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MATERIALS CHARACTERIZATION REPORT
SAINT ANTHONY MINE SITE

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TABLE OF CONTENTS

Section No. **Page No.**

1.0 INTRODUCTION 1-1
1.1 BACKGROUND 1-1
1.2 PURPOSE 1-1
1.3 PHYSICAL SETTING 1-1
1.3.1 Site Description 1-1
1.3.2 Physiography and Climate 1-2
1.3.3 Geology 1-2

2.0 FIELD INVESTIGATION METHODS 2-1
2.1 INTRODUCTION 2-1
2.2 GAMMA EXPOSURE RATE SURVEY 2-2
2.3 SOIL SAMPLING 2-2
2.4 ANALYTICAL PROGRAM 2-3

3.0 GAMMA EXPOSURE RATE SURVEY RESULTS 3-1
3.1 INTRODUCTION AND SUMMARY STATISTICS 3-1
3.2 BACKGROUND, BORROW AND FORMER BORROW AREAS 3-1
3.3 TOPSOIL AND OVERBURDEN STOCKPILES 3-2
3.4 NON-ECONOMIC MATERIALS STORAGE PILES 3-2
3.5 WESTERN SHAFT AREA 3-3

4.0 SOIL SAMPLING AND CHEMICAL ANALYTICAL RESULTS 4-1
4.1 SOIL DESCRIPTIONS 4-1
4.2 SOIL RADIONUCLIDE ANALYTICAL RESULTS 4-2
4.2.1 Summary of Results 4-2
4.2.2 Background and Borrow Areas 4-2
4.2.3 Topsoil and Overburden Stockpiles 4-3
4.2.4 Non-Economic Materials Storage Piles 4-3
4.2.5 Shaft Area 4-4
4.3 SOIL LEACHATE ANALYITICAL RESULTS 4-4
4.4 SOILS AGRONOMIC ANALYTICAL RESULTS 4-5
4.4.1 Arsenic 4-5
4.4.2 Copper 4-5
4.4.3 Radium-226 4-6
4.4.4 Selenium 4-6
4.4.5 Thorium-230 4-6
4.4.6 Uranium 4-6
4.4.7 Sulfate 4-7
4.4.8 Soluble Salts, SAR and pH 4-7
4.4.9 Other Constituents 4-7
4.4.10 Summary of Agronomic Results 4-8

5.0 SUMMARY AND CONCLUSIONS 5-1

6.0 REFERENCES 6-1

LIST OF TABLES

Table No.	Description
1	Summary of Soil Sampling Program
2	Soil Analytical Program
3	Surface Gamma Radiation Survey Results
4	Descriptive Statistics, Gamma Measurements
5	Soil Analytical Results, Radionuclides
6	Descriptive Statistics, Soil Radionuclide Analytical Results
7	Soil Analytical Results, Synthetic Precipitation Leaching Procedure
8	Soil Analytical Results, Agronomic Analyses

LIST OF FIGURES

Figure No.	Description
1	Site Location
2	Site Layout
3	Results of Field Gamma Radiation Survey
4	Frequency of Gamma Measurements
5	Soil Analytical Results
6	Frequency of Radium-226 Concentrations
7	Frequency of Uranium Concentrations

LIST OF APPENDICES

Appendix No.	Description
A	Radiation Survey Field Forms
B	Laboratory Analytical Data and Data Validation Results
C	Field Notes, Test Pit Logs, and Boring Logs

1.0 INTRODUCTION

1.1 BACKGROUND

This Materials Characterization Report describes the objectives, scope of work, and results of the Materials Characterization conducted at the St. Anthony Mine (the Site), and nearby areas between April 2006 and July 2007. The Materials Characterization consisted of investigating surface and subsurface materials at various areas within and near the Site in accordance with the approved *Materials Characterization Work Plan* (MWH, 2007).

The St. Anthony Mine was an open pit and underground shaft uranium mine located on the Cebolleta Land Grant approximately 40 miles West of Albuquerque, New Mexico in Cibola County approximately 4.6 miles southeast of Seboyeta, New Mexico. The mine site is located in a very remote, sparsely populated area. The location of the Site is shown on Figure 1, *General Location Map*. UNC operated the St. Anthony Mine from 1975 to 1981, pursuant to a mineral lease with the Cebolleta Land Grant, the owner of the surface and mineral rights at the time. The original lease covered approximately 2,560 acres. This lease was obtained on February 10th, 1964 and was surrendered by a Release of Mineral Lease dated October 24, 1988. UNC has access to the Site through access agreements with the Cebolleta Land Grant and an adjacent landowner.

1.2 PURPOSE

The *Materials Characterization Work Plan* (MWH, 2007) was prepared in conjunction with the *St. Anthony Mine Closeout Plan* (MWH, 2006) submitted to the New Mexico Mining and Minerals Division (MMD) January 6, 2006. The purpose of the Materials Characterization was to determine soil suitability as a growth media and radiological risk. Modifications to the Closeout Plan may be made based on the actions required to mitigate any risks identified from data collected during the Materials Characterization. The Materials Characterization included a radiological survey of non-economic materials at the Site, drilling and sampling of non-economic materials and sampling of potential cover material borrow sources.

1.3 PHYSICAL SETTING

1.3.1 Site Description

The Site includes underground workings consisting of one shaft and one vent shaft that are sealed at the surface, two open pits (one containing a pond), five inactive ponds, seven piles of non-economical mine materials with some revegetation, numerous smaller piles of non-economical mine materials, and three topsoil piles. The underground mine workings have been sealed at the surface and no shafts or vents for the underground mines were located during the investigation activities. The layout of the Site is shown on Figure 2, *Site Layout*. The two open pits at the mine site are located in Sections 19 and 30, Township 11 North, Range 4 West, and the entrance to the underground mine is located in Section 24, Township 11 North, Range 5 West. The actively mined area encompasses approximately 430 acres and includes roads and other disturbed areas along with the open pits and non-economical mine materials piles.

The two open pits include a large pit on the west side of the Site that perennially contains standing water and a smaller pit southeast of the large pit, that intermittently contains pooled water. These pits have been identified in other documents (including the Stage 1 Abatement Plan [MWH, 2002]) as Pit #1 and Pit #2, respectively). There are several large overburden piles on the eastern portion of the Site, located next to Meyer Draw. Meyer Draw is an ephemeral drainage that runs only during and shortly after storms large enough to produce run-off. From the north boundary of the Site, the arroyo passes between the open pits and several large overburden piles in a southeasterly direction and is joined by Arroyo de Pedro Padilla from the northeast before leaving the Site and entering the Laguna Pueblo, which is directly south of the Site.

The Site remains in the condition it was left at the time of lease termination as part of the terms of the Site lease from the Cebolleta Land Grant. There are no remaining building structures on the Site. Besides the pits and overburden piles, some of the mine infrastructure equipment and components still exist, including roads, utility lines across the Site, utility connection locations, a surface completion of an old well, and the slab of a former structure.

1.3.2 Physiography and Climate

This section provides a brief overview of the Physiography of the Site. The information in this section was adapted from the *Stage I Abatement Plan Investigation Report* (Intera, 2006).

The regional surface topography is a combination of steep-sided mesas separated by broad, gently sloping valleys. These valleys are infilled with alluvial and colluvial deposits, with primary stream channels incised through previously-deposited sediments. Regional drainage is to the south, first to Rio Moquino, then Rio Paguate, then into Rio San Jose, then Rio Puerco further south and east, and eventually into the Rio Grande in central New Mexico. To the north and northwest of the Site, surface topography is dominated by the Mount Taylor volcanic field, which consists of broad, gently sloping basaltic flows with steep sides at flow edges. Numerous volcanic plugs occur in the area, similar to Cerro Negro immediately north of the Site. To the south and east, topography consists of mesas and valleys.

The mine area receives a mean of 9.85 inches of precipitation annually, based on Laguna, New Mexico meteorological station data gathered between 1914 and 2006 (WRCC, 2007), which is the closest weather station of record to the Site. The state-wide annual means range from approximately 13 to 15 inches (WRCC, 2007). Approximately 51% of the precipitation recorded at the Laguna weather station occurs in the monsoonal months of July, August, and September. Mean monthly temperatures at the Laguna meteorological station range from a minimum of 19.5 degrees Fahrenheit (°F) in January to a maximum of 90.3°F in July.

Potential evaporation in New Mexico is much greater than mean precipitation. The mean annual net pan evaporation is approximately 63 inches, based on the Laguna, New Mexico meteorological station data gathered between 1914 and 2006 (WRCC, 2007). Maximum monthly evaporation (approximately 10-12 inches) occurs in June and July, and the minimum (no evaporation) occurs in December through March. Wind speeds over the state are usually moderate, although relatively strong winds often accompany occasional frontal activity during late winter and spring months (WRCC, 2007). Blowing dust and soil erosion is a concern during dry spells. Winds generally predominate from the southeast in summer and from the west in winter, but local surface wind directions will vary greatly because of local topography and mountain and valley breezes. Based on data from Grants (WRCC, 2007), mean wind speeds range from 7.2 to 10.9 miles per hour.

1.3.3 Geology

The Site is located in the southeastern part of the San Juan Basin, a large structural basin covering parts of New Mexico, Colorado, Arizona, and Utah within the regional Colorado Plateau Province. Stratigraphy at the Site includes, from oldest to youngest, the Morrison Formation (Late Jurassic), the Dakota Sandstone (Cretaceous), the Mancos Shale (Late Cretaceous), and Quaternary Alluvium. Quaternary Alluvium is found in Meyer Draw, which runs through the Site in a northwest to southeast direction. The units are relatively flat lying, with a minor dip to the north-northwest at approximately 1.5 degrees Fahrenheit. The Mancos Shale covers much of the surface, while the Dakota Sandstone and Jackpile sandstone are exposed southeast of the Site along Meyer Draw (outside the mining lease), and in the open pits. The information in this section was adapted from the *Stage I Abatement Plan Investigation Report* (Intera, 2006), which provides additional details of the geology of the Site.

2.0 FIELD INVESTIGATION METHODS

2.1 INTRODUCTION

The materials characterization focused on the borrow and stockpile sources, non-economic materials piles, and mine facilities within the western Shaft Area. The areas included in the materials characterization are listed below, and shown on Figure 2:

Background Area, Borrow Sources, and Topsoil Stockpiles

- Background Area
- Borrow South
- Lobo Tract Borrow Area
- Topsoil South
- Topsoil North
- Topsoil/Overburden Pile

Additionally, former Borrow Areas 1 and 2 were included in the gamma survey.

