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October 29, 1993

Mr. Ramon Hall, Director
Uranium Recovery Field Office
U.S. Nuclear Regulatory Commission
P.O. Box 25325
Denver, CO 80225

**RE: Docket No. 40-1162, SUA-56, Transmittal of Revision No. 5 to the June 1987 Western Nuclear, Inc. Split Rock Millsite Tailings Reclamation Plan**

Dear Mr. Hall:

Please find enclosed five [5] copies of the referenced Split Rock Millsite Tailings Reclamation Plan [TRP]. This Revision No. 5 contains an Executive Summary, Technical Specifications, Tables and Reclamation Plan Drawings (Volume 1). All assumptions, supporting data, calculations and documentation for the current TRP No.5 design are contained in Volumes 2 and 3 of this report.

This Revision No. 5 TRP supersedes all previous submittals and subsequent revisions and should be considered to be a stand alone document. All pertinent information derived from the 1987 TRP and Revision Nos. 2, 3, and 4 have been incorporated herein. Also, the calculations and design modifications set forth in this Revision No. 5 are developed based on the general concurrence and understanding agreed upon by the NRC and WNI in our recent meetings. We emphasize that this TRP No. 5 design conforms with NRC policy as set forth in current NRC guidance regarding tailing reclamation plan design.

The primary purpose of this Revision No. 5 TRP is to incorporate new radiological source-term data; a re-design of the radon barrier layer, diversion ditches, riprap and rock mulch sizing; and reclamation of groundwater corrective action program winter storage ponds. These modifications and re-design were necessary due to the following:

94-0051

- **Radiological Source-term**: During late 1992, WNI conducted additional drilling, sampling and testing to better define the radiological source term existing as a result of tailing regrading operations during 1990 and 1991. The results are incorporated herein and provide the design basis for the radon barrier layer.

- **Radon Barrier Layer**: Based on a field test conducted in July 1992, WNI determined that construction of the soil/bentonite amended radon barrier layer incorporated in TRP No. 4 was not possible. WNI confirmed during a July 1993 field test, that construction of a clay layer (comprised of Cody shale) is both cost effective and achievable. Therefore, a re-design of the radon barrier layer using an imported clay layer is incorporated herein.

- **Diversion Ditches, Riprap and Rock Mulch Sizing**: These design modifications are merely a fine-tuning of the TRP No. 4 design, and provide for optimization of both earthwork excavation and rock riprap requirements. As agreed upon between the NRC and WNI in several meetings, design calculations for rock armoring of diversion ditches are based on the U.S. Army Corps of Engineers [USACOE] Shear Stress Method and the Safety Factors Method, as applicable.

- **Reclamation of Groundwater Corrective Action Program Winter Storage Ponds**: Incorporation of this reclamation design will allow for the timely and orderly completion of final surface reclamation at the site.

This Revision No. 5 TRP is contained in three [3] volumes. A "roadmap" of the contents of the plan is attached to this transmittal letter to assist your review.

As we stated in each of our several meetings with your staff, WNI is currently planning to commence construction of tailing reclamation work in the Spring of 1994. Both the rock quarry and the clay (Cody shale) pit are being planned for start-up prior to that time. Sufficient lead time is required to complete the extensive planning that is required to undertake such a considerable construction project. In view of the foregoing, WNI respectfully requests your review and approval of our Split Rock Mill Tailings Reclamation Plan by December 1, 1993.

Your assistance and cooperation in this matter is much appreciated. Should you have any questions, please contact us at your earliest convenience.

Very truly yours,

M. A. Pasha
Manager of Engineering Services

Attachments

cc: S. J. Baker
R. W. Collins
E. M. Schern

# "Roadmap" of Plan Contents

## Volume 1

1. **Executive Summary** - Rewritten or modified in its entirety.

2. **Technical Specifications** - Rewritten or modified in its entirety.

3. **Tables** - All 5 tables have been redone or modified to reflect the design changes.

4. **Figures** - All 12 figures have been re-drafted or modified to reflect the design changes with the exception of Figures 2, 7, 11 and 12.

5. **Reclamation Plan Drawings** - Repeat of Figures 1 through 10 on 24" x 36" size blue line drawings (provided separately).

## Volume 2

**Appendix A: Field and Laboratory Data** - Section A.1 through A.4 are unchanged and same as in TRP No. 3; Sections A.5 through A.8 have been redone or modified in their entirety; Section A.9 has been added.

**Appendix B: Surface Water Control Design Calculations** - Redone or modified in its entirety.

**Appendix C: Erosion Protection Design Calculations** - Redone or modified in its entirety.

**Appendix D: Alternate Channel Design Comparison** - Unchanged and same as in TRP No. 3.

## Volume 3

**Appendix E: Soil/Rock Matrix Design Calculations** - Redone or modified in its entirety.

**Appendix F: Confluence Erosion Protection** - Redone or modified in its entirety.

**Appendix G: Radon Barrier Cover Design** - Redone in its entirety.

**Appendix H: Radiological Testing Procedures** - Unchanged and same as in TRP No. 3; Old Appendix H in TRP No. 3 has been deleted and Appendix I in TRP No. 3 is now Appendix H in TRP No. 5

**Appendix I: Radiological Survey Review** - Unchanged and same as in TRP No. 3; Appendix J in TRP No. 3 is now Appendix I in TRP No. 5.

**Appendix J: Nuclear Density and Moisture Correlations** - Unchanged and same as in TRP No. 3; Appendix K in TRP No. 3 is now Appendix J in TRP No. 5.

**Appendix K: Health and Safety Program Responses** - Unchanged and same as in TRP No. 3; Appendix L in TRP No. 3 is now Appendix K in TRP No. 5.

40-1162

Report

# Western Nuclear, Inc. Split Rock Mill October 1993 - Revision No. 5 to the June 30, 1987 Uranium Tailings Reclamation Plan

w/ltr 10/29/93
94-0051

SMI
Shepherd Miller, Inc.

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24" X 36" Size Blue Line Drawings Provided Separately)

| FIGURE NUMBER | DRAWING NUMBER | TITLE |
|---|---|---|
| 1 of 10 | 91-225-E50 | Title Sheet |
| 2 of 10 | 91-225-E51 | 1989 Site Conditions |
| 3 of 10 | 91-225-E52 | Test Pits, Borings, and Borrow Area Locations |
| 4 of 10 | 91-225-E53 | Reclaimed Uranium Mill and Tailings Disposal Area |
| 5 of 10 | 91-225-E54 | Limits of Erosion Protection and Diversion Ditch Locations for Reclaimed Uranium Mill and Tailings Disposal Area |
| 6 of 10 | 91-225-E55 | Diversion Ditch and Tailings Swale Cross Sections and Junction Details |
| 7 of 10 | 91-225-E56 | Existing and Regraded Site Cross Sections |
| 8 of 10 | 91-225-E57 | Diversion Ditch Profiles |
| 9 of 10 | 91-225-E58 | Typical Erosion Apron Details |
| 10 of 10 | 91-225-E59 | Cover Profiles and Details |

# LIST OF APPENDICES

# EXECUTIVE SUMMARY
# RECLAMATION PLAN FOR
# URANIUM TAILING DISPOSAL AREA
# WESTERN NUCLEAR, INC. SPLIT ROCK MILL SITE
# JEFFREY CITY, WYOMING

## Introduction

This document provides the fifth revision to the Reclamation Plan for the Western Nuclear, Inc. (WNI) Split Rock Mill uranium tailing disposal site located north of Jeffrey City, Wyoming. The Reclamation Plan addresses reduction of radon emissions and long-term stability of the former uranium mill tailing disposal and mill areas. The reclamation design is in accordance with the requirements identified in Appendix A of 10 Code of Federal Regulations 40 and current U.S. Nuclear Regulatory Commission (NRC) guidance documents.

A Reclamation Plan for the Split Rock Mill Site was submitted to NRC on June 30, 1987. The Plan was revised to incorporate NRC and Wyoming Department of Environmental Quality comments, and was resubmitted to NRC on March 1, 1988. Following further revision to incorporate additional NRC comments, Revision 2 to the Reclamation Plan was submitted to NRC in March 1989.

NRC provided comments to Revision 2 of the Reclamation Plan on May 14, 1991. WNI submitted a detailed response document to NRC on March 12, 1992 (March 1992 RTC). On April 21, 1992, the third revision to the Reclamation Plan was submitted to NRC. On September 9, 1992 a fourth revision to the Reclamation Plan was submitted to NRC. The Plan was approved by the NRC on June 17, 1993.

This fifth revision includes an Executive Summary; revised Appendices containing modifications to the radon barrier, diversion ditch design, and riprap sizing calculations; revised Technical Specifications; and revised Reclamation Plan Drawings.

This revision also addresses the reclamation of the groundwater corrective action program winter storage ponds.

Reclarnation Plan Overview

In accordance with NRC guidance, reclamation shall be conducted to stabilize the tailing area, to prevent further migration of tailing by either wind or surface water runoff, and to reduce infiltration of precipitation through the tailing. The Reclamation Plan for the former mill area and the uranium tailing disposal area consists of three primary components:

1. Surface reconfiguration and interim soil cover. This task includes regrading the tailing, excavation and relocation of windblown tailing and affected soils, excavation of surface water diversion ditches and the tailing swale, and placement of an interim soil cover layer. With the exception of the excavation of surface water diversion ditches, these tasks were completed in January 1992 in compliance with the provisions of License Condition No. 33 to SUA-56.

2. Final reclamation cover. This task includes placement of an imported clay layer and a borrow soil layer designed to reduce radon emissions and to reduce surface water infiltration.

3. Erosion protection. This task includes the construction of a soil/rock matrix to protect the radon barrier and borrow soil layers comprising the final reclamation cover over the former mill site, the uranium mill tailing disposal area, and the groundwater winter storage ponds, and placement of riprap and filter layers within the tailing swale and the surface water diversion ditches.

The final reclaimed configuration of the former mill and tailing disposal area is intended to promote surface water drainage away from the site. The maximum design slope, exclusive of diversion ditches, is five horizontal to one vertical (5H:1V).

Surface water diversion ditches that are to be constructed around the perimeter of the former mill site and the uranium tailing disposal area, as well as the drainage swale through the new tailing pond ("tailing swale"), have been designed in accordance with NRC guidance to manage the Probable Maximum Flood (PMF) without allowing erosion of the final reclamation cover, diversion ditches, or tailing swale. These surface water control structures will act not only to minimize run-on of precipitation to the reclaimed area, but also to efficiently remove surface water from the reclaimed area. Efficient removal of surface water from the tailing surface will provide additional ground water protection by reducing infiltration to the former tailing disposal area. As added protection against erosion, four rock aprons have been designed to prevent headcutting at the points where diversion ditches discharge to native soil.

The radon barrier layer included in the final reclamation cover has been designed to limit the radon-222 release to an average rate of less than 20 picoCuries per square meter per second over a 1000-year design period, in accordance with NRC regulatory guidance. Relative to the radiological source term for radon emissions, the existing regraded tailing configuration was used in the design of the radon barrier layer. To provide a conservative design, the radon attenuation properties of the interim soil cover layer have not been included in the design of the radon barrier layer. The radon barrier layer will consist of an imported clay layer, with a thickness varying from 6 inches to approximately 44 inches, that will be placed over the previously regraded and stabilized surface.

A 12-inch borrow soil layer will be placed over the imported clay layer. The radon attenuation properties of the borrow soil layer have not been considered in the design of the radon barrier. The average contribution to radon emanation from possible

residual contamination in borrow soil, however, has been accounted for in the design of the radon barrier layer to assure the calculated average radon-222 flux from the surface of the final reclamation cover remains less than 20 picoCuries per square meter per second.

In addition to limiting radon emanation from the tailing, the final reclamation cover will reduce surface water infiltration at the site. This reduction of infiltration will provide additional protection of ground water beneath the former uranium tailing disposal site.

Erosion protection for the radon barrier and the borrow soil layers will consist of rock mulch combined with borrow soil to form a soil/rock matrix. Erosion protection within the surface water control structures will consist of either one or two filter layers (as required) and appropriately-sized, well-graded, granite riprap. The erosion protection was designed in accordance with existing NRC guidance documents using hydrologic data for the PMF. Durability testing on the riprap borrow material has indicated that the material will satisfy NRC durability requirements. If future testing indicates rock of lower quality than anticipated is encountered, then riprap will be oversized to compensate for weathering properties, in accordance with the procedures described in the NRC August 1990 Staff Technical Position Paper.

Status of Reclamation Activities

Reclamation activities completed by WNI since 1988 have included the following:

1. Completed mill decommissioning.

2. Dissipated standing water over tailing.

3. Regraded fine and coarse tailing to achieve slopes less than 5H:1V.

4. Removed windblown tailing and affected soils from areas outside of the boundaries of the final reclamation cover and placed them within the reclaimed area.

5. Constructed the tailing swale.

6. Placed an interim soil cover over all millsite and tailing areas. In addition, in preparation for final reclamation cover placement, significant borrow material has been placed in certain areas to achieve the desired subgrade configuration.

These tasks have been completed by WNI in accordance with NRC License Condition NO.33 to SUA-56, and with the methods identified in Revision 2 of the Reclamation Plan, as modified by the March 1992 RTC.

Activities that remain to be conducted include the following:

1. Place small quantities of fill material, as required, to achieve the desired subgrade configuration where tailing have settled subsequent to placement of the interim cover.

2. Construct the radon barrier and borrow soil layers that comprise the final reclamation cover.

3. Construct erosion protection over the final reclamation cover and in the surface water control structures.

4. Regrade and revegetate soil borrow areas disturbed by reclamation activities.

These activities are described in detail in the enclosed Technical Specifications and are shown on the enclosed revised Reclamation Plan Drawings.

# TECHNICAL SPECIFICATIONS

# TECHNICAL SPECIFICATIONS FOR RECLAMATION OF URANIUM TAILING DISPOSAL AREA WESTERN NUCLEAR, INC. SPLIT ROCK MILL SITE JEFFREY CITY, WYOMING

## 1.0 GENERAL PROJECT REQUIREMENTS

### 1.1 General Description of Work

The work covered by these Specifications consists of reclamation construction activities for the tailing disposal area at Western Nuclear Inc.'s (hereinafter referred to as "Owner") former uranium milling facility located approximately two miles north of Jeffrey City, Wyoming. All work performed shall be in accordance with these Specifications and the Reclamation Plan Drawings attached. In the event of discrepancies, or if any aspect of the work is questionable, the Contractor shall be solely responsible for requesting clarification from the Owner. Work shall be conducted in basic accordance with the schedule provided by the Owner. The work will be considered as having been completed upon inspection and written approval by the Owner.

Work by the Contractor shall be conducted in compliance with the Health and Safety Plan identified herein. The materials and products used shall be as specified herein for the services intended. Products or materials may be substituted only with the written consent of the Owner.

The methods used shall produce satisfactory work for the services intended and shall be in accordance with standard construction industry practices.

## 1.2 Reclamation Work Items

Reclamation shall be conducted to stabilize the tailing area, to prevent further migration of tailing by either wind or surface water runoff, and to reduce infiltration of precipitation through the tailing. Work categories which will be required during reclamation are as follows:

| Work Category | Specifications Section |
|---|---|
| Clearing and Grubbing | 2.0 |
| Excavation | 3.0 |
| Final Reclamation Cover Placement | 4.0 |
| Erosion Protection Placement | 5.0 |
| Revegetation | 6.0 |
| Quality Control | 7.0 |
| Health and Safety | 8.0 |

A general description of the proposed activities is provided below. Detailed descriptions of the seven specific work categories listed above are provided in the subsequent sections of these specifications.

- Windblown tailing shall be excavated as described in these Specifications. Affected soils as defined in these Specifications shall be excavated and placed according to the criteria described in these Specifications.

- Surface water diversion ditches shall be excavated in native soil or tailing to the dimensions described in these Specifications, and as shown on the Reclamation Plan Drawings. Tailing excavated from diversion ditches

shall be placed within the tailing impoundment. Excavated native soils meeting the requirements of these Specifications shall be used as either borrow for the reclamation soil cover or as clean fill to meet the subgrade, if necessary. Riprap and filter material shall be placed in the diversion ditches and in the tailing swale to provide erosional stability for these structures.

- A final reclamation cover will be placed over either the existing interim cover or over the fill required to meet the desired subgrade. The final reclamation cover will consist of the following:

  1. A radon barrier layer comprised of imported clay with varying thickness from 6 inches to 44 inches, placed over subgrade material (i.e., tailing, clean fill, or interim soil cover).

  2. A one foot thick borrow soil layer placed over the radon barrier layer. This soil layer shall be at least 12 inches thick.

  3. Each component of the reclamation cover will be placed, moistened, and compacted in accordance with the specific requirement for each layer as described in these Specifications.

- A six inch thick erosion protection layer consisting of a soil/rock matrix shall be placed over the borrow soil layer to provide erosional stability for the reclamation cover system.

- Reclamation shall be completed by revegetating all soil borrow areas disturbed by the reclamation efforts.

- All on-site workers shall be required to comply with the Health and Safety Plan included as part of these Specifications. These requirements include use of on-site health and safety protection and monitoring equipment, and radiological surveying and decontamination of all equipment or materials leaving the site.

## 1.3 Sanitary Facilities

A potable water supply and suitable sanitary facilities shall be provided and maintained on the construction site at all times. These facilities shall be subject to approval by the county and state health departments.

## 1.4 Reclamation Plan Drawings

The Reclamation Plan Drawings accompany and form a part of the Specifications. The location, extent, and general character of the work is shown on the Reclamation Plan Drawings and is described within these Specifications. The work shall be executed in accordance with these Reclamation Plan Drawings and such additional or supplemental drawings as may be developed periodically by the Owner.

## 1.5 As-Built Reclamation Plan Drawings

As-built Reclamation Plan Drawings will be produced after the construction work is complete.

## 1.6 State, Local, and Environmental Laws and Permits

The work will comply with all federal, state, and local laws. All appropriate permits and licenses will be obtained.

## 1.7 Archaeological Considerations

Should Contractor find or uncover any significant archaeological or anthropological artifact within the Work area, Contractor shall notify Owner immediately. All cultural features will be evaluated for cultural significance by Owner and shall be protected. Owner may decide to temporarily stop Work until matters are resolved and clearance is obtained from the regulatory agencies.

Specifically, all equipment operators or any other parties who may have reason to excavate materials from any borrow area will be instructed to stop all excavation activities in that area should any of the following cultural features be observed:

- Black soil stains or rings
- Artifacts including arrowheads
- Any other archaeological or anthropological artifact that Owner deems significant

Provisions for this training will be made in Radiation Work Permits.

## 1.8 Construction Water

River water, if granted by the State, or water from an on-site well may be used.

## 1.9 Codes and Standards

Work described herein shall be conducted in accordance with industry standards including, but not limited to, the most current designation of the codes and standards designated herein. Wherever the following abbreviations are used in these Specifications or on the plans, they shall be construed the same as the respective expressions represented:

1. ASTM, "American Society for Testing of Materials."

2. ASTM D 698, "Test Method for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 5.5-lb. (2.49-kg) Hammer and 12-in (305-mm) Drop."

3. ASTM D 422, "Method for Particle-Size Analysis of Soils."

4. D 1140-54 (1971), "Amount of Material in Soils Finer than the No. 200 (75 um) Sieve."

5. D 2922-81, "Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)."

6. D 1556-82, "Density of Soil In Place by the Sand-Cone Method."

7. D 3017-88, "Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)."

8. D 4643-87, "Water (Moisture) Content of Soil by the Microwave Oven Method, Determining."

### 1.9.1 Health and Safety

All work shall be conducted in accordance with the Health and Safety Plan included as part of these Specifications.

## 1.10 Submittals

### 1.10.1 Permits

If required by federal, state, or local ordinances, permits will be obtained prior to the commencement of the permitted activity including, but not limited to, the following:

1. Fugitive Dust,
2. Surface Water Control,
3. Burning,
4. Road Use,
5. General Construction,
6. Off-site Materials Disposal, and
7. Construction Water.

### 1.10.2 Products

Before use, appropriate documentation for all products used in construction shall be obtained, stating and supplying supporting data that the products meet or exceed the specifications requirements given for each product. The products requiring submittals prior to use are presented below:

1. Riprap,
2. Filter Material,
3. Clay (Cody Shale)
4. Seed Mixture,
5. Fertilizer, and
6. Mulch.

## 1.11 Definitions

As used in these Specifications, the following terms are detailed as follows:

Affected Soil - Affected soil is any soil at depth in the borrow areas exhibiting a gamma radiation survey value greater than 20 $\mu$R/hr in areas not affected by shine and greater than 32 $\mu$R/hr in areas affected by shine (i.e. within approximately 50 feet of either granite or exposed tailing). Affected soil shall be handled as tailing material and placed within the tailing impoundment beneath the radon barrier layer or in a stockpile for subsequent appropriate disposal.

Affected soil shall be identified during each construction season using an external gamma radiation survey conducted in each borrow area as specified in Section 7.0.

Diversion Ditch - Perimeter ditches constructed around the regraded tailing that intercept water flowing toward the reclaimed area, that collect water flowing from the reclaimed area, and that convey runoff off-site.

Erosion Apron - Area at the outlet of a diversion ditch designed to decrease the depth of flow and flow velocity, and to prevent headcutting at the interface of the diversion ditch and natural soils.

Filter Layer - Sized angular granite obtained from an approved rock borrow area to be placed beneath riprap in the diversion ditches, the tailing swale, and the erosion aprons.

Final Reclamation Cover - The soil cover system that is placed over the existing surface that consists of a clay radon barrier layer and a borrow soil layer.

Imported Clay - Imported clay shall consist of material from the designated borrow area which is located approximately 7 miles south of the site. The material shall have at least 90 % passing the number 200 sieve.

Reclamation Areas - The areas comprising the mill tailing and former mill area are divided into 8 different areas. These areas will receive different radon barrier layer thicknesses because of the different source term associated with each area. The limits of these areas are shown on Figure 4 of the Reclamation Plan Drawings.

Area 1A — The eastern portion of the new tailing impoundment is designated as Area 1A. This area covers approximately 81 acres.

Area 1B — The western portion of the new tailing impoundment is designated as Area 1B. This area covers approximately 47 acres

Area 1C — The old tailing impoundment is designated as Area 1C. This area covers approximately 24 acres.

Area 2A — The alternate tailing area is designated as Area 2A. This area covers approximately 39 acres.

Area 2B — The southern portion of the old tailing impoundment and the low level radioactive waste burial area is designated as Area 2B. This area covers approximately 6 acres.

