

SECTION 02200 – EARTHWORK

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall perform the following specific earthwork as indicated and required for construction of the WORK, complete and in place, in accordance with the Contract Documents.
- B. Preparation of the mine waste repository to receive waste shall be conducted in accordance with this section.
- C. Cover placement over mine waste shall be conducted in accordance with this section.
- D. All uncontaminated fill materials shall be placed in accordance with this section. Riprap is specified in 02273.
- E. Excavation and disposal of mine waste materials shall be conducted in accordance with Section 02205 – Mine Waste Excavation and Disposal.

1.2 REFERENCE REMEDIAL ACTION DESIGN PLANS

- A. The work under this section shall be conducted in substantial compliance with the following work plans included as part of the Contract Documents in accordance with Section 01015 – Remedial Design Work Plans:
 - 1. Stormwater Management Plan
 - 2. Dust Control and Air Monitoring Plan
 - 3. Construction Quality Assurance Plan
 - 4. Cleanup Verification Plan
 - 5. Revegetation Plan

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. ASTM C117 - Standard Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing
- B. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
- C. ASTM D75 – Standard Practices for Sampling Aggregates.
- D. ASTM D422 – Standard Test Method for Particle-size Analysis of Soil.
- E. ASTM D698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.
- F. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.
- G. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes.

- H. ASTM D3665 – Standard Practice for Random Sampling of Construction Materials.
- I. ASTM D4220 – Standard Practices for Preserving and Transporting Soil Samples.
- J. ASTM D4718 – Standard Practice for Correction of Unit Weight and Water Content for Soil Containing Oversize Particles.
- K. ASTM D6913 – Standard Test Method for Particle Size Distribution (Gradation) Using Sieve Analysis.
- L. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.4 CONTRACTOR SUBMITTALS

- A. Submit in accordance with Section 01300 – Contractor Submittals.
- B. Submit CONTRACTOR's Detailed Shoring Plan as follows:
 - 1. The CONTRACTOR, prior to beginning any trench or structure excavation 4 feet deep or deeper, shall submit to the ENGINEER and shall be in receipt of the ENGINEER's written acceptance of the CONTRACTOR's detailed plan showing the design of shoring, bracing, sloping of the sides of excavation, or other provisions for worker protection against the hazard of caving ground during the excavation of such trenches or structure excavation.
 - 2. If such plan varies from the shoring system standards established by OSHA, such alternative systems plans shall be prepared by a civil or structural engineer licensed in the State of New Mexico.
 - 3. The ENGINEER's acceptance of said plan shall be for verification of submittal of the plan with this requirement.
- C. Submit product Information for imported and on-site processed materials including pertinent information to evaluate proposed materials for compliance with the specifications such as grain-size distribution, soil classification, durability data, and other pertinent material information.
- D. Samples: The CONTRACTOR shall submit samples of materials proposed for the WORK, if requested by the ENGINEER.

PART 2 -- PRODUCTS

2.1 FILL AND BACKFILL MATERIAL REQUIREMENTS

- A. Fill and backfill materials and placement locations shall conform to the Drawings.
- B. Fill materials that are to be placed within 6 inches of any structure or pipe shall be free of rocks or unbroken masses of earth materials having a maximum dimension larger than 3 inches.

2.2 DEFINITIONS

A. Suitable Materials:

1. Materials not defined below as unsuitable shall be considered as suitable materials and may be used in fills, backfilling, and embankment construction subject to the indicated requirements. Suitable materials may be obtained from on-Site borrow areas and excavations, or may be processed on-Site materials.
2. Suitable materials may be imported. If imported materials are required by this Section or are required in order to meet the quantity requirements of the WORK, the CONTRACTOR shall provide imported materials as part of the WORK, unless a unit price item is included for imported materials in the Bidding Schedule.

B. Unsuitable materials:

1. Materials that in the opinion of the ENGINEER 1) exhibit poor strength or durability qualities; 2) are compressible or expansive; 3) are too wet or dry to be placed or compacted properly; 4) are frozen; 5), contain contaminants, organics, debris, or other deleterious materials; 6) are corrosive or react with concrete or steel; or 7) are otherwise not suitable for the intended use of the material. Unsuitable material placed as fill in unapproved areas shall be removed and replaced with suitable material in accordance with these Specifications at the CONTRACTOR's expense.

C. General Fill:

1. Except as noted below, General Fill and shall consist of suitable materials with no cobbles or rock larger than 3 inches.
 - a. General fill used for haul and access road embankment fill may contain particles greater than 3 inches in size upon approval by the ENGINEER.

D. Soil Cover:

1. Soil Cover shall consist of suitable materials from the approved borrow areas, with no cobbles or rock larger than 1.5 inches.
- 4.2. Soil cover thickness shall be confirmed by survey measurement of the completed layers by comparison with the top of the underlying surface (tolerance of 0% to +5% thickness of the design layer) and approved by the ENGINEER prior to placement of the next layer.

E. Soil Cover with Rock (Admixture)

1. Soil Cover with rock shall consist of Soil Cover as defined in Paragraph 2.2D, mixed with rock material of the specified D_{50} . The mixed material shall contain 33 percent rock by volume. The rock for the admixture layer may be crushed or rounded rock.
2. The following rock gradations shall be used:
 - a. D_{50} = 1.5-inch.

| D-sizes Percent Passing | Minimum Diameter (in) |
|------------------------------------|----------------------------------|
| d ₀ 0% Passing | 0.75 |
| d ₅₀ 50% Passing | 1.5 |
| d ₁₀₀ 100% Passing | 3.0 |

This gradation may be field adjusted by the ENGINEER based on the gradation of rock salvaged in accordance with Part 3.5 of this Section.

- b. D₅₀ = 2 inches:

| D-sizes Percent Passing | Minimum Diameter (in) |
|------------------------------------|----------------------------------|
| D ₀ 0% Passing | 1.0 |
| d ₅₀ 50% Passing | 2.0 |
| d ₁₀₀ 100% Passing | 4.0 |

- c. D₅₀ = 3 inches:

| D-sizes Percent Passing | Minimum Diameter (in) |
|------------------------------------|----------------------------------|
| d ₀ 0% Passing | 1.5 |
| d ₅₀ 50% Passing | 3.0 |
| d ₁₀₀ 100% Passing | 5.0 |

3. All rock used for cover erosion protection must meet NRC durability requirements described in Section 02273 – Riprap.
4. Mixing methods shall be determined by the CONTRACTOR and approved by the ENGINEER prior to initial mixing.
5. Rock material shall be from on-site stockpiles or be imported materials and shall be approved by the ENGINEER.
 - a. Rock by volume in the admixture in-place on the cover shall be confirmed by survey measurement of the layer thicknesses prior to mixing (Tolerance -5% to +5% on 33% rock by volume).
 - b. The rock must be thoroughly and uniformly incorporated into the soil by mixture, the adequacy of the mixing method to provide a uniform mixture shall be approved by the ENGINEER prior to large-scale implementation.
 - c. Volume of rock in the mixture will be confirmed after mixing by test-pitting the full depth of the mixture layer in-place to sample the mixture (Tolerance -5% to +5% on 33% rock by volume). One sample per acre from the cover on a grid pattern

with equidistant spacing of points. The ENGINEER must approve the sample locations prior to sampling.