Non-Economic Materials Storage Piles

- Piles 3 through 7
- West Disturbance Area
- Crusher Stockpile Area

Western Shaft Area

- Mine Dump
- Shaft Pad
- Storage Area
- Ponds 1 through 5
- Ore Storage Areas 1 and 2
- Access Road

Several methods were employed in conducting this field investigation. Initially, a gamma exposure rate survey was conducted in each area on a regular grid, with a grid interval between 100 and 400 feet, depending on the size of the feature being surveyed (actual intervals are presented in Section 3.0). Judgmental gamma measurements were collected in Pits 1 and 2 to characterize small non-economic piles located within the pits. The locations for the survey points are shown on Figure 3. Following the gamma survey, surface soil samples and subsurface soil samples were collected from the ground surface, test pits and drill holes.

Survey pin flags were used in the field to indicate static gamma measurement and soil sample locations. Each of the sampling points was located using a Differentially Corrected Global Positioning System (DGPS). The DGPS consisted of a Trimble Geo XT GPS receiver with real time differential correction using OMNI STAR satellite, Tripod Data System (TDS) Ranger data logger with SOLO surveying software capable of navigating to a point. The differential correction provided submeter accuracy of point locations.

2.2 GAMMA EXPOSURE RATE SURVEY

The radiological survey was designed to identify gamma exposure rates in each survey area. All gamma exposure rate measurements were collected by a certified Radiation Safety Officer (RSO) using a Ludlum Model 19 μR Meter. The meter was calibrated annually to a Cesium-137 source. A visual inspection of the instrument and a function check using a Cesium-137 source was conducted daily prior to usage, as necessary.

A grid was established at each facility where a gamma exposure survey was performed. The grid interval varied depending on the size of the facility. Three measurements were made at each location: shielded contact with the ground, shielded one-meter above ground, and unshielded one-meter above ground. Additionally, a portion of each soil sample collected in test pits and drill holes (see Section 2.3) was put into a plastic bag for contact shielded measurements of the gamma exposure rates. The gamma exposure rate was also measured on material in each area being sampled to estimate the ambient gamma exposure rates. The ambient exposure rates were measured prior to sampling from a test pit or drill hole. The exposure rates for the actual test pit or drill hole samples were then taken as the greater of the background exposure rate at the measurement location or the measured exposure rate for the sample.

Background gamma exposure rates were measured in an area where past mining activity was not conducted. The area for the background rate measurement was located to the north of the access road to the Shaft Area, as shown on Figure 2. Shielded contact, shielded one meter and unshielded one meter exposure rates were measured at identified locations in the background area.

2.3 SOIL SAMPLING

Soil sampling was conducted in test pits and drill holes. Test pits were co-located with the surface gamma survey points with the highest readings in each local area. Test pits were used, as opposed to drill holes, where native soil was anticipated to be present at less than 15 feet bgs. The test pits were excavated using a rubber-tired backhoe that was capable of reaching to a maximum depth of 15 feet bgs. Once the sampling was completed in each test pit, the excavation was backfilled with the excavated soils, and the surface was restored to similar conditions as before the work. Soils within the test pits were visually classified in the field, in accordance with the Unified Soil Classification System, and further described using the U.S. Department of Agriculture (USDA) methods.

Composite soil samples were generally collected from the test pits from the top two feet, two to four feet and one sample for every six feet to the bottom of the excavation, except in the background reference area and the potential borrow area. Test pits in the background reference area were excavated to a depth of four feet with representative samples collected of the material in the top two feet and the bottom two feet. Test pits in the potential borrow area were excavated to a depth of six-feet with a representative composite sample collected of each soil strata encountered.

Drill holes were advanced to native ground in areas at the Site where native ground was expected to be present at greater than 15 feet bgs. The drill holes were drilled with an air rotary hammer rig. Composite soil samples were collected for gamma measurements and soil descriptions from the drill holes at depths of 0-2 feet, 2-4 feet, and every 8 feet thereafter to native ground. Drill cuttings were visually classified in the field, in accordance with the Unified Soil Classification System, and further described using the U.S. Department of Agriculture (USDA) methods.

Surface composite samples were collected for analysis of leachate using EPA Method 1312, Synthetic Precipitation Leaching Procedure (SPLP). The SPLP samples were collected by mixing 30 subsamples from the same area of interest (Smith, 2000) and blending them into one sample for analysis. The subsamples were collected on a regular gird within each area, grabbed with a clean spoon, and blended with the other subsamples. The 30 subsamples were passed through a two millimeter (mm) sieve, and placed into gallon-sized plastic bags (doubled) for shipment to the laboratory; sample preservation was not required. The SPLP method simulates the conditions of rain water percolating through the soil.

The 30-point composite SPLP technique of sampling and analysis is biased towards over-predicting potential impacts to water quality because the sieving process isolates the less than 2-mm size fraction of the composite sample which is generally the most reactive and higher concentrations of chemical constituents can be leached from the small size fractions. Therefore, SPLP analyses from these samples would provide the most conservative scenario for evaluating potential environmental effects. The SPLP method is also an aggressive test that errs on the side of overestimating leachate concentrations because the samples are continuously agitated in a closed system. The method results in an average value for the area sampled.

2.4 ANALYTICAL PROGRAM

Samples selected for analysis were submitted to Energy Laboratories, Inc. (ELI) in Casper, Wyoming. A summary of the soil sampling program is included in Table 1, *Summary of Soil Sampling Program*. A minimum of two samples were submitted for analysis from each drill hole. Samples collected from the non-economic material piles and the Shaft Area test pits and drill holes were submitted to ELI based on the radiological survey. Gamma ray exposure measurements were made on all soil samples following the procedures presented in Section 2.1. The two samples from each location with the highest gamma readings were submitted for analysis, except from the Shaft Area Access Road where only one sample per location was submitted for analysis. A representative sample of each general material type encountered in the drill holes was collected, except where only one material type was encountered, in which case, representative samples from the upper five feet and the lower portion of the drill hole were collected for analysis. Alternatively, all samples from the topsoil and overburden piles and the borrow areas were submitted for analysis regardless of the gamma readings. Additionally, samples collected from the two background locations with the median ground contact radiation readings from the gamma radiation exposure survey were submitted for analysis.

Samples were analyzed for three groups of analytes, as listed below:

- Radiochemical parameters
- Metals in leachate (SPLP)
- Agronomic properties

The analytes, analytical methods, and detection limits are presented in Table 2, *Soil Analytical Program*.

One surface soil sample (≤0.5 feet below ground surface) and one subsurface soil sample was also collected from each survey area, except the borrow area, prepared for analysis of leachate (SPLP), and analyzed for the constituents shown in Table 2. One 30-point composite surface sample was collected from each survey area, as described in Section 2.3. One soil samples from each test pit and drill hole was also submitted for SPLP analysis, based on the gamma survey (i.e., the sample with the highest gamma concentration was submitted for SPLP analysis).

3.0 GAMMA EXPOSURE RATE SURVEY RESULTS

3.1 INTRODUCTION AND SUMMARY STATISTICS

The objective of the gamma exposure rate surveys was to characterize the nature and lateral extent of radium-226 surface concentrations, using an exposure rate meter fitted with (and without) a lead shield that serves to reduce the inclusion of scattered radiation from other than the material of interest. The following measurements were collected, as described in Section 2.0:

- Contact shielded (in contact with the ground surface)
- One-meter shielded
- One-meter unshielded

The results of the gamma survey are listed in Table 3*, Surface Gamma Radiation Survey Results*. Figure 3, *Results of Field Gamma Radiation Survey* presents the results graphically. The field data sheets are included in Appendix A.

For the purposes of this discussion, only contact shielded measurements will be presented in the text of this report, except in those instances where there appears to be a significant difference in the readings between the different methods. Contact shielded is discussed here as opposed to the other results, because this method gives results that are most representative of that specific location. Both the 1-meter shielded and the 1-meter unshielded are subject to a greater amount of radiation shine from side slopes or higher gamma values at nearby locations.

A total of 309 gamma measurements were collected at the Site, including the main mine area, where the open pits are, and the western Shaft Area. Table 4, *Descriptive Statistics*, provides a basic statistical summary of the entire gamma data set. The statistical summary shows that gamma measurements ranged from 5 to 800 μR/hr (all measurement methods), with a mean of 55 to 100 uR/hr, depending on the measurement method. The standard deviations are relatively high, reflecting the heterogeneous nature of the distribution of gamma values within the materials at the Site, especially within the non-economic materials, as presented in the following sections. Figure 4, *Frequency of Gamma Value, Contact Shielded*, which shows the frequency of gamma measurements from all areas. As shown on Figure 4, the five highest gamma measurements (410 to 600 μR/hr) were detected on Pile 7, the Crusher Stockpile Area, and the Ore Storage Area 2. The 30 highest (10% of the dataset) gamma measurements (145 to 600 μR/hr) came from the following areas:

- Pile 7
- Crusher Stockpile Area
- West Disturbance Area
- Mine Dump
- Ore Storage Areas 1 and 2
- Ponds 1 and 4
- Shaft Access Road

Figure 4 also indicates that gamma readings from the background area, all borrow areas, and all topsoil piles ranged from 4 to 13 μR/hr, with a mean of approximately 7 μR/hr.

3.2 BACKGROUND, BORROW AND FORMER BORROW AREAS

The Background Area is located to the north of the mine site, as shown on Figures 1 and 3. A total of 18 gamma measurements were collected in the Background Area on grid with a 200-foot grid spacing, as shown on Figure 3. Gamma measurements (contact shielded) ranged from 5 to 13 μR/hr (mean 8 μR/hr), as shown in Table 3. The maximum 1-meter unshielded reading was 21 μR/hr.

Two borrow areas are currently being considered for use at the Site, Borrow Area South and the Lobo Tract Area, both shown on Figure 2. A total of 18 gamma measurements were collected in the Borrow Area South on a 200-foot grid, which ranged from 5 to 10 μR/hr (mean 7 μR/hr). The maximum 1-meter unshielded reading was 26 μR/hr.

A total of 21 gamma measurements were collected in the Lobo Tract Area on a 400-foot grid, which ranged from 5 to 8 μR/hr (mean 7 μR/hr). The maximum 1-meter unshielded reading was 17 μR/hr.

In addition to the two borrow areas discussed above, there are two areas to the east and northeast of the mine area that were formerly considered as borrow sources (former Borrow Areas 1 and 2). While these two areas are no longer being considered as borrow sources, gamma measurements had already been conducted in these areas. A total of 55 gamma measurements were collected in the two former borrow areas on a 400-foot grid; readings ranged from 4 to 7 μR/hr (mean 5 μR/hr). The maximum 1-meter unshielded reading was 13 μR/hr.

The ranges and mean values of gamma readings from the Background Area, the Borrow Area South, the Lobo Tract Area, and the two former borrow areas are similar, suggesting that they are all representative of background conditions. The gamma measurements from all five areas ranged from 4 to 13 μR/hr (mean 6 μR/hr). The maximum 1-meter unshielded reading was 26 μR/hr, from Borrow Area South.