Area 2C — The winter storage pond area is designated as Area 2C. This area covers approximately 19 acres.

Area 3A — The former mill area that contains imported tailing is designated as Area 3A. This area covers approximately 43 acres.

Area 3B The former mill area that did not receive imported tailing is designated as Area 3B. This area covers approximately 8 acres.

Riprap - Sized angular granite obtained from an approved rock borrow area to use as erosion protection in diversion ditches, the tailing swale, and erosion aprons.

Rock - Rock shall consist of all earth materials harder than soil that must be excavated by ripping with a D-9 Caterpillar bulldozer, or equivalent, equipped with a single shank ripper, hammering, or blasting. Rock exhibits a natural background external gamma radiation value in excess of 35 $\mu$R/hr.

Soil - Soil consists of all earth materials capable of being excavated with conventional earthwork excavation equipment without the use of hammers, or blasting, as may be required for rock. Soil shall be free from freshly redeposited windblown tailing materials, affected soil, debris, branches, and stumps. Minor amounts of elevated Ra-226 are acceptable for the soil material since these Ra-226 concentrations have been accounted for in the radon barrier layer design calculations.

Soils that are considered acceptable to use as borrow soil cover material shall meet the following criteria:

1. Soil shall not contain windblown tailing or affected soil.

2. No more than 10 percent of the soil volume shall contain particles larger than 6 inches.

Soil/Rock Matrix - A layer consisting of sized angular granite with interbedded and overlying acceptable soil obtained from approved soil and rock borrow areas to use as erosion protection for the final reclamation cover.

Tailing - Tailing consist of milled ore materials that are a by-product of the extraction of uranium. The tailing are low level radioactive wastes that were hydraulically discharged during past milling operations to the tailing disposal area identified on the Reclamation Plan Drawings.

Tailing Swale - Channel that collects water from the regraded top of the tailing impoundment and that conveys the runoff to the North Diversion Ditch.

Windblown Tailing - Windblown tailing consist of tailing that have been transported by wind. Windblown tailing generate an external gamma radiation value greater than 20 $\mu$R/hr in areas not affected by shine and greater than 32 $\mu$R/hr in areas affected by shine (i.e. within approximately 50 feet of granite outcrops or exposed tailing). Windblown tailing shall be placed beneath the radon barrier layer of the final reclamation cover.

Windblown tailing shall be identified before each construction season using an external gamma radiation survey conducted in each borrow area as specified in Section 7.0.

# 2.0 CLEARING AND GRUBBING

## 2.1 General

### 2.1.1 Scope of Work

Unless otherwise specified by the Owner, the Contractor shall furnish all labor, materials, and required equipment, and shall conduct all operations in connection with clearing and grubbing in accordance with the Reclamation Plan Drawings and these Specifications.

### 2.1.2 Related Work

Section 1.0 - General Project Requirements
Section 6.0 - Revegetation
Section 8.0 - Health and Safety

### 2.1.3 Definitions

A complete list of definitions is provided in Section 1.11.

### 2.1.4 Products

Not applicable.

## 2.2 Execution

As necessary, limited clearing and grubbing shall be conducted primarily within the approximate limits of the Southwest Valley and Northwest Valley soil borrow areas,

shown on Figure 3 of 10 of the Reclamation Plan Drawings. Clearing and grubbing shall also be conducted to a minimum distance of 20 feet outside the limits to be disturbed by construction activities. The work shall provide for completely removing all brush and trees on the surface and all major root systems beneath the surface. Where feasible all uncontaminated vegetative debris shall be placed in a stockpile for reuse in revegetation. All fill and reclamation cover materials shall be reasonably free of vegetative debris.

After removing trees and shrubs, uncontaminated topsoil containing roots, grasses, and forbes shall be stripped to the topsoil depth available or to a minimum depth of 6 inches. This material shall be stockpiled and used as seed bed material for the areas to be revegetated. Additional material may be stripped and stockpiled, as determined by the Owner, for use as seed bed material.

# 3.0 EXCAVATION

## 3.1 General

### 3.1.1 Scope of Work

Unless otherwise specified by the Owner, the Contractor shall furnish all labor, materials, and required equipment, and shall conduct all operations in connection with natural soils, affected soil, wind blown tailing and tailing excavation in accordance with the Reclamation Plan Drawings and these Specifications.

The work described in this section is intended to achieve the desired configuration, to reduce radon gas emanation, to reduce surface water erosion of tailing, and to reduce precipitation infiltration before placing the final reclamation cover.

Work shall include, but not be limited to, the following activities, as described in these Specifications and shown on the Reclamation Plan Drawings:

1. Excavating tailing material to:

    - Construct the remaining unbuilt section of the tailing swale in Area 3A.

    - Achieve desired configuration, where necessary.

2. Excavating windblown tailing and affected soils, where present, and placing within the tailing impoundment beneath the radon barrier layer or in a stockpile for subsequent appropriate disposal.

3. Excavating tailing or native soil to construct surface water diversion ditches. The excavated tailing shall be placed within the tailing impoundment to meet the subgrade requirements beneath the final reclamation cover. Excavated native soils meeting the requirements in these Specifications shall be used for the borrow soil layer in the reclamation cover system, as soil for the soil/rock matrix layer or for clean fill to meet the subgrade beneath the reclamation cover, if necessary. A summary of the diversion ditch design is presented on Table 1.

4. Placing soil fill material to achieve desired configuration before placing the radon barrier layer.

5. Conducting the required testing to comply with the requirements of the Reclamation plan Drawings and these Specifications.

The Owner shall designate, by staking, all areas subjected to earthwork operations identified herein. The Owner will be responsible for providing all surveying necessary to conduct earthwork to the configuration specified.

3.1.2 Related Work

Section 1.0 - General Project Requirements
Section 2.0 - Clearing and Grubbing
Section 4.0 - Final Soil Cover Placement
Section 5.0 - Erosion Protection Placement
Section 7.0 - Quality Control
Section 8.0 - Health and Safety

### 3.1.3 Definitions

A complete list of definitions is provided in Section 1.11.

### 3.1.4 Products

Not applicable.

## 3.2 Execution

### 3.2.1 General

The Reclamation Plan Drawings, Figures 4 and 5, indicate the location of settlement platforms, the extent of the soil cover (i.e., area to be reclaimed), the location of soil borrow areas, the location of diversion ditches and the tailing swale, and the final reclaimed contours (i.e., top of erosion protection layer).

In soil borrow areas to be disturbed, excavation and grading operations shall begin by clearing and grubbing the work area.

All work shall be conducted in a manner that minimizes surface water runoff into tailing disposal areas and construction or fill areas. Surface water runoff from exposed tailing surfaces, if any, shall be collected and pumped to areas within the tailing and shall not be allowed to flow outside the tailing disposal area.

The Contractor shall also use adequate water from a source designated by the Owner for dust suppression on haul/access roads and for all grading and compaction work.

All work shall be conducted in strict accordance with the Health and Safety Plan included as part of these Specifications. These requirements include worker

protective equipment, and environmental monitoring during, but not limited to, all earth moving and regrading activities.

### 3.2.2 Tailing Material Excavation and/or Regrading

All tailing have been regraded and embankments have been recontoured to achieve slopes equal to or less than 5H:1V.

### 3.2.3 Windblown Tailing Excavation and Grading

Windblown tailing located in the Northeast and Northwest Valleys were removed during previous construction activities involving interim stabilization, and removal was verified by radiological survey by Owner. The results of the survey were previously submitted to NRC. Excavated windblown tailing were placed within the tailing impoundment.

To confirm that windblown tailing have not been redeposited over the borrow soils, an external gamma radiation survey shall be conducted in each borrow area before each construction season. This survey is required annually for the four borrow areas indicated on Figure 3. The details of the survey are provided in Section 7.0 of these Specifications. Rejected soils or materials shall be removed and placed beneath the radon barrier layer of the final reclamation cover.

### 3.2.4 Affected Soil Excavation

To prevent any affected soil from being used as the borrow soil layer of the final reclamation cover, affected soils shall be identified during each construction season using an external gamma radiation survey conducted in each borrow area as specified in Section 7.0.

Random external gamma radiation surveys shall be conducted daily during construction according to the procedures and criteria described in Section 7.0. The purpose of these surveys is to detect any affected soils located at depth in the soil borrow areas that would require excavation and ultimate placement within the tailing impoundment beneath the radon barrier layer.

3.2.5 Diversion Ditch Excavation and Grading

The diversion ditches shall be graded to conform to the configurations shown on the Reclamation Plan Drawings. All tailing encountered in the excavations shall be placed on the tailing surface prior to placement of the radon barrier layer. Soils excavated during construction of the ditches that meet the criteria in these Specifications may be used in the borrow soil layer of the final reclamation cover (see Section 4.0) or in the soil portion of the soil/rock matrix erosion protection layer.

Any fill placed in the swale or ditches shall be placed as described in Section 3.2.7 and Section 7.0 of these Specifications. The final elevation of all components of the diversion ditches, including the outlets of the ditches, shall be constructed to achieve the approximate contours shown on the Reclamation Plan Drawings, and shall be consistent with contours of adjacent areas. Grading of the diversion ditches to the final elevations shall allow for placing all of the elements of reclamation (i.e. the radon barrier layer, the borrow soil layer, soil/rock matrix, filter layers and riprap as required).

3.2.6 Placement of Interim Soil Cover

Using borrow soil meeting the requirements of these Specifications, a 2-foot thick interim soil cover was placed in Areas 2A, 2B, 3A and 3B over regraded tailing and the former mill area. In addition, a 1-foot thick interim soil cover was placed in Areas 1A, 1B and 1C over regraded tailing. These Areas are shown on Figure 4 of the Reclamation Plan Drawings. The interim soil cover was placed and compacted in

accordance with the performance criteria for compacted fill described in these Specifications. No credit has been taken, however, for any radon attenuation afforded by the interim soil cover.

3.2.7 Placement of Fill to Achieve Desired Subgrade

The base maps for Figures 4 and 5 of the Reclamation Plan Drawings show the topographic contours existing as of February 1, 1992, and also show the desired final reclaimed contours indicating the top of the soil/rock matrix. As described above, significant earthwork, including tailing regrading, excavation, and placement of windblown tailing, and placement of an interim soil cover has previously been conducted by the Owner. However, in order to achieve the desired subgrade, additional placement of fill may be required before placing the final reclamation cover.

Excavated soil and tailing resulting from diversion ditch construction shall be used to achieve the desired configuration indicated on the Reclamation Plan Drawings. If necessary, borrow soil may be used to achieve desired grades. Placement of fill to final elevations will allow for placing not only the final reclamation cover, but also the filter material, riprap and soil/rock matrix to meet the configuration shown on the Reclamation Plan Drawings.

Fill shall not be placed in excess of a 12-inch maximum loose lift thickness. Depressions on slopes shall be filled beyond the configuration shown on the Reclamation Plan Drawings and shall then be trimmed to the desired configuration for subsequent placement of the final reclamation cover. The fill shall be graded such that the surface of the final reclamation cover has a uniform grade without localized depressions and maintains the general configuration shown on Figures 4 and 5.

The regraded tailing surface may have settled prior to final reclamation construction operations. The subgrade configuration depicted on the Reclamation Plan Drawings

was determined immediately upon completion of regrading operations. If modest settlement of the tailing has been observed, fill shall be placed to attain the configuration shown on the Reclamation Plan Drawings. If instead, significant settlement of the tailing has been observed (i.e., significant settlement precludes reasonably attaining the configuration identified on the Reclamation Plan Drawings), then adjustments to the general configuration of the impoundment top will be made to compensate for observed field conditions and settlement. In all cases, the fill shall be graded such that the surface of the final reclamation cover has a uniform grade without localized depressions and maintains the general configuration shown on Figures 4 and 5.

# 4.0 FINAL RECLAMATION COVER PLACEMENT

## 4.1 General

The final reclamation cover consists of a clay radon barrier layer and a borrow soil layer. The final reclamation cover will be stabilized with a soil\rock matrix erosion protection layer. The radon barrier and the borrow soil layer are discussed in this Section of the Specifications. The soil/rock matrix erosion protection layer is discussed in Section 5.0

The radon barrier layer has been designed to limit the release of radon-222 from uranium by-product materials and to reduce infiltration due to precipitation. An imported clay layer, with thickness varying from 6 inches to 44 inches that will be placed over subgrade, has been designed to limit radon-222 release to an average rate of 20 picoCuries per square meter per second. The radon barrier layer does not account for radon attenuation afforded by borrow soil layers placed as either interim cover or to meet subgrade requirements. The thickness of the radon barrier layer for each Reclamation Area is shown on Figure 10 of the Reclamation Plan Drawings. Tables 3A-3H present a summary of the input parameter used to design the radon barrier layer. Table 4 summarizes all of the radon barrier input parameters for all of the areas.

Placement of the final reclamation cover shall be initiated only after completion of primary consolidation of tailing. Completion of primary consolidation shall be identified by the Owner. This information will be provided to the Nuclear Regulatory Commission (NRC) for review and approval. Once primary consolidation has been achieved to the satisfaction of NRC, placement of the radon barrier layer may begin. In the event primary consolidation has not been achieved to NRC's satisfaction, Owner may suspend work for an indefinite period. Work will resume upon NRC approval.

Surveying shall be conducted as necessary to perform all work in accordance with the Reclamation Plan Drawings and these Specifications.

4.1.1 Scope of Work

Unless otherwise specified by the Owner, the Contractor shall furnish all labor, materials, and required equipment, and shall conduct all operations in connection with excavating and placing the final reclamation cover in accordance with the Reclamation Plan Drawings and these Specifications.

Work shall include, but not be limited to, excavating, placing, and grading the materials that will comprise the radon barrier and the borrow soil layers of the final reclamation cover.

The Owner and/or Owner's representative (QA/QC Contractor) shall conduct the following work:

1. Testing borrow areas to confirm the soils, including imported clay, are acceptable for use in the final reclamation cover, and

2. Materials testing to comply with the requirements of the Reclamation Plan Drawings and these Specifications.

The Owner shall designate, by staking, all areas subject to earthwork operations identified herein. All surveying necessary to conduct earthwork to the final configuration shall be specified by the Owner.

4.1.2 Related Work

Section 1.0 - General Project Requirements
Section 2.0 - Clearing and Grubbing
Section 3.0 - Excavation
Section 5.0 - Erosion Protection Placement
Section 7.0 - Quality Control
Section 8.0 - Health and Safety

4.1.3 Definitions

A complete list of definitions is provided in Section 1.11.

4.1.4 Products

Not applicable.

4.2 Execution

4.2.1 General

If necessary, excavation and grading operations shall begin by clearing and grubbing the soil borrow area. All work shall be conducted in a manner that minimizes surface water runoff into construction or fill areas and that prevents surface water runoff from exiting the site.

All slopes and excavations shall be configured by either cutting existing materials to form the design configuration, or by placing compacted fill to beyond the desired configuration and subsequently trimming to the design configuration. All soil shall be placed in maximum 6-inch thick lift(s) and compacted as specified.

Adequate water shall be used for dust suppression on haul/access roads and on all areas where grading and compaction work is conducted.

4.2.2 Placement and Grading of Final Reclamation Cover

The final reclamation cover shall be placed over the regraded tailing area to the general configuration shown on the Reclamation Plan Drawings, making an allowance in elevation for riprap and rock armor placement. The final reclamation cover will be constructed as follows:

1. A radon barrier layer comprised of imported clay with a minimum thickness varying from 6 inches to 44 inches placed over subgrade material (i.e., interim soil cover, fill material, or tailing), and

2. A 12-inch (minimum) borrow soil layer.

Contractor shall verify that minimum layer thicknesses shown on the Reclamation Plan Drawings, have been achieved at the intersecting points of a 200-foot by 200-foot survey grid. The minimum radon barrier and borrow soil layer thicknesses shall have a tolerance of +/- 0.1 foot.

The radon barrier layer shall be graded such that the surface of the final reclamation cover has a uniform grade without localized depressions and maintains the general configuration shown on Figures 4 and 5, making allowance for the thickness of either the soil/rock matrix or the riprap and filter layer(s).

4.2.2.1 Excavation, Hauling, Preparation, Placement, and Grading of Imported Clay Layer

The imported clay shall be obtained from an off-site borrow area. This borrow area is permitted by the WDEQ/LQD (permit number TFN2 2/307). Specific information regarding the location of that borrow area is included in that permit and is not repeated here.

Placement and completion of the radon barrier layer shall be in accordance with the following:

1. The imported clay shall be obtained from the designated borrow area and shall have at least 90 percent passing the number 200 sieve as determined by (ASTM D 1140)

2. The maximum density shall be determined using the Standard Proctor method (ASTM D 698). The compacted material shall be placed at a density of greater than 90% of the maximum density for the first six inch lift and 95% for any subsequent lifts. The moisture content shall be between 2 percent below to 4 percent above the optimum moisture content determined using the Standard Proctor method (ASTM D 698).

3. The imported clay layer shall be placed in lifts with a maximum nominal compacted thickness of 6 inches. Measurements will be taken at the intersecting points of a 200-foot by 200-foot survey grid to verify thickness of both the first 6 inch layer that must be compacted to at least 90% of the standard Proctor density and, also, of the entire radon barrier layer following placement of the final lift comprising the radon barrier layer.

3a. The thickness of the first 6 inch lift of the radon barrier layer may be less than 6 inches in all areas that will receive additional radon barrier material (Areas 1A, 1B, 1C 2A, 2B, and 3A). Thickness measurements of the first 6 inch layer compacted at 90% of the standard Proctor density shall be taken just prior to placement of the second 6 inch layer to ensure the required thickness of the initial 6 inch lift has been placed.

3b. In areas where the total thickness of the radon barrier layer will be only 6 inches (Areas 3A and 2C) the radon barrier layer shall be at least 6 inches thick. All clay radon barrier material in these two areas shall be compacted to at least 90% of the standard Proctor density.

3c. Thickness measurements of the entire radon barrier layer shall be taken just prior to placement of the borrow soil layer to ensure the required thickness has been placed.

3d. For all areas, the total thickness of the radon barrier layer shall be at least the thickness required for the specific area as shown on the Reclamation Plan Drawings. Measurements shall have a tolerance of +/- 0.1 foot. The imported clay layer shall be graded to have a uniform grade without localized depressions and to maintain the general configuration shown on Figures 4 and 5, making an allowance for the thickness of the soil/rock matrix.

4. Imported clay material placed adjacent to previously compacted imported clay material shall be placed such that the new material overlaps the previously compacted material. At the area of overlap, the new and

previously placed material shall be compacted together such that the imported clay layer is continuous without gaps or discernable seams.

5. After quality control testing assures the imported clay layer has been placed and compacted as specified (e.g., considering density and moisture criteria), moisture shall be added to the surface of the imported clay layer, as necessary, to prevent drying of the layer until the borrow soil layer is placed over the imported clay layer. In addition, the borrow soil layer shall be constructed, as specified below, over the clay radon barrier layer, following completion of each portion of the imported clay layer as soon as practicable as directed by the owner.

4.2.2.2 Placement and Grading of Borrow Soil Layer

Borrow soils that meet the requirements of these Specifications shall be used in the borrow soil layer of the reclamation cover system. Placement of the borrow soil layer shall be in accordance with the following:

1. The borrow soil layer shall be constructed as soon as practicable over the radon barrier layer following completion of each portion of the imported clay layer.

2. The borrow soil layer shall be a minimum of 12 inches thick as measured at the intersecting points of a 200-foot by 200-foot survey grid. Thickness measurements of the borrow soil layer shall be taken just prior to placement of the soil/rock matrix layer to ensure the required thickness of borrow soil layer has been placed. The minimum borrow soil layer thickness shall have a tolerance of +/- 0.1 foot. The top surface of the borrow soil layer shall be graded to have a uniform grade without localized depressions and to maintain the general configuration

shown on Figures 4 and 5, making an allowance for the thickness of the soil/rock matrix.

3. Grading of the top surface of the borrow soil layer shall take into consideration shaping of the diversion ditches and tailing swale. The ditches and swale shall be graded to the configuration shown on the Reclamation Plan Drawings, making an allowance for the thickness of the riprap and filter layer(s).

4. After quality control testing assures that the minimum thickness of the borrow soil layer has been placed, moisture shall be added to the surface of the borrow soil layer, as necessary, to prevent drying of the layer until the layer is temporarily stabilized. The borrow soil layer shall be temporarily stabilized by placing either a physical agent or the rock mulch portion of the soil/rock matrix over the borrow soil layer. In addition, the temporary stabilization of the borrow soil layer shall be achieved following completion of each portion of the borrow soil layer.

5. There are no compaction or moisture specifications for the borrow soil layer.

For details of testing requirements, frequencies, and quality control, see Section 7.0.

# 5.0 EROSION PROTECTION PLACEMENT

## 5.1 General

### 5.1.1 Scope of Work

Unless otherwise specified by the Owner, the Contractor shall furnish all labor, materials, and required equipment, and shall conduct all operations in connection with placement of erosion protection in accordance with the Reclamation Plan Drawings and these Specifications.

As indicated on the Reclamation Plan Drawings, the work shall include, but not be limited to, the following:

1. Placing a filter layer or layers as required in the tailing swale and diversion ditches,

2. Placing riprap in the tailing swale and diversion ditches, and

3. Placing soil/rock matrix to protect the final reclamation cover, where applicable.

4. Placing soil/rock matrix to protect existing native soils lying between the final reclamation cover and the diversion ditches, where applicable.

The size, thickness, and areal extent of erosion protection shall be as designated on the Reclamation Plan Drawings and in these Specifications.

5.1.2 Related Work

Section 1.0 - General Project Requirements
Section 3.0 - Excavation
Section 4.0 - Final Soil Cover Placement
Section 7.0 - Quality Control
Section 8.0 - Health and Safety

5.1.3 Definitions

A complete list of definitions is provided in Section 1.11.

5.1.4 Products

5.1.4.1 Riprap

Riprap shall consist of sized angular granite obtained from the specified on-site rock source (see Figure 3) or an alternate source approved by the Owner. The material shall be angular, resistant to abrasion and weathering, and shall be free from cracks, seams, and other defects that would tend to increase weathering by water and frost action. Only riprap approved by the Owner shall be used. Riprap shall be well-graded and sized as specified for each particular ditch reach or apron in these Specifications (Table 2A), unless otherwise approved by the Owner.