- d. The quality control (QC) method utilized to verify uniformity of the rock and soil in the admixture layer must be submitted by the CONTRACTOR and approved by the ENGINEER prior to initiation of placement of the admixture layer.
 - e. If the CONTRACTOR proposes to mix the materials off the cover, volume testing to confirm the volumes are correct in the mixture is required from material stockpiles prior to materials being moved to the cover AND subsequently following placement on the cover to ensure the materials do not segregate during transport to the cover.
6. The CONTRACTOR must prepare an additional 1000 CY of the 2-inch soil rock mixture and 12,000 CY of the 1.5-inch soil rock mixture to stockpile for the O&M period to address cover repairs, if necessary.
- a. This material is to be stockpiled in a location approved by the ENGINEER.

F. Rock Cover with Soil (Admixture)

- 1. Rock cover with soil shall consist of rock material of the specified $D_{50} = 1.5$ inches mixed with Soil Cover as defined in Paragraph 2.2D. The mixed material shall contain 15 percent soil by volume.
- 2. The following rock gradations shall be used:
 - a. $D_{50} = 1.5$ -inch. This gradation may be field adjusted by the ENGINEER based on the gradation of rock salvaged in accordance with Part 3.5 of this Section.

| D-sizes Percent Passing | Minimum Diameter (in) | Maximum Diameter (in) |
|------------------------------------|----------------------------------|----------------------------------|
| d_{15} 15% Passing | 0.75 | 1.0 |
| d_{50} 50% Passing | 1.5 | 2.0 |
| d_{100} 100% Passing | 3.0 | 4.0 |

- 3. The rock cover with soil is only for use on the 5:1 (20%) Repository slope.
- 4. Mixing methods shall be determined by the CONTRACTOR and approved by The ENGINEER prior to initial mixing.
 - a. Rock by volume in the admixture in-place on the cover shall be confirmed by survey measurement of the layer thicknesses prior to mixing (Tolerance -5% to +5% on 15% soil by volume).
 - b. The soil must be thoroughly incorporated into the rock by mixture, the adequacy of the mixing method to provide a uniform mixture will be approved by the ENGINEER prior to large-scale implementation.
 - c. Volume of soil in the mixture will be confirmed after mixing by test-pitting the full depth of the mixture layer in-place to sample the mixture. One sample per acre

from the cover on a grid pattern with equidistant spacing of points. The ENGINEER must approve the sample locations prior to sampling.

- d. If the CONTRACTOR proposes to mix the materials off the cover, volume testing to confirm the volumes are correct in the mixture is required from material stockpiles prior to materials being moved to the cover AND subsequently following placement on the cover to ensure the materials do not segregate during transport to the cover.

G. Crushed Gravel

1. Crushed Gravel shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying.
2. Crushed Gravel shall be uniformly graded, and shall meet the following gradation requirements.

| Sieve Size | Percentage Passing |
|------------|--------------------|
| 1 1/4-inch | 100 |
| 1-inch | 80 -100 |
| 5/8-inch | 50 – 80 |
| No. 4 | 25 – 45 |
| No. 40 | 3 – 18 |
| No. 200 | Less than 7.5 |

H. Culvert Bedding

1. General fill shall be used for culvert bedding unless otherwise noted on the Drawings.

I. Rip Rap and Filter

1. Rip Rap and Filter materials shall conform to Section 02273 – Rip Rap and the Drawings. These materials shall not contain any unsuitable material.

2.3 MATERIALS TESTING

- A. Testing of on-site processed materials and imported materials to verify conformance to specified standards shall be performed by the CONTRACTOR and submitted to the ENGINEER for approval.
- B. Soils testing of samples submitted by the CONTRACTOR shall be performed by a testing laboratory approved by the ENGINEER.
- C. The ENGINEER may direct the CONTRACTOR to supply samples for testing of any material used in the WORK.
- D. Particle-size analysis of soils and aggregates shall be performed per section 3.17
- E. Sample Collection and Handling
 1. Samples shall be collected in accordance with ASTM D75.
 2. Samples selection shall be conducted in accordance with ASTM D3665.

3. Samples shall be preserved and transported in accordance with ASTM D4220.

2.4 SOIL CLASSIFICATION

- A. Soils Classification for all aspects of the WORK, including references in these Specifications and the Drawings to soil classification types and standards shall have the meanings and definitions indicated in ASTM D 2487.
- B. Rock Classifications for all aspects of the WORK, including references in these Specifications and the Drawings to rock classification types and standards shall have the meanings and definitions indicated in the U.S. Bureau of Reclamation (USBR) Field Manual, unless specifically noted otherwise.
- C. The CONTRACTOR shall be bound by applicable provisions of ASTM D 2487 and the U.S. Bureau of Reclamation (USBR) Field Manual in the interpretation of soil and rock classifications.

PART 3 -- EXECUTION

3.1 SURFACE PREPARATION

- A. Clearing, grubbing, and stripping shall be conducted in accordance with Section 02100 – Site Preparation prior to performing any excavation or placing any fill.
- B. Surfaces to receive fill materials shall be smooth and firm, free of brush, trees, stumps, and other objectionable material, and shall be brought to the line and grade indicated.
- C. Frozen Material
 - 1. Do not place material on surfaces that are muddy, frozen, or contain frost and/or ice.
 - 2. Fill containing any frozen materials shall be considered unsuitable material.

3.2 DRAINAGE

- A. At all times, site grading shall promote drainage. Surface runoff shall be diverted from excavations. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and be pumped or drained by gravity from the excavation to maintain a bottom free from standing water.
- B. Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry.
- C. Construct any storm drainage features at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils.
- D. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new suitable material as specified herein. It is the responsibility of the CONTRACTOR to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

- E. Dewatering of trenches and other excavations shall be considered as incidental to the construction of the WORK and all costs thereof shall be included in the various contract unit and lump sum prices in the price bid, unless a separate bid item has been established for dewatering.