3.3 TOPSOIL AND OVERBURDEN STOCKPILES

There are five topsoil or overburden piles at the Site, Topsoil North, Topsoil South, the Topsoil/Overburden Pile, and the Shale 1 and Shale 2 piles, as shown on Figure 2. Thirty-two gamma measurements were collected on a 400-foot grid, which ranged from 5 to 13 μR/hr (mean 8 μR/hr). The maximum 1-meter unshielded reading was 34 μR/hr from the Topsoil/Overburden Pile. These values appear to be similar to background values, and suggest that these soils are similar to background and have not been impacted by mine materials.

Additionally, three gamma measurements were also collected in the arroyo located southwest of the Topsoil South pile ("FL Area"). The gamma readings from these three locations ranged from 17 to 35 μR/hr (mean 26 μR/hr). The maximum 1-meter unshielded reading was 34 μR/hr.

3.4 NON-ECONOMIC MATERIALS STORAGE PILES

A total of 201 gamma measurements were collected from the non-economic materials storages piles. The contact shielded gamma measurements from all of these piles ranged from 5 to 470 μR/hr (mean 62 μR/hr), and had a standard deviation of 80 μR/hr. Measurements from the individual areas or piles were as described below (see Table 3).

Twenty gamma measurements were collected on Pile 3 on a 200-foot grid, which had readings ranging from 14 to 125 μR/hr (mean 43 μR/hr). The maximum 1-meter unshielded reading was 165 μR/hr. These results were consistent with the results of the contact, shielded measurements from the samples collected during drilling, which ranged from 70 to 135 μR/hr (averaged 105 μR/hr). The readings were generally higher on the elevated, northern section of Pile 3 (maximum 125 μR/hr) compared with the lower southern portion of Pile 3 (maximum 40 μR/hr), as shown on Figure 3.

Ninety-one gamma measurements were collected on Pile 4 on a 200-foot grid, which had readings ranging from 5 to 40 μR/hr (mean 13 μR/hr). The maximum 1-meter unshielded reading was 65 μR/hr. These results were consistent with the results of the contact, shielded measurements from the samples collected during drilling, which ranged from 11 to 45 (averaged 27 μR/hr). The gamma concentrations were distributed relatively evenly across the whole pile without any obvious hot spots.

Six gamma measurements were collected on Pile 5 on a 200-foot grid, which had readings ranging from 45 to 105 μR/hr (mean 74 μR/hr). The maximum 1-meter unshielded reading was 180 μR/hr. The gamma readings evenly distributed across the pile with no obvious hotspots.

Eight gamma measurements were collected on Pile 6 on a 100-foot grid, which had readings ranging from 30 to 65 μR/hr (mean 42 μR/hr). The maximum 1-meter unshielded reading was 115 μR/hr. The gamma readings evenly distributed across the pile with no obvious hotspots.

Five gamma measurement were collected on Pile 7 on a 200-foot grid, which had readings ranging from 60 to 410 μR/hr (mean 169 μR/hr). The maximum 1-meter unshielded reading was 600 μR/hr. The gamma readings were fairly evenly distributed, with the exception of the one reading on the south side of the pile, which was twice the next highest reading from Pile 7.

The West Disturbance Area, west of Pile 6, consists of nine small piles less than 500 feet in diameter. A total of 21 gamma readings were taken from those nine piles on a 100-foot grid, which had readings ranging from 35 to 320 μR/hr (mean 144 μR/hr). The maximum 1-meter unshielded reading was 440 μR/hr. The gamma readings were not evenly distributed, with readings on one or two of the piles 1.5 to 3 times higher than readings on the other piles, as shown on Figure 3.

Forty-nine gamma measurements were collected on the Crusher Stockpile Area on a grid with a 100- to 200-foot grid spacing, which had readings ranging from 23 to 470 μR/hr (mean 119 μR/hr). The maximum 1-meter unshielded reading was 800 μR/hr. The gamma readings were fairly evenly distributed, but with slightly higher values in the southeastern half of the area.

Mine material storage piles located in Pit 1 were also surveyed. Eleven gamma measurements were collected in Pit 1 at judgmental locations, which had readings from 20 to 63 μR/hr (mean 38 μR/hr). The maximum 1-meter unshielded reading was 138 μR/hr. The gamma readings were relatively evenly distributed, with no apparent hot spots.

3.5 WESTERN SHAFT AREA

A total of 207 gamma measurements were collected from the western mine Shaft Area, which included readings taken along the Shaft Access Road, and the two Ore Storage Piles located along the access road (see Figure 3). The gamma measurements from the whole area ranged from 6 to 600 μR/hr (mean 79 μR/hr), and had a standard deviation of 105 μR/hr. Measurements from the individual areas or piles were as described below (see Table 3).

Five gamma measurements were collected on the Mine Dump on a 100-foot grid, which had readings ranging from 65 to 250 μR/hr (mean 144 μR/hr). The maximum 1-meter unshielded reading was 230 μR/hr. These results were consistent with the results of the contact, shielded measurements from the samples collected during drilling, which ranged from 60 to 110 μR/hr (averaged 89 μR/hr). The gamma readings were fairly evenly distributed, but with slightly higher values in the middle of the dump.

Five gamma measurements were collected on the Shaft Pad on a 100-foot grid, which had readings ranging from 20 to 48 μR/hr (mean 34 μR/hr). The maximum 1-meter unshielded reading was 70 μR/hr. The gamma readings were evenly distributed across the Shaft Pad.

Two gamma measurements were collected on the Shaft Storage Area spaced 100 feet apart. The contact-shielded readings 6 and 7 μR/hr. These values are within the range of background values, and suggests that this area has not been impacted by mine materials.

Seven gamma measurements were collected from the Shaft Area Settling Ponds (Ponds 1 through 5), one in each of Ponds 1 through 4, one between Ponds 2 and 3, and two in Pond 5 (100 feet apart). with readings ranging from 7 to 280 μR/hr (mean 109 μR/hr). The maximum 1-meter unshielded reading was 390 μR/hr. The gamma readings were highest in Ponds 1, 2 and 4 (140 to 280 μR/hr), and lowest in Pond 5 (7 to 9 μR/hr).

Twelve gamma measurements were collected on Ore Storage Areas 1 and 2 on a 100-foot grid, with readings ranging from 20 to 600 μR/hr (mean 140 μR/hr). The maximum 1-meter unshielded reading was 500 μR/hr. The gamma readings were unevenly distributed, with the highest concentrations from Ore Storage 1, except one reading in Ore Storage 2 (600 μR/hr).

Thirty-three gamma measurements were collected on the Shaft Access Road spaced 100 feet apart, with readings ranging from 6 to 270 μR/hr (mean 46 μR/hr). The maximum 1-meter unshielded reading was 270 μR/hr. The gamma readings were fairly evenly distributed, but with the highest concentrations near the Ore Storage Areas, as well as one location at the east end of the road where it turns south (see Figure 3).

4.0 SOIL SAMPLING AND CHEMICAL ANALYTICAL RESULTS

4.1 SOIL DESCRIPTIONS

Soil samples were visually classified in the field, in accordance with the Unified Soil Classification System, and further described using the U.S. Department of Agriculture (USDA) methods, as discussed in Section 2.0. A summary of the soil samples collected from the test pits, as well as test pit and drill hole logs are included Appendix C.

Native soils at the Site observed in the background and borrow areas consist of well-drained silty sands (SM) and inorganic silts and clays (see Appendix C), characteristic of a semi-arid pinyon-juniper region. Soils in some areas, such as in the background area, contained some organic material. As per the American Soil Taxonomy classification system (USDA), these soils appeared to be aridisols.

Soils observed in the soil and overburden stockpiles primarily consisted of gravelly sands and silts (SM/GM). The topsoil/overburden pile contained abundant organic material in places. Since these piles represent displaced native materials, and are therefore primarily a chaotic mixture of materials, no soil horizons were present. These soils most closely resembled an aridisol, with the organic sections resembling a mollisol.

The remainder of the materials observed at the Site consisted of mine materials displaced from their place of origin, and placed into piles of mixed material. Most of these materials are not soils, as they are crushed or broken rock that came from the open pits or mine shaft, and were formerly bedrock. Most of the material observed (see Appendix C) consisted of gravelly sands and silts, with abundant boulder and cobble-sized material in places. Most of the material at a particular location was of similar nature, without distinct layering or varying soil types. Some minor exceptions were observed, such as in Pile 5, which primarily contained light brown, gravelly sands, but also contained two thin (less than six inches) greenish clayey silt layers. The water treatment ponds (Ponds 1-5) were originally filled with water and sediments, and therefore surface soils in these ponds represent sludge material from the mine waters (clays and silts). The Access Road contained varying mixtures of silt, sand, and gravel; some with a distinct grayish white color. Since these materials were formerly bedrock or materials from the mine pits and shaft, and have been displaced from their place of origin, they are not formal soils and therefore soil taxonomy is not applicable to them. However, these materials most closely resembled an aridisol.

Materials observed in Piles 3 and 4, which were drilled to native ground, were primarily varying mixtures of sand and gravel, with some silt-sized material, and abundant boulder and cobble sized material. No distinct layering was observed. The material was mostly medium to light brown in color, with some sections exhibiting more of a light gray color. The materials observed during drilling through the Mine Dump were similar, but tending towards finer grained (silty sands with gravel) and more of a light brown to buff color.

Table C-1 and the test pit logs in appendix C indicate the depths at which native ground was observed. All drill holes were advanced to native ground in Piles 3 and 4 and the Mine Dump (see Appendix C); native ground was observed at the following depths:

- Pile 3 : 90 to 119 feet bgs
- Pile 4: 105 to 154 feet bgs
- Mine Dump: 11 to 25 feet bgs

Additional details on the nature of the observed materials, and depths to native ground can be found in Appendix C.

4.2 SOIL RADIONUCLIDE ANALYTICAL RESULTS

4.2.1 Summary of Results

The objective of this sampling and analysis program was to characterize the distribution of concentrations of radionuclides in the materials at the Site. The results of the radionuclide analyses are shown in Table 5*, Soil Analytical Results, Radionuclides*. Figure 5, *Soil Analytical Results* presents the results graphically. [Note: the concentrations shown on Figure 5 are the maximum concentrations detected at each location, regardless of depth]. Additional samples were collected for analysis of metals by the SPLP method and agronomic parameters, as discussed in Section 2.0.

A total of 96 primary soil samples (not including duplicates) were collected for analysis of radionuclides at the Site, including the main mine area, where the open pits are, and the western Shaft Area. Table 6, *Descriptive Statistics, Soil Radionuclide Analytical Results* provides a basic statistical summary of the entire soil radionuclide data set. The statistical summary shows the following:

- Radium-226 ranged from non-detect to 611 pCi/g (mean 59.9 pCi/g)
- Uranium ranged from non-detect to 1,660 mg/kg (mean 164.2 mg/kg)
- Thorium ranged from non-detect to 602 pCi/g (mean 45.3 pCi/g)
- Gross alpha ranged from 4.6 to 2,490 pCi/g (mean 248.4)

For comparison, mean background values for radium-226, uranium, thorium-230 and gross alpha were 1.6 pCi/g, 3.8 mg/kg, 0.9 pCi/g, and 12.8 pCi/g, respectively.