5.1.4.2 Filter Material

The filter material shall consist of sized angular granite as required to meet these Specifications. The granite shall be obtained from the specified on-site sources (see Figure 3) or an alternate source approved by the Owner. The filter material shall be reasonably free from clay, loam, or deleterious material. The filter material shall be

well-graded and sized as specified for each particular ditch reach or apron in these Specifications (Table 2B), unless otherwise approved by the Owner.

5.1.4.3 Soil/Rock Matrix

The soil/rock matrix shall consist of sized angular granite and soil obtained from the specified on-site borrow sources (see Figure 3), soil obtained during excavation of the ditches or alternate sources approved by the Owner. The soil used must be acceptable as defined in these Specifications. The rock material shall be angular, resistant to abrasion and weathering, and shall be free from cracks, seams, and other defects that would tend to increase weathering by water and frost action. Only rock material approved by the Owner shall be used. Rock material shall be well graded and sized as specified for each particular area in these Specifications (Table 2C), unless otherwise approved by the Owner.

5.2 Execution

5.2.1 Rock Durability Testing and Permissible Use

Laboratory durability test results and durability rating for each rock borrow area shall be developed before use of the rock.

Durability testing shall consist of the following:

1. Bulk Specific Gravity ASTM C-127,
2. Adsorption ASTM C-127,
3. Sodium Sulfate Soundness ASTM C-88, and
4. L.A. Abrasion at 100 cycles ASTM C-131 or ASTM C-535.

The results of the above testing shall be used to determine a rock durability rating in accordance with Table D1 of the NRC's Staff Technical Position (STP) "Design of Erosion Protection Covers for Stabilization of Uranium Mill Tailing Sites," August, 1990. The following criteria shall be used to determine acceptable uses of rock borrow based on the rock durability rating:

1. Rock having a durability rating of greater than or equal to 80 may be used as riprap, filter, or soil/rock matrix,

2. Rock having a durability rating of less than 80 and greater than or equal to 65 may be placed in diversion ditches or the tailing swale (i.e., "critical areas" as defined by the NRC's August 1990 STP) as riprap or filter material only after being oversized in accordance with the criteria in Section 5.2.2 of these Specifications,

3. Rock having a durability rating of less than 80 and greater than or equal to 50 may be used in the rock mulch portion of the soil/rock matrix, a "non-critical area," only after being oversized in accordance with the criteria in Section 5.2.2 of these Specifications,

4. Rock having a durability rating of less than 65 may not be used for riprap or filter, and

5. Rock having a durability rating of less than 50 may not be used for any application.

In addition to durability testing before use, rock durability testing also shall be conducted periodically during construction. Details of testing frequencies are presented in Section 7.0.

5.2.2 Riprap, Filter, and Matrix Rock Size and Gradation Requirements

Tables 2A, 2B and 2C of these Specifications indicate the design $D_{50}$ (median rock size) for each riprap and filter layer and for rock mulch sizes. Riprap, filter, and rock mulch shall conform with the following criteria:

1. A minimum of 50 percent by weight of the material shall be greater than the design $D_{50}$ shown in Tables 2A, 2B and 2C of these Specifications.

2. The material shall be well-graded and shall meet the gradation requirements shown in Tables 2A, 2B and 2C of these Specifications.

3. Rock to be used for riprap, filters or rock mulch shall have a minimum durability rating as specified in Section 5.2.1 above.

Based on previous testing conducted for the on-site borrow area, test results of available rock have durability ratings in excess of 80. However, should testing indicate a durability rating less than 80, the rock from these sources shall be oversized by applying an oversizing factor that is the difference between the tested durability rating and the required durability rating of 80, expressed as the percentage to be increased. For example, if the rock durability rating is 67, the rock would require oversizing of at least 13 percent (i.e., 80 - 67 = 13).

The results of rock oversizing calculations, if necessary, shall be submitted to the Owner prior to use. The following information shall be provided:

1. A modified gradation curve accounting for required oversizing and ensuring material is well graded, and

2. Modified gradation envelopes that ensure minimum sizing requirements are met and material will be well graded.

At least five days before placing any erosion control material, particle-size analysis of the crushed rock shall be developed and approved for each rock gradation. The Contractor shall provide the Owner with samples of crushed rock for quality control gradation checks at the frequencies described in Section 7.0.

5.2.3 Riprap Placement

Riprap shall be placed at the locations and grades shown on the Reclamation Plan Drawings. The riprap shall be placed in a manner to prevent segregation and to provide a layer of riprap of the specified thickness. Hand placing will be required only to the extent necessary to ensure the results specified above.

Material which does not meet the requirements described in Section 7.0, shall be either reworked, or removed and replaced as necessary to meet these Specifications.

5.2.4 Filter Material Placement

Each filter layer will be placed in one lift and tracked in-place by three passes of a Caterpillar D-8 bulldozer or equivalent. Minimum filter layer thicknesses for each particular application are specified in Table 2B. Each layer shall be placed in a manner that prevents segregation of the material.

Material which does not meet the requirements described in Section 7.0, shall be either reworked, or removed and replaced as necessary to meet these Specifications.

### 5.2.5 Soil/Rock Matrix

Placement of the soil/rock matrix shall commence following placement of the final soil cover. The soil/rock matrix gradation specified in Table 2C shall be placed at the locations and to the depths shown on the Reclamation Plan Drawings. Care shall be taken while placing the rock to prevent segregation of materials.

The rock for the soil/rock matrix shall be placed first by end or belly dump trucks or other means in a manner that shall minimize degradation and separation of the material. Next, the soil for the soil/rock will be placed and spread in a similar manner. The material shall be spread with a road grader to achieve the desired specifications listed below.

The soil/rock matrix shall be compacted with a vibratory roller/compactor to push the soil into the rock mulch. The soil shall be forced into the rock voids while maintaining a maximum thickness of 2 inches of soil above the rock layer after compaction. Compaction shall densify the soil/rock matrix by tightly wedging the stones. If the desired soil rock matrix cannot be achieved in this manner, alternative placement procedures will be used as directed by the Owner. If the total rock mulch layer thickness measures less than 6-inches, additional soil material will be spread until measurement verifies the appropriate thickness has been placed.

The thickness of the emplaced soil/rock matrix shall be at least 6 inches and verified by construction control, staking, and probing, as described in Section 7.0. Material that does not meet the requirements specified above and in Table 2C shall be either reworked, or removed and replaced as necessary to meet these Specifications.

### 5.2.6 Erosion Aprons

The erosion protection at the discharge location for the diversion ditch outlets has been extended into riprap lined flares and rock aprons to prevent headcutting. Figure 5 of the Reclamation Plan Drawings provides the plan locations of each erosion flare and apron (four total), and Figure 9 shows typical details of the erosion flare and apron.

The flares shall be constructed using the same filter and riprap as specified for the diversion ditch reach immediately upstream of the flare (i.e., North Reach 7, South Reach 5, North Central Reach 3, and South Central Reach 2). Filter(s) and riprap in the flare shall be well-graded, and shall be sized, placed, and tested in accordance with the criteria specified for diversion ditch riprap and filter materials.

Each rock apron shall be constructed using the same riprap as specified for the diversion ditch reach immediately upstream of the flare (i.e., North Reach 7, South Reach 5, North Central Reach 3, and South Central Reach 2). Each rock apron shall be constructed by excavating a trench to a depth equal to or greater than the appropriate scour depth specified on Figure 9 of the Reclamation Plan Drawings. Riprap shall be placed against the upstream sideslope of the excavated trench in a manner that achieves a uniform distribution of the larger and smaller rock fragments. These fragments shall form a densely placed layer of riprap that meets the thickness specified for the corresponding diversion ditch reach.

After the rock apron is constructed, the apron trench shall be backfilled with soil material to conform to the surrounding soil surface and to provide drainage from the flare to the native soil.

# 6.0 REVEGETATION

## 6.1 General

### 6.1.1 Scope of Work

Revegetation efforts shall be directed at all areas disturbed by construction and shall include, soil borrow areas, windblown tailing excavation areas, and Contractor staging areas. Unless otherwise specified by the Owner, the Contractor shall furnish all labor, materials, and required equipment, and shall conduct all operations in connection with replacing topsoil (if available) and revegetating in accordance with the Reclamation Plan Drawings and these Specifications.

### 6.1.2 Related Work

Section 1.0 - General Project Requirements
Section 2.0 - Clearing and Grubbing
Section 7.0 - Quality Control
Section 8.0 - Health and Safety

### 6.1.3 Definitions

A complete list of definitions is provided in Section 1.11.

### 6.1.4 Products

#### 6.1.4.1 General

Submittals for each of the following products shall be provided to the Owner for approval before use of the products.

6.1.4.2 Site Seed Mixture

All seed for the disturbance areas shall be fresh, clean, new crop seed of the following composition by weight of pure live seed (PLS) per acre:

| Scientific Name | Common Name | Seeding Rate (pounds of PLS per acre (recommended increase) |
|---|---|---|
| Agropyron Dasystachyum | Thickspike Wheatgrass (Critana) | 3.0 |
| Agropyron Inerme | Beardless Bluebunch Wheatgrass (Whitmar) | 2.5 |
| Agropyron Riparium | Streambank Wheatgrass (Sodar) | 3.0 |
| Agropyron Smithii | Western Wheatgrass (Arriba/Rosana) | 3.0 |
| Oryzopsis Hymenoides | Indian Ricegrass (Paloma) | 2.5 |
| Stipa Comata | Needle and Thread (Common) | 1.5 |
| | TOTAL | 15.5 |

The specified application rates are for drill seeding. The application rates for broadcast methods should be increased by 1.5 times the rate given. All seed shall be furnished in original containers showing analysis of seed mixture, seed source and production location, percentage of PLS, year of production, net weight, date, and location of packaging. Seed which has become moldy or otherwise damaged in

transit or storage shall not be accepted. The seed mixture may be adjusted to include other perennial grass species and/or forb species depending upon site specific conditions and seed availability.

6.1.4.3 Mulch

Mulch shall be certified weed-free small-grain hay or straw in a dry condition. Mulch shall be free of foreign matter detrimental to plant life.

Wood fiber mulch, if used, shall be virgin long fiber aspen mulch, Douglas fir mulch, or other similar wood fiber such as mulch from trees located on-site that will be cleared from borrow areas. The mulch shall not be from recycled material and shall be free from foreign material such as printers ink, glues, etc.

6.2 Execution

6.2.1 General

Replacing topsoil (if available) and revegetating shall be conducted as specified on the soil borrow and windblown tailing areas, and any other areas disturbed by the reclamation activities. All seeding shall be conducted only in the fall months (between September 1 and November 30) provided the soil in not frozen. Areas that cannot be seeded during the same season that construction occurs may be temporarily stabilized until the next seeding season. Temporary stabilization will be accomplished using mulch or an annual agronomic plant species adapted to site conditions.

### 6.2.2 Preparation

The area to be revegetated shall be prepared by first replacing topsoil removed and stockpiled during clearing and grubbing (see Section 2.0), if available. Construction staging areas will be ripped to a depth of 6-12 inches prior to topsoil placement to alleviate compaction that may have occurred. Available topsoil shall be spread evenly over the area to be revegetated in a nominal 6-inch unconsolidated layer. If topsoil is not available to replace over an area to be revegetated, the soil shall be prepared by first cultivating to a minimum depth of 6 inches.

Fertilizer shall be added, if required, to the soil at an application rate to be determined after soil analyses are conducted by the Owner and shall be worked into the upper 6 inches of soil by disking along the contours to the extent practical.

Native and introduced species have different responses to fertilizer requirements. A program capable of stimulating initial growth and root development without favoring one species or group of species over another is required. Introduced species have the ability to use abundant levels of plant nutrients with greater efficiency than many native species. Overstimulations of a species group could increase competition and cause a reduction in the total native plant population.

Both native and introduced species play an important role in the revegetation process. Introduced species provide rapid establishment of cover and production, while the native species provide a stable plant community with the ability to regenerate while being subjected to varying climatic conditions. A balance must be maintained when both introduced and native species are seeded so that a reduction in native species does not result from competition with introduced species, due to the fertilization program.

To alleviate the problem of overcompensation, a soil investigation may be conducted before final revegetation. Results of the soil test would allow determination of the amount of nutrients contained in the replaced topsoil or existing surface soil. Samples should be taken from areas which represent distinctly different soil conditions to determine inherent plant available nutrient levels, including the following:

1. Available nitrogen (N) for seed germination and plant development,

2. Available phosphorus ($P_2O_5$) to stimulate root development and plant growth,

3. Available potash ($K_2O$), and

4. Organic matter.

Composite soil samples should be collected from the surface to a suitable depth from each area that represents distinctly different soil conditions. One composite sample should be taken to represent each soil condition. The composite sample should consist of five to eight random grab samples from a given area. The random samples should be mixed together and a composite sample extracted from the mixture to represent a given soil condition.

Guidelines for fertilization should be developed from the above criteria. Deficiencies in nutrient availability could therefore be predicted and controlled.

Fertilizer shall be applied, as necessary, using one of the following methods:

1. Broadcast,

2. Hydrofertilization, or

3. Drill.

The method used will be dependent on climatic conditions, rate of application, time of application, and will be determined on an area-by-area basis and pre-approved by the Owner.

6.2.3 Seeding

Seeding shall be conducted by drill or broadcast seeding the specified seed mixture (as specified in Section 6.1.4.2) at the specified application rates along the contours or opposite the direction of the prevailing wind.

Broadcast seeding may be allowed upon approval by the Owner using 1.5 times the application rate specified for drill seeding. Seeding shall not be conducted immediately following a heavy rain, during windy periods, or when the ground is too dry. Drill seeding shall use a roller attachment, or its equivalent, attached behind the drill to inhibit movement of seeds previously sown. No seeding shall be conducted in areas too large to be mulched the same day.

6.2.4 Mulching

Certified weed-free straw, grass hay, or suitable wood fiber mulch will be applied to all seeded areas to conserve soil moisture and to protect against soil erosion. Application will immediately follow seeding unless soil or climate conditions prohibit the operation (wet soils or inclement weather). Certified weed-free straw or hay mulch shall be anchored with a crimper except for those slopes where crimping is not possible. All slopes too steep for crimping will have cellulose wood fiber mulch (hydromulch) applied at the rate of 2,000 pounds per acre minimum. If an area is of

critical concern, or if otherwise necessary, a mulch netting may be applied rather than the cellulose wood fiber.

### 6.2.5 Restoration

Intact plant communities outside of planned disturbance areas that may be disturbed during reclamation will be restored using methods described above. Any revegetated area or portion of an area that exhibits poor plant establishment or no plant establishment, shall be reseeded during the next growing season with the specified seed mixture and methodology.

# 7.0 QUALITY CONTROL

## 7.1 General

### 7.1.1 Scope

This section summarizes inspection and testing for construction and verification that the execution of the Reclamation Plan Drawings and Specifications will meet the intent of the Reclamation Plan, and meet or exceed all design criteria.

Unless otherwise specified, the Owner shall furnish all labor, materials, and required equipment, and shall perform all operations in connection with conducting quality control monitoring in accordance with the Reclamation Plan Drawings and these Specifications.

Quality control tasks shall include, but not be limited to, materials testing and settlement monitoring. Table 5 summarizes required field and laboratory testing and inspection frequencies.

### 7.1.2 Related Work

All sections included in these Specifications.

### 7.1.3 Definitions

A complete list of definitions is provided in Section 1.11.

### 7.1.4 Products

Not applicable.

## 7.2 Execution

### 7.2.1 Settlement Monitoring

To monitor settlement of the tailing, settlement monitoring platforms were installed in 1990 and 1991 during regrading operations and in 1992 during the placement of the vertical band drains at the approximate locations shown on the Reclamation Plan Drawings. Elevation readings shall continue to be recorded (minimum of one reading per quarter) until primary consolidation has occurred.

Final soil cover placement shall not begin until primary consolidation of the tailing has occurred. The Owner shall determine when primary consolidation has been completed, as approved by the NRC.

Following NRC approval that primary consolidation has been achieved and before final soil cover placement, the settlement monitoring platforms will be removed.

### 7.2.2 Borrow Soil Placement, and Testing

The quality control and testing procedures described in this section are applicable to any and all soil used as fill during reclamation including, but not limited to, the following:

1. Placing soil fill to achieve desired contours and grades before placing the radon barrier layer, and

2. Placing a 12-inch borrow soil layer above the imported clay radon barrier layer.

Inspection and testing described herein of all earth moving shall be conducted by the Owner to ensure that specified materials are placed and compacted as designated on the Reclamation Plan Drawings and in these Specifications.

All borrow soils placed will be compacted using passive means in that compaction will be achieved by construction traffic. No active compaction will be used and no density requirements or testings of the borrow soils is specified herein.

7.2.2.1 Windblown Tailing Identification Survey

Before each construction season, an external gamma radiation survey shall be conducted in each borrow area to confirm that windblown tailing have not been redeposited over the borrow soils. An external gamma radiation value of either 20 $\mu$R/hr in areas not affected by shine or 32 $\mu$R/hr in areas affected by shine (i.e. within approximately 50 feet of either granite outcrops or exposed tailing) will be used to determine if freshly deposited windblown tailing are present in the soil borrow area. Soils or materials exceeding these criteria shall be removed and placed beneath the radon barrier layer.

7.2.2.2 Affected Soils Identification Survey

A random external gamma survey shall be conducted during borrow area excavation to identify affected soils present at depth in the soil borrow areas. The survey shall be conducted by traversing the borrow area at the following frequencies:

1. At least once each day for each active onsite borrow area previously impacted by windblown tailing, and

2. At least once each shift if the soil volume excavated exceeds 15,000 cubic yards per day per borrow area.

The survey shall be conducted more frequently as conditions warrant, such as:

1. Anomalously high readings,

2. Visual indications of tailing, or

3. Visual indications of previous disturbance at depth such as buried man-made debris.

If the random external gamma survey to identify affected soils at depth in the soil borrow areas indicates an external gamma measurement value exceeding either 20 $\mu$R/hr in areas not affected by shine or 32 $\mu$R/hr in areas affected by shine (i.e. within approximately 50 feet of either granite outcrops or exposed tailing), then the following restrictions apply to the material:

1. The material cannot be used in the tailing cover,

2. The material cannot remain in an area to be released for unrestricted access, and

3. The material shall be segregated and disposed of as tailing material (i.e., shall be placed within the tailing impoundment beneath the final radon barrier layer or in a stockpile for subsequent appropriate disposal).

If the random external gamma survey to identify affected soils at depth in the soil borrow areas indicates an external gamma measurement value less than that specified above, then the soil is acceptable for use in the tailing cover.

### 7.2.3 Imported Clay Layer Mixture Preparation, Placement, Compaction, and Testing

#### 7.2.3.1 Imported Clay Gradation Testing

Gradation testing for percent passing the #200 sieve (ASTM D1140), of off-site borrow soil to be used in the imported clay layer shall be conducted at the following frequencies:

1. Minimum of one test for each 1,000 cubic yards of imported clay to be placed, and

2. Minimum of one test for each day when imported clay borrow soil in excess of 150 cubic yards is placed.

#### 7.2.3.2 Imported Clay Compaction Testing

The Standard Proctor test (ASTM D 698) will be used to determine the maximum density for compaction. The compacted material shall be placed at a density of greater than 90% percent of the maximum density for the first 6 inch and 95% for any subsequent lifts. The clay shall be placed at a moisture content between 2 percent below and 4 percent above optimum moisture content as determined using the Standard Proctor test. To satisfy the in-place density and moisture content criteria, field tests of the imported clay as placed and as compacted shall be conducted at the following frequencies:

1. Minimum of one test for each 500 cubic yards of placed imported clay,

2. Minimum of two tests for each day when imported clay in excess of 150 cubic yards is placed, and

3. Minimum of one test per lift and a minimum of one test per full shift of imported clay compaction operations.

Field tests to determine density and moisture content of the imported clay may be conducted using the nuclear gauge with the quality control restrictions described in Section 7.2.6.

Any area that fails either the density or moisture specification shall be reworked, moisture conditioned and recompacted as necessary to achieve the required specifications.

Tests result documentation shall be included in the weekly inspection reports required by these Specifications (Section 7.2.7).

The required thickness of the initial layer of clay to be compacted to 90% of the standard Proctor density and the total clay thickness shall be tested as specified in Section 4.0.

7.2.4 Riprap and Filter Rock Sizing and Testing

7.2.4.1 Rock Durability Testing

In accordance with the STP requirements, the durability testing frequency will include a minimum of initial testing before use and testing for each additional 10,000 cubic yards of rock from a particular rock source. Additional tests more frequent than every 10,000 cubic yards may be conducted as directed by the Owner if it is suspected that

the rock has changed substantially from that previously tested. Any visual change that is noted will be recorded as described in Section 7.2.7.

7.2.4.2 Riprap and Filter Gradation and Thickness

Testing of the riprap as placed will include verifying that both the crushed rock gradation and the riprap layer thickness are consistent with the design as specified below.

The riprap gradation used for erosion protection will be verified, at the frequency recommended in the January 1989 NRC STP on "Testing and Inspection Plans," for each different gradation of rock specified. Specifically, the gradation testing frequency will include a minimum of initial testing and testing for each additional 10,000 cubic yards of the particular riprap size (i.e., gradation requirement). A minimum of three gradation tests will be required for those riprap sizes with less than 30,000 cubic yards of riprap required (i.e., before use and after one-third and two-thirds of the total volume).

The in-place riprap shall be visually inspected to confirm that material has been placed according to Section 5.0 of these Specifications. Furthermore, the riprap layer thickness shall be measured to confirm that the thickness is greater than the minimum specified in Tables 2A and 2B. The thickness of riprap placed in the diversion ditches shall be verified by measuring the layer thickness in a test section (August 1990 NRC STP) constructed at the initial placement of a specific size riprap. In addition, the riprap layer thickness shall then be measured at the leading edge of the rock layer placement at intervals of 100 lineal feet.

### 7.2.5 Soil/Rock Matrix Placement, Compaction, and Testing

A soil/rock matrix shall be constructed over the entire extent of the final reclamation cover for erosion protection as shown on Figure 5 of the Reclamation Plan Drawings.

The thickness of the emplaced soil/rock matrix shall be verified by construction control, staking, and probing. The measurements shall be conducted using the following procedures:

1. Establish a 200-foot by 200-foot grid over the tailing impoundment,

2. Use a tape measure or surveying equipment to locate and mark the center point of each grid square,

3. Use a spade to make a vertical, straight-edged cut that penetrates the soil/rock matrix at the grid square is center point,

4. Place a straight-edge horizontally on top of the rock at the edge of the cut and measure the vertical distance from the bottom of the straight-edge to the bottom of the soil/rock matrix to the nearest 0.1 foot,

5. Record the thickness measurements for the rock mulch and overlying soil at each test location,

6. If the average soil/rock matrix thicknesses within the grid meet the requirements specified in Section 5, the soil/rock matrix within the grid area is acceptable, and

7. If the average thicknesses within the grid do not meet the requirements specified in Section 5, mark the location and add additional soil/rock

matrix, or remove and recompact as necessary to achieve the specifications. Then repeat the test, starting with Step 2 above.