3.3 TEMPORARY STOCKPILES

- A. The CONTRACTOR shall establish their stockpile areas in accordance with Section 01552 – Staging and Stockpile Areas.
- B. Inactive stockpiles shall be stabilized in accordance with the Construction Stormwater Pollution Prevention Plan (CSWPPP). The CONTRACTOR shall keep stockpiles in a neat and well-drained condition, giving due consideration to drainage at all times.
- C. The CONTRACTOR shall protect stockpiles of suitable materials from contamination which may destroy the quality and fitness of the stockpiled material.
- D. If the CONTRACTOR fails to protect the stockpiles, and any material becomes unsuitable, remove and replace such material with suitable material from approved sources.
- E. Removal and Restoration:
 - 1. Permanent stockpiles shall not be allowed.
 - 2. Upon depletion of any stockpile, the CONTRACTOR shall grade the area to match the surrounding topography. Stockpile areas shall be revegetated in accordance with Section 2970 – Revegetation.
 - 3. The CONTRACTOR shall repair or replace drainage paths and other landscaping items affected by temporary stockpiles.
 - 4. All restoration shall be approved by the ENGINEER.

3.4 HAUL AND ACCESS ROAD GRADES AND ALIGNMENTS

- A. The CONTRACTOR shall construct haul and access roads to the lines and grades shown on the Drawings.
- B. Coordinates along the centerline of the Mine Waste Haul Road shall be provided to the CONTRACTOR by the ENGINEER.
- C. The CONTRACTOR and the ENGINEER shall review and discuss the survey information and examine the centerline in the field at a mutually agreed upon date(s) prior to clearing activity.
 - 1. All adjustments to plan and profile shall be proposed in writing.
- D. Uniform grade adjustments of less than 5 feet; and horizontal alignment changes of less than 10 feet, if approved by the ENGINEER, may be conducted in the field and shall not require revisions to the design drawings.

3.5 REPOSITORY PREPARATION

- A. The existing radon barrier above the tailings in the TDA shall be prepared to serve as the foundation layer for the Repository.

- B. **Rock Mulch Removal:** The erosion protection layer overlying the radon barrier is a nominal 6-inch-thick layer of rock mulch that consists of soil mixed with rock that has a D_{50} of 1.5 inches.
1. The rock mulch on the surface of the radon barrier shall be excavated in a manner that minimizes removal of the underlying radon barrier material.
 2. Excavated material shall be screened on-site to separate the rock ($D_{50}=1.5$ inches) from the soils. Screening methods shall be proposed by the CONTRACTOR and shall result in the separation of rock greater than 0.75-inch size from the soil.
 3. Rock and soil shall be stockpiled for re-use in accordance with Paragraph 3.5D.
 4. Water shall be added, as necessary, for dust control during rock mulch removal.
- C. **Riprap Removal:** Riprap ($D_{50}=1.5$ inches) lining the existing swales shall be removed and screened to separate residual soils and vegetation from rock material. Rock shall be combined with the rock separated from the rock mulch.
- D. **Re-Use of Materials:**
1. The residual soils from the existing erosion protection layer shall be reused as General Fill on the Repository cover construction, to fill in the swales located on the existing cover, or for other fill use at the Repository.
 2. Soil materials shall be used as General Fill in the swales located on the existing cover or in cover soils.
 3. The rock shall be reused on the new cover or used for erosion protection on other areas of the site.
- E. **Potential to Expose Existing Tailings**
1. The CONTRACTOR shall take care to not expose tailings by observing all excavations into the radon barrier during the process of removing rock from the cover layer and swales.
 2. In general, tailing can be identified by a light gray color and differs in appearance from the soil cover.
 3. If the CONTRACTOR suspects that tailings are exposed during the process, work must stop so the RSO may conduct a radiological scan of the ground surface in the work area.
 4. Material that is confirmed to be tailing must be returned to beneath the existing radon barrier. This will be accomplished by excavating an area of the existing cover approved by the ENGINEER (likely in one of the existing swales), placing the material, and recompacting the radon barrier in 6-inch conditioned lifts. The radon barrier in the area of exposed tailings shall also be reconstructed in compacted lifts to match the original design.
 5. The work area must then be confirmed by scans that the tailing material has been removed from the surface.

- F. **Subgrade (Improved Radon Barrier) Conditioning:** The subgrade (improved radon barrier) shall be graded, moisture conditioned and compacted prior to placement of mine waste.
1. Grading: The excavated surface of the subgrade (improved radon barrier) shall be graded where necessary to smooth the surface for compaction.
 2. Compaction: The subgrade (improved radon barrier) surface shall be compacted to achieve 95 percent of standard Proctor dry density for the material in the top 6 inches of the subgrade (improved radon barrier). The water content for the subgrade (improved radon barrier) shall be below optimum moisture.
 - a. Additional reworking or excavation or ripping into the subgrade (improved radon barrier) shall not be allowed due to the potential for contact with and exposure of underlying tailings.
 - b. Water shall be added, as necessary, for dust control during subgrade (improved radon barrier) compaction. Excessive watering shall not be allowed.

3.6 GENERAL EXCAVATION

A. General:

1. Perform excavation of every type of material encountered within the limits of the project to the lines, grades, elevations, and tolerances indicated and as specified. Except when specifically provided to the contrary, excavation shall include the removal of materials, including obstructions that would interfere with the proper execution and completion of the WORK.
2. Excavate unsuitable materials encountered within the limits of the Work below grade and replace with Suitable materials as directed. Include such excavated material and the suitable material ordered as replacement in excavation.
3. Excavations shall commence from high to low elevation with a horizontal working surface and an elevated surface at the downhill portion of the active excavation area to retain storm water within the excavation area.
4. Excavate material required for fill, embankment, or cover in excess of that produced by excavation within the grading limits from the borrow areas indicated or from other approved areas as designated by the ENGINEER.

B. Ditches, Channels and Sediment Ponds

1. Finish excavation of ditches, channels and sediment ponds by cutting accurately to the cross sections, grades, and elevations shown on the Drawings. Do not excavate ditches or channels below grades shown.
2. Backfill any excessive open ditch or channel excavation with thoroughly compacted suitable material to grades shown.
3. Maintain excavations free of leaves, brush, sticks, trash, and other debris until final acceptance of the Work.

C. Over-Excavation:

1. Indicated: Where areas are indicated to be over-excavated, excavation shall be to the depth indicated, and fill shall be installed to the grade indicated.
2. Not Indicated: When ordered to over-excavate areas deeper and/or wider than required by the Contract Documents, the CONTRACTOR shall over-excavate to the dimensions ordered and fill to the indicated grade.
3. Neither Indicated nor Ordered: Any over-excavation carried below the grade that is neither ordered or indicated shall be filled and compacted to the required grade with the indicated material as part of the WORK and at the CONTRACTOR'S expense.

