooth drum finishing rollers shall be used to achieve the specified compaction. The areas that are inaccessible to large compaction equipment shall be compacted using jumping jack, plate compactors or other compaction methods approved by the Engineer.

Prior to placing the top lift of material, the surface of the bottom lift shall be lightly scarified or roughened with a pad foot compactor to provide a roughened surface for the two layers to bond together. The purpose is to avoid a slip plane between the two layers.

The General Contractor shall protect the finished surface of the LHCSL from desiccation cracking and weather damage between placement activity and coverage by the LHCSL cover material. Areas that exhibit desiccation cracks in excess of three-quarter (¾) inch in depth or are damaged due to weather shall be reworked prior to cover material placement.

If any area of LHCSL does not comply with the requirements of the Specifications and is not approved by the Engineer it shall be considered in nonconformance and the General Contractor shall be required to rework the area until acceptable.

6.6.14. LHCSL Cover

LHCSL cover material will consist of the same material as Common Fill with the exception that the maximum particle size shall be 2/3 of the lift thickness and there is no compaction or moisture content specification. The purpose of the material is to keep the LHCSL covered to protect from drying and freezing. The minimum lift thickness is two feet. Deviations from the material classification shall be approved by the Engineer.

7. LINER SURFACE PREPARATION OF AREAS TO RECEIVE GEOSYNTHETIC LINING

Areas to receive geomembrane lining shall be free of angular particles protruding over three-quarter (¾) inch and hard objects that may damage the geomembrane. Where excessive coarse material is exposed at the surface, rock removal by appropriate methods or other surface finishing as directed by the Engineer will be required. Rough areas with depressions or loose material shall be covered with a cushion of fine-grained materials or for large depressions, with screened material (passed over one-half (½) inch mesh screen) or equivalent.

After placement of the Common Fill and Liner Bedding materials, some oversize and/or objectionable materials should be anticipated by the General Contractor. Removal of oversize and objectionable materials by blading, rock-raking, hand picking or other methods shall be required to meet the Specifications for finished surface preparation. All areas to receive geomembrane lining shall meet the requirements for finished surface preparation as defined herein. No separate payment shall be made for rock removal; it shall be included as part of surface preparation.

Once the General Contractor believes that the surface preparation is complete, an inspection will be completed by the geomembrane Lining Contractor, Engineer, Inspector, and Owner with the General Contractor present. The General Contractor shall fix any areas found during inspection that need repairing prior to Geomembrane Installation. Following the verification of the surface, the Lining Contractor shall sign an acceptance form and assumes full responsibility for the verified area should conditions be altered by occurrences outside the control of the General Contractor.

8. COMPACTION EQUIPMENT

Sufficient compaction equipment, of the types and sizes required to complete the work, shall be provided for compaction of the various fill materials. The use of alternative equipment will be dependent upon completion of suitable test fills to the satisfaction of the Engineer to confirm that the alternative equipment will compact the fill materials to the specified density.

Compaction equipment shall be maintained in good working condition at all times to ensure that the amount of compaction obtained is a maximum for the equipment. The General Contractor shall provide the Owner and Engineer a list of proposed compaction equipment to be used before commencing Work.

8.1. Smooth Drum Vibratory Roller

Smooth drum vibratory rollers shall be equipped with a suitable cleaning device to prevent the accumulation of material on the drum during rolling. Each roller shall have a total static weight of not less than 20,000 pounds at the drum when the roller is standing on level ground. The drum shall be not less than sixty (60) inches in diameter and seventy eight (78) inches in width. The vibration frequency of the roller drum during operation shall be between 1,100 and 1,500 vibrations per minute, and the centrifugal force developed by the roller, at 1,250 vibrations per minute, shall not be less than 38,000 pounds.

For compaction by the vibratory roller, a single coverage shall be defined as one (1) pass of the roller. A minimum overlap of twelve (12) inches shall be maintained between the surfaces traversed by adjacent passes of the roller drum. During compaction, the roller shall be propelled at two (2) miles per hour (mph) or lesser speed as approved by the Engineer. The power of the motor driving the vibrator shall be sufficient to maintain the specified frequency and centrifugal force under the most adverse conditions that may be encountered during the compaction of the fill. Propulsion equipment for the roller shall be adequate to propel the roller at speeds up to four (4) mph.

8.2. Tamping-Foot Roller

The majority of the fill may be compacted with a tamping-foot roller. The tamping-foot roller shall be self-propelled and fully ballasted with a standard tamping-foot design developing 5,000 pounds in force per linear foot of width at rest on level ground or equivalent as approved by the Engineer.