7.2.6 Quality Control Procedures: Nuclear Density and Moisture Correlations

The quality control procedures in this section shall apply if a nuclear gauge is used in the field to measure in-place density and moisture to meet the requirements of Section 7.2.3.

Density Correlation Background - During interim stabilization activities in 1990, 52 in-situ density tests were conducted using both the sand cone apparatus and the nuclear gauge. These test results were used to establish a correlation between the sand cone and nuclear gauge density measurements. Using the least-squares linear regression method, the "best-fit" line has an equation of:

$$\text{Sand Cone Density} = 4.25 + 0.96\ (\text{Nuclear Density})$$

and an $r^2$ of 0.94. Therefore, the correlation between the results using the nuclear density gauge and the sand cone apparatus is very strong (i.e., greater than 0.9) for this site.

Density Correlation Specification - Figure 11 of these Specifications includes the 95 percent confidence boundary for the 52 results from 1990 field measurements and the 95 percent confidence prediction interval for determining the acceptability of future field testing results using this correlation equation. All density measurements determined using the nuclear density gauge shall be adjusted using the above equation.

As a quality control procedure, duplicate analyses shall be conducted using both the sand cone apparatus and the nuclear gauge once in every 10 tests of in-place density

using the nuclear density gauge. As additional duplicate density results -- determined using both the sand cone apparatus and nuclear gauge -- become available during final reclamation, the data shall be plotted on the graph included as Figure 11. If the duplicate results plot within the 95 percent prediction interval, use of the nuclear gauge will be considered acceptable. If the results for any of the duplicate analyses plot outside of the 95 percent prediction interval, the nuclear gauge will no longer be acceptable until the results of an additional 20 consecutive duplicate analyses fall within the 95 percent prediction interval.

Moisture Correlation Background - Similarly, in-situ moisture tests were conducted in 1990 using both the oven-drying method and the nuclear gauge. These test results were used to establish a correlation between the oven-drying method and nuclear gauge moisture measurements. Using the least-squares linear regression method, the "best-fit" line has an equation of:

$$\text{Oven Moisture Content} = 0.203 + 0.923\ (\text{Nuclear Moisture})$$

and an $r^2$ of 0.98. Therefore, the correlation between the results using the nuclear gauge and the oven-drying method is very strong (i.e., greater than 0.9) for this site.

Moisture Correlation Specification - Figure 12 of these Specifications includes the 95 percent confidence boundary for the 52 results from 1990 field measurements and the 95 percent confidence prediction interval for determining the acceptability of future field testing results using this correlation equation. All in-situ moisture measurements determined using the nuclear gauge shall be adjusted using this equation.

If field moisture tests are being conducted with the nuclear gauge, duplicate analyses for the moisture content shall be conducted using the following laboratory method:

> ASTM D 2216, "Laboratory Determined Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures" (oven-drying method).

Duplicate analyses shall be conducted using both the oven-drying method and the nuclear gauge once in every 10 tests of in-place moisture using the nuclear gauge. As additional duplicate moisture results -- determined using both the oven-drying method and nuclear gauge -- become available during final reclamation, the data shall be plotted on the graph included as Figure 12. If the duplicate results plot within the 95 percent prediction interval, the nuclear gauge will be considered acceptable. If the results for any of the duplicate analyses plot outside of the 95 percent prediction interval, the nuclear gauge will no longer be acceptable until the results of an additional 20 consecutive duplicate analyses fall within the 95 percent prediction interval.

If field moisture tests are not being conducted with a nuclear gauge, laboratory moisture content tests will constitute the moisture test corresponding to each field density test. The moisture content analyses will be conducted using the following laboratory methods:

1. ASTM D 2216, "Laboratory Determined Water (Moisture) Content of soil, Rock, and Soil-Aggregate Mixtures" (oven-drying method).

2. ASTM D 6463, "Determination of Water (Moisture) Content by the Microwave Oven Method for Expedited Test Results" (microwave method) with the following restrictions.

Where the microwave method may be used, the oven-drying method shall also be conducted as a duplicate analysis for the first series of ten consecutive laboratory moisture tests to confirm that the two test methods are producing results within ± 1.0 percent moisture. If all ten pairs of results are within this tolerance, the microwave method may be used for subsequent testing with the following restrictions:

1. After the first series of ten tests, the oven-drying method shall also be conducted as a duplicate analysis at a frequency of once every ten tests using the microwave method.

2. If for any tenth test, the results of the duplicate analyses are not within ± 1.0 percent moisture, then only the oven-drying method will be used until another ten consecutive duplicate tests confirm that the microwave method will produce results within ± 1.0 percent moisture of the oven-drying method. Alternatively, only the oven-drying method may be used for all laboratory moisture tests.

7.2.7 Records

Weekly inspection reports shall be written that address the adequacy, progress, details of construction activities, and decisions. The reports shall include the results of visual inspection, measurements, and daily tests performed in the laboratory and in the field. Volumes of placed materials and the number of field and laboratory tests performed on each material on a weekly basis shall be summarized. The inspection and test reports shall become part of the permanent record of the implementation of the Reclamation Plan.

Records shall include the date, name of the tester, items inspected or tested, type of inspection or test, identification of test method, results, acceptability and acceptance

criteria, and name and initials of the reviewer. The records shall also identify the testing equipment or instruments used in performing the test. When documenting deviations, nonconformances, and stop work order situations, the report shall provide sufficient details so that acceptability of the necessary corrective action and final resolution can be independently reviewed.

# 8.0 HEALTH AND SAFETY

## 8.1 General

### 8.1.1 Scope

This section is intended to provide working conditions and monitoring that will ensure the health and safety of workers. This section, though comprehensive, does not necessarily satisfy all of the Owner's requirements for worker protection. All work will be conducted under the auspices of a Radiation Work Permit (RWP). The Contractor in conjunction with the Owner's Safety Director will develop a health and safety plan (HASP) that will direct site activities to protect workers.

All work shall be carried out in strict compliance with applicable NRC, State Mine Inspector, and Owner requirements.

All radiological contamination surveys and radiological monitoring will be conducted by the Owner.

Site conditions are expected to vary. The Radiation Safety Officer (RSO) and the Safety Director, with approval of the Site General Manager who represents the Owner may authorize deviations from the schedule of reclamation activities and the HASP after evaluating the potential hazards of changing the sequence.

### 8.1.2 Related Work

All sections included in these Specifications.

### 8.1.3 Definitions

A complete list of definitions is provided in section 1.11.

## 8.2 Safety Equipment

### 8.2.1 Personal Protective Equipment

Personal protective equipment shall consist of a hard hat, work clothes or coveralls, respirators with appropriate cartridges if required, safety glasses, and work boots.

### 8.2.2 Exposure Monitoring

The Owner will conduct external gamma ray exposure rate surveys monthly. Time studies will be correlated after gamma survey results to determine worker exposure.

The Owner will outfit at least one worker with a lapel monitor to measure airborne uranium as discussed in Section 8.4.5.

## 8.3 Hazard Analysis

The potential hazards associated with site activities include physical and radiological hazards. The radiological hazards include exposure to external radiation (gamma), and to internal radiation (alpha and beta via inhalation and ingestion of airborne contamination). Physical hazards include potential physical (e.g., lifting, welding, wind, heat, cold, blasting) and mechanical (e.g., equipment operation and working around moving machines) hazards. The Contractor shall specify the measures to be taken to mitigate or minimize these hazards and any other hazards anticipated during site activities in the HASP.

## 8.4 Radiological Safety

The radiation safety program consists of the following elements:

1. The Owner, RSO and all workers will share in the responsibility of a written and practiced as low as reasonably achievable (ALARA) philosophy.

2. The RSO has the authority to suspend, postpone, or modify any work activity that is potentially hazardous to workers or a violation of NRC rules or license conditions.

3. The RSO is delegated the authority to enforce regulations and administrative policy that affects any aspect of the radiological safety program.

4. The RSO develops and administers the ALARA program and is active in review and approval of plans for changes or changes in operating procedures. This ensures that the plans do not adversely affect the protection program against uranium and its decay products.

5. RWPs are required for all activities involving radioactive materials.

6. Daily inspections are conducted by the RSO.

7. Weekly inspections are conducted and documented by radiation personnel.

8. Technically qualified personnel are employed and key personnel continue to receive training.

9. A comprehensive radiation safety training program is implemented.

10. An extensive surveying and monitoring program is conducted by the radiation safety staff.

11. Respiratory protection is provided for employees, if required.

12. Areas of potential exposure to airborne radioactivity are restricted.

13. Dusting of tailing is minimized.

14. Written procedures are followed for instrument operation, sample collection, instrument calibration, and documentation.

15. Records relating to the radiation safety program are maintained and filed.

The Owner shall specify minimum equipment requirements for the levels of protection to be maintained on-site, in accordance with the RSO's program. The Contractor shall provide all equipment for his employees. All site visitors, Contractor personnel, and regulatory personnel shall provide their own equipment that meets or exceeds the levels specified in the HASP.

8.4.1 ALARA Program

The Owner, RSO and all workers will share in the responsibility of a written and practiced ALARA philosophy. The RSO develops and administers the ALARA program in accordance with NRC Regulatory Guide 8.31 "Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Mills Will Be as Low as Reasonably Achievable (ALARA)" and is active in the review and approval of plans for changes in operating procedures. This process ensures that the reclamation plans do not

adversely affect worker protection from uranium and its decay products. The program consists of specific worker training regarding the potential radiological hazards of each task, and applicable routine radiation surveys as required by 10 Code of Federal Regulations (CFR) Part 20. Respiratory protection, a bioassay program, independent inspection by RSO or his designate, ongoing review of both personnel and on-site monitoring data, and modification of work practices as appropriate are also part of the ALARA program. At least semi-annually, an audit will be conducted of the radiation protection and ALARA program.

In addition to the initial inspection conducted prior to issuance of radiation work permits, documented daily inspections for radiation safety hazards will be conducted by the RSO or delegate. Results of these daily inspections will be submitted to the Site General Manager for periodic review and corrective action as warranted.

8.4.2 Training

The Contractor and all Contractor's workers will be given general radiation safety training, by the Owner, that complies with the provisions of 10 CFR 19.12, Instructions to Workers. Female workers will also be instructed in the potential health problems associated with prenatal radiation exposures outlined in NRC Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure." A written test addressing applicable principles of the radiation safety program will be administered to each worker. Test results will be reviewed and any incorrect answers discussed to ensure worker understanding of appropriate protection practices. Results of testing will be maintained in each worker's file.

In addition, task training will be conducted as necessary in accordance with specific hazards identified when issuing the radiation work permits.

All visitors and subcontractors shall be instructed in industrial and/or radiation safety requirements relating to their project-specific function. All visitors touring the restricted area will be escorted by someone properly trained and knowledgeable about the site hazards.

The site RSO has completed four weeks of specialized classroom training in health physics specifically applicable to uranium milling. In addition, the RSO has attended refresher training on uranium mill health physics.

### 8.4.3 Management Audits

Independent auditing of all radiation-associated practices will be conducted by the Owner at the Owner's expense at least every six months during reclamation activities. The Contractor and Subcontractor will be involved with the RSO or delegate in a review of work practices, including possible interviews with the Owner, an inspection performed prior to issuance of radiation work permits, and documented daily inspections for radiation safety hazards. Results of the daily inspections will be submitted to the Site General Manager for periodic review and corrective action as warranted.

### 8.4.4 Radiation Work Permits

RWPs are required for all activities involving work around radioactive materials and are issued in accordance with Section A of the Owner's Written Procedures (see Section 8.4.11).

### 8.4.5 Radiation Surveys

Radiation surveys will be performed as described in NRC Regulatory Guide 8.30 "Health Physics Surveys in Uranium Mills".

1. Gamma - External gamma surveys of the project area will be performed monthly with a gamma detector (PRM-7 or equivalent). Time studies of the workers will be performed and documented. The time any worker is on the site will be documented on the Contractor Daily Log and/or the Contractor's time sheets. The time and gamma exposure rate will be transferred to the Contractor's Restricted Area Occupancy Log for subsequent calculation for gamma exposure. The gamma exposure will be recorded.

2. Airborne Radionuclides - Surveys for airborne radionuclides will be conducted weekly during the construction activities. At least one worker in each construction area will be required to wear a calibrated constant flow air sampling pump. The sampling apparatus will be distributed at the beginning of the shift and collected at the end of the shift. The filters will be analyzed for gross alpha. If the calculated uranium concentration exceeds 10 percent of Derived Air Concentration (DAC), exposure calculations will be performed and recorded for each worker in that construction area.

### 8.4.6 Radiological Contamination Surveys

Radiological contamination surveys will be conducted in the construction equipment cabs, lunch rooms, change rooms, and offices at a typical frequency of once every two weeks during active reclamation tasks. Any contaminant level exceeding 1,000 disintegrations per minute (dpm)/100 centimeters squared removable alpha is cause for investigation by the RSO and subsequent decontamination. Equipment used for alpha counting will be calibrated semiannually and after any repairs.

All workers involved in reclamation activities will be required to monitor themselves before leaving the property. A written procedure will be posted near the personnel

monitor and all workers will be instructed in the proper use of the instrument. If the preset alarm indicates an action level of 1,000 dpm total alpha/100 square centimeters is exceeded, the worker will wash and perform a follow-up survey. Results of all exit surveys will be documented on a log sheet positioned near the survey monitor. Performance testing of monitor response will be conducted and documented on a daily basis by using a check source. The exit monitor will be calibrated at least semiannually or following repair.

Release of equipment or materials from the restricted area shall be in accordance with "Guidelines for Decontamination of Facilities and Equipment Prior to Release For Unrestricted Use or Termination of Licenses for By Product or Source Materials" dated September 1984.

Policy statements shall be issued regarding housekeeping and cleanup requirements. Individuals shall be suspended for violations of management radiation safety rules.

8.4.7 Respiratory Protection

Respiratory protection will be provided to workers in accordance with the provisions of 10 CFR Part 20.103(c)(d)(e) and as described in NRC Regulatory Guide 8.15 "Applicable Programs for Respiratory Protection." Respirators will be required whenever the weekly samples for airborne radionuclides exceed 50 percent of DAC.

A routine physical evaluation (pulmonary function test) will be required for all workers who will use respirators.

As part of the respiratory protection program, bioassays will be collected and analyzed in accordance with NRC Regulatory Guide 8.22 "Bioassays at Uranium Mills." Specifically, urine samples will be collected from each worker on the first work day. Urine samples may be collected during the course of the work if airborne radionuclide

concentrations exceed 50 percent of DAC to evaluate the effectiveness of the respiratory protection program. A final urine sample will be collected from each worker on their last work day.

### 8.4.8 Inspections

Daily inspections are conducted by the RSO or his designate and are recorded on the Contractor's Daily Log. All monitoring and exposure data will be reviewed quarterly and any trends or deviations in the ALARA philosophy will be addressed and a formal report will be submitted to the Site General Manager.

### 8.4.9 Restricted Area Access

In accordance with Condition 37 of Source Material License SUA-56, all entrances to the restricted area are conspicuously posted in accordance with Section 20.203(e)(2) of 10 CFR Part 20 and with the words, "Any area within this facility may contain radioactive material."

### 8.4.10 Minimizing Dusting

Dusting from the tailing will be minimized by spraying water from a water truck over haul roads and active working areas.

### 8.4.11 Written Procedures

Written procedures are established for site reclamation activities, including sample collection, instrument operation, instrument calibration, and documentation.

All instruments will be calibrated semiannually or after any repair. The results of sampling, analysis, surveys, and monitoring, the calibration of equipment, reports on

audits and inspections, and all meeting and training courses will be documented and maintained.

## 8.5 Responsible Personnel

The Owner shall designate safety personnel and lines of authority.

### 8.5.1 Management Control

The Owner shall be responsible for management control to the extent provided herein. Contractor shall consult with the designated Owner personnel in the morning, at noon, and at the end of the day (and at such other times during the day as deemed necessary or appropriate by either party) on every work day to discuss the implementation and adherence to dismantling procedures and radiation protection programs. The primary Owner personnel to be consulted in such regard are the Site General Manager, the Director of Safety, or the RSO.

Contractor shall consult with the Site General Manager on a daily basis to assure that all reclamation activities are conducted in the most cost- and time-effective manner. The Director of Safety and the RSO are responsible for the implementation of and adherence to the radiation safety programs, and the Contractor shall coordinate its activities and consult with them in that regard.

The RSO, through the Site General Manager, has the authority to suspend, postpone, or modify any work activity that is potentially hazardous to workers or is a violation of NRC requirements. The RSO is also responsible for administering the ALARA program and actively reviewing and approving of plans or changes in plans for reclamation activities to assure that the procedures do not adversely affect worker protection.

## 8.6 Emergency Procedures

The Owner shall designate a local facility for treatment of work injuries. Appropriate routes to the treatment center must be maintained on-site. The Contractor shall provide a copy of the "Emergency Procedures" to Owner.

Methods of emergency contact shall also be specified. A list of emergency phone numbers shall be maintained on-site.

## 8.7 Site Control and Decontamination

The Owner shall designate a support area and a decontamination area.

The methods to be used for the decontamination of equipment and personnel shall be specified.

All equipment contacting tailing shall be cleaned and surveyed in an area designated by the Owner prior to its removal from the site. Release of equipment shall be in accordance with "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for By Product or Source Materials," dated September 1984.

## 8.8 General Site Health and Safety and Work Rules

The Contractor shall delineate its standard operating rules and a chain of command as applying to job safety.

# TABLES

# TABLE 1

## SUMMARY OF DIVERSION DITCH SPECIFICATIONS

| Diversion Ditch | Reach Number (a) | Stations | Channel Slope (ft/ft) | Bottom Width (ft) | Channel Depth (b) (ft) | Channel Sideslope (ftH:ftV) | Peak Discharge Q (cfs) |
|---|---|---|---|---|---|---|---|
| North | Transition | all | 0.0598 | 15 | 7.5 | 3:1 | 1112 |
| North Reach | N1 | all | 0.0050 | 15 | 7.6 | 3:1 | 1645 |
| North Reach | N2 | all | 0.0050 | 15 | 8.1 | 3:1 | 1954 |
| North Reach | N3 | 29+00 - 29+50 | 0.0050 | 15 | 7.3 | 3:1 | 2468 |
| North Reach | N3 | 29+50 - 36+70 | 0.0387 | 15 | 6.4 | 3:1 | 2468 |
| North Reach | N4 | all | 0.0387 | 15 | 8.4 | 3:1 | 2539 |
| North Reach | N5 | all | 0.0303 | 15 | 9.2 | 3:1 | 4217 |
| North Reach | N6 | all | 0.0200 | 15 | 9.1 | 3:1 | 4618 |
| North Reach | N7 | 53+00 - 56+60 | 0.0300 | 15 | 8.5 | 3:1 | 4985 |
| North Reach | N7 | Flare/Apron | 0.0050 | varies | varies | 3:1 | 4985 |
| Swale Reach | SW1 | all | 0.0070 | 15 | 4.4 | 16:1 | 590 |
| Swale Reach | SW2 | all | 0.0070 | 15 | 5.1 | 16:1 | 1601 |
| Swale Reach 3 | SW3 | all | 0.0409 | 15 | 4.4 | varies | 1736 |
| North Central Reach | NC1 | all | 0.0050 | 15 | 3.6 | 3:1 | 327 |
| North Central Reach | NC2 | 4+95 - 11+90 | 0.0300 | 15 | 6.1 | 3:1 | 471 |
| North Central Reach | NC2 | 11+90 - 13+00 | 0.0050 | 15 | 5.7 | 3:1 | 471 |
| North Central Reach | NC3 | 13+00 - 15+15 | 0.0050 | 15 | 3.8 | 3:1 | 960 |
| North Central Reach | NC3 | Flare/Apron | 0.0050 | varies | varies | 3:1 | 960 |
| South Central Reach | SC1 | 0+00 - 6+50 | 0.0069 | 15 | 4.5 | 3:1 | 799 |
| South Central Reach | SC1 | 6+50 - 8+00 | 0.0400 | 15 | 3.9 | 3:1 | 799 |
| South Central Reach | SC1 | 8+00 - 15+75 | 0.0154 | 15 | 6.5 | 3:1 | 799 |
| South Central Reach | SC2 | 15+75 - 22+50 | 0.0090 | 15 | 6.1 | 3:1 | 1609 |
| South Central Reach | SC2 | 22+50 - 23+00 | 0.0068 | 15 | 6.1 | 3:1 | 1609 |
| South Central Reach | SC2 | Flare/Apron | 0.0068 | varies | varies | 3:1 | 1609 |
| South | Transition | all | 0.0650 | 15 | 1.3 | 3:1 | 24 |
| South Reach | S1 | 1+00 - 11+50 | 0.0082 | 15 | 8.4 | 3:1 | 864 |
| South Reach | S1 | 11+50 - 14+00 | 0.0040 | 15 | 8.3 | 3:1 | 864 |
| South Reach | S2 | all | 0.0040 | 15 | 9.7 | 3:1 | 2052 |
| South Reach | S3 | 26+00 - 45+00 | 0.0040 | 15 | 8.2 | 3:1 | 3171 |
| South Reach | S3 | 45+00 - 48+00 | 0.0229 | 15 | 7.5 | 3:1 | 3171 |
| South Reach | S3 | 48+00 - 49+00 | 0.0231 | 15 | 8.9 | 3:1 | 3171 |
| South Reach | S4 | all | 0.0231 | 15 | 8.8 | 3:1 | 4654 |
| South Reach | S5 | 57+00 - 66+00 | 0.0231 | 15 | 8.7 | 3:1 | 4896 |
| South Reach | S5 | Flare/Apron | 0.0050 | varies | varies | 3:1 | 4896 |

(a) See Reclamation Plan Drawings for plan location of each diversion ditch and reach.

(b) Depth at end of reach including required 12 inches of freeboard.