Figure 6, *Frequency of Radium-226 Concentrations*, shows the frequency of radium-226 concentrations from all areas. As shown on Figure 6, the eight highest radium-226 concentrations (221 to 611 pCi/g) were detected on Pile 6, and Ponds 1 through 4. The 24 highest (25% of the dataset) radium-226 concentrations (52.2 to 611 pCi/g) came from the following areas:

- Piles 5, 6 and 7
- Mine Dump
- Ore Storage Area 2
- Ponds 1 through 4
- Shaft Access Road

Figure 6 also indicates that radium-226 concentrations from the background area, all borrow areas, and all topsoil piles ranged from non-detect to 3.4 pCi/g, with mean concentrations from 0.5 to 1.6 pCi/g. Figure 7, *Frequency of Uranium Concentrations*, shows a similar distribution.

Discussions of the analytical results for each area are included in the following sections. For the purposes of this report, only radium-226 and uranium concentrations are discussed (see Table 5). However, the analytical results of thorium-230 and gross alpha are also included in Tables 5 and 6.

4.2.2 Background and Borrow Areas

Eight soils samples were collected from four test pits in the background area (see Table 5). The samples were collected from two depths intervals in each test pit (0 to 2 feet bgs and 2 to 4 feet bgs). Concentrations of radium-226 ranged from non-detect to 3.4 pCi/g (mean 1.6 pCi/g). Uranium concentrations ranged from 0.7 to 9.2 mg/kg (mean 3.8 mg/kg). The concentrations of these analytes were relatively evenly distributed across the area. Concentrations were consistently higher in the 0- to 2-foot intervals than in the 2- to 4-foot intervals in test pits 1, 3 and 4.

Two soil samples were collected from two test pits from Borrow Area South (see Table 5), as a composite sample from 0 to 6 feet bgs. Radium-226 concentrations were non-detect, and uranium concentrations were 0.69 and 0.74 mg/kg. These concentrations are within the ranges of concentrations detected in the background area.

Five soil samples were collected from four test pits from the Lobo Tract Area (see Table 5). The samples were collected as composite samples from 0 to 6 feet bgs, 0 to 2 feet bgs, and/or 2 to 6 feet bgs, depending on soil conditions. Radium-226 concentrations ranged from non-detect to 1.5 pCi/g, and uranium concentrations ranged from 1.06 to 1.74 mg/kg. These concentrations are within the ranges of concentrations detected in the background area.

4.2.3 Topsoil and Overburden Stockpiles

Thirteen soil samples were collected from three test pits in the Topsoil/Overburden Pile, and the Topsoil North and Topsoil South piles (see Table 5). Radium-226 concentrations ranged from non-detect to 1 pCi/g (mean 0.5 pCi/g), and uranium concentrations ranged from 0.51 to 1.1 mg/kg (mean 0.7 mg/kg). These concentrations are within the ranges of concentrations detected in the background area.

4.2.4 Non-Economic Materials Storage Piles

Five soil samples were collected from two drill holes on Pile 3 (see Table 5). Both drill holes were drilled to native ground, and samples were collected for analysis of radionuclides at the depths with the highest gamma readings taken during drilling (see Appendix A), as described in Section 2.0. Radium-226 concentrations ranged from 11.9 to 34.6 pCi/g (mean 19.2 pCi/g) and uranium concentrations ranged from 27.4 to 125 mg/kg (mean 70.6 mg/kg). Concentrations appear to decrease slightly with depth in drill hole DH7, yet appear to increase slightly with depth in drill hole DH8. All concentrations were elevated compared to the concentrations detected in the background area.

Twelve soil samples were collected from six drill holes on Pile 4 (see Table 5). All drill holes were drilled to native ground, and samples were collected for analysis of radionuclides at the depths with the highest gamma readings taken during drilling (see Appendix A). Radium-226 concentrations ranged from 3.2 to 47.7 pCi/g (mean 16.9 pCi/g) and uranium concentrations ranged from 5.5 to 125 mg/kg (mean 45.8 mg/kg). In all but one drill hole (DH3), the deeper samples in each drill hole contained the higher concentration of radionuclides (see Table 5).

Two samples from one test pit were collected from Pile 5. Radium-226 concentrations were 55.1 and 70.7 pCi/g (mean 62.9 pCi/g), and uranium concentrations were 143 and 182 mg/kg (mean 162.5 mg/kg). The deeper sample contained the lower concentration of radium-226, while uranium, thorium-230 and gross alpha concentrations were all higher in the deeper sample.

Two soil samples from one test pit were collected from 0 to 2 and 10 feet bgs in Pile 6. The radium-226 concentrations ranged from 32.3 to 41.3 pCi/g (mean 36.8 pCi/g), and the uranium concentrations ranged from 75.5 to 80.9 mg/kg (mean 78.2 mg/kg).

Two samples from one test pit were collected in Pile 7. The radium-226 concentrations were 26.9 and 23.6 pCi/g (mean 25.3 pCi/g), and the uranium concentrations were 137 and 108 mg/kg (mean 122.5 mg/kg). The higher concentrations were detected in the shallower sample.

Ten soil samples were collected from five test pits in the West Disturbance Area. The West Disturbance Area consists of nine separate piles (see Figure 2). Radium-226 concentrations ranged from 24.8 to 590 pCi/g (mean 162.6 pCi/g) and uranium concentrations ranged from 46.1 to 1,660 mg/kg (mean 478.2 mg/kg). Concentrations were not consistently high or lower in the deeper samples from each test pit; however, the maximum concentrations, which were more than twice the next highest concentrations, were detected in test pit TP4. Test pit TP4 was located on one of the smaller piles in the middle portion of the West Disturbance Area.

Eight soil samples from four test pits were collected from the Crusher/Stockpile Area. Radium-226 concentrations ranged from 10 to 119 pCi/g (mean 57.5 pCi/g) and uranium concentrations ranged from 20.9 to 385 mg/kg (mean 211 mg/kg). Concentrations were not consistently higher or lower from either the upper or lower depth intervals from each test pit, except the 0 to 2 foot layer from test pit TP1, which had concentrations three to five times lower than the other samples from that area.

4.2.5 Shaft Area

Four soil samples were collected from two drill holes in the Mine Dump (see Table 5). Both drill holes were drilled to native ground, and samples were collected for analysis of radionuclides at the depths with the highest gamma readings taken during drilling (see Appendix A), as described in Section 2.0. Radium-226 concentrations ranged from 28.9 to 74.7 pCi/g (mean 45.3 pCi/g) and uranium concentrations ranged from 127 to 288 mg/kg (mean 173 mg/kg). The higher concentrations were detected in the shallower sample in both drill holes.

Two samples from the same depth (0 to 1 foot bgs) were collected from one test pit in the Shaft Pad. Native ground was encountered at one foot bgs. The mean radium-226 concentration was 37 pCi/g and the mean uranium concentration was 63.2 mg/kg.

Eleven samples were collected in five test pits from Ponds 1 through 5. Radium-226 concentrations ranged from non-detect to 611 pCi/g (mean 218 pCi/g) and uranium concentrations ranged from 7.5 to 1,090 mg/kg (mean 460.3 mg/kg). The higher concentrations were detected in the shallower sample in both drill holes. Concentrations were lowest in Pond 5, by an order of magnitude or more compared to concentrations detected in Ponds 1 through 4.

Seven soil samples were collected from three test pits in Ore Storage Areas 1 and 2. Radium-226 concentrations ranged from 2.4 to 181 pCi/g (mean 39.1 pCi/g) and uranium concentrations ranged from 7.5 to 573 mg/kg (mean 154.3 mg/kg).

Five soil samples were collected from five test pits in the Access Road. Radium-226 concentrations ranged from 7.2 to 94.3 pCi/g (mean 42.1 pCi/g) and uranium concentrations ranged from 17.8 to 286 mg/kg (mean 149.5 mg/kg).

Two soil samples were collected from one test pit in the Storage Area. The mean radium-226 concentration was 1.1 pCi/g, and the mean uranium concentration was 2.4 mg/kg.

4.3 SOIL LEACHATE ANALYITICAL RESULTS

The SPLP method was used to evaluate the relative potential for leaching metals into groundwater and surface waters. It will not enable a prediction of concentrations that might actually be found in water, however, for the reasons presented in Section 2.3. The results of the analyses conducted on SPLP samples are presented in Table 7, *Soil Analytical Results, Synthetic Precipitation Leaching Procedure*. A comparison of the SPLP results with New Mexico surface water standards (see NMAC 20.6.4), reveals that the only consistuents with concentrations greater than the surface water standards for livestock watering, wildlife and aquatic life are gross alpha and radium-226. Aluminum concentrations were greater than the New Mexico groundwater standard for irrigation (NMAC 20.6.2). These data suggest that potential constituents of concern during site closure for protecion of surface water or groundwater may include gross alpha, radium-226 and possibly aluminum in limited areas of the Site. However, it is important to note that these results do not indicate that surface water or groundwater would be adverserly impacted by site soils due to leaching, since the SPLP method is highly conservative and does not represent actual field conditions (see Section 2.3).

4.4 SOILS AGRONOMIC ANALYTICAL RESULTS

Soil samples were collected in the field and submitted to the laboratory for agronomic testing and constituent analysis. Surface and subsurface samples were analyzed for several elements to identify the potential risks to plant establishment based on the concentrations of constituents present. Results from the laboratory analysis were used to evaluate borrow source materials and to success of direct revegetation for several areas at the Site. Although toxicity thresholds of plants for each constituent will vary by individual species and life form (e.g. grasses, forbs, shrubs, trees), general toxicity guidelines and potential impacts on plant establishment for only constituents of concern are outlined below. The results of these analyses are presented in Table 8, *Agronomic Analytical Results*.

4.4.1 Arsenic

The concentration of arsenic that plants tolerate varies by plant species and life form. Although some species of grass are extremely tolerant of high concentrations of arsenic and maintain normal growth at very high concentrations, most plants will begin to exhibit symptoms of toxicity (reduction in plant biomass, decreased root growth, deceased germination) when arsenic concentrations in the soils reach 50 to 100 mg/kg. Studies evaluating the effect of arsenic toxicity on ryegrass, reported lowest observable effective concentration (LOEC) for arsenic in soils at 50 mg/kg, with substantial reductions in plant growth occurring at 250 mg/kg (Jiang and Singh 1994). Arsenic concentrations detected at the site ranged from 0.018 to 0.817 mg/kg, which are well below the toxicity threshold of 50 mg/kg reported in the literature and, therefore would not negatively impact plant establishment at the Site.