8.3. Special Compactors

Special compactors shall be used to compact materials that, in the opinion of the Engineer, cannot be compacted properly by the specified larger vibratory roller because of location or accessibility.

Special compaction measures shall be adopted such as hand-held or small walk behind compactors or other methods approved by the Engineer to compact fill in trenches, around structures, and in other confined areas that are not accessible to the larger vibratory roller or tamping-foot roller. Such compaction shall be to the specified density for the particular material.

9. CONSTRUCTION QUALITY ASSURANCE (CQA)

The Engineer CQA team will monitor and perform the QA testing for the project. Any questions with regard to the Drawings or Technical Specifications associated with the proposed construction shall be addressed to the Engineer for clarifications in accordance with the established project protocol. The Engineer shall approve all changes to the Drawings or Specifications prior to implementing the change.

Construction Quality Control (CQC) functions are the responsibility of the General Contractor and the Lining Contractor and entail completing and recording (as detailed herein) field inspection and control for the project. CQA shall be performed under the direction of a Nevada Professional Engineer and shall be performed by a laboratory from a company that holds current accreditations from AASHTO, AMRL and CCRL.

Testing of the work by CQA does not relieve the Contractors of liability for substandard work.

The General Contractor is responsible for setting out the correct lines and grades to ensure that the Work is constructed accordingly. The project Surveyor will check lines and grades and will verify all quantity measurements and calculations.

The Engineer shall be the interpreter of the Technical Specifications, and shall direct observations and tests as considered necessary to assess and accept the quality of the Work. An Inspector under the direction of the Engineer shall make continuous observations and tests of construction operations. The Engineer shall represent the Owner and shall be responsible during construction for the following:

- Construction observations for quality assurance
- CQA materials testing and inspection for compliance with the Specifications
- Reporting

CQA shall be performed in accordance with the latest test methods in accordance with American Society for Testing and Materials (ASTM) and other recognized industry standards. The tests shall include Control and Record Tests.

9.1. Control Tests

CQA shall complete tests for gradation, moisture content, moisture density relationship and other tests as applicable on samples of fill materials taken from borrow areas and on the fill after spreading and prior to compaction at the frequencies listed in Section 11. Testing shall be sufficient to ensure that the fill material is in full compliance with the Technical Specifications. Materials not meeting the specified material properties shall be reworked or rejected until passing results are achieved.

9.2. Record Tests

CQA shall conduct field density, moisture content, and other tests on the compacted in-place fill and shall obtain samples of the compacted fill for related laboratory testing at such frequency as the Engineer considers necessary to determine that the compacted fill is in full compliance with the Technical Specifications. Areas with failing field tests shall be reworked until passing tests are achieved.

The Inspector, under the supervision of the Engineer, shall perform testing to classify each specified construction material type. Tests performed shall consist of grain-size distribution analyses and Atterberg limits testing to classify each material type for its specified use in construction. Additionally, moisture content, moisture-density relationships, in-place density and moisture tests shall be performed to verify that the construction conforms to the Drawings and Technical Specifications. Observations and tests performed by the Inspector shall not relieve the General Contractor of responsibility for providing adequate CQC measures nor of responsibility for damage to or loss of material before acceptance. The General Contractor shall, at his expense, furnish any labor and equipment necessary to assist the Inspector in obtaining samples for testing. The General Contractor shall allow sufficient time for the Inspector to carry out the required testing and observations at no additional cost to the Owner.

9.3. Reporting

The Engineer shall submit daily reports of observations and tests to the Construction Manager. The reports shall be submitted in a timely fashion. Items of non-conformance will be brought to the attention of the Construction Manager as soon as possible, after identification.

A copy of all test results will be maintained at the construction site, and shall include the following:

- Date issued
- Project title and number
- Date of testing and/or sampling
- Designation or use of material tested
- Type of test and specification
- Location of test
- Description of work activities
- Photos
- Discussion of inspection and test results and issues
- Observations regarding compliance or noncompliance with Drawings and Technical Specifications

Upon completion of construction, the Engineer shall submit a Record of Construction (ROC) Report stating that the project was completed in substantial conformance with the approved Drawings and Technical Specifications and presenting test summaries, record drawings, as-built drawings and other supporting data necessary to document the completed construction.