TABLE 2A

SUMMARY OF RIPRAP GRADATION REQUIREMENTS

(Allowable Percent Passing Given Dimensions)

Revised: October, 1993

| Location | Stations | Necessary (a) D50 (inches) | Design (b) D50 (inches) | Effective Oversizing (percent) | Layer Thickness (in) | 24" | 20" | 15" | 12" | 10" | 6" | 4" | 3" | 2" | 1" | 3/4" | 1/2" | 3/8" | Sieve No. 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North Transition | 0+00 - 1+00 | 18 | | 0 | | | | | | | | | | | | | | | |
| North Reach 3 | 29+50 - 30+00 | 15 | | 20 | | | | | | | | | | | | | | | |
| North Reach 3, 4, 5 | 30+00 - 46+50 | 18 | 18 | 0 | | | | | | | | | | | | | | | |
| North Reach 6 | 46+50 - 53+00 | 15 | | 20 | | | | | | | | | | | | | | | |
| | | | | | 27 | 100 | 30-60 | 15-37 | 10-32 | 4-20 | 0-10 | 0-5 | 0-1 | | | | | | |
| North Reach 7 | 53+00 - 56+00 | 18 | | 0 | | | | | | | | | | | | | | | |
| South Reach 3, 4, 5 | 45+00 - 66+00 | 18 | 18 | 0 | | | | | | | | | | | | | | | |
| North Central Confluence 1 | | 13 | | 38.5 | | | | | | | | | | | | | | | |
| South Confluence 2 | | 16 | | 12.5 | | | | | | | | | | | | | | | |
| South Confluence 4 | | 16 | | 12.5 | | | | | | | | | | | | | | | |
| Swale Reach 3 | 21+50 - 28+95 | 12 | | 0 | | | | | | | | | | | | | | | |
| North Central Reach 2 | 4+95 - 11+90 | 12 | | 0 | | | | | | | | | | | | | | | |
| | | | 12 | | 18 | | 100 | 30-100 | 25-50 | 17-42 | 5-20 | 0-13 | 0-10 | 0-6 | 0-1 | | | | |
| South Central Reach 1 | 6+50 - 8+00 | 12 | | 0 | | | | | | | | | | | | | | | |
| North Confluence 1 | | 12 | | 0 | | | | | | | | | | | | | | | |
| South Confluence 1 | | 8 | | 50 | | | | | | | | | | | | | | | |
| South Confluence 3 | | 10 | | 20 | | | | | | | | | | | | | | | |
| North Reach 7 | 56+00 - 56+65 | 6 | | 0 | | | | | | | | | | | | | | | |
| | Flare/Apron | 4 | 6 | 50 | | | | | | | | | | | | | | | |
| South Reach 5 | Flare/Apron | 6 | | 0 | | | | | | | | | | | | | | | |
| | | | | | 12 | | | 100 | 85-100 | 71-92 | 30-50 | 10-35 | 2-20 | 0-10 | | | | | |
| South Central Reach 1 | 0+00 - 6+50 | 4 | | 50 | | | | | | | | | | | | | | | |
| South Central Reach 1, 2 | 8+00 - 23+00 | 6 | 6 | 0 | | | | | | | | | | | | | | | |
| | Flare/Apron | 6 | | 0 | | | | | | | | | | | | | | | |
| Swale Reach 1, 2 | 2+00 - 21+50 | 2 | | 33 | | | | | | | | | | | | | | | |
| North Reach 1, 2, 3 | 1+00 - 29+50 | 3 | | 0 | | | | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | | | | | |
| South Transition | 0+00 - 1+00 | 3 | | 0 | | | | | | | | | | | | | | | |
| | | | | | 6 | | | | | 100 | 89-100 | 55-69 | 35-50 | 10-30 | 0-10 | 0-6 | | | |
| South Reach 1, 2, 3 | 1+00 - 45+00 | 3 | | 0 | | | | | | | | | | | | | | | |
| North Central Reach 1 | 0+00 - 4+95 | 3 | | 0 | | | | | | | | | | | | | | | |
| North Central Reach 2 | 11+90 - 13+00 | 3 | | 0 | | | | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | | | | | |
| North Central Reach 3 | 13+00 - 15+15 | 3 | | 0 | | | | | | | | | | | | | | | |
| | Flare/Apron | 2 | | 33 | | | | | | | | | | | | | | | |

(a) Taken from ditch design caculcations, Appendix C, Section C.1

(b) Taken from ditch design calculations, Appendix C, Section C.3

TABLE 2B

SUMMARY OF FILTER GRADATION REQUIREMENTS
(Allowable Percent Passing Given Dimensions)

| Filter Layer | Locations | Stations | Design D50 (c) (inches) | Filter Layer Thickness (inches) | 54" | 48" | 36" | 24" | 20" | 15" | 12" | 10" | 6" | 4" | 3" | 2" | 1" | 3/4" | 1/2" | 3/8" | Sieve No. 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Borrow Soil | | | | | | | | | | | | | | | | | | | | | |
| Pre-Filter | South Transition | 0+00 - 1+00 | N/A | 6 | | | | | | | | | | | | | | | | | |
| | South Reach 1, 2, 3 | 1+00 - 48+00 | | | | | | | | | | | | | | | | | | | |
| | North Central Reach 1 | 0+00 - 4+95 | | | | | | | | | | | | | | | | | | | |
| | Swale Reach 1, 2, 3 | 2+00 - 28+50 | | | | | | | | | | | | | | | | | | | |
| Filter I (a) | All | All | 0.62 | 6 | | | | | | | | | | | | 100 | 85-95 | 61-78 | 38-52 | 26-39 | 10-21 |
| Filter IIABC (b) | North Transition | 0+00 - 1+00 | 3 | 6 | | | | | | | | | 100 | 56-74 | 32-51 | 12-26 | 0-1 | | | | |
| | North Reach 3, 4, 5, 6, 7 | 29+50 - 56+00 | | | | | | | | | | | | | | | | | | | |
| | Swale Reach 3 | 21+50 - 28+95 | | | | | | | | | | | | | | | | | | | |
| | South Reach 3, 4, 5 | 45+00 - 66+00 | | | | | | | | | | | | | | | | | | | |
| | North Central Reach 2 | 4+95 - 11+90 | | | | | | | | | | | | | | | | | | | |
| | South Central Reach 1 | 6+50 - 8+00 | | | | | | | | | | | | | | | | | | | |
| | North Confluence 1 | | | | | | | | | | | | | | | | | | | | |
| | South Confluence 1, 2, 3, 4 | | | | | | | | | | | | | | | | | | | | |
| | North Central Confluence 1 | | | | | | | | | | | | | | | | | | | | |

(a) Filter Layer I shall be placed in each diversion ditch.

(b) Filter Layer II shall be placed in diversion ditches as noted, above Filter Layer I.

(c) Taken from Appendix C, Section C.3

Revised: October, 1993

TABLE 2C

SUMMARY OF ROCK MULCH GRADATION REQUIREMENTS
(Allowable Percent Passing Given Dimensions)

| Rock Mulch Type | Location | Design D50(a) (inches) | Thickness (inches) | 24" | 20" | 15" | 12" | 10" | 6" | 4" | 3" | 2" | 1" | 3/4" | 1/2" | 3/8" | Sieve No. 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 inch | See Figure 5 | 2 | 4 | | | | | | 100 | 98-100 | 82-88 | 40-50 | 2-20 | 0-12 | | | |

(a) Taken from soil/rock matrix design calculations, Appendix E

TABLE 3A

RADON INPUT PARAMETER BACKUP SUMMARY AND LOCATION IN TRP #5
AREA 1A - EAST NEW TAILING

| Input Parameter | Value Used in TRP #5 | Source | Location in TRP #5 Page(s) |
|---|---|---|---|
| Radium Concentration | 280 pCi/g | SMI[A] 1993 tailing borings 9, 10, 11, 12 & 13 | A-84, G-42 |
| | | WWL[B] 1988 tailing surface samples SS-1 through SS-14 | A-15, G-42 |
| | | WWL 1988 new embankment surface sample | A-15, G-42 |
| | | WWL 1988 tailing borings 1, 2, 3, & 4 | A-13, G-42 |
| Emanation Coefficient | 0.28 | WWL 1988 tailing borings 1, 2, 3, & 4 | A-13, G-42 |
| | | WWL 1988 tailing surface sample SS-5 | A-15, G-42 |
| | | WWL 1988 new embankment surface sample | A-15, G-42 |
| Long Term Moisture | 1.5% | Canonie coarse tailing sample, listed as sample 7 | A-24, G-14 |
| Dry Density | 1.62 g/cm$^3$ | SMI 1993 tailing borings 9, 10, 11, & 12 | A-79, G-43 |
| Specific Gravity | 2.65 | Default value | G-42 |
| Porosity | 0.39 | Calculated using dry density and specific gravity | G-43 |
| Diffusion Coefficient | 5.667E-02 cm$^2$/sec | Calculated by the RADON model | G-21 |
| Source Term | 6.839E-04 pCi/sec/cm$^3$ | Calculated by the RADON model | G-21 |

[A] SMI is Shepherd Miller, Inc.
[B] WWL is Water, Waste, and Land

TABLE 3B

RADON INPUT PARAMETER BACKUP SUMMARY AND LOCATION IN TRP #5
AREA 1A - WEST NEW TAILING

| Input Parameter | Value Used in TRP #5 | Source | Location in TRP #5 Page(s) |
|---|---|---|---|
| Radium Concentration | 450 pCi/g | WWL[A] 1988 tailing borings 1, 2, 3, & 4 | A-13, G-44 |
| Emanation Coefficient | 0.37 | WWL 1988 tailing boring 3 | A-13, G-44 |
| Long Term Moisture | 1.5% | Canonie coarse tailing sample, listed as sample 7 | A-24, G-45 |
| Dry Density | 1.55 g/cm$^3$ | Calculated from porosity and specific gravity | G-45 |
| Specific Gravity | 2.59 | WWL 1988 tailing boring 3 | A-13, G-44 |
| Porosity | 0.4 | Default value | G-45 |
| Diffusion Coefficient | 5.758-02 cm$^2$/sec | Calculated by the RADON model | G-24 |
| Source Term | 1.355E-03 pCi/sec/cm$^3$ | Calculated by the RADON model | G-24 |

[A] WWL is Water, Waste, and Land

TABLE 3C

RADON INPUT PARAMETER BACKUP SUMMARY AND LOCATION IN TRP #5
AREA 1C & 2B - OLD TAILING

| Input Parameter | Value Used in TRP #5 | Source | Location in TRP #5 Page(s) |
|---|---|---|---|
| Radium Concentration | 341 pCi/g | SMI[A] 1993 tailing borings 14, 15, 16, 21 & 22<br>WWL[B] 1988 tailing borings 5 & 6 | A-84 & 85, G-46<br>A-14, G-46 |
| Emanation Coefficient | 0.25 | WWL 1988 tailing boring 5<br>SMI 1993 tailing composite sample #1 | A-14, G-47<br>A-88, G-47 |
| Long Term Moisture | 3.58% | SMI 1993 tailing composite sample #1 | A-89, G-47 |
| Dry Density | 1.61 g/cm$^3$ | SMI 1993 tailing borings 14, 15, 16, 21 & 22 | A-79 & 80, G-48 |
| Specific Gravity | 2.65 | SMI 1993 tailing composite sample #1 | A-87, G-47 |
| Porosity | 0.39 | Calculated using dry density and specific gravity | G-48 |
| Diffusion Coefficient | 4.239E-02 cm$^2$/sec | Calculated by the RADON model | G-27 |
| Source Term | 7.391E-04 pCi/sec/cm$^3$ | Calculated by the RADON model | G-27 |

[A] SMI is Shepherd Miller, Inc.
[B] WWL is Water, Waste, and Land

TABLE 3D

RADON INPUT PARAMETER BACKUP SUMMARY AND LOCATION IN TRP #5
AREA 2A - ALTERNATE TAILING

| Input Parameter | Value Used in TRP #5 | Source | Location in TRP #5 Page(s) |
|---|---|---|---|
| Radium Concentration | 448 pCi/g | SMI[A] 1993 tailing borings 17, 18, 19, 20, 23, 24 & 25 | A-84 & 85, G-49 |
| | | WWL[B] 1988 tailing borings 7 & 8 | A-14, G-49 |
| | | WWL 1988 old embankment surface sample | A-14, G-49 |
| Emanation Coefficient | 0.25 | SMI 1993 tailing sample composite #4 | A-88, G-50 |
| | | WWL 1988 tailing borings 7 & 8 | A-14, G-50 |
| | | WWL 1988 old embankment surface sample | A-14, G-50 |
| Long Term Moisture | 2.15% | SMI 1993 tailing composite sample #4 | A-89, G-50 |
| Dry Density | 1.64 g/cm$^3$ | SMI 1993 tailing borings 17, 18, 19, 20, 23, 24 & 25 | A-79 & 80, G-51 |
| Specific Gravity | 2.65 | SMI 1993 tailing composite sample #4 | G-87, G-50 |
| Porosity | 0.36 | Calculated using dry density and specific gravity | G-51 |
| Diffusion Coefficient | 4.977E-02 cm$^2$/sec | Calculated by the RADON model | G-30 |
| Source Term | 1.071E-03 pCi/sec/cm$^3$ | Calculated by the RADON model | G-30 |

[A] SMI is Shepherd Miller, Inc.
[B] WWL is Water, Waste, and Land

TABLE 3E

RADON INPUT PARAMETER BACKUP SUMMARY AND LOCATION IN TRP #5
AREA 3A - MILL AREA WITH TAILING

| Input Parameter | Value Used in TRP #5 | Source | Location in TRP #5 Page(s) |
|---|---|---|---|
| Radium Concentration | 88 pCi/g | SMI[A] 1993 tailing borings 1, 2, 3, 4, 5, 6, 7 & 8 | A-84, G-52 |
| Emanation Coefficient | 0.17 | SMI 1993 tailing composite sample #4 | A-88, G-53 |
| Long Term Moisture | 2.15% | SMI 1993 tailing composite sample #4 | A-89, G-53 |
| Dry Density | 1.65 g/cm$^3$ | SMI 1993 tailing borings 1, 2, 3, 4, 5, 6, 7 & 8 | A-79, G-53 |
| Specific Gravity | 2.62 | SMI 1993 tailing composite sample #4 | A-87, G-53 |
| Porosity | 0.37 | Calculated using dry density and specific gravity | G-53 |
| Diffusion Coefficient | 5.027E-02 cm$^2$/sec | Calculated by the RADON model | G-33 |
| Source Term | 1.401E-04 pCi/sec/cm$^3$ | Calculated by the RADON model | G-33 |

[A] SMI is Shepherd Miller, Inc.

TABLE 3F

RADON INPUT PARAMETER BACKUP SUMMARY AND LOCATION IN TRP #5
AREA 3B - MILL AREA WITHOUT TAILING

| Input Parameter | Value Used in TRP #5 | Source | Location in TRP #5 Page(s) |
|---|---|---|---|
| Radium Concentration | | | |
| Top 12 inches | 20.3 pCi/g | REM[A] 1987 tailing borings 3-1, 3-2, 3-3, 3-5 & 3-6 | A-175, G-54 |
| Lower 14 feet | 5.5 pCi/g | Canonie 1989 composite surface sample C-3 | A-38, G-54 |
| | | REM 1987 tailing borings 3-1, 3-2, 3-3, 3-5 & 3-6 | A-175, G-55 |
| Emanation Coefficient | 0.35 | Default value | G-56 |
| Long Term Moisture | 1.5% | Canonie coarse tailing sample, listed as sample 7 | A-24, G-56 |
| Dry Density | 1.57 g/cm$^3$ | Calculated from porosity and specific gravity | G-56 |
| Specific Gravity | 2.61 | Canonie 1989 composite surface sample C-4, listed as sample 5 | A-23, G-56 |
| Porosity | 0.4 | Default value | G-56 |
| Diffusion Coefficient | | | |
| Top 12 inches | 5.744E-02 cm$^2$/sec | Calculated by the RADON model | G-36 |
| Lower 14 feet | 5.744E-02 cm$^2$/sec | Calculated by the RADON model | G-36 |
| Source Term | | | |
| Top 12 inches | 5.856E-05 pCi/sec/cm$^3$ | Calculated by the RADON model | G-36 |
| Lower 14 feet | 1.587E-05 pCi/sec/cm$^3$ | Calculated by the RADON model | G-36 |

[A] REM is Radiant Energy Management

TABLE 3G

RADON INPUT PARAMETER BACKUP SUMMARY AND LOCATION IN TRP #5
CODY SHALE RADON BARRIER

| Input Parameter | Value Used in TRP #5 | Source | Location in TRP #5 Page(s) |
|---|---|---|---|
| Radium Concentration | 0 pCi/g | Radium activity is neglected since the Cody Shale is obtained from an uncontaminated area | G-57 |
| Emanation Coefficient | 0 | N/A[B] | N/A |
| Long Term Moisture | 16.9% | SMI[A] Cody Shale composite sample #2 | A-155, G-57 |
| Dry Density | | | |
| 90% Proctor | 1.59 g/cm$^3$ | SMI Cody Shale composite sample #2 | A-155, G-57 |
| 95% Proctor | 1.65 g/cm$^3$ | SMI Cody Shale composite sample #2 | A-155, G-57 |
| Specific Gravity | 2.78 | SMI Cody Shale composite sample #2 | A-155, G-57 |
| Porosity | 0.44 | Calculated using dry density and specific gravity | G-57 |
| | 0.41 | Calculated using dry density and specific gravity | G-57 |
| Diffusion Coefficient | | | |
| 90% Proctor | 6.950E-03 cm$^2$/sec | Calculated by the RADON model | G-37 |
| 95% Proctor | 4.068E-03 cm$^2$/sec | Calculated by the Radon model | G-37 |
| Source Term | 0 | N/A | N/A |

[A] SMI is Shepherd Miller, Inc.
[B] N/A is not applicable

TABLE 3H

RADON INPUT PARAMETER BACKUP SUMMARY AND LOCATION IN TRP #5
BORROW SOIL LAYER

| Input Parameter | Value Used in TRP #5 | Source | Location in TRP #5 Page(s) |
|---|---|---|---|
| Radium Concentration | 1.1 pCi/g | Assumed as agreed by WNI[A] and NRC[B] to account for the possible presence of affected soils in the sandy soil borrow area. | G-58 |
| Emanation Coefficient | 0.35 | Default value | G-58 |
| Long Term Moisture | 2.0% | Assumed value typical for sandy soil | G-58 |
| Dry Density | 1.55 g/cm$^3$ | Calculated from default specific gravity and porosity | G-58 |
| Specific Gravity | 2.65 | Default value | G-58 |
| Porosity | 0.40 | Default value | G-58 |
| Diffusion Coefficient | 5.395E-02 cm$^2$/sec | Calculated by the RADON model | G-22 |
| Source Term | 3.133E-06 pCi/sec/cm$^3$ | Calculated by the RADON model | G-22 |

[A] WNI is Western Nuclear, Inc.
[B] NRC is Nuclear Regulatory Commission

# TABLE 4
# SUMMARY OF RADON BARRIER DESIGN INPUT PARAMETERS

| AREA | RADIUM CONCENTRATION (pCi/g) | EMANATION COEFFICIENT | LONG TERM MOISTURE (%) | DRY DENSITY ($g/cm^3$) | SPECIFIC GRAVITY | POROSITY | DIFFUSION COEFFICIENT ($cm^2/sec$) | SOURCE TERM ($pCi/sec/cm^3$) |
|---|---|---|---|---|---|---|---|---|
| AREA 1A - EAST NEW TAILING | 280 | .28 | 1.5% | 1.62 | 2.65 | .39 | 5.667E-02 | 6.839E-04 |
| AREA 1B - WEST NEW TAILING | 450 | .37 | 1.5% | 1.55 | 2.59 | .40 | 5.758E-02 | 1.355E-03 |
| AREA 1C - OLD TAILING | 341 | .25 | 3.58% | 1.61 | 2.65 | .39 | 4.239E-02 | 7.391E-04 |
| AREA 2A - ALTERNATE TAILING | 448 | .25 | 2.15% | 1.64 | 2.62 | .36 | 4.977E-02 | 1.071E-03 |
| AREA 2B - OLD TAILING | 341 | .25 | 3.58% | 1.61 | 2.65 | .39 | 4.239E-02 | 7.391E-04 |
| AREA 2C - WINTER STORAGE PONDS | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AREA 3A - MILL AREA WITH TAILING | 88.0 | .17 | 2.15% | 1.65 | 2.62 | .37 | 5.027E-02 | 1.401E-04 |
| AREA 3B - MILL AREA W/O TAILING | | | | | | | | |
| TOP 1 FOOT | 20.3 | .35 | 1.5% | 1.57 | 2.61 | .40 | 5.744E-02 | 5.865E-05 |
| LOWER 14 FEET | 5.5 | .35 | 1.5% | 1.57 | 2.61 | .40 | 5.744E-02 | 1.587E-05 |
| CODY SHALE RADON BARRIER | | | | | | | | |
| 90% PROCTOR | 0 | 0 | 16.9 | 1.59 | 2.78 | .44 | 6.950E-03 | 0 |
| 95% PROCTOR | 0 | 0 | 16.9 | 1.65 | 2.78 | .41 | 4.068E-03 | 0 |
| BORROW SOIL | 1.1 | 0.35 | 2.0 | 1.55 | 2.65 | 0.4 | 5.395E-02 | 3.133E-06 |

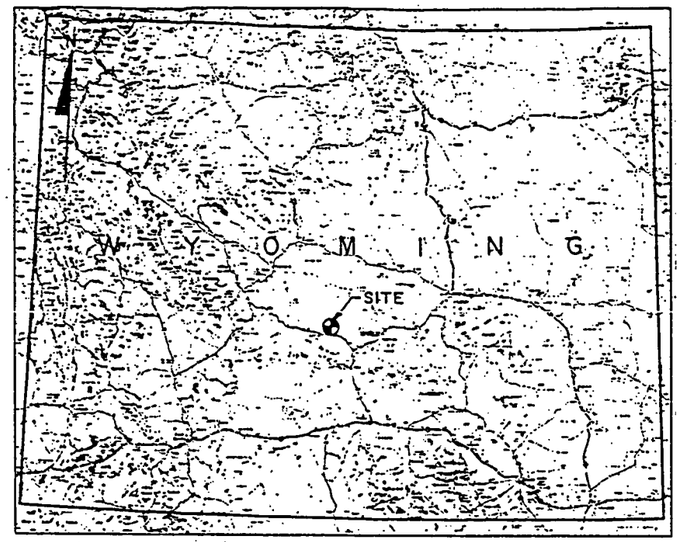
TABLE 5
SUMMARY OF FIELD TESTING AND INSPECTION FREQUENCIES

| Quality Control Activity | NRC Staff Technical Position Frequency[a] |
|---|---|
| **Cody Shale Radon Barrier Layer:** | |
| Laboratory Density (i.e. standard proctor) | One test per every 15 field density tests |
| One-point proctor tests | One test per every 5 field density tests |
| Field test for moisture/density | One test for each 500 cubic yards (cy) or a minimum of two tests for each day of Cody Shale placed in excess of 150 cy |
| Gradation tests | Minimum of one test each day of material in excess of 150 cy and one test per 1000 cy |
| Nuclear density gauge correlation | One sand cone test and one oven-dry test per every 10 nuclear density tests |
| **Riprap, Filter and Rock for Soil/Rock Matrix:** | |
| Gradation tests | One test prior to placement and one test for every 10,000 cy of each size of material placed with a minimum of 3 tests for each material size |
| Rock durability tests (specific gravity, absorption, soundness, L.A. Abrasion) | One test series prior to placement and one test series for every 10,000 cy of material from the rock source |

[a] The August 1990 NRC Staff Technical Position Paper is officially titled "Testing and Inspection Plans during Construction of DOE's Remedial Action at Inactive Uranium Mill Tailings Sites."