4.4.2 Copper

Although copper is one of the least mobile heavy metals in soil, it is abundant in soils of all types. The concentration of total copper that occurs naturally in soils within the United States varies and ranges from 3 to 300 mg/kg, with an average concentration of 26 mg/kg (Kabata-Pendias 2000). The portion of the total concentration available to plants is highly dependent upon the type of soil (physical properties and parent material), pH, and redox potential of the soil profile. Overall solubility of copper for both cationic and anionic forms increases below a neutral pH (Kabata-Pendias 2000).

The concentration of copper that plants tolerate varies by plant species and life form. In general, grasses and forbs tend to be less tolerant to excess copper than shrubs and trees. For example, the grass little bluestem, shows very little decrease in plant biomass at 5.74 mg/kg available copper, with a 68% reduction in plant growth occurring at 14.3 mg/kg available copper (Miles and Parker 1979a). For forbs, the study reported 100% mortality for black-eyed Susan seedlings at 28.6 mg/kg available copper during a 12-week study. Copper tolerance for these species are much lower when compared to species of pine (Jack pine, white pine), that have little disruption in plant growth at 35.7 mg/kg available copper (Miles and Parker 1979b). Kabata-Pendias report excessive concentrations of plant toxicity in soils when copper concentrations reach 60 to 100 mg/kg.

Copper concentrations at the Site ranged from non-detect to 2.7 mg/kg, with an average of 0.2 mg/kg site-wide. In the non-economic material storage pile test pits, copper concentrations were the highest and occurred in areas where the pH is acidic enough (below5.5) where copper would be readily available for plant uptake. However, based on toxicity thresholds report in the literature, even the highest concentration of 2.7 mg/kg is still below the concentration where plant toxicity should occur and therefore copper concentrations are not a concern for plants at the Site.

4.4.3 Radium-226

Radium-226 is the most abundant and stable radionuclide in the biosphere, with increased mobility and solubility in soils under extremely acidic conditions (Kabata-Pendias, 2000). Although results from the laboratory analysis report concentrations of radium-226 at the Site ranged from 3.2 pCi/g to 611 pCi/g, the impact of these concentrations on vegetation establishment cannot be determined. No information was uncovered in the literature that would provide an adequate way to measure the phytotoxicity of radium-226, therefore the impact of radium-226 on plant establishment cannot be evaluated.

4.4.4 Selenium

Selenium is a naturally occurring element found in rocks, soil and water. Selenium enters the soil profile through the weathering of selenium-rich rocks, moving through the soil until adsorbed on clay particles, iron hydroxides or organic particles. Selenite and selenates are produced in the soil by microorganisms from the less soluble forms of selenium. When selenium occurs in alkaline soils and becomes oxidized as selenate, the selenium becomes water-soluble. This form is highly toxic and easily leached from the soil, thus facilitating uptake of selenium by certain plants. Although some studies have shown sensitive species of ryegrass exhibiting selenium toxicity in sandy soils with selenate concentrations as low as 2 mg/kg (Smith et al. 1984), symptoms of selenium toxicity for most plants occur when selenium concentrations in the soils range from 10 to 20 mg/kg. Selenium concentrations detected at the Site ranged from less than 0.005 to 0.167 mg/kg. These concentrations are significantly lower than the toxicity thresholds of 10 to 20 mg/kg reported in the literature, and therefore will not impact plant establishment at the Site.

4.4.5 Thorium-230

Very little information is available on the impacts of thorium-230 on plant growth and sorption. In reference soils, thorium-230 concentrations are reported to be relatively high, ranging from 8 to 27 mg/kg in soils in China, and 3.8 to 12.4 in U.S. soils. Soluble fractions of thorium-230 seem to be readily absorbed by plants, with land plants ranging from less than 8 mg/kg to 1,330 mg/kg and vegetable containing thorium-230 ranging from less than 5 mg/kg to 20 mg/kg. Moss colleted from Norway was found to have thorium-230 concentrations as high as 5,100 mg/kg (Kabata-Pendias, 2000). Although no literature values for thorium-230 are available, thorium-230 concentrations at the Site in the non-economic storage piles, Mine Dump, ore storage areas and Access Road, and the Shaft Area ponds contain concentrations significantly higher than the borrow and topsoil samples, suggesting that thorium-230 could potentially impact plant establishment and growth.

4.4.6 Uranium

Uranium is a naturally occurring element found in low concentrations within all rock, soil, and water, existing in +4 and +6 valence states in most geologic environments (Kabata-Pendias, 2000). Through the process of weathering, uranium forms mainly organic complexes in the soil that are easily soluble and mobile, with the distribution of uranium highly controlled by the oxidation state and Eh-pH of the system. Although few studies have been conducted to evaluate the toxicity of uranium on plants, one study conducted in 1995 found no adverse effect of uranium on native plant species at uranium concentrations of 5,000 mg/kg in soil (Meyer et al. 1997). Concentrations of uranium detected at the Site occurred in the non-economic storage piles, Shaft Area Mine Dump, ore storage areas, the Shaft Area Access Roads, and mine shaft ponds, and ranged from 288 to 1,660 mg/kg. These concentrations are below the no observable effective concentration (NOEC) of 5,000 mg/kg from the literature, indicating uranium concentrations in the soil would not negatively impact plant establishment at the Site.

4.4.7 Sulfate

Sulfates of metals are likely to occur in soils under oxidizing conditions. They are readily soluble and heavily involved in soil equilibrium processes. Sulfates are also readily available to plants (Kabata-Pendias, 2000). Although sulfate concentrations at the Site are higher than average concentrations found in soils, the elevated concentrations are likely due to abundant gypsum that occurs naturally in the soils of the region and are not due to mining activities. Therefore, plant establishment in these areas will likely be similar to the establishment success in the native soils where high concentrations of sulfate occur.

4.4.8 Soluble Salts, SAR and pH

Soluble salts, Sodium Absorption Ratio (SAR) and pH are important factors of soils and can impact the success of plant growth and establishment. When high amounts of soluble salts (calcium, magnesium, potassium) are present, severe plant growth problems can occur. In addition, soils high in sodium or elevated SAR can present physical restrictions in the soil for plant growth. When high concentrations of sodium are present, exchange sites on the soil particles become saturated with sodium, creating dense layers, restricting root development and plant growth.

Soil pH controls the solubility of ions and impacts plant growth under extreme alkaline or acidic conditions. Under acidic conditions, many soil minerals dissolve, increasing the concentration of metal ions in solution to toxic concentrations, inhibiting plant growth. Under alkaline conditions, the solubility of minerals can decrease to the point that nutrient deficiencies can occur, reducing plant biomass.

Laboratory analytical results report near neutral or slightly basic pH at the Site, and low soluble salts and SAR, except for one soil sample taken from test pit 5 in Pile 7 (see Table 8) where the SAR concentration was 19.1. When SAR concentrations fall within the range of 19 to 26, sodium buildup on most soil types occurs, restricting plant root growth and development, suggesting plant establishment may be stunted or restricted where excessive sodium is present. Since a majority of the soils samples are below a SAR of 19, impacts from elevated sodium are not expected to be problematic.

4.4.9 Other Constituents

Results from the agronomic analysis indicate that the remaining agronomic parameters (see below) pose no toxicity risk to plant growth (concentrations detected at the Site were less than the toxicity threshold for plants) or are not directly relevant to plant toxicity. However, for completeness, a brief explanation for each element and the toxicity threshold, where applicable, are provided below and is based on published literature (Kabata-Pendias, 2000).

- Calcium - nontoxic to plants.
- Chlorine - can be toxic to plants at greater than 500 mg/kg
- Cadmium - can be toxic to plants at 10-20 mg/kg
- Chromium - can be toxic to plants at 75-100 mg/kg
- Lead - can be toxic to plants at 100-200 mg/kg
- Mercury - can be toxic to plants at 0.3-5 mg/kg
- Nickel - can be toxic to plants at 100 mg/kg
- Zinc - can be toxic to plants at 70-400 mg/kg

Conductivity, which is a measure of the soils ability to transmit (conduct) an electrical charge, is and important parameter in ion/metals exchange; it is nontoxic to plants.

4.4.10 Summary of Agronomic Results

Contaminant concentrations at the Site are relatively low and the quality of the soil high, suggesting most areas at the Site would be able to support plant communities without additional soil cover. However, SAR samples exceeding the recommended range for plants indicate the Ore Storage Areas may not support vegetation establishment. Radium 226, thorium-230 and sulfates may also impact the success of direct revegetation at the Site, suggesting that additional soil cover may be required to provide an adequate growth medium for vegetation establishment.

5.0 SUMMARY AND CONCLUSIONS

This report describes the results of the Materials Characterization conducted at the Site and adjacent properties between April 2006 and July 2007. The Materials Characterization consisted of investigating surface and subsurface soils and sediments at various areas within and near the Site, in accordance with the Materials Characterization Work Plan. The materials characterization focused on the borrow and stockpile sources, non-economic materials piles, and mine facilities within the western Shaft Area. The areas included in the materials characterization are listed below:

<u>Background Area, Borrow Sources, and Topsoil Stockpiles</u>

- Background Area
- Borrow South
- Lobo Tract Borrow Area
- Topsoil South
- Topsoil North
- Topsoil/Overburden Pile

Additionally, former Borrow Areas 1 and 2 were included in the gamma survey.

<u>Non-Economic Materials Storage Piles</u>

- Piles 3 through 7
- West Disturbance Area
- Crusher Stockpile Area

<u>Western Shaft Area</u>

- Mine Dump
- Shaft Pad
- Storage Area
- Ponds 1 through 5
- Ore Storage Areas 1 and 2
- Access Road

Surface gamma surveying was conducted on a regular grid in each of these areas, and consisted of three measurements with a Ludlum Model 19 μR Meter: shielded contact with the ground, shielded one-meter above ground, and unshielded one-meter above ground. A total of 309 gamma measurements were collected at the Site, including the main mine area, where the open pits are, and the western Shaft Area. Gamma measurements ranged from 5 to 800 μR/hr (all measurement methods), with a mean of 55 to 100 uR/hr. The standard deviations are relatively high, reflecting the heterogeneous nature of the distribution of gamma values within the materials at the Site, especially within the non-economic materials. The highest gamma measurements (145 to 600 μR/hr) came from the following areas:

- Pile 7
- Crusher Stockpile Area
- West Disturbance Area
- Mine Dump
- Ore Storage Areas 1 and 2

- Ponds 1 and 4
- Shaft Access Road

Soil sampling was conducted from the test pits and drill holes, as well as surface composite soil sampling for SPLP analysis. Test pits were co-located with the surface gamma survey points with the highest readings in each local area. Drill holes were advanced to native ground in areas at the Site where native ground was expected to be greater than 15 feet bgs. Composite soil samples were collected from the test pits and drill holes for gamma measurements, soil descriptions, and samples submitted for chemical analysis.