10. CONSTRUCTION TOLERANCES

The General Contractor shall construct the various aspects of the project to the lines and grades shown on the Drawings, or as required by the Engineer, within the following tolerances:

- Finish grades and slopes for the improvements shall be in general conformance with the Drawings. Deviations from finished grades and slopes are subject to approval by the Engineer and shall not result in low spots, pockets, non-uniform slopes or contours, or result in slopes which deviate by more than 0.1 feet from the design. The overall slope shall be the same as shown on the Drawings. When specified, maximum grades shall not be exceeded.
- Unless noted otherwise on the Drawings, maximum permissible combined horizontal deviation from the lines and grades shown on the Drawings or as required by the Engineer shall be 1.0 feet. The intent of the design must be maintained.
- Pond and sump crest elevations shown on the Drawings shall be minimum allowable elevations and shall not be exceeded by more than 0.1 feet.
- All pipes shall be constructed to the following tolerances: alignment and grade shall not deviate from Manufacturer recommendations and more than five (5) percent of the nominal diameter of the pipe from a straight line between control points. All pipelines shall be constructed to the grade percentages shown on the drawings.

11. TESTING FREQUENCIES

CQA shall carry out frequent quality control and quality assurance tests to determine compliance of the Work with the Technical Specifications.

Both Control tests and Record tests count towards the total number of tests required. The latest edition of standard procedures shall be used for all activities, and in general, these will be adopted from recognized organizations such as ASTM. The Table 11-1 outlines the test methods and the minimum testing requirements for the project are presented in Tables 11-2 through 11-15. Testing frequencies may be modified if approved by the Engineer depending on the consistency or variability of the materials.

Table 11-1: Test Methods

Test	Type of Test	Test Method
C1, R1	Atterberg Limits	ASTM D4318
C2, R2	Moisture Content	ASTM D6938 or D2216
C3, R3	Particle Size Distribution	ASTM D6913*, ASTM C136
C4, R4	Laboratory Compaction - Modified Proctor	ASTM D1557
R5a	Nuclear Density	ASTM D6938
R5b	Sand Cone	ASTM D1556
R5c	Water Replacement	ASTM D5030
C6, R6	Flexible Wall Permeability	ASTM D5084
C7, R7	Rigid Wall Constant Head Permeability	USBR 5605
C8, R8	Los Angeles Abrasion	ASTM C131/C535
R9	Wolman Count	USDOT FLH T521

Notes: **C = Control Tests; R = Record Tests**
All samples to be washed over a No.200 sieve.
Minimum test Frequencies provided include both Control and Record Tests combined.
[a] Hydrometer tests down to the 2-micron size will be carried out as directed by the Engineer but will generally not be required

Table 11-2: Test Frequency – Surface Preparation/Liner Bedding

Test	Type of Test	Frequency (one per)
R1	Atterberg Limits	Soil Type / 250,000 sf
R2	Moisture Content	Soil Type / 250,000 sf
R3	Particle Size Distribution	Soil Type / 250,000 sf
R4	Laboratory Compaction	Soil Type / 500,000 sf
R5a	Nuclear Density	50,000 sf
Note: Required number of tests shall be determined by whichever method of determining the frequency requires the most tests.		

Table 11-3: Test Frequency – Rockfill

Activity	Frequency (one per)
Visual Inspection and Documentation	Continuous during placement activities
US Army Corps of Engineers Test Fill (EM 1110-2-2301)	Test fill for rock type

Table 11-4: Test Frequency – Common Fill

Test	Type of Test	Frequency (one per)
C1, R1	Atterberg Limits	Soil Type / 50,000 cy
C2, R2	Moisture Content	per nuclear density requirements
C3, R3	Particle Size Distribution	Soil Type / 50,000 cy
C4, R4	Laboratory Compaction	Soil Type / 200,000 cy
R5a	Nuclear Density	5,000 cy in CTFS, CGS & WRSF areas, every 1,000 cy pond areas & every 1,000 LF for anchor trenches
R5b/R5c	Sand Cone or Water Replacement Density	As Needed by CQA
Note: Required number of tests shall be determined by whichever method of determining the frequency requires the most tests.		

Table 11-5: Test Frequency – Select Gravel

Test	Type of Test	Frequency (one per)
C1, R1	Atterberg Limits	20 cy
C3, R3	Particle Size Distribution	20 cy
C8, R8	Los Angeles Abrasion	Per Soil Type
Note: Required number of tests shall be determined by whichever method of determining the frequency requires the most tests.		

Table 11-6: Test Frequency – Overliner

Test	Type of Test	Frequency (one per)
C1, R1	Atterberg Limits	Soil Type / 10,000 cy
R2	Moisture Content	Soil Type / 10,000 cy
C3,R3	Particle Size Distribution	Soil Type / 10,000 cy
C7	Rigid Wall Constant Head Permeability	100,000 cy
R8	Los Angeles Abrasion	Soil Type/ 300,000 cy
Note: Required number of tests shall be determined by whichever method of determining the frequency requires the most tests.		