D. Rock Excavation

1. Rock excavation shall include removal and stockpiling at an on-site location designated by the ENGINEER of the following items:
 - a. Boulders measuring 1/3 of a cubic yard or more in volume;
 - b. Rock material in ledges, bedding deposits, and un-stratified masses that cannot be removed using conventional equipment as defined herein and which require systematic drilling and blasting for removal;
 - c. Conglomerate deposits or weathered bedrock that are so firmly cemented that they possess the characteristics of solid rock and cannot be removed using conventional equipment as herein defined and require systematic drilling and blasting for removal.
2. Explosives and Blasting: Blasting shall not be permitted unless authorized in writing by the ENGINEER.

3.7 TRENCH EXCAVATION

A. General

1. Excavate the trench as shown on the Drawings.
2. The CONTRACTOR shall furnish, place, and maintain supports and shoring required to maintain stability of all aspects of the excavations.
3. Excavations shall be sloped or otherwise supported in a safe manner in accordance with applicable state safety requirements and the requirements of OSHA Safety and Health Standards for Construction (29 CFR 1926).
4. Below the top of pipe elevation, do not exceed a trench width of 24 inches plus pipe outside diameter (O.D.) for pipes of less than 18 inches inside diameter, and do not exceed 36 inches plus pipe O.D. for sizes larger than 18 inches inside diameter. Where recommended trench widths are exceeded, provide redesign, stronger pipe, or special installation procedures by the CONTRACTOR. The CONTRACTOR is responsible for the cost of redesign, stronger pipe, or special installation procedures without any additional cost to the OWNER.

B. Trenching in Embankments, Fills and Structural Backfills:

1. Where pipelines are to be installed in embankments, fills, or structure backfills, the fill shall be constructed to a level at least one foot above the top of the pipe before the trench is excavated.
2. Upon completion of the embankment or structural backfill, a trench conforming to the appropriate detail shall be excavated and the pipe shall be installed.

C. Trench Bottom Preparation:

1. Grade the bottoms of trenches accurately and uniformly to an elevation 6 inches below the bottom of pipe.
2. Remove particles of 3 inches or greater, unless otherwise specified by the pipe manufacturer, to avoid point bearing.
3. Removal of unsuitable material: Where Unsuitable material is encountered in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with General Fill. When removal of unsuitable material is required due to the CONTRACTOR's fault or neglect in performing the Work, the CONTRACTOR is responsible for excavating the resulting material and replacing it at the expense of the CONTRACTOR.

D. Open Trenches

1. Trenches shall be fully backfilled at the end of each day or, in lieu thereof, shall be covered by heavy steel plates adequately braced and capable of supporting vehicular traffic in those locations where it is impractical to backfill at the end of each day.
2. These requirements for backfilling or use of steel plate shall be waived in cases where the trench is located further than 100 feet from any traveled roadway or occupied structure; in such cases, however, barricades and warning signs meeting appropriate safety requirements shall be provided and maintained.

E. Trench Shield

1. If a moveable trench shield is used during excavation operations, the trench width shall be wider than the shield such that the shield is free to be lifted and then moved horizontally without binding against the trench sidewalls and causing sloughing or caving of the trench walls.
2. If the trench walls cave or slough, the trench shall be excavated as an open excavation with sloped sidewalls or with trench shoring, as indicated and as required by the pipe structural design.
3. If a moveable trench shield is used during excavation, pipe installation, and fill operations, the shield shall be moved by lifting the shield free of the trench bottom or fill and then moving the shield horizontally.
4. The CONTRACTOR shall not drag trench shields along the trench causing damage or displacement to the trench sidewalls, the pipe, or the bedding and fill.

3.8 EXCAVATION BENEATH RIPRAP, STRUCTURES AND EMBANKMENTS:

- A. The subgrade areas beneath fills and embankments shall be excavated to remove all deleterious, loose, and otherwise unsuitable material and not less than the top 6 inches of native material. Where such subgrade is sloped, the native material shall be benched.
- B. After the required excavation or over-excavation for fills and embankments has been completed, the exposed surface shall be scarified to a depth of 6 inches, brought to -5% to +2% of optimum moisture content, and rolled with heavy compaction equipment to obtain 95 percent of maximum density as determined by the Standard Proctor Test (ASTM D 698).
- C. Ensure that foundation and footing subgrades have been inspected and approved by the ENGINEER prior to concrete placement.
- D. Notification of ENGINEER:
 - 1. The CONTRACTOR shall notify the ENGINEER at least 3 Days in advance of completion of any structure or roadway excavation and shall allow the ENGINEER a review period of at least one day before the exposed foundation is scarified and compacted or is covered with fill or with any construction materials.

3.9 BORROW AREA EXCAVATION (COVER SOILS)

- A. CONTRACTOR shall establish of stormwater and erosion control features at each borrow area locations in accordance with the CSWPPP and the Stormwater Management Plan.
- B. Surface vegetation and topsoil shall be stripped to a depth of 12 inches from the proposed excavation placed in a topsoil stockpile adjacent to each borrow area. The stockpiled topsoil shall be reused during borrow area reclamation activities.
- C. Excavations shall provide drainage away from the current borrow area working face to minimize disruption of the borrow activities due to stormwater.
- D. Sloped excavations shall be completed to the grades (to a maximum 3H:1V slope) and elevations shown on the Drawings.
- E. To the extent possible, excavated borrow materials shall be loaded directly into haul trucks, transported, and placed within the repository.
 - 1. Exceptions to this requirement include:
 - a. Stockpiling of borrow material prior to cover material placement to meet project schedule requirements
 - b. Stockpiling of excavated sandy material from Jetty borrow to be screened and used as filter materials in stormwater control channels site-wide.
- F. Borrow Areas Reclamation
 - 1. Each borrow area shall be reclaimed upon completion of excavation, and concurrent with the development of the subsequent borrow area.
 - 2. Post-excavation grading surfaces for each of borrow areas shall be as shown on the Drawings.

3. Topsoil stockpiled at each borrow area shall be placed in a uniform lift over the graded disturbed area and revegetated in accordance with Section 02970 – Revegetation.