Surface composite samples were collected for SPLP analysis by mixing 30 subsamples collected on a grid and blending them into one sample for analysis for each area. The SPLP method simulates the conditions of rain water percolating through the soil and is biased towards over-predicting potential impacts to water quality, and provides a conservative scenario for evaluating potential environmental effects. The SPLP method is also an aggressive test that errs on the side of overestimating leachate concentrations because the samples are continuously agitated in a closed system.

Soil samples collected in the test pits and drill holes were visually classified in the field, in accordance with the USCS and USDA methods. Native soils at the Site observed in the background and borrow areas consist of well-drained silty sands and inorganic silts and clays. Soils in some areas, such as in the background area, contained some organic material. As per the American Soil Taxonomy classification system (USDA), these soils appeared to be aridisols.

Soils observed in the soil and overburden stockpiles primarily consisted of gravelly sands and silts (SM/GM). The topsoil/overburden pile contained abundant organic material in places. Since these piles represent displaced native materials, and are therefore primarily a chaotic mixture of materials, no soil horizons were present. These soils most closely resembled an aridisol, with the organic sections resembling a mollisol.

The remainder of the materials observed at the Site consisted of mine materials displaced from their place of origin, and placed into piles of mixed material. Most of these materials are not soils, as they are crushed or broken rock that came from the open pits or mine shaft, and were formerly bedrock. Most of the material observed consisted of gravelly sands and silts, with abundant boulder and cobble-sized material in places. Most of the material at a particular location was of a similar nature, without distinct layering or varying soil types.

Soil samples submitted to the laboratory were analyzed for radiochemical parameters, metals in leachate (SPLP), and agronomic properties. A total of 96 primary soil samples (not including duplicates) were collected for analysis of radionuclides at the Site, including the main mine area, where the open pits are, and the western Shaft Area. The analytical results showed the following:

- Radium-226 ranged from non-detect to 611 pCi/g (mean 59.9 pCi/g)
- Uranium ranged from non-detect to 1,660 mg/kg (mean 164.2 mg/kg)
- Thorium ranged from non-detect to 602 pCi/g (mean 45.3 pCi/g)
- Gross alpha ranged from 4.6 to 2,490 pCi/g (mean 248.4)

For comparison, mean background values for radium-226, uranium, thorium-230 and gross alpha were 1.6 pCi/g, 3.8 mg/kg, 0.9 pCi/g, and 12.8 pCi/g, respectively. The highest radium-226 concentrations (52.2 to 611 pCi/g) came from the following areas:

- Piles 5, 6 and 7
- Mine Dump

- Ore Storage Area 2
- Ponds 1 through 4
- Shaft Access Road

The results of the analyses conducted on SPLP samples were consistent with total soil concentrations. Comparison of the SPLP results with New Mexico surface water standards (see NMAC 20.6.4), reveals that the only consistuents with concentrations greater than the surface water standards for livestock watering, wildlife and aquatic life are gross alpha and radium-226. Aluminum concentrations were greater than the New Mexico groundwater standard for irrigation (NMAC 20.6.2). These data suggest that potential constituents of concern during site closure for protecion of surface water or groundwater may include gross alpha, radium-226 and possibly aluminum in limited areas of the Site. However, it is important to note that these results do not indicate that surface water or groundwater would be adverserly impacted by site soils due to leaching, since the SPLP method is highly conservative and does not represent actual field conditions.

Agronomic parameter concentrations at the Site are relatively low and the quality of the soil high, suggesting some areas within the Site would be able to support plant communities without additional soil cover. However, SAR samples exceeding the recommended range for plants indicate that the Ore Storage Areas may not support vegetation establishment. Radium 226, thorium-230 and sulfates may also impact the success of direct revegetation at the Site, suggesting that additional soil cover may be required to provide an adequate growth medium for vegetation establishment.

Overall, the gamma and soil analytical results indicate that the non-economic materials storage piles and mine facilities in the western Shaft Area, contain concentrations of radionuclides above background concentrations. The areas with the highest concentrations include:

- Piles 5, 6 and 7
- Crusher Stockpile Area
- West Disturbance Area
- Mine Dump
- Ore Storage Areas 1 and 2
- Ponds 1 through 4
- Shaft Access Road

Additionally, the borrow sources and soil or overburden stockpiles all contain radionuclides at concentrations similar to background concentrations.

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TABLES

	Sample Number	Location Type	Depth Interval	Date	Time	Gamma in µR/hr	Analysis			Notes
							Rads	SPLP	Agro	
Background Area										
Background Area	BG-TP1-124	Test Pit	0-2	6/21/07	1600	12	X			
	BG-TP1-125	Test Pit	2-4	6/21/07	1600	12	X			
	BG-TP2-126	Test Pit	0-2	6/21/07	1615	22	X			
	BG-TP2-127	Test Pit	2-4	6/21/07	1620	na	X			
	BG-TP3-120	Test Pit	0-2	6/21/07	1530	9	X			
	BG-TP3-310	Test Pit	0-2	6/21/07	1530	10	X			Rep. of BG-TP3-120
	BG-TP3-121	Test Pit	2-4	6/21/07	1535	9	X			
	BG-TP4-122	Test Pit	0-2	6/21/07	1545	10	X			
	BG-TP4-123	Test Pit	2-4	6/21/07	1545	10	X			
Borrow Areas										
Borrow Area South	BS-TP1-041/042	Test Pit	0-6	6/19/07	1600	n/a	X		X	
	BS-TP2-069/070	Test Pit	0-6	6/20/07	1420	11	X		X	
	BS-TP2-305	Test Pit	0-6	6/20/07	1420	11	X			Rep. of BS-TP2-069/070
Lobo Tract	LOBO-TP1-130/131	Test Pit	0-6	6/22/07	1430	10	X		X	
	LOBO-TP2-132	Test Pit	0-2	6/21/07	1445	11	X			
	LOBO-TP2-133	Test Pit	2-6	6/21/07	1450	10	X			
	LOBO-TP3-134	Test Pit	0-6	6/22/07	1505	11	X			
	LOBO-TP3-135	Test Pit	0-6	6/22/07	1505	11	X			Rep. Of LOBO-TP3-134
	LOBO-TP4-136	Test Pit	0-6	6/22/07	1520	11	X			
Topsoil Stockpiles										
Topsoil South	TS-TP1-064/065	Test Pit	0-2	6/20/07	1320	10	X		X	
	TS-TP1-066	Test Pit	2-4	6/20/07	1325	11	X	X		
	TS-TP1-067	Test Pit	10	6/20/07	1335	10	X			
	TS-TP1-068	Test Pit	13	6/20/07	1350	10	X			
Topsoil North	TN-TP1-071	Test Pit	0-2	6/20/07	1500	11	X		X	
	TN-TP1-072	Test Pit	0-2	6/20/07	1500	11	X		X	
	TN-TP1-073	Test Pit	2-4	6/20/07	1505	11	X	X		
	TN-TP1-074	Test Pit	10	6/20/07	1515	10	X			
	TN-TP1-075	Test Pit	15	6/20/07	1530	10	X			
Topsoil/ Overburden	TO-TP1-015/016	Test Pit	0-2	6/19/07	855	11	X		X	
	TO-TP1-017	Test Pit	2-4	6/19/07	905	11.5	X			
	TO-TP1-018	Test Pit	10	6/19/07	915	12	X			
	TO-TP1-019	Test Pit	15	6/19/07	955	11.5	X			
Non-Economic Materials Storage Areas										
Pile 3	P3-DH7-002	Drillhole	2-4	7/16/07	11:25	75	X		X	
	P3-DH7-009	Drillhole	52-60	7/16/07	12:00	70		X		
	P3-DH7-015	Drillhole	100-108	7/16/07	12:30	75	X			
	P3-DH8-001	Drillhole	0-2	7/6/07	16:10	135			X	
	P3-DH8-005	Drillhole	20-28	7/6/07	16:47	140	X	X		
	P3-DH8-007	Drillhole	36-44	7/6/07	16:57	125	X			
	P3-DH8-301	Drillhole	36-44	7/6/07	17:07	125				Rep. of P3-DH8-007.
	P3-DH8-010	Drillhole	60-68	7/16/07	8:05	130	X			
	P3-DH8-302	Drillhole	60-68	7/16/07	8:05	130	X			Rep. of MD-DH8-010.
	P3-DH8-014	Drillhole	92-100	7/16/07	8:30	120			X	
Pile 4	P4-DH1-001	Drillhole	0-2	7/3/07	8:10	13			X	
	P4-DH1-013	Drillhole	84-92	7/3/07	13:10	15	X			
	P4-DH1-015	Drillhole	100-108	7/3/07	13:35	25	X	X		
	P4-DH2-001	Drillhole	0-2	7/2/07	12:31	11			X	
	P4-DH2-010	Drillhole	60-68	7/2/07	13:55	23	X			
	P4-DH2-011	Drillhole	68-76	7/2/07	11:30	35	X	X		
	P4-DH3-001	Drillhole	0-2	7/1/07	10:55	25			X	
	P4-DH3-004	Drillhole	12-20	7/1/07	11:10	30	X	X		
	P4-DH3-005	Drillhole	20-28	7/1/07	11:10	30	X			
	P4-DH3-300	Drillhole	20-28	7/1/07	11:15	30	X			Rep. of P4-DH3-005.
	P4-DH4-001	Drillhole	0-2	7/4/07	8:34	18			X	
	P4-DH4-012	Drillhole	76-84	7/4/07	9:46	35	X			
	P4-DH4-014	Drillhole	92-100	7/4/07	10:04	45	X	X		
	P4-DH5-001	Drillhole	0-2	7/6/07	9:45	14			X	
	P4-DH5-007	Drillhole	36-44	7/6/07	10:15	30	X			
	P4-DH5-016	Drillhole	108-116	7/6/07	11:30	45	X	X		
	P4-DH6-001	Drillhole	0-2	7/4/07	14:09	16			X	
	P4-DH6-007	Drillhole	36-44	7/4/07	14:44	35	X			
	P4-DH6-008	Drillhole	44-52	7/4/07	14:52	40	X	X		