Table 11-7: Test Frequency – Wearing Course

Test	Type of Test	Frequency (one per)
C1,R1	Atterberg Limits	2,000 cy
C3,R3	Particle Size Distribution	2,000 cy
C4,R4	Laboratory Compaction	10,000 cy
R5a	Nuclear Density	2,500 LF
Note: Required number of tests shall be determined by whichever method of determining the frequency requires the most tests.		

Table 11-8: Test Frequency – Pipe Backfill and Pipe Bedding

Test	Type of Test	Minimum Frequency (one per)
C1, R1	Atterberg Limits	Soil type/500 cy or 1 per structure
C2, R2	Moisture Content	per nuclear density requirements
C3, R3	Particle Size Distribution	Soil type/500 cy or 1 per structure
C4, R4	Laboratory Compaction	Soil type/500 cy or 1 per structure
R5a	Nuclear Density	15 cy*
Note: Frequency of testing for backfill for minor foundations shall be determined by the Project Field Engineer. Required number of tests shall be determined by whichever method of determining the frequency requires the most tests. *Minimum 1 per lift for each side of pipe.		

Table 11-9: Test Frequency – Filter Sand

Test	Type of Test	Minimum Frequency (one per)
C1, R1	Atterberg Limits	Soil type/20 cy
C2, R2	Moisture Content	per nuclear density requirements
C3, R3	Particle Size Distribution	20 cy
C4, R4	Laboratory Compaction	Soil type/40 cy
R5a	Nuclear Density	1 per lift per each side of pipe
C7	Rigid Wall Constant Head Permeability	Soil Type/ 1,000cy
Note: Required number of tests shall be determined by whichever method of determining the frequency requires the most tests.		

Table 11-10: Test Frequency – Riprap

Test	Type of Test	Frequency (one per)
Visual Inspection and Documentation		Continuous during placement
R9	Wolman Count	One per size and every 750 linear feet of channel

Table 11-11: Test Frequency – Structural Tailings

Test	Type of Test	Frequency (one per)
R1	Atterberg Limits	1 per week/ 60,000 cy
R2	Moisture Content	per nuclear density requirements
R3	Particle Size Distribution	1 per week/ 60,000 cy
R4	Laboratory Compaction	1 per week/ 60,000 cy
R5a	Nuclear Density	1 per lift/ 1 per day of placement/ 5,000 cy
Note: Required number of tests shall be determined by whichever method of determining the frequency requires the most tests.		

Table 11-12: Test Frequency – Non-Structural Tailings

Test	Type of Test	Frequency (one per)
R1	Atterberg Limits	1 per week/ 60,000 cy
R2	Moisture Content	per nuclear density requirements
R3	Particle Size Distribution	1 per week/ 60,000 cy
R4	Laboratory Compaction	1 per week/ 60,000 cy
R5a	Nuclear Density	1 per lift / 1 per day of placement/ 10,000 cy
Note: Required number of tests shall be determined by whichever method of determining the frequency requires the most tests.		

Table 11-13: Test Frequency – Chimney Drain

Test	Type of Test	Frequency (one per)
C1, R1	Atterberg Limits	Soil Type/ 1,000 cy
R2	Moisture Content	Per nuclear density requirements
C3, R3	Particle Size Distribution	Soil Type/ 1,000 cy
C4, R4	Laboratory Compaction	Soil type/ 5,000 cy
R5a	Nuclear Density	500 cy
C7	Rigid Wall Constant Head Permeability	Soil Type/ 10,000cy
Note: Required number of tests shall be determined by whichever method of determining the frequency requires the most tests.		

Table 11-14: Test Frequency – LHCSL

Test	Type of Test	Frequency (one per)
C1, R1	Atterberg Limits	Soil Type /10,000 cy
C2, R2	Moisture Content	Soil Type /10,000 cy
C3, R3	Particle Size Distribution	Soil Type /10,000 cy
C4, R4	Laboratory Compaction	Soil Type /50,000 cy
R5a	Nuclear Density	2,000 cy
R5b	Sand Cone	As Needed by CQA
C6, R6	Laboratory Permeability	25,000 cy
R7	In Situ Permeability	50,000 cy
Note: Test frequencies are per lift unless indicated otherwise. Laboratory permeability tests can be used in combination with field permeability tests to meet the required frequency of 1 per 25,000cy. Permeability testing in areas of steep slopes to be determined using laboratory methods.		

Table 11-15: Test Frequency – LHCSL Cover

Test	Type of Test	Frequency (one per)
C1, R1	Atterberg Limits	Soil Type/ 100,000 cy
C3, R3	Particle Size Distribution	Soil Type/ 100,000 cy
Note: Required number of tests shall be determined by whichever method of determining the frequency requires the most tests.		