# FIGURES

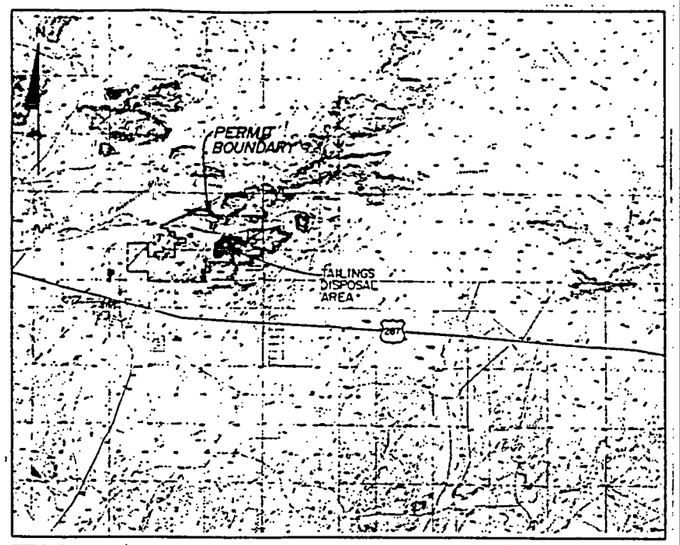
DRAWING NUMBER 91-225-E50




LOCATION MAP

SCALE
40 0 40 80 MILES

| INDEX OF DRAWINGS | | |
|---|---|---|
| FIGURE NO. | DRAWING NO. | TITLE |
| 1 of 10 | 91-225-E50 | TITLE SHEET |
| 2 of 10 | 91-225-E51 | 1989 SITE CONDITIONS |
| 3 of 10 | 91-225-E52 | TEST PITS, BORINGS, AND BORROW AREA LOCATIONS |
| 4 of 10 | 91-225-E53 | RECLAIMED URANIUM MILL AND TAILINGS DISPOSAL AREA |
| 5 of 10 | 91-225-E54 | LIMITS OF EROSION PROTECTION AND DIVERSION DITCH LOCATIONS FOR RECLAIMED URANIUM MILL AND TAILINGS DISPOSAL AREA |
| 6 of 10 | 91-225-E55 | DIVERSION DITCH AND TAILINGS SWALE CROSS SECTIONS AND JUNCTION DETAILS |
| 7 of 10 | 91-225-E56 | EXISTING AND REGRADED SITE CROSS SECTIONS |
| 8 of 10 | 91-225-E57 | DIVERSION DITCH PROFILES |
| 9 of 10 | 91-225-E58 | TYPICAL EROSION APRON DETAILS |
| 10 of 10 | 91-225-E59 | COVER PROFILES AND DETAILS |




REFERENCE:
USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLES OF STAMPEDE MEADOW, JEFFREY CITY, SPLIT ROCK NW, AND BLACK ROCK GAP, WYOMING.
DATED: 1951.

VICINITY MAP

SCALE
6000 0 6000 12000 FEET

# RECLAMATION PLAN DRAWINGS
# URANIUM MILL AND TAILINGS DISPOSAL AREA

JEFFREY CITY, WYOMING

PREPARED FOR

## WESTERN NUCLEAR, INC.

| No. | DATE | ISSUE / REVISION | DWN. BY | CK'D BY | AP'D BY |
|---|---|---|---|---|---|
| 2 | 10-25-93 | ISSUED FOR REVISION 3 | T.A.B. | J.B.C. | J.A.C. |
| 1 | 4-20-92 | ISSUED FOR USE AS RECLAMATION PLAN DRAWING | D.F.S. | P.E.C. | D.W.K. |

SMI REVISED DATE: OCTOBER, 1993

DATE: 4-10-92
SCALE: AS SHOWN

FIGURE 1

DRAWING NUMBER 91-225-E50 2

TITLE SHEET
PREPARED FOR
WESTERN NUCLEAR, INC.
CanonieEnvironmental

| DRAWN BY | M.B.H. | 2-14-89 |
|---|---|---|
| CHECKED BY | | |
| APPROVED BY | | |
| T.H.B. | Dirg | |
| 3-30-89 | 3-30-89 | |
| DRAWING NUMBER | 88-194-E12 | |

N

WINDBLOWN TAILINGS AREA (12.7 acres)

LOW-LEVEL ORE PAD (0.5 acres)

NORTHWEST WINDBLOWN TAILINGS AREA (22.9 acres)

NORTHEAST WINDBLOWN TAILINGS AREA (7.1 acres)

ACID PLANT COOLING POND AREA (7.3 acres)

WINDBLOWN TAILINGS AREA (62.6 acres)

DEMOLISHED MILL DEBRIS

ENHANCED EVAPORATION SYSTEM

EXISTING MISTER SYSTEM

BARGE WITH 2-75 HP PUMPS

EXISTING POND WATER ELEVATION 6374.4 FEET AS OF 2-10-89

NEW TAILINGS POND (127.2 acres)

MAIN OFFICE

GUARD HOUSE

RELAY STATION

ORE PAD (1.0 acres)

ACID PLANT (4.1 acres)

MILL AREA (EXISTING FOUNDATIONS AND CONCRETE SLABS) (8.8 acres)

OLD TAILINGS POND (128.9 acres)

EXISTING MISTER SYSTEM

NEW TAILINGS EMBANKMENT

OLD TAILINGS EMBANKMENT

ALTERNATE TAILINGS POND (23.8 acres)

SEWAGE LAGOON (13.2 acres)

LOW LEVEL RADIOACTIVE WASTE BURIAL TRENCH (7.7 acres)

PERMIT BOUNDARY

E 7,000 E 8,000 E 9,000 E 10,000 E 11,000 E 12,000 E 13,000 E 14,000 E 15,000

N 9,000 N 8,000 N 7,000 N 6,000 N 5,000 N 4,000

NOTE:

1. EXISTING TOPOGRAPHIC CONTOUR INTERVALS VARY AS SHOWN.

LEGEND:

APPROXIMATE EXTENT OF WINDBLOWN TAILINGS

EXTENT OF WINDBLOWN TAILINGS TO BE COVERED IN PLACE

EXISTING GROUND SURFACE CONTOUR ELEVATION ABOVE 6000 FEET

SCALE

300 0 300 600 FEET

REFERENCE:
TOPOGRAPHY DIGITIZED FROM MAP PROVIDED BY WESTERN NUCLEAR, INC. PREPARED BY INTRASEARCH. SCALE: 1"=200'. DATED: 4-16-87.

| No. | DATE | ISSUE NUMBER / REVISIONS | DRWN BY DATE | CK'D BY DATE | APP'D BY DATE |
|---|---|---|---|---|---|
| △ | 3-31-89 | ISSUED FOR USE AS CONSTRUCTION DRAWINGS | M.B.H. | | |

EXISTING SITE CONDITIONS

PREPARED FOR

WESTERN NUCLEAR, INC.

CanonieEnvironmental

| DATE: 2-14-89 | FIGURE 2 | DRAWING NUMBER 88-194-E12 | REV. 1 |
|---|---|---|---|
| SCALE: AS SHOWN | | | |

DRAWING NUMBER 91-225-E52

N

NORTHWEST VALLEY SOIL BORROW

NORTHWEST VALLEY

ROCK ARMOR/RIPRAP BORROW

NORTHEAST VALLEY SOIL BORROW

TAILING

OLD EMBANKMENT TEST PIT

NEW EMBANKMENT TEST PIT

SOUTHWEST VALLEY

SOUTH SOIL BORROW

PERMIT BOUNDARY

SOUTHWEST VALLEY SOIL BORROW

ARCHAEOLOGICAL SENSITIVE AREA

E 7,000 E 8,000 E 9,000 E 10,000 E 11,000 E 12,000 E 13,000

N 9,000 N 8,000 N 7,000 N 6,000 N 5,000 N 4,000

NOTE:
1. EXISTING TOPOGRAPHIC CONTOUR INTERVALS VARY AS SHOWN.

LEGEND:

- SMI-8 — 1993 SHEPHERD MILLER INC. BORING LOCATION AND DESIGNATION
- TP-11 — 1991 CANONIE TEST PIT LOCATION AND DESIGNATION
- SB-2 — 1991 CANONIE SOIL BORING LOCATION AND DESIGNATION
- MA-3,4 — 1991 CANONIE IN-SITU DENSITY TESTS FOR MILL AREA SOIL LOCATIONS
- 3-3 — 1987 WESTERN NUCLEAR, INC. INVESTIGATION APPROXIMATE TEST PIT LOCATIONS
- 20 — 1988 WATER, WASTE AND LAND, INC. INVESTIGATION APPROXIMATE TEST PIT LOCATIONS
- 7 — 1988 WATER, WASTE AND LAND, INC. INVESTIGATION APPROXIMATE BORING LOCATIONS
- C-2 — 1989 CANONIE APPROXIMATE SURFACE SAMPLE LOCATIONS.
- SS-1 — 1988 WATER, WASTE, AND LAND, INC. SURFACE SAMPLE LOCATIONS
- 7-5 — 1987 REM SAMPLE LOCATIONS
- SOIL BORROW AREA
- ROCK ARMOR/RIPRAP BORROW AREA

REFERENCE:
TOPOGRAPHY PREPARED BY INTRASEARCH DENVER, CO. FOR WESTERN NUCLEAR, INC.
DATED: 2-1-92
SCALE: 1"=200'
CONTOUR INTERVAL 2 FT.

SCALE
300 0 300 600 FEET

| No. | DATE | ISSUE / REVISION | DWN. BY | CK'D BY | AP'D BY |
|---|---|---|---|---|---|
| 3 | 10-25-93 | ISSUED FOR REVISION 5 | T.G.B. | J.B.C. | J.D.C. |
| 2 | 8-24-92 | ISSUED FOR REVISION 4 ADDENDUM | D.F.S. | J.W.S | D.W.K. |
| 1 | 4-20-92 | ISSUED FOR USE AS RECLAMATION PLAN DRAWING | S.C.C. | P.E.C. | D.W.K |

SMI REVISED DATE: OCTOBER, 1993

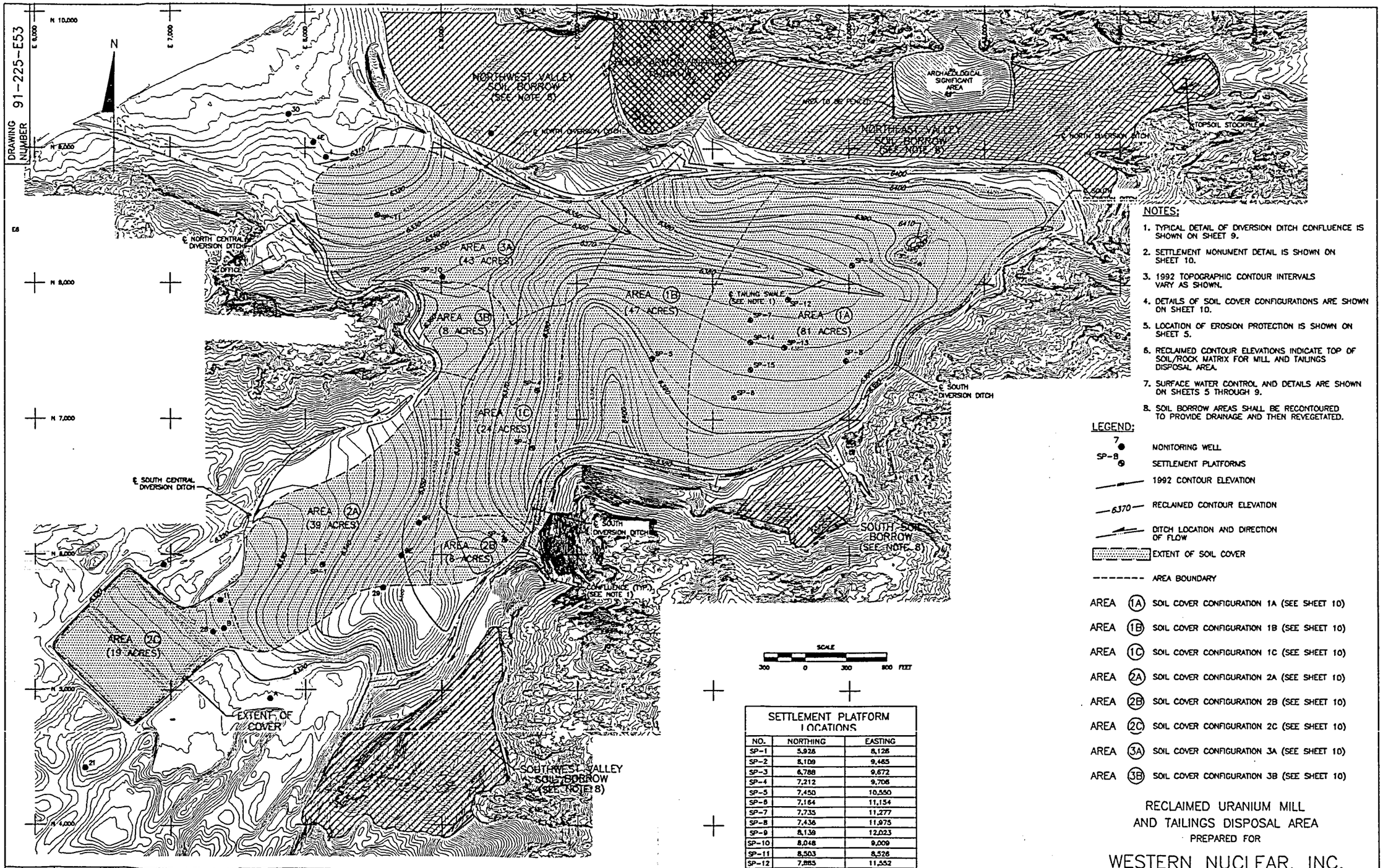
DATE: 3-18-92
SCALE: AS SHOWN

FIGURE 3

DRAWING NUMBER 91-225-E52 3

TEST PITS, BORINGS, AND BORROW AREA LOCATIONS
PREPARED FOR
WESTERN NUCLEAR, INC.
CanonieEnvironmental

DRAWING NUMBER 91-225-E53




NOTES:

1. TYPICAL DETAIL OF DIVERSION DITCH CONFLUENCE IS SHOWN ON SHEET 9.
2. SETTLEMENT MONUMENT DETAIL IS SHOWN ON SHEET 10.
3. 1992 TOPOGRAPHIC CONTOUR INTERVALS VARY AS SHOWN.
4. DETAILS OF SOIL COVER CONFIGURATIONS ARE SHOWN ON SHEET 10.
5. LOCATION OF EROSION PROTECTION IS SHOWN ON SHEET 5.
6. RECLAIMED CONTOUR ELEVATIONS INDICATE TOP OF SOIL/ROCK MATRIX FOR MILL AND TAILINGS DISPOSAL AREA.
7. SURFACE WATER CONTROL AND DETAILS ARE SHOWN ON SHEETS 5 THROUGH 9.
8. SOIL BORROW AREAS SHALL BE RECONTOURED TO PROVIDE DRAINAGE AND THEN REVEGETATED.

LEGEND:

- 7 ● MONITORING WELL
- SP-8 ⊕ SETTLEMENT PLATFORMS
- 1992 CONTOUR ELEVATION
- 6370 RECLAIMED CONTOUR ELEVATION
- DITCH LOCATION AND DIRECTION OF FLOW
- EXTENT OF SOIL COVER
- AREA BOUNDARY
- AREA (1A) SOIL COVER CONFIGURATION 1A (SEE SHEET 10)
- AREA (1B) SOIL COVER CONFIGURATION 1B (SEE SHEET 10)
- AREA (1C) SOIL COVER CONFIGURATION 1C (SEE SHEET 10)
- AREA (2A) SOIL COVER CONFIGURATION 2A (SEE SHEET 10)
- AREA (2B) SOIL COVER CONFIGURATION 2B (SEE SHEET 10)
- AREA (2C) SOIL COVER CONFIGURATION 2C (SEE SHEET 10)
- AREA (3A) SOIL COVER CONFIGURATION 3A (SEE SHEET 10)
- AREA (3B) SOIL COVER CONFIGURATION 3B (SEE SHEET 10)

SCALE
300 0 300 800 FEET

SETTLEMENT PLATFORM LOCATIONS

| NO. | NORTHING | EASTING |
|---|---|---|
| SP-1 | 5,926 | 8,126 |
| SP-2 | 8,109 | 9,465 |
| SP-3 | 6,788 | 9,672 |
| SP-4 | 7,212 | 9,706 |
| SP-5 | 7,450 | 10,550 |
| SP-6 | 7,164 | 11,154 |
| SP-7 | 7,735 | 11,277 |
| SP-8 | 7,436 | 11,975 |
| SP-9 | 8,139 | 12,023 |
| SP-10 | 8,048 | 9,009 |
| SP-11 | 8,503 | 8,526 |
| SP-12 | 7,885 | 11,552 |
| SP-13 | 7,533 | 11,524 |
| SP-14 | 7,571 | 11,276 |
| SP-15 | 7,368 | 11,276 |

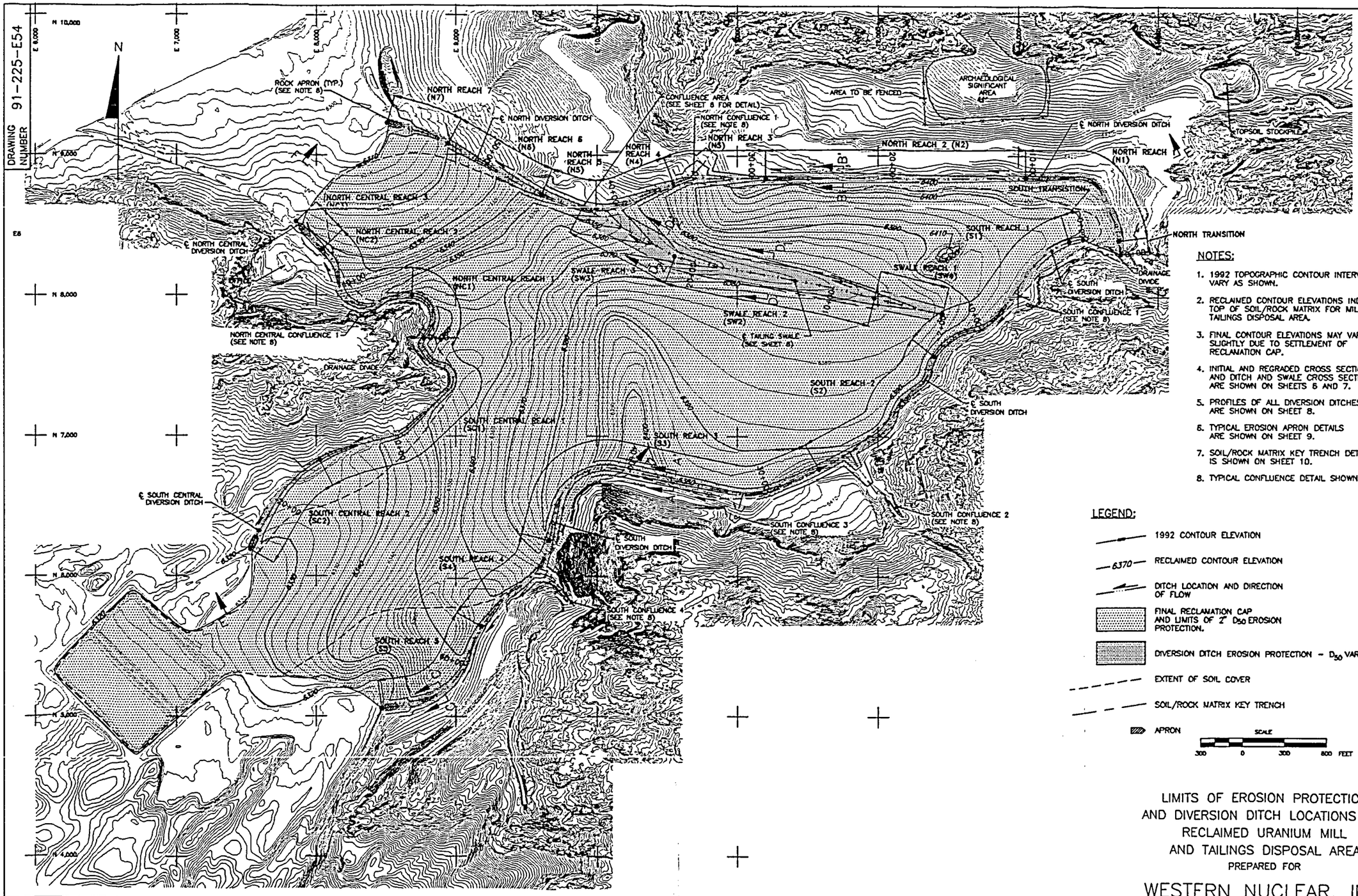
| No. | DATE | ISSUE / REVISION | DWN. BY | CK'D BY | APP'D BY |
|---|---|---|---|---|---|
| 3 | 10-25-93 | ISSUED FOR REVISION 5 | T.B.B. | J.E.C. | J.D.C. |
| 2 | 8-24-92 | ISSUED FOR REVISION 4 ADDENDUM | M.T.H. | J.W.S. | D.W.K. |
| 1 | 4-20-92 | ISSUED FOR USE AS RECLAMATION PLAN DRAWING | R.A.L. | P.E.C. | D.W.K. |

REFERENCE:
TOPOGRAPHY PREPARED BY INTRASEARCH DENVER, CO. FOR WESTERN NUCLEAR, INC.
DATED: 2-1-92
SCALE: 1"=200'
CONTOUR INTERVAL 2 FT.