Table 1
Summary of Soil Sampling Program

	Sample Number	Location Type	Depth Interval	Date	Time	Gamma in μR/hr	Analysis			Notes
							Rads	SPLP	Agro	
Pile 5	P5-TP1-009	Test Pit	0-2	6/18/07	1610	90	--	--	--	Gamma only
	P5-TP1-010	Test Pit	0-2	6/18/07	1610	90	X	X		
	P5-TP1-011/012	Test Pit	2-4	6/18/07	1620	90	X		X	
	P5-TP1-013	Test Pit	10	6/18/07	1630	90	--	--	--	Gamma only
	P5-TP1-014	Test Pit	15	6/18/07	1720	90	--	--	--	
Pile 6	P6-TP1-027	Test Pit	0-2	6/19/07	1330	95	--	--	--	Gamma only
	P6-TP1-028	Test Pit	0-2	6/19/07	1330	95	X			
	P6-TP1-029	Test Pit	2-4	6/19/07	1335	90	--	--	--	Gamma only
	P6-TP1-030	Test Pit	10	6/19/07	1335	90	X	X		
	P6-TP1-301	Test Pit	10	6/19/07	1335	90	X			Rep. of P6-TP1-030
	P6-TP1-031	Test Pit	13.5	6/19/07	1410	90	--	--	--	
West Disturbance Area	P6-TP2-032/033	Test Pit	0-2	6/19/07	1425	160	X		X	
	P6-TP2-034	Test Pit	2-4	6/19/07	1435	155	--	--	--	Gamma only
	P6-TP2-035	Test Pit	10	6/19/07	1450	175	X	X		
	P6-TP2-036	Test Pit	15	6/19/07	1505	165	--	--	--	
	P6-TP3-037/038	Test Pit	0-2	6/19/07	1520	140	X		X	
	P6-TP3-039	Test Pit	2-4	6/19/07	1530	150	X	X		
	P6-TP3-040	Test Pit	9	6/19/07	1540	140	--	--	--	
	P6-TP3-302	Test Pit	9	6/19/07	1540	140	X			Rep. of P6-TP3-039
	P6-TP4-043/044	Test Pit	0-2	6/19/07	1620	250	X		X	
	P6-TP4-045	Test Pit	2-4	6/19/07	1630	150	--	--	--	Gamma only
	P6-TP4-046	Test Pit	10	6/19/07	1640	160	--	--	--	Gamma only
	P6-TP4-047	Test Pit	15	6/19/07	1650	175	X	X		
	P6-TP5-057/058	Test Pit	0-2	6/20/07	1045	120	X		X	
	P6-TP5-059	Test Pit	2-4	6/20/07	1050	125	X			
	P6-TP6-060	Test Pit	0-2	6/20/07	1115	190	X		X	
	P6-TP6-304	Test Pit	0-2	6/20/07	1115	170	X			Rep. of P6-TP6-060.
	P6-TP6-061	Test Pit	2-4	6/20/07	1120	160	X			
	P6-TP6-062	Test Pit	10	6/20/07	1130	150	--	--	--	Gamma only
	P6-TP6-063	Test Pit	15	6/20/07	1145	150	--	--	--	Gamma only
Pile 7	P7-TP2-020/021	Test Pit	0-2	6/19/07	1040	100	X		X	
	P7-TP2-300	Test Pit	0-2	6/19/07	1040	110	X			Rep. of P7-TP2-021/020
	P7-TP2-022	Test Pit	2-4	6/19/07	1045	110	X	X		
Crusher/ Stockpile Area	P7-TP1-001/002	Test Pit	0-2	6/18/07	1425	120	X		X	
	P7-TP1-003	Test Pit	2-4	6/18/07	1430	105	--	--	--	Gamma only
	P7-TP1-004	Test Pit	2-4	6/18/07	1430	120	--	--	--	Gamma only
	P7-TP1-005	Test Pit	10	6/18/07	1500	130	X	X		
	P7-TP1-006	Test Pit	10	6/18/07	1500	120	--	--	--	Gamma only
	P7-TP1-007	Test Pit	12.5	6/18/07	1520	120	--	--	--	
	P7-TP1-008	Test Pit	12.5	6/18/07	1520	120	--	--	--	Gamma only
	P7-TP3-023/024	Test Pit	0-2	6/19/07	1100	140	X		X	
	P7-TP3-025	Test Pit	2-4	6/19/07	1110	155	--	--	--	Gamma only
	P7-TP3-026	Test Pit	10	6/19/07	1120	155	X	X		
	P7-TP3-027	Test Pit	13.5	6/19/07	1135	145	--	--	--	
	P7-TP4-048/049	Test Pit	0-2	6/20/07	935	250	X		X	
	P7-TP4-050	Test Pit	2-4	6/20/07	940	220	X	X		
	P7-TP4-303	Test Pit	2-4	6/20/07	940	220	X			Rep. of P7-TP4-050.
	P7-TP4-051	Test Pit	10	6/20/07	950	220	--	--	--	Gamma only
	P7-TP4-052	Test Pit	13	6/20/07	955	230	--	--	--	
	P7-TP5-053/054	Test Pit	0-2	6/20/07	1010	145	X		X	
	P7-TP5-055	Test Pit	2-4	6/20/07	1015	150	X	X		
	P7-TP5-056	Test Pit	10	6/20/07	1025	145	--	--	--	
Western Shaft Area										
Mine Dump	MD-DH9-002	Drillhole	2-4	7/16/07	16:23	65	X			
	MD-DH9-003	Drillhole	4-12	7/16/07	16:28	60	X		X	
	MD-DH10-001	Drillhole	0-2	7/17/07	8:10	110		X		
	MD-DH10-002	Drillhole	2-4	7/17/07	8:12	110	X			
	MD-DH10-303	Drillhole	2-4	7/17/07	8:12	95	X			Rep. of MD-DH10-002.
	MD-DH10-004	Drillhole	12-20	7/17/07	8:23	95	X		X	
	Mine Dump	30-Pt Comp.	0.25	6/21/07	1130	n/a		X		All composite sample IDs end in "-SPLP-COMP"
Shaft Pad	SP-TP2-086/087	Test Pit	0-1	6/21/07	1030	55	X		X	
	SP-TP2-088	Test Pit	0-1	6/21/07	1030	55	X	X		

Table 1 Summary of Soil Sampling Program										
	Sample Number	Location Type	Depth Interval	Date	Time	Gamma in µR/hr	Analysis			Notes
							Rads	SPLP	Agro	
Pond 1	PO1-TP1-099/100	Test Pit	0-2	6/21/07	1245	110	X		X	
	PO1-TP1-308	Test Pit	0-2	6/21/07	1245	130	X			Rep. of PO1-TP1-099/100
	PO1-TP1-101	Test Pit	2-4	6/21/07	1300	90	--	--	--	
	PO1-TP1-102	Test Pit	2-4	6/21/07	1300	90	--	--	--	Gamma only
	PO1-TP1-103	Test Pit	0-2	6/21/07	1300	95	X			
	Pond 1	30-Pt Comp.	0.25	6/21/07	1245	n/a		X		All composite sample IDs end in "-SPLP-COMP"
Pond 2	PO2-TP2-104	Test Pit	0-2	6/21/07	1315	90	--	--	--	Gamma only
	PO2-TP2-105/110	Test Pit	0-2	6/21/07	1315	120	X		X	
	PO2-TP2-309	Test Pit	0-2	6/21/07	1330	90	X			Rep. of PO2-TP2-105/110.
	PO2-TP2-106	Test Pit	2-4	6/21/07	1320	70	X	X		
	PO2-TP2-107	Test Pit	2-4	6/21/07	1320	70	--	--	--	Gamma only
	PO2-TP2-108	Test Pit	6	6/21/07	1325	60	X			
	PO2-TP2-109	Test Pit	6	6/21/07	1325	45				Gamma only
	Pond 2	30-Pt Comp.	0.25	6/21/07	1300	n/a		X		All composite sample IDs end in "-SPLP-COMP"
Pond 3	PO3-TP3-114/115	Test Pit	0-2	6/21/07	1420	65	X		X	
	PO3-TP3-116	Test Pit	0-2	6/21/07	1420	80	X	X		
	Pond 3	30-Pt Comp.	0.25	6/21/07	1315	n/a		X		All composite sample IDs end in "-SPLP-COMP"
Pond 4	PO4-TP4-111/112	Test Pit	0-2	6/21/07	1355	90	X		X	
	PO4-TP4-113	Test Pit	0-2	6/21/07	1355	120	X	X		
	Pond 4	30-Pt Comp.	0.25	6/21/07	1330	n/a		X		All composite sample IDs end in "-SPLP-COMP"
Pond 5	PO5-TP5-117/118	Test Pit	0-2	6/21/07	1440	n/a	X		X	
	PO5-TP5-119	Test Pit	0-2	6/21/07	1440	n/a	X	X		
	Pond 5	30-Pt Comp.	0.25	6/21/07	1230	n/a		X		All composite sample IDs end in "-SPLP-COMP"
Ore Storage 1	OS1-TP6-079/080	Test Pit	0-2	6/21/07	910	90	X		X	
	OS1-TP6-306	Test Pit	0-2	6/21/07	910	90	X			Rep. of 79/80 or 081?
	OS1-TP6-081	Test Pit	2-4	6/21/07	915	70	X	X		
	OS1-TP6-082	Test Pit	6	6/21/07	920	80	X			Very high gamma readings, 1000+ µR/hr in the area.
	Ore Storage 1	30-Pt Comp.	0.25	7/1/07	9/26/02	n/a		X		All composite sample IDs end in "-SPLP-COMP"
Ore Storage 2	OS2-TP5-092/093	Test Pit	0-2	6/21/07	1110	90	X		X	
	OS2-TP5-094	Test Pit	2-4	6/21/07	1115	45	X	X		
	OS2-TP5-096	Test Pit	6	6/21/07	1120	50	X			
	OS2-TP5-098	Test Pit	0-2	6/21/07	1120	80	X			High gamma readings, around 600-700 µR/hr
	Ore Storage 2	30-Pt Comp.	0.25	7/1/07	10/26/02	n/a		X		All composite sample IDs end in "-SPLP-COMP"
Access Road	AR7-TP1-076	Test Pit	0-1.5	6/20/07	1545	60	X			
	AR15-TP1-077	Test Pit	0-1.5	6/20/07	1605	60	X			
	AR19-TP1-078	Test Pit	0-1.5	6/20/07	1610	n/a	X			
	AR24-TP1-083	Test Pit	0-1.5	6/21/07	940	70	X			
	AR34-TP1-084	Test Pit	0-1.5	6/21/07	1015	20	X			
	AR34-TP1-085	Test Pit	0-1.5	6/21/07	1015	21	--	--	--	
Storage Area	SA-TP1-089	Test Pit	0-1	6/21/07	1045	12	X		X	
	SA-TP1-090	Test Pit	0-1	6/21/07	1045	12	X		X	
	SA-TP1-307	Test Pit	0-1	6/21/07	1045	12	X			Rep. of SA-TP1-090
	SA-TP1-091	Test Pit	0-1	6/21/07	1045	12		X		
	Storage Area	30-Pt Comp.	0.25	6/21/07	1120	n/a		X		All composite sample IDs end in "-SPLP-COMP"

Notes:
Rads = radiochemcial constituents, agro = agronomic parameters
SPLP = Synthetic Precipitation Leachate Procedure constituents
"Rep. = replicate, which are soil sample splits from the same sampling location and interval