3.10 FILL – ALL TYPES

A. Pre-Placement Conditions

1. Surface preparation beneath structures and embankments shall conform to Part 3.8 of this specification.
2. Except for drain gravel being placed in over-excavated areas or trenches, fill shall be placed after water is removed from the excavation and the trench sidewalls and bottom have been dried to a moisture content suitable for compaction.
3. Immediately prior to placement of fill materials, the bottoms and sidewalls of trenches and structure excavations shall have any loose, sloughing, or caving soil and rock materials removed.
4. Trench sidewalls shall consist of excavated surfaces that are in a relatively undisturbed condition before placement of fill materials.

B. Placement

1. Fill shall not be dropped directly upon any structure or pipe.
2. Fill shall not be placed around nor upon any structure until the concrete has attained sufficient strength to withstand the loads imposed.
3. Fill around water-retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed.
4. Fill materials shall be placed and spread evenly in horizontal lifts, and shall be mixed as necessary to promote uniformity of material.
5. Unless otherwise indicated, when compaction is achieved using mechanical equipment, the horizontal lifts shall be evenly spread such that when compacted each horizontal lift shall not exceed 12 inches in compacted thickness.

C. Moisture Content

1. Where the fill material moisture content is below the specified moisture content range, water shall be added before or during spreading until the proper moisture content is achieved.
2. Where the fill material moisture content is above the specified moisture content range, the material shall be dried until the proper moisture content is achieved.

3.11 TRENCH BACKFILL

A. General

1. Backfill trenches as approved by the ENGINEER to the grade shown.
2. Replacement of Unyielding Material – Replace unyielding material removed from the bottom of the trench with General Fill.

3. Replacement of Unstable Material – Replace unstable material removed from the bottom of the trench or excavation with General Fill as directed in lifts not exceeding 6 inches in uncompacted thickness.
4. Immediately prior to placement of fill materials, the bottoms and sidewalls of trenches shall have any loose, sloughing, or caving soil and rock materials removed.
5. Trench sidewalls shall consist of excavated surfaces that are in a relatively undisturbed condition before placement of fill materials.

B. Trench Shield:

1. If a moveable trench shield is used during fill operations, the shield shall be lifted to a location above each layer of fill material prior to compaction of the layer.

C. Definitions

1. Pipe Bedding Zone: The bedding is defined as that portion of the trench between a plane 6-inches below the bottom of the pipe and a plane 12 inches above the top of the pipe.
2. Trench Backfill Zone: The trench backfill zone is defined as fill in the trench cross-sectional area from the top of the bedding zone to final grade, or subgrade.

D. Bedding:

1. General Fill shall be used for the Bedding Zone backfill and shall be compacted to the density specified in Part 3.15 A.
2. Bedding shall be placed in two or more lifts. The first lift shall provide 6 inches compacted thickness under the pipe, and shall be placed, spread, and compacted before the pipe is installed so that the pipe is uniformly supported along the barrel. Subsequent lifts of pipe bedding, of not more than 6 inches in thickness shall be placed and compacted along the sides. Lifts shall be brought up together on both sides of the pipe and shall be worked carefully under the pipe haunches and then compacted.

E. Trench Backfill Zone Fill: Fill the remainder of the trench as designated below:

1. Beneath Roadways/Embankments/Structures: Place General Fill backfill up to the required subgrade elevation as specified. Deposit backfill in lifts of a maximum of 12 inches loose thickness. Do not permit water flooding or jetting methods of compaction. Spread each lift uniformly and moisten or aerate as necessary and compact to the density specified in Part 3.15 A.
2. Open Areas: Place General Fill backfill up to the required subgrade elevation as specified. Deposit backfill in lifts of a maximum of 12 inches loose thickness. Do not permit water flooding or jetting methods of compaction. Spread each lift uniformly and moisten or aerate as necessary and compact to the density specified in Part 3.15 A.

3.12 COMPACTED GENERAL FILL

- A. Fill for appurtenances and structures shall be placed and spread evenly in horizontal lifts, and shall be mixed as necessary to promote uniformity of material, with each lift moistened and aerated as necessary.

- B. Unless otherwise approved by the ENGINEER, no lifts shall exceed 12 inches of compacted thickness.
- C. Compacted General Fill shall be compacted to the density specified in Part 3.15 A.
 - 1. Flooding, ponding, and jetting shall not be used for fill around structures, for final fill materials, or aggregate base materials.
- D. Embankment Fill
 - 1. Fill for roads and stormwater control embankments shall be placed and spread evenly in horizontal lifts, and shall be mixed as necessary to promote uniformity of material, with each lift moistened and aerated as necessary.
 - 2. When an embankment is to be constructed and compacted against hillsides or fill slopes steeper than 4:1, the slopes of the hillsides or fills shall be horizontally benched in order to key the embankment to the underlying ground.
- E. Appurtenances
 - 1. After a box culvert, inlet, outlet or similar structure has been constructed and the concrete has been allowed to cure in accordance with Section 03000 – Cast-in-Place Concrete, place, backfill in such a manner that the structure is not damaged by the shock of falling earth. Deposit the backfill material, compact it as specified, and bring up the backfill evenly on all sides of the structure to prevent eccentric loading and excessive stress.
- F. Heavy Equipment:
 - 1. Equipment weighing more than 10,000 pounds shall not be used closer to walls than a horizontal distance equal to the vertical depth of the fill above undisturbed soil at that time.
 - 2. Hand-operated power compaction equipment shall be used where the use of heavier equipment is impractical or restricted due to weight limitations.

3.13 CRUSHED GRAVEL PLACEMENT

- A. The following roads shown on the Drawings shall receive gravel surfacing:
 - 1. Mine Waste Haul Road
 - 2. Mine Waste Haul Road Spur
 - 3. Clean Access Road
 - 4. Clean Access Ramp
 - 5. Pipeline Canyon Road Improvement
- B. Ensure areas to be surfaced are free from debris, snow, ice and water and that ground surfaces are not in a frozen condition.
- C. Do not place gravel over ponded water or existing subgrade surfaces which are yielding, disturbed or softened.

- D. Placing of gravel shall be suspended when the climatic conditions shall not allow proper placement and compaction of fill.
- E. Place properly moisture conditioned gravel in a horizontal layers which do not exceed 6 inches in thickness. Spread evenly and mix thoroughly during spreading to ensure uniformity of material in each layer.
- F. Compaction shall be accomplished with suitable equipment. The compacted material shall be visually moist and compacted over the full width of each layer until visual displacement ceases. Gravel shall be compacted to the density indicated in part 3.15.