RECLAIMED URANIUM MILL
AND TAILINGS DISPOSAL AREA
PREPARED FOR
WESTERN NUCLEAR, INC.
CanonieEnvironmental

SMI REVISED DATE: OCTOBER, 1993 | DATE: 3-5-92 | SCALE: AS SHOWN | FIGURE 4 | DRAWING NUMBER 91-225-E53 | 3

DRAWING NUMBER 91-225-E54




NOTES:

1. 1992 TOPOGRAPHIC CONTOUR INTERVALS VARY AS SHOWN.
2. RECLAIMED CONTOUR ELEVATIONS INDICATE TOP OF SOIL/ROCK MATRIX FOR MILL AND TAILINGS DISPOSAL AREA.
3. FINAL CONTOUR ELEVATIONS MAY VARY SLIGHTLY DUE TO SETTLEMENT OF RECLAMATION CAP.
4. INITIAL AND REGRADED CROSS SECTIONS AND DITCH AND SWALE CROSS SECTIONS ARE SHOWN ON SHEETS 6 AND 7.
5. PROFILES OF ALL DIVERSION DITCHES ARE SHOWN ON SHEET 8.
6. TYPICAL EROSION APRON DETAILS ARE SHOWN ON SHEET 9.
7. SOIL/ROCK MATRIX KEY TRENCH DETAIL IS SHOWN ON SHEET 10.
8. TYPICAL CONFLUENCE DETAIL SHOWN ON SHEET 9.

LEGEND:

- 1992 CONTOUR ELEVATION
- 6370 RECLAIMED CONTOUR ELEVATION
- DITCH LOCATION AND DIRECTION OF FLOW
- FINAL RECLAMATION CAP AND LIMITS OF 2" $D_{50}$ EROSION PROTECTION.
- DIVERSION DITCH EROSION PROTECTION - $D_{50}$ VARIES
- EXTENT OF SOIL COVER
- SOIL/ROCK MATRIX KEY TRENCH
- APRON

SCALE: 300 0 300 600 FEET

| No. | DATE | ISSUE / REVISION | DWN. BY | CK'D BY | APP'D BY |
|---|---|---|---|---|---|
| 3 | 10-25-93 | ISSUED FOR REVISION 5 | T.G.B. | J.E.C. | J.E.C. |
| 2 | 8-24-92 | ISSUED FOR REVISION 4 ADDENDUM | N.T.H. | J.W.S. | D.W.K. |
| 1 | 4-20-92 | ISSUED FOR USE AS RECLAMATION PLAN DRAWING | D.F.S. | P.E.C. | D.W.K. |

REFERENCE:
TOPOGRAPHY PREPARED BY INTRASEARCH DENVER, CO. FOR WESTERN NUCLEAR, INC.
DATED: 2-1-92
SCALE: 1" = 200'
CONTOUR INTERVAL 2 FT.

# LIMITS OF EROSION PROTECTION AND DIVERSION DITCH LOCATIONS FOR RECLAIMED URANIUM MILL AND TAILINGS DISPOSAL AREA

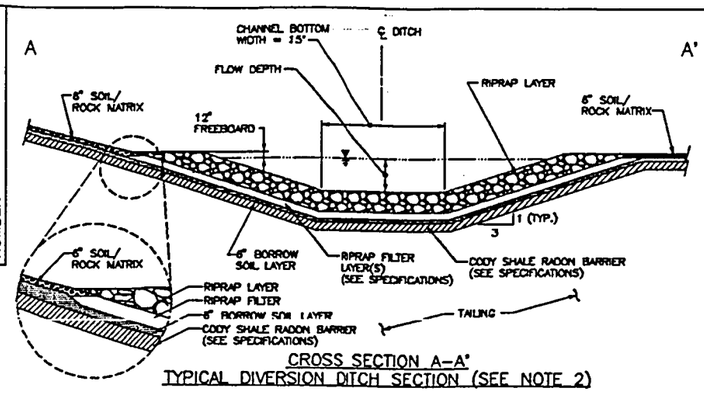
PREPARED FOR

WESTERN NUCLEAR, INC.

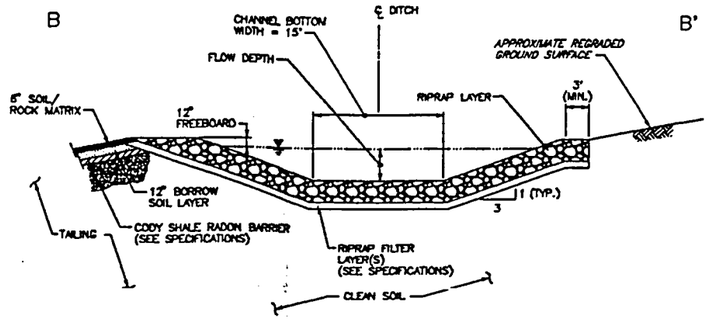
Canonie Environmental

| | | | |
|---|---|---|---|
| SMI REVISED DATE: OCTOBER, 1993 | DATE: 3-18-92 | FIGURE 5 | DRAWING NUMBER 91-225-E54 3 |
| | SCALE: AS SHOWN | | |

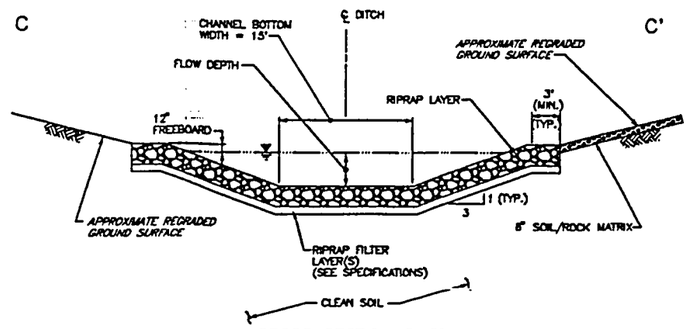
DRAWING NUMBER 91-225-E55



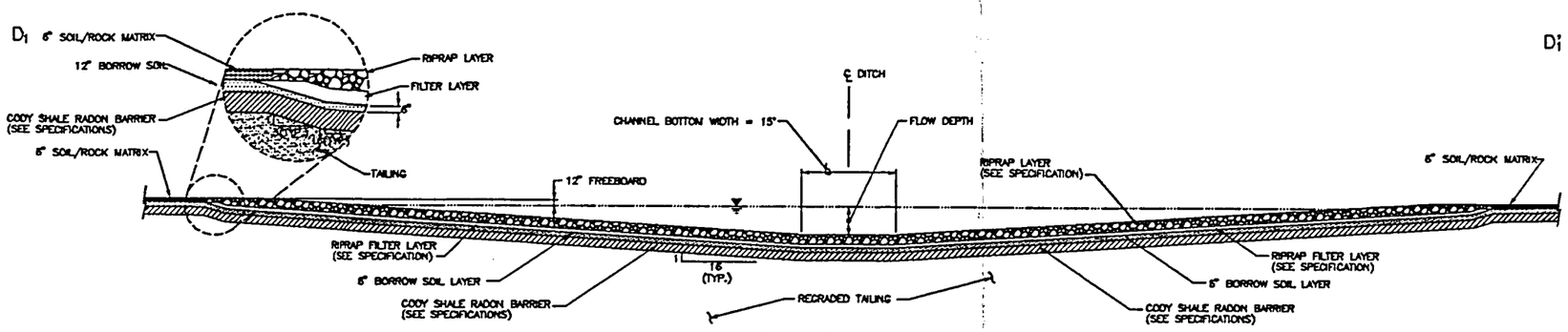

CROSS SECTION A-A'
TYPICAL DIVERSION DITCH SECTION (SEE NOTE 2)



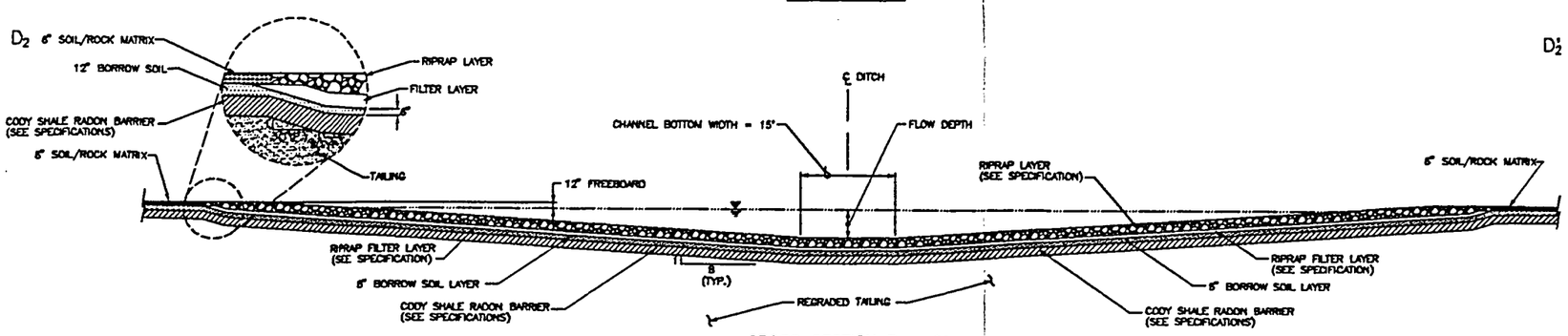

CROSS SECTION B-B'
TYPICAL DIVERSION DITCH SECTION (SEE NOTE 3)



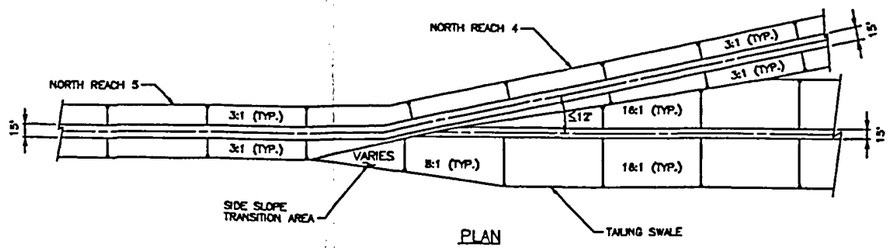

CROSS SECTION C-C'
TYPICAL DIVERSION DITCH SECTION (SEE NOTE 4)




CROSS SECTION $D_1$ – $D_1'$
TAILING SWALE




CROSS SECTION $D_2$ – $D_2'$
TAILING SWALE




PLAN
TAILING SWALE AND
NORTH DIVERSION DITCH JUNCTION

NOTES:

1. PLAN LOCATIONS OF CROSS SECTIONS AND LOCATIONS OF DITCHES AND REACHES ARE SHOWN ON SHEET 5.
2. TYPICAL OF NORTH CENTRAL 1, FIRST FEW HUNDRED FEET OF SOUTH CENTRAL 1, SOUTH 1, 2, AND 3.
3. TYPICAL OF NORTH CENTRAL 2 AND 3, AND ALL NORTH REACHES.
4. TYPICAL OF LAST SEVERAL HUNDRED FEET OF SOUTH CENTRAL 1, SOUTH CENTRAL 2, SOUTH 4, AND SOUTH 5 (i.e. BEYOND EXTENT OF TAILING IMPOUNDMENT).
5. DITCH SECTION DIMENSIONS AND RIPRAP AND FILTER GRADATIONS ARE GIVEN IN THE SPECIFICATIONS.
6. DITCH PROFILES ARE SHOWN ON SHEET 8.
7. THIS DRAWING IS NOT TO SCALE.

| No. | DATE | ISSUE / REVISION | DWN. BY | CK'D BY | AP'D BY |
|---|---|---|---|---|---|
| A | 10-25-93 | ISSUED FOR REVISION 9 | T.B.B. | J.B.C. | J.B.C. |
| A | 9-24-92 | ISSUED FOR USE AS RECLAMATION PLAN DRAWING | R.A.L. | J.W.S. | D.W.K. |

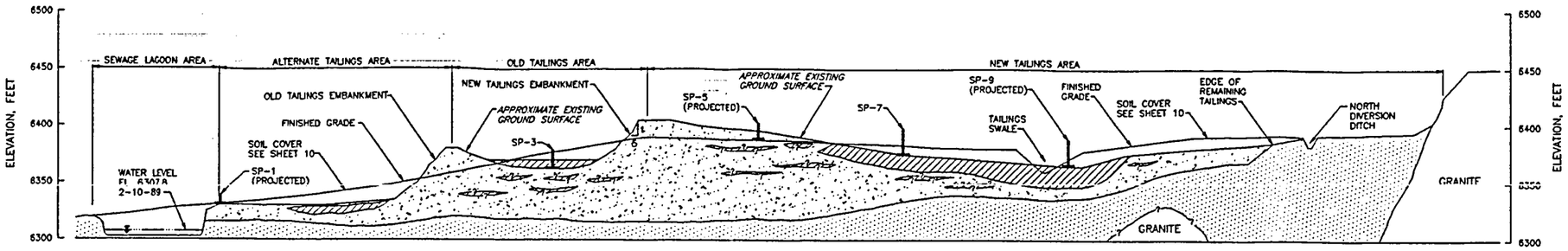
DIVERSION DITCH AND TAILINGS SWALE
CROSS SECTION AND JUNCTION DETAILS
PREPARED FOR
WESTERN NUCLEAR, INC.
Canonie Environmental

SMI REVISED DATE: OCTOBER, 1993

| DATE: | 3-16-92 | FIGURE 6 | DRAWING NUMBER 91-225-E55 | A |
|---|---|---|---|---|
| SCALE: | AS SHOWN | | | |

DRAWING NUMBER 91-225-E56

E

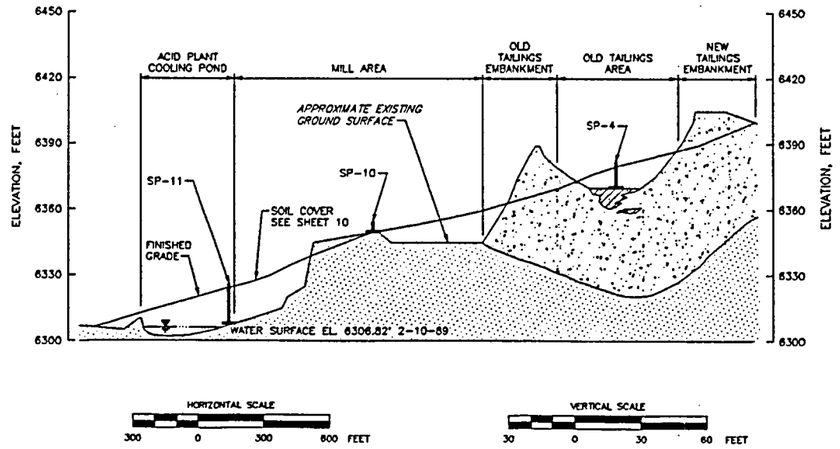



VERTICAL EXAGGERATION = 6X

CROSS SECTION E-E'

F

F'




VERTICAL EXAGGERATION = 10X

CROSS SECTION F-F'

NOTES:

1. CROSS SECTION LOCATIONS SHOWN ON SHEET 5.
2. FINISHED GRADE REPRESENTS TOP OF EROSION PROTECTION ELEVATION (1992 DESIGN).
3. SETTLEMENT PLATFORMS WITHIN 200 FEET OF SECTION ARE SHOWN.

LEGEND

- COARSE TAILINGS
- INTERBEDDED SLIMES, APPROXIMATE LOCATION
- NATURAL SAND
- SP-4 — SETTLEMENT PLATFORM LOCATION AND DESIGNATION

| No. | DATE | ISSUE / REVISION | S.C.G. DWN. BY | P.E.C. CK'D BY | D.W.K. AP'D BY |
|---|---|---|---|---|---|
| 1 | 4-20-92 | ISSUED FOR USE AS RECLAMATION PLAN DRAWING | | | |

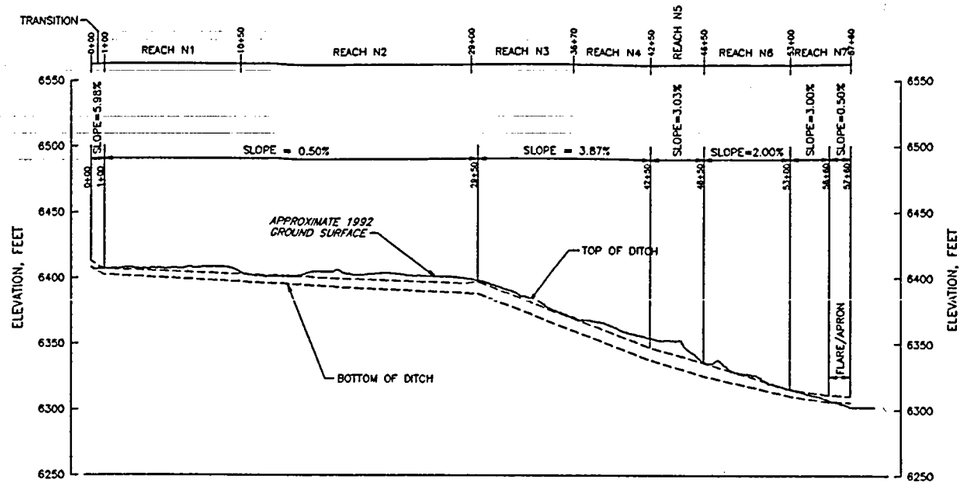
EXISTING AND REGRADED
SITE CROSS SECTIONS
PREPARED FOR

WESTERN NUCLEAR, INC.

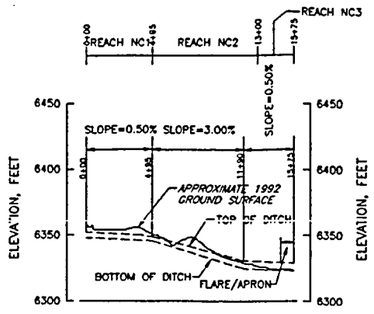
CanonieEnvironmental

| | | | |
|---|---|---|---|
| DATE: 3-17-92 | FIGURE 7 | DRAWING NUMBER 91-225-E56 | 1 |
| SCALE: AS SHOWN | | | |

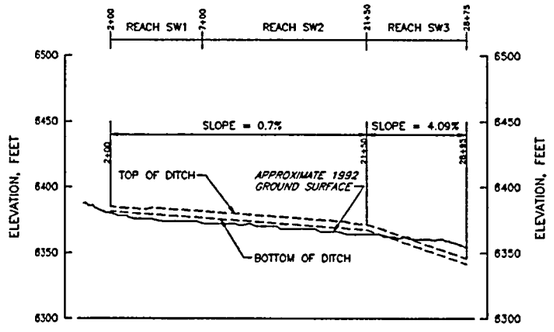
DRAWING NUMBER 91-225-E57



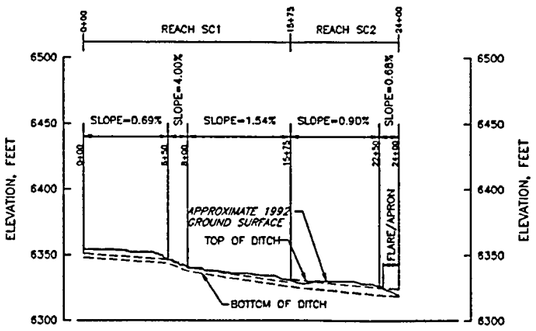

NORTH DIVERSION DITCH PROFILE
(LOOKING SOUTH)



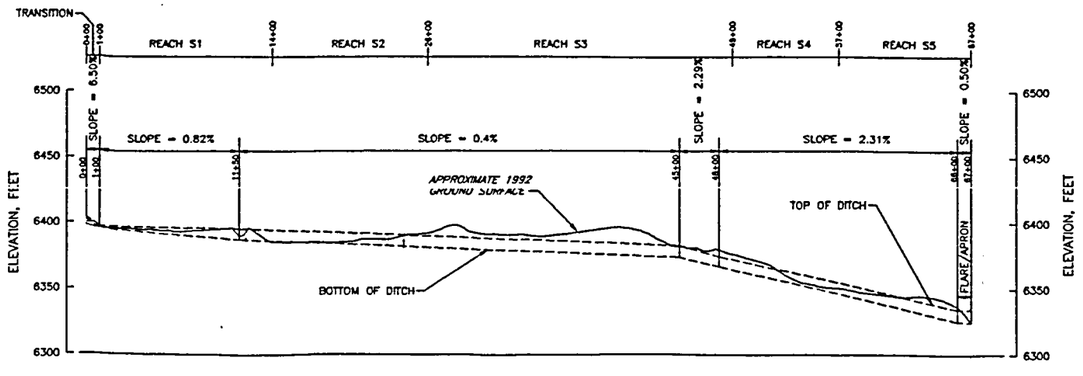

NORTH CENTRAL DIVERSION DITCH PROFILE
(LOOKING SOUTHWEST)




TAILING SWALE PROFILE
(LOOKING SOUTHWEST)




SOUTH CENTRAL DIVERSION DITCH PROFILE
(LOOKING SOUTHEAST)




SOUTH DIVERSION DITCH PROFILE
(LOOKING SOUTHEAST)

NOTE:

1. SEE SHEET 5 FOR DIVERSION DITCH LOCATIONS.

VERTICAL SCALE
50 0 50 100 FEET

HORIZONTAL SCALE
500 0 500 1000 FEET

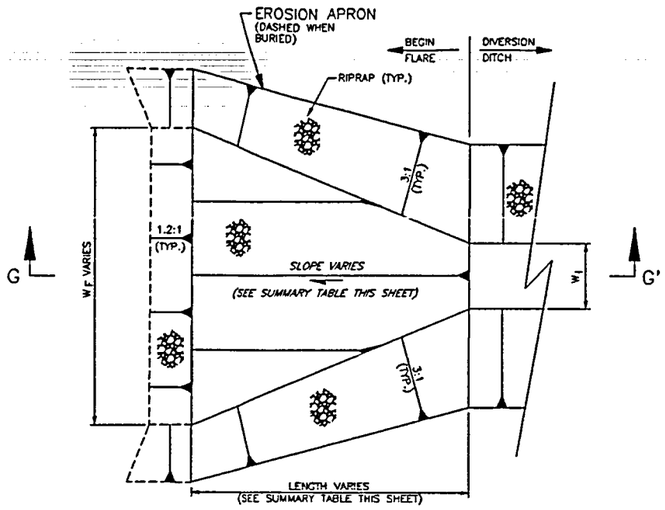
VERTICAL EXAGGERATION = 10x

| No. | DATE | ISSUE / REVISION | DWN. BY | CK'D BY | AP'D BY |
|---|---|---|---|---|---|
| 3 | 10-25-93 | ISSUED FOR REVISION 5 | T.C.B. | J.G.C. | J.G.C. |
| 2 | 8-24-92 | ISSUED FOR USE AS RECLAMATION PLAN DRAWING | B.K.R. | J.W.S. | D.W.K. |

DIVERSION DITCH PROFILES
PREPARED FOR
WESTERN NUCLEAR, INC
CanonieEnvironmental

SMI SHEPHERD MILLER, INC. REVISED DATE: OCTOBER, 1993 | DATE: 3-18-92 | SCALE: N.T.S. | FIGURE 8 | DRAWING NUMBER 91-225-E57 | 3

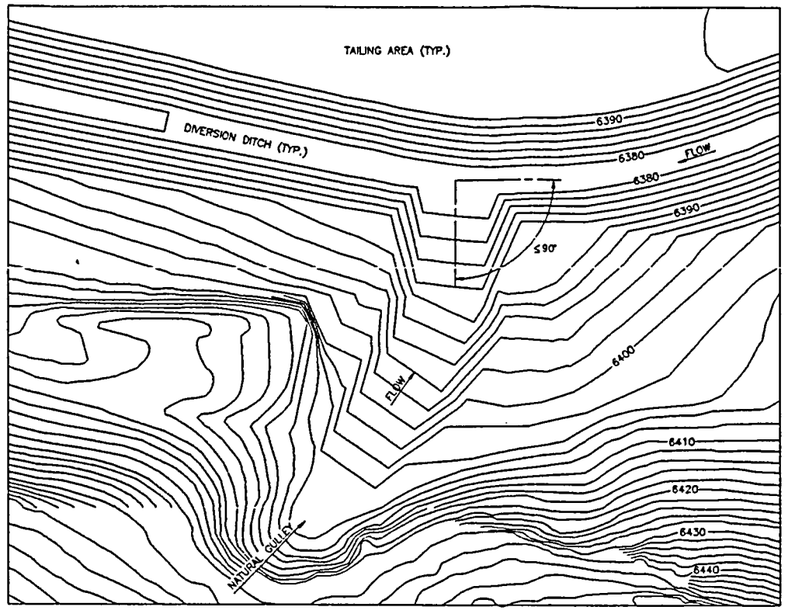
DRAWING NUMBER 91-225-E58




PLAN

RIPRAPPED EROSION APRON (TYP.)