3.14 REPOSITORY COVER PLACEMENT

- A. Soil Cover and General Fill shall be placed over compacted mine waste as shown on the Drawings.
- B. Any equipment that contacts mine waste shall be decontaminated before contacting cover material.
- C. Placement

1. Soil Cover

- a. Place the material in successive horizontal lifts of loose material not more than 12 inches in depth. Spread each lift uniformly and moisten or scarify as necessary to achieve the compaction specified in Part 3.15.
- b. Placement, spreading, and compaction shall be performed with equipment appropriate to achieve the required level of compaction for the cover.
- c. Soil cover placement shall commence in a manner that prevents runoff from mine waste to flow onto cover soils.

2. Admixture Layers

- a. Lifts to be mixed in-place shall be no thicker than 9 inches once compacted, following mixing. Each lift must meet specifications (density and moisture) before placement of additional materials.
- b. Placement, spreading, and compaction shall be performed with equipment appropriate to achieve the required level of compaction for the cover.

D. Finishing and Plantings

- 1. Finishing and planting shall conform to Section 02970 – Revegetation.
- 2. Finished surface shall be graded with a uniform surface to the slopes and grades shown on the drawings.

3.15 COMPACTION REQUIREMENTS

- A. The following compaction requirements shall be in accordance with the Standard Proctor test (ASTM D 698). If more than 30% of the material is larger than ¾-inch in size, an oversize correction shall be applied in accordance with ASTM D4718.

| TRENCHES | % of Maximum Dry Density | % Optimum Moisture |
|--|--------------------------|--------------------|
| Pipe Bedding Zone | 90 (min) | +2 to -5% |
| Trench Backfill Zone: Beneath Roads/Structures/Embankments | 95 (min) | +2 to -5% |
| Trench Backfill Zone: Open Areas | 90 (min) | +/- 5% |

| REPOSITORY and COVER | % of Maximum Dry Density | % Optimum Moisture |
|-------------------------------|--------------------------|--------------------|
| Radon Barrier (existing) | 95 (min) | Dry of Optimum |
| Soil Cover (Approved Borrow) | 88-93 | Dry of Optimum |
| Soil Cover – Admixture Layers | 88-93 | Dry of Optimum |

| FILL/BACKFILL | % of Maximum Dry Density | % Optimum Moisture |
|------------------------|---|--------------------|
| General Fill | 90 (min) | +0 to -5% |
| Compacted General Fill | 95 (min) | +0 to -5% |
| Safety Berms | Compact with bucket tamping or other methods to retain shape and reduce erosion | |

| GRAVEL AND FILTERS | % of Maximum Dry Density | % Optimum Moisture |
|---------------------------|--------------------------|--------------------|
| Crushed Gravel | 95 (min) | N/A |
| Filter Type I/II | 95 (min) | +/-3% |

- B. Equipment that is capable of achieving the required degree of compaction shall be used and each layer shall be compacted over its entire area while the material is within the specified moisture content range.
- C. Cover material tested and found to be compacted to greater than the range of percentages for maximum dry density for the material must be scarified and retested, prior to the placement of additional fill.
- D. Moisture and density testing shall be completed as close to the time of placement of the next lift of material as practical, to ensure the materials are not adversely affected during delays.
- E. Materials tested for density and moisture must meet the specifications at the time of placement for subsequent lifts. If weather, traffic or other impacts affect the fill density and moisture, following testing and before additional fill is placed, the CONTRACTOR will be required to rework, recompact, and retest the materials, in order to meet the specifications, at the discretion of the ENGINEER.

3.16 TEST FILLS

- A. Method specifications for compaction of rock fill or materials that contain more than 30% by weight material greater than ¾-inch in size may be used when authorized in writing by the ENGINEER.

- B. Method specifications for compaction of soil and debris mixtures may be used when authorized in writing by the ENGINEER
- C. A test fill shall be used to define appropriate placement procedures including :
 - 1. Lift thickness
 - 2. Compaction equipment type
 - 3. Number of passes
 - 4. Moisture conditioning
- D. Test Fills shall be conducted in the presence of the ENGINEER.

3.17 FIELD TESTING

- A. Field testing shall be performed by the CONTRACTOR or a CONTRACTOR-retained testing laboratory.
- B. When test results indicate that compaction is not as specified, recompact the materials, or if necessary remove the material, replace and recompact. Tests shall be performed on recompacted areas to determine conformance with Specification requirements.
- C. The following number of tests, if performed at the appropriate time, shall be the minimum acceptable for each type operation. Additional testing may be required at the discretion of the ENGINEER.
 - 1. Gradation:
 - a. Gradation of fill and backfill material determined in accordance with ASTM C117, ASTM C136, or ASTM D6913 as appropriate for the material being tested.
 - b. Compacted General Fill:
 - 1) Roads, Appurtenances, Miscellaneous Uses: One test per 10,000 cubic yards of stockpiled or in-place source material, or, in the determination of the ENGINEER, as source materials change.
 - c. Crushed Gravel: One test per 10,000 cubic yards of material imported or stockpiled or, in the determination of the ENGINEER, as source materials change.
 - d. Filters: One test per 5,000 cubic yards of material imported or stockpiled or, in the determination of the ENGINEER, as source materials change.
 - 2. Cover mixture volumes:
 - a. Measurements must determine the volume of the total admixture sample and volume of the rock added, to determine the percent by volume of rock in the mixture (Tolerance -5% to +5% on 33% rock by volume, each test).
 - b. Sample sizes per ASTM C136. If the sample size is smaller than recommended in ASTM C136, the sample size shall be appropriate for the QC method utilized and approved by the Engineer.

- c. Admixture mixed on the cover requires 1 volume test per acre of cover.
 - d. Admixture mixed off the cover requires 1 volume test per 6,000 CY prior to placement AND 1 test per acre post-placement.
 - e. Volume test results from tests conducted on the cover that do not fall within the specified tolerance for rock by volume, require 4 additional retested samples, each from 50-foot grid points centered on the location of the failed test.
 - f. Once defined, the area with the mixture that is outside the specified tolerance shall be remixed to remedy, and resampled/retested.
3. Optimum Moisture and Laboratory Maximum Density (Proctor)
- a. Where soil or admixture material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content shall be determined in accordance with the Standard Proctor test (ASTM D 698) with rock corrections as applicable.
 - b. Tests for each type material or source of material including borrow material shall be performed to determine the optimum moisture and laboratory maximum density values as listed below:
 - 1) **Radon Barrier:** One representative test per 150,000 square feet of conditioned radon barrier surface.
 - 2) **Soil Cover and Admixture:** Three tests minimum per cover mixture.
 - 3) **Trench Fill:** One representative test shall be performed per material used of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.
 - 4) **Compacted General Fill**
 - a) Roads, Appurtenances, Miscellaneous Uses: One test per 10,000 cubic yards of stockpiled or in-place source material, or, in the determination of the ENGINEER, as source materials change.
 - b) Soil Cover: A minimum of three (3) representative tests per borrow area, or, in the determination of the ENGINEER, as source materials change.
 - 5) **Crushed Gravel:** One test per 10,000 cubic yards of material imported or stockpiled or, in the determination of the ENGINEER, as source materials change.
4. Placed Density
- a. Field density in-place tests shall be performed with the nuclear density gauge method (ASTM D 6938), or by such other means acceptable to the ENGINEER.
 - b. Field density test results will be compared with laboratory results for each soil type from Section 3.17 (3).