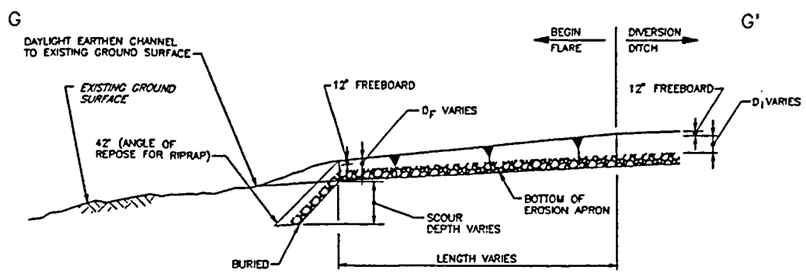
NOT TO SCALE




PLAN

CONFLUENCE DETAIL (TYP.)

NOT TO SCALE




SIDE VIEW

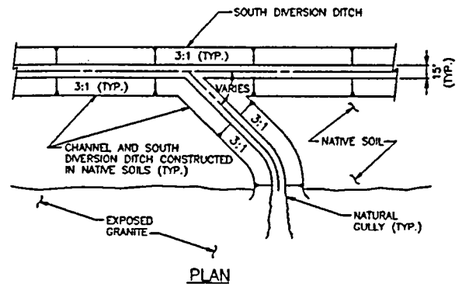
SECTION G-G'

NOT TO SCALE

| SUMMARY TABLE OF APRON CHARACTERISTICS | | | | | | | |
|---|---|---|---|---|---|---|---|
| CHANNEL REACH | CHANNEL AND APRON SLOPE (ft/ft) | BOTTOM WIDTH (ft) | | FLOW DEPTH (ft) | | LENGTH (ft) | SCOUR DEPTH (ft) |
| | | INITIAL | FINAL | INITIAL | FINAL | | |
| NORTH DIVERSION DITCH OUTLET | 0.0050 | 15 | 90 | 7.50 | 3.06 | 100 | 13.1 |
| SOUTH DIVERSION DITCH OUTLET | 0.0050 | 15 | 90 | 7.70 | 2.37 | 100 | 12.6 |
| SOUTH CENTRAL DIVERSION DITCH OUTLET | 0.0068 | 15 | 50 | 5.08 | 2.09 | 50 | 7.0 |
| NORTH CENTRAL DIVERSION DITCH OUTLET | 0.0050 | 15 | 50 | 3.86 | 1.47 | 50 | 5.4 |

NOTES:

1. DETAILS ARE TYPICAL OF EROSION APRONS AT THE TERMINATION OF EACH DIVERSION DITCH (4 TOTAL).
2. PLAN LOCATION OF EACH APRON SHOWN ON SHEET 5.
3. THIS DRAWING IS NOT TO SCALE.




PLAN

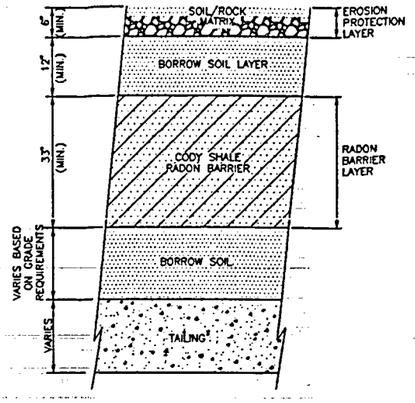
MODIFIED CONFLUENCE
SOUTH DIVERSION DITCH (TYP.)

| No. | DATE | ISSUE / REVISION | DWN. BY | CK'D BY | AP'D BY |
|---|---|---|---|---|---|
| 3 | 10-25-93 | ISSUED FOR REVISION 3 | T.G.B. | J.G.C. | J.G.C. |
| 2 | 8-24-92 | ISSUED FOR REVISION 4 ADDENDUM | S.C.G. | J.W.S. | D.W.K. |
| 1 | 4-20-92 | ISSUED FOR USE AS RECLAMATION PLAN DRAWING | B.K.R. | P.E.C. | D.W.K. |

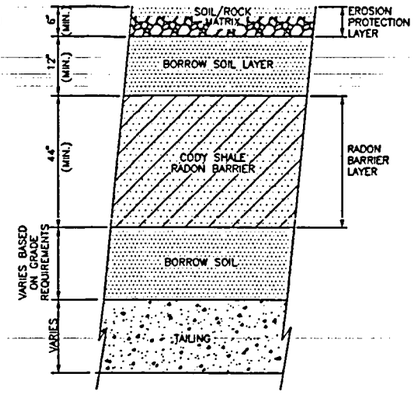
TYPICAL EROSION APRON DETAILS
PREPARED FOR
WESTERN NUCLEAR, INC.
CanonieEnvironmental

SMI REVISED DATE: OCTOBER, 1993 | DATE: 3-17-92 | SCALE: N.T.S. | FIGURE 9 | DRAWING NUMBER 91-225-E58 | 3

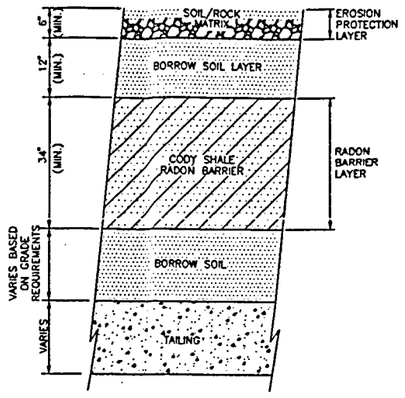
DRAWING NUMBER 91-225-E59



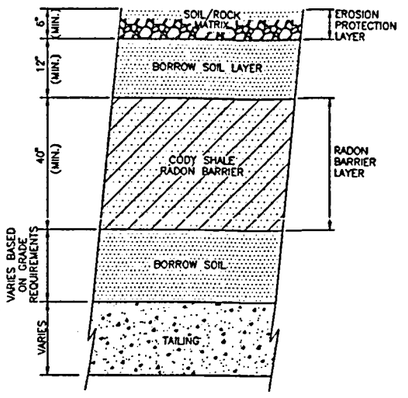

AREA 1A
FINAL SOIL LAYER PROFILE
EAST NEW TAILING



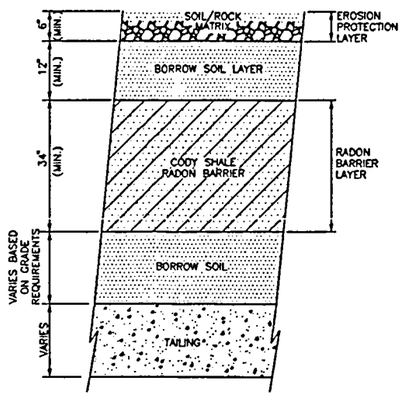

AREA 1B
FINAL SOIL LAYER PROFILE
WEST NEW TAILING



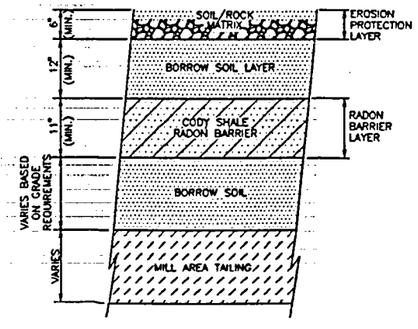

AREA 1C
FINAL SOIL LAYER PROFILE
OLD TAILING



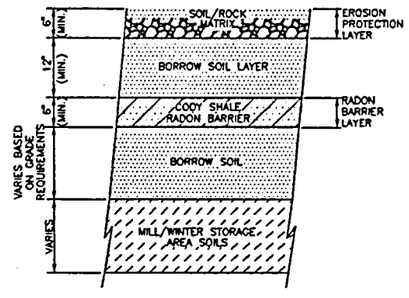

AREA 2A
FINAL SOIL LAYER PROFILE
ALTERNATE TAILING



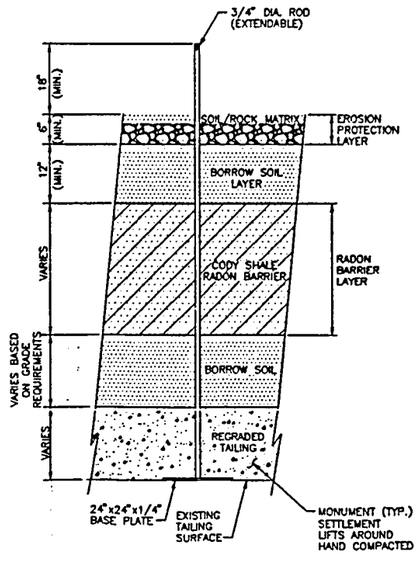

AREA 2B
FINAL SOIL LAYER PROFILE
OLD TAILING



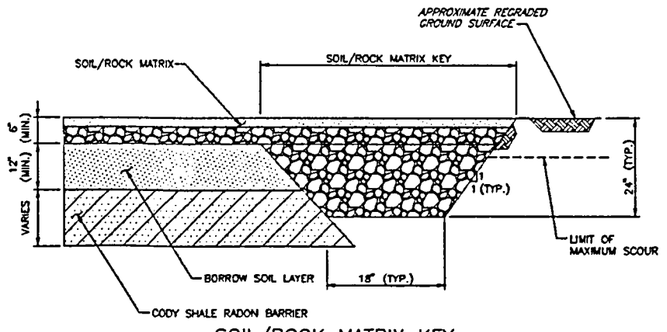

AREA 3A
FINAL SOIL LAYER PROFILE
MILL AREA TAILING




AREA 3B AND 2C
FINAL SOIL LAYER PROFILE
MILL/WINTER STORAGE POND AREA SOILS




SETTLEMENT MONUMENT (TYP.)
(SEE NOTE 2)




SOIL/ROCK MATRIX KEY

NOTES:

1. PLAN LOCATION OF SOIL LAYER CONFIGURATIONS IS SHOWN ON SHEET 4.
2. PLAN LOCATION OF SETTLEMENT MONUMENTS IS SHOWN ON SHEET 4.
3. THIS DRAWING IS NOT TO SCALE.

| No. | DATE | ISSUE / REVISION | DWN. BY | CK'D BY | AP'D BY |
|---|---|---|---|---|---|
| 2 | 10-25-93 | ISSUED FOR REVISION 5 | T.G.B. | J.G.C. | J.G.C. |
| 1 | 8-24-92 | ISSUED FOR USE AS RECLAMATION PLAN DRAWING | S.C.G. | J.W.S. | D.W.K. |

COVER PROFILES AND DETAILS
PREPARED FOR
WESTERN NUCLEAR, INC.
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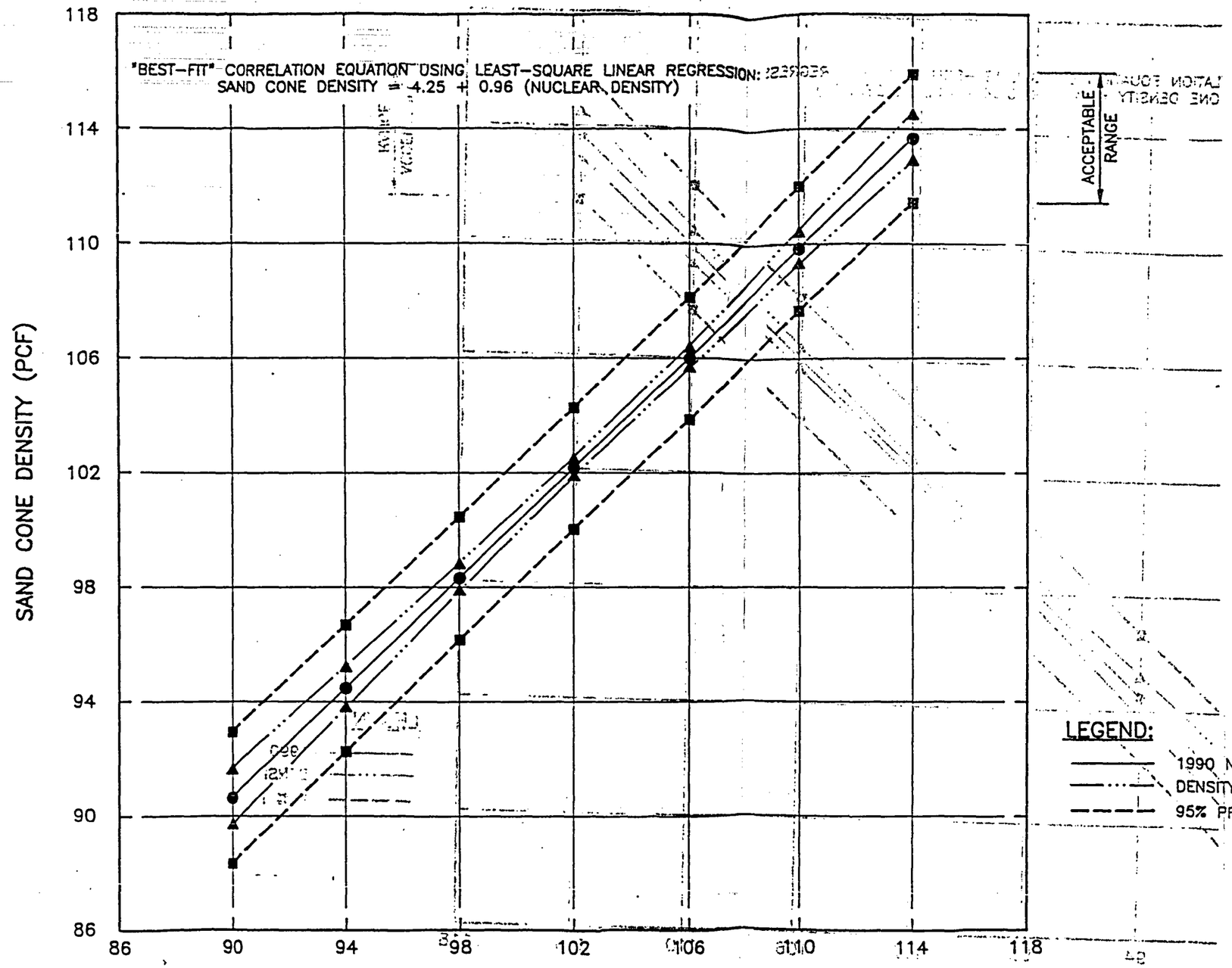
SMI REVISED DATE: OCTOBER, 1993 | DATE: 3-17-92 | SCALE: N.T.S. | FIGURE 10 | DRAWING NUMBER 91-225-E59 | 2

DRAWING NUMBER 91-225-B61

"BEST-FIT" CORRELATION EQUATION USING LEAST-SQUARE LINEAR REGRESSION:
SAND CONE DENSITY = -4.25 + 0.96 (NUCLEAR DENSITY)




| No. | DATE | ISSUE / REVISION | DWN. BY | CK'D BY | APP'D BY |
|---|---|---|---|---|---|
| 1 | 4-15-92 | ISSUED FOR TECHNICAL SPECIFICATIONS | B.K.R. | PEC | DWK |

LINEAR REGRESSION OF
NUCLEAR GAUGE/SAND CONE DENSITY

PREPARED FOR
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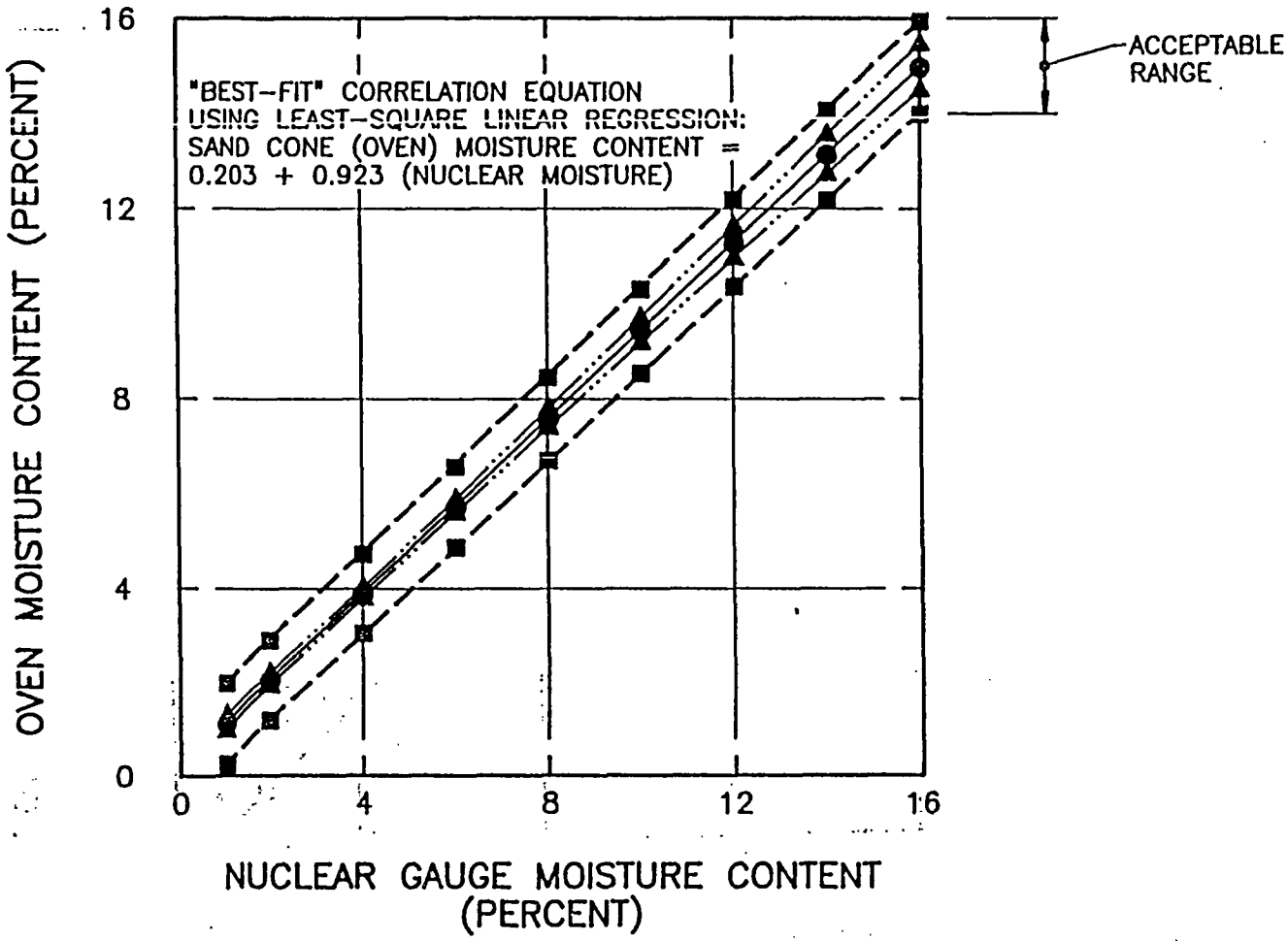
| DATE: 3-27-92 | FIGURE 11 | DRAWING NUMBER 91-225-B61 |
|---|---|---|
| SCALE: AS SHOWN | | |

1

DRAWING NUMBER 91-225-A62




**LEGEND:**

——— 1990 NUCLEAR GAUGE AND SAND CONE MOISTURE CONTENT DATA

——·—— MOISTURE CONTENT DATA 95% CONFIDENCE BOUNDS

— — — — 95% PREDICTION INTERVAL

LINEAR REGRESSION OF NUCLEAR GAUGE/OVEN DRY MOISTURE CONTENT

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| No. | DATE | ISSUE / REVISION | DWN. BY | CK'D BY | AP'D BY |
|---|---|---|---|---|---|
| 1 | 4-15-92 | ISSUED FOR TECHNICAL SPECIFICATIONS | B.K.R. | PEL | DWK |

| DATE: 3-27-92 | FIGURE 12 | DRAWING NUMBER 91-225-A62 |
|---|---|---|
| SCALE: AS SHOWN | | |

1