- c. CONTRACTOR must provide geo-located (GPS) locations for all density tests, in an electronic format acceptable to the ENGINEER.
- d. Frequency
 - 1) **Radon Barrier:** One test per 30,000 square feet of conditioned radon barrier surface.
 - 2) **Soil Cover and Admixture:** One test per 30,000 square feet, or fraction thereof, of each lift of fill, or as otherwise directed by the ENGINEER.
 - 3) **Trench Fill:** One test per each lift for each culvert, or other frequency approved by the ENGINEER.
 - 4) **Compacted General Fill:**
 - a) One test per 100,000 square feet, or fraction thereof, of each lift of fill of compacted general fill used as cover soil.
 - b) One test per 500 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines and backfill around appurtenances.
 - c) One test per 500 linear feet, or fraction thereof, of each lift of structural fill beneath roadways.
 - 5) **Crushed Gravel**
 - a) One test per 10,000 square feet, or fraction thereof, of gravel surfacing.
 - b) One test per 500 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines and backfill beneath or around appurtenances.

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SECTION 02273 – RIPRAP

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide riprap, including associated earthwork, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

| | |
|--------------|--|
| NUREG 1623 | Design of Erosion Protection for Long-term Stabilization, USNRC |
| ASTM D 5240 | Standard Test Method for Testing Rock Slabs to Evaluate Soundness of Riprap by use of Sodium Sulfate or Magnesium Sulfate |
| ASTM D 5519 | Standard Test Methods for Particle Size Analysis of Natural and Man-Made Riprap Materials |
| ASTM D 6825 | Standard Guide for Placement of Riprap Revetments |
| ASTM C 88 | Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate |
| ASTM C 535 | Standard Test Method for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine. |
| AASHTO T 85 | Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate |
| AASHTO T 210 | Method of Test for Aggregate Durability Index. |

1.3 CONTRACTOR SUBMITTAL

- A. Furnish submittals in accordance with Section 01300 – Contractor Submittals.
- B. Proposed source of riprap and riprap bedding.
- C. Test Certifications from a qualified testing agency shall be submitted prior to acceptance of the rock source(s) to be used for construction at the Mill Site to verify conformity to the requirements of the Contract Documents. Evaluation shall include the following:
 - 1. Petrographic evaluation by a geologist experienced in petrographic analyses.
 - 2. Laboratory durability testing:
 - a. L.A. Abrasion (ASTM C535, modified for 100 revolutions)
 - b. Bulk specific gravity and absorption (ASTM C127)
 - c. Sodium Sulfate (ASTM C88)

- d. Schmidt Hammer (ASTM D5873)
- e. Or alternates per NUREG 1623, approved by ENGINEER

D. Test frequencies per Section 2.6.

PART 2 -- PRODUCT

2.1 PARTICLES FOR RIPRAP

- A. Particles shall be graded in size to produce a reasonably dense mass. Riprap shall consist of dense, natural rock fragments. Rock pieces shall be angular or sub-angular rock fragments with at least 90 percent of the face area freshly broken. Particles shall be resistant to weathering and to water action; free from overburden, spoil, shale, and organic material; and shall meet the gradation requirements below. Shale and particles with shale seams are not acceptable.
- B. Riprap shall conform to the size types as follows:
 - 1. D_{50} = 3-inch Riprap:

| D-sizes Percent Passing | Minimum Diameter (in) | Maximum Diameter (in) |
|------------------------------------|----------------------------------|----------------------------------|
| d_{15} 15% Passing | 1.0 | 2.0 |
| d_{50} 50% Passing | 3.0 | 3.5 |
| d_{85} 85% Passing | 3.5 | 4.0 |
| d_{100} 100% Passing | 4.5 | 6.0 |

- 2. D_{50} = 6-inch Riprap:

| D-sizes Percent Passing | Minimum Diameter (in) | Maximum Diameter (in) |
|------------------------------------|----------------------------------|----------------------------------|
| d_{15} 15% Passing | 2 | 4 |
| d_{50} 50% Passing | 6 | 7 |
| d_{85} 85% Passing | 8 | 9 |
| d_{100} 100% Passing | 10 | 11 |

- 3. D_{50} = 9-inch Riprap:

| D-sizes Percent Passing | Minimum Diameter (in) | Maximum Diameter (in) |
|------------------------------------|----------------------------------|----------------------------------|
| d_{15} 15% Passing | 4 | 6 |
| d_{50} 50% Passing | 9 | 11 |

| D-sizes Percent Passing | Minimum Diameter (in) | Maximum Diameter (in) |
|------------------------------------|----------------------------------|----------------------------------|
| d ₈₅ 85% Passing | 11 | 13 |
| d ₁₀₀ 100% Passing | 14 | 16 |

4. D₅₀ = 15-inch Riprap:

| D-sizes Percent Passing | Minimum Diameter (in) | Maximum Diameter (in) |
|------------------------------------|----------------------------------|----------------------------------|
| d ₁₅ 15% Passing | 6 | 9 |
| d ₅₀ 50% Passing | 15 | 18 |
| d ₈₅ 85% Passing | 18 | 21 |
| d ₁₀₀ 100% Passing | 22 | 26 |

5. D₅₀ = 24-inch Riprap:

| D-sizes Percent Passing | Minimum Diameter (in) | Maximum Diameter (in) |
|------------------------------------|----------------------------------|----------------------------------|
| d ₁₅ 15% Passing | 10 | 15 |
| d ₅₀ 50% Passing | 24 | 28 |
| d ₈₅ 85% Passing | 29 | 34 |
| d ₁₀₀ 100% Passing | 36 | 41 |

6. D₅₀ = 27-inch Riprap:

| D-sizes Percent Passing | Minimum Diameter (in) | Maximum Diameter (in) |
|------------------------------------|----------------------------------|----------------------------------|
| d ₁₅ 15% Passing | 11 | 17 |
| d ₅₀ 50% Passing | 27 | 31 |
| d ₈₅ 85% Passing | 33 | 38 |
| d ₁₀₀ 100% Passing | 41 | 46 |

- C. The greatest dimension of 50 percent of the particles shall be at least two-thirds but not more than 1-1/2 times the diameter of the average size. Neither the breadth nor thickness of any piece of riprap shall be less than one-third its length. Material shall be of shapes which shall form a stable protection structure of required depth. Rounded boulders or cobbles shall not be used.
- D. Particles shall consist of durable, sound, hard, angular rock and rock for the Mill Site must rate with a minimum score of 65 per NUREG-1623, rock rating below 80 will require oversizing.

- E. Less durable riprap, may be acceptable for applications at the Mine Site, with approval by the ENGINEER.
- F. Control of gradation shall be by visual inspection. The CONTRACTOR shall furnish a sample of the proposed gradation of at least 5 tons or 10 percent of the total riprap weight, whichever is less. If approved, the sample may be incorporated into the finished riprap at a location where it can be used as a frequent reference for judging the gradation of the remainder of riprap.
- G. The acceptability of the stones and gradation shall be determined by the ENGINEER prior to placement. Any difference of opinion between the ENGINEER and the CONTRACTOR shall be resolved by dumping and checking the gradation of two random truckloads of particles. Arranging for and the costs of mechanical equipment, a sorting site, and labor needed in checking particles and gradation shall be the CONTRACTOR's responsibility.

2.2 FILTER MATERIAL

- A. Filter material shall be clean and free from organic matter. It shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying. The material shall be uniformly graded and shall conform to the following gradation:

1. Type I

| Size | Percentage Passing |
|---------|--------------------|
| No. 4 | 90-100 |
| No. 16 | 45-70 |
| No. 50 | 4-25 |
| No. 100 | 0-2 |

2. Type II

| Size | Percentage Passing |
|----------|--------------------|
| 3-inch | 80 – 100 |
| 1.5-inch | 55-70 |
| ¾-inch | 30-50 |
| 3/8-inch | 7-25 |
| No. 4 | 0-5 |

2.3 SURFACE PREPARATION

- A. Surfaces to receive riprap shall be smooth and firm, free of brush, trees, stumps, and other objectionable material identified by the ENGINEER, and shall be brought to the line and grade indicated.
- B. If a boulder is encountered during excavation of areas where large riprap is to be placed, the CONTRACTOR shall excavate around the boulder. If the boulder is larger than the largest allowable stone size for that area, the CONTRACTOR shall break up the boulder to an acceptable size or remove it entirely.

2.4 PLACEMENT OF FILTER BLANKET

- A. Area of riprap placement shall be excavated to the bottom of the filter blanket as indicated and in accordance with Section 02200 – Earthwork. The finished grade shall be even, self-draining, and in conformance with the slope of the finished grade.
- B. Filter material shall be placed, spread, and compacted in lifts of a minimum of 6 inches. Where filter material is indicated to be 12 inches thick or greater, lift placement shall not exceed 12 inches.
- C. The CONTRACTOR shall remove any portion of the filter blanket that has been disturbed to the degree that the layers become mixed. The CONTRACTOR shall replace the removed portion with the required sizes.
- D. No filter material is required if riprap is placed directly on bedrock.

2.5 PLACEMENT OF RIPRAP

- A. Placement of riprap shall begin at the toe of the slope and proceed up the slope. The particles may be placed by dumping and may be spread by bulldozers, excavators, or other suitable equipment as long as the underlying material is not displaced. Particles shall be placed so as to provide a minimum of voids. Smaller particles shall be uniformly distributed throughout the mass. Sufficient hand work shall be done to produce a neat and uniform surface, true to the lines, grades, and sections indicated.
- B. Provide laborers during placement for rearrangement of loose rock fragments, "chinking" of void spaces and hand placement as necessary to create a well-keyed and stable layer of rock riprap.
- ~~C.~~ Where riprap is placed over a Geotextile, the riprap shall be placed so as to avoid damage to the Geotextile. Particles shall not be dropped from a height greater than 3 feet, nor shall large particles be allowed to roll downslope.
- ~~C-D.~~ Riprap thickness shall be confirmed by survey measurement of the completed layers by comparison with the top of the underlying surface (tolerance of -20% to +40% thickness of the design layer) and approved by the ENGINEER prior to placement of the next layer.

2.6 FIELD AND LAB TESTING

- A. Field testing shall be performed by the CONTRACTOR or a CONTRACTOR-retained testing laboratory.
- B. When test results indicate that compaction is not as specified, recompact the materials, or if necessary remove the material, replace and recompact. Tests shall be performed on recompacted areas to determine conformance with Specification requirements.
- C. The following number of tests, if performed at the appropriate time, shall be the minimum acceptable for each type operation.
 - 1. Petrographic Analysis (rock):
 - a. Results from the selected rock source must be submitted by the CONTRACTOR to the ENGINEER for approval, prior to initiating production.

- b. Rock source must rank as “fair”, or better, based on the petrography (see NUREG-1623), before durability testing.
2. Durability tests (rock):
 - a. Each test listed in 1.3, shall be performed on samples prior to production (for approval of the source), and at ¼, ½ and ¾ of the total produced volume.
 - b. Alternate tests may be substituted, if approved by the ENGINEER.
3. Gradation (filters):
 - a. Gradation of fill and backfill material determined in accordance with ASTM C117, ASTM C136, or ASTM D6913 as appropriate for the material being tested.
 - b. Frequency: One test per 5,000 cubic yards of material imported or stockpiled or, in the determination of the ENGINEER, as source materials change.
4. Compaction requirements (filters)
 - a. Where soil or admixture material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content shall be determined in accordance with the Standard Proctor test (ASTM D 698).
 - 1) Frequency: Minimum of 3 representative tests must be performed per material used of filters, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.
5. Density (Filters):
 - a. Field density in-place tests shall be performed with the nuclear density gauge method (ASTM D 6938), or by such other means acceptable to the ENGINEER.
 - b. Field density test results will be compared with laboratory Proctor results for each soil type.
 - c. The following compaction requirements shall be in accordance with the Standard Proctor test (ASTM D 698). If more than 30% of the material is larger than ¾-inch in size, an oversize correction shall be applied in accordance with ASTM D4718.

| FILTERS | % of Maximum Dry Density | % Optimum Moisture |
|------------------|---------------------------------|---------------------------|
| Filter Type I/II | 95 (min) | +/-3% |

- d. CONTRACTOR must provide geo-located (GPS) locations for all density tests, in an electronic format acceptable to the ENGINEER.
 - e. Frequency: One test per 2,000 cubic yards of material imported or stockpiled or, in the determination of the ENGINEER, as source materials change.

- END OF SECTION -