Table 2 Soil Analytical Program		
Analyte	**Detection Limit**	**Extraction/Analytical Method**
Radiochemical Analytes		
Uranium	0.001 mg/g	EPA M6020, ICP/MS
Gross Alpha	2 pCi/g	ESM 4103
Radium 226	1.0 pCi/g	EPA M9315
Thorium 230	0.2 pCi/g	ESM 4506
Synthetic Precipitation Leachate Precedure Analytes		
Aluminum	0.1 mg/l	EPA 200.7, ICP
Arsenic	0.001 mg/l	EPA 200.7, ICP
Barium	0.010 mg/l	EPA 200.7, ICP
Calcium	0.20 mg/l	EPA 200.7, ICP
Lead	0.04 mg/l	EPA 200.7, ICP
Manganese	0.010 mg/l	EPA 200.7, ICP
Magnesium	0.020 mg/l	EPA 200.7, ICP
Molybdenum	0.001 mg/l	EPA 200.7, ICP
Potassium	3.0 mg/l	EPA 200.7, ICP
Selenium	0.001 mg/l	EPA 200.7, ICP
Sodium	5.0 mg/l	EPA 200.7, ICP
Uranium	0.0001 mg/l	EPA 200.8, ICP-MS
Vanadium	0.005 mg/l	EPA 200.7, ICP
Gross Alpha	1 pCi/l	EPA 900.0
Radium 226	1 pCi/l	EML HASL 300, 4.5.2.3
Radium 228	1.4 pCi/l	EML HASL 300, 4.5.2.3
Agronomic Analytes		
pH	0.01 s.u.	ASA No. 9, Method 10-3.2
Electrical Conductivity	0.01 mmhos/cm	ASA No. 9, Method 10-3.3
Saturation Percentage	0.10%	USDA Handbook 60, Method 27A
Texture	1%	ASA No. 9, Method 15-5
Rock Fragment Percentage	–	ASA No. 9, Method 15-5
Sodium Adsorption Ratio (SAR)	0.01	ASA No. 9, Method 10-3.4
Nitrate as N	1 mg/kg	ASA No. 9, Method 33-3
Phosphorous	1 mg/kg	ASA No. 9, Method 24-2
Potassium	1 mg/kg	EPA 200.7
Chloride	5 mg/kg	SW6010B
Sulfate	0.1 mg/kg	SW6010B
Organic Carbon	0.00%	ASA No. 9, Method 29-3.5.2
Arsenic	5 µg/Kg	Water Extraction
Cadmium	10 µg/Kg	DPTA Extraction
Chromium	50 µg/Kg	Total, SW-846
Copper	6 µg/Kg	DPTA-TEA Extraction
Lead	10 µg/Kg	DPTA Extraction
Mercury	5 µg/Kg	Total, SW-846
Selenium	5 µg/Kg	Water Extraction
Zinc	10 µg/Kg	DPTA Extraction
Nickel	10 µg/Kg	DPTA Extraction
Note:		
1. All SPLP parameters are for dissolved fraction.		

Table 3 Summary of Gamma Radiation Survey Results			
Location ID	**Contact Shielded**	**1-Meter Shielded**	**1-Meter Unshielded**
Background and Borrow Areas			
Background Reference Area			
BCKA L1-1	5	6	11
BCKA L1-2	5	5	11
BCKA L1-3	5	6	11
BCKA L1-4	6	6	13
BCKA L1-5	6	6	14
BCKA L1-6	8	8	17
BCKA L2-1	6	6	13
BCKA L2-2	7	8	15
BCKA L2-3	9	8	17
BCKA L2-4	8	8	16
BCKA L2-5	9	9	18
BCKA L2-6	8	8	18
BCKA L3-1	13	12	21
BCKA L3-2	10	10	19
BCKA L3-3	9	9	19
BCKA L3-4	11	11	21
BCKA L3-5	11	11	21
BCKA L3-6	8	9	21
Mean	**8**	**8**	**16**
Minimum	**5**	**5**	**11**
Maximum	**13**	**12**	**21**
Borrow Area South			
BA3 L1-1	7	8	11
BA3 L1-2	10	11	26
BA3 L1-3	8	11	26
BA3 L1-4	9	10	25
BA3 L2-1	7	8	17
BA3 L2-2	6	7	16
BA3 L2-3	5	6	16
BA3 L2-4	6	6	16
BA3 L3-1	8	9	17
BA3 L3-2	6	6	13
BA3 L3-3	5	6	13
BA3 L3-4	6	7	15
BA3 L4-1	8	8	14
BA3 L4-2	6	6	13
BA3 L4-3	6	6	14
BA3 L4-4	7	7	17
BA3 L5-1	6	6	11
BA3 L5-2	7	7	14
Mean	**7**	**8**	**16**
Minimum	**5**	**6**	**11**
Maximum	**10**	**11**	**26**

Table 3 Summary of Gamma Radiation Survey Results			
Location ID	**Contact Shielded**	**1-Meter Shielded**	**1-Meter Unshielded**
Lobo Tract Area			
L-1	6	7	16
L-2	6	6	7
L-3	5	6	13
L-4	7	7	15
L-5	6	6	13
L-6	6	6	12
L-7	6	6	12
L-8	5	5	10
L-9	5	5	11
L-10	7	7	15
L-11	7	7	15
L-12	7	7	15
L-13	7	7	15
L-14	7	7	15
L-15	8	8	17
L-16	7	7	16
L-17	8	7	15
L-18	7	7	14
L-19	7	8	14
L-20	7	8	15
L-21	7	7	14
Mean	**7**	**7**	**14**
Minimum	**5**	**5**	**7**
Maximum	**8**	**8**	**17**
Former Borrow Areas			
Area 1			
BA1 L1-1	5	5	9
BA1 L1-2	5	5	11
BA1 L1-3	6	5	11
BA1 L1-4	7	8	13
BA1 L1-5	6	6	11
BA1 L2-1	6	5	10
BA1 L2-2	5	4	9
BA1 L2-3	6	6	11
BA1 L2-4	4	4	8
BA1 L2-5	6	6	11
BA1 L3-1	5	5	10
BA1 L3-2	5	5	9
BA1 L3-3	7	7	11
BA1 L3-4	4	4	8
BA1 L3-5	6	6	12
BA1 L4-1	5	5	11
BA1 L4-2	5	4	8
BA1 L4-3	5	5	10
BA1 L4-4	6	6	11
BA1 L4-5	4	5	9
BA1 L5-1	6	6	12
BA1 L5-2	4	4	9
BA1 L5-3	5	5	9
BA1 L5-4	5	5	10
BA1 L5-5	6	6	11

Table 3 Summary of Gamma Radiation Survey Results			
Location ID	**Contact Shielded**	**1-Meter Shielded**	**1-Meter Unshielded**
Area 2			
BA2 L1-1	5	5	10
BA2 L1-2	5	5	9
BA2 L1-3	5	5	10
BA2 L1-4	4	4	9
BA2 L2-1	7	7	13
BA2 L2-2	5	5	10
BA2 L2-3	6	6	11
BA2 L2-4	4	4	8
BA2 L3-1	4	4	8
BA2 L3-2	6	6	11
BA2 L3-3	4	5	9
BA2 L4-1	6	5	10
BA2 L4-2	5	5	9
BA2 L4-3	6	6	10
BA2 L5-1	5	5	9
BA2 L5-2	5	5	9
BA2 L5-3	5	5	9
BA2 L5-4	6	6	10
BA2 L6-1	5	5	11
BA2 L6-2	5	6	11
BA2 L6-3	5	5	10
BA2 L6-4	5	5	9
BA2 L7-1	5	6	11
BA2 L7-2	5	5	9
BA2 L7-3	4	4	9
BA2 L7-4	7	6	13
BA2 L8-1	5	5	9
BA2 L8-2	5	5	8
BA2 L8-3	5	5	9
BA2 L9-1	5	5	9
Mean	**5**	**5**	**10**
Minimum	**4**	**4**	**8**
Maximum	**7**	**8**	**13**
Soil Stockpiles			
Shale 1			
S1 L1-1	7	8	14
S1 L1-2	6	6	13
S1 L1-3	13	11	16
S1 L2-1	6	7	13
S1 L2-2	7	6	14
S1 L3-1	7	8	14
Mean	**8**	**8**	**14**
Minimum	**6**	**6**	**13**
Maximum	**13**	**11**	**16**

Table 3 Summary of Gamma Radiation Survey Results			
Location ID	**Contact Shielded**	**1-Meter Shielded**	**1-Meter Unshielded**
Shale 2			
S2 L1-1	6	5	11
S2 L1-2	5	5	12
S2 L1-3	11	8	14
S2 L2-1	8	8	14
S2 L2-2	13	11	19
S2 L3-2	5	5	12
S2 L3-3	6	6	13
Mean	**8**	**7**	**14**
Minimum	**5**	**5**	**11**
Maximum	**13**	**11**	**19**
Topsoil Pile South			
TS-110	5	6	12
TS-111	7	7	13
TS-112	5	5	12
TS-113	7	8	15
TS-267	6	6	13
TS-268	9	9	14
Mean	**7**	**7**	**13**
Minimum	**5**	**5**	**12**
Maximum	**7**	**8**	**15**
Top Soil Pile North			
TS L2-1	7	7	16
TS L2-2	6	7	19
TS L2-3	7	9	22
RSP TPL	6	7	18
Mean	**7**	**8**	**19**
Minimum	**6**	**8**	**19**
Maximum	**6**	**8**	**20**
Topsoil/Overburden Pile			
TS OB L1-1	9	11	25
TS OB L1-2	7	9	23
TS OB L1-3	9	9	22
TS OB L1-4	8	9	20
TS OB L1-5	7	8	16
TS OB L2-1	12	13	34
TS OB L2-2	13	14	34
TS OB L2-3	10	11	30
TS OB L2-4	10	11	25
Mean	**9**	**11**	**25**
Minimum	**7**	**8**	**16**
Maximum	**13**	**14**	**34**
FL Area			
FL-264	35	29	51
FL-265	26	25	46
FL-266	17	17	31

Table 3 Summary of Gamma Radiation Survey Results			
Location ID	**Contact Shielded**	**1-Meter Shielded**	**1-Meter Unshielded**
Mine Area Non-Economic Materials Piles			
Pile 3			
P3	23	26	60
P3 NE 117	75	65	105
P3 NW 116	34	33	70
P3 SE 115	33	33	65
P3 SW 114	32	30	65
P3-278	50	42	75
P3-279	14	14	36
P3-280	20	21	46
P3-281	37	31	65
P3-282	26	27	60
P3-283	21	20	46
P3-284	27	32	62
P3-286	40	38	70
P3-287	46	46	98
P3-288	125	110	165
P3-289	55	70	125
P3-290	26	34	80
P3-291	40	46	105
P3-292	60	60	105
P3-293	85	75	135
Mean	**43**	**43**	**82**
Minimum	**14**	**14**	**36**
Maximum	**125**	**110**	**165**
Pile 4			
P4 L10-1	25	26	46
P4 L10-2	25	27	47
P4 L10-3	40	28	50
P4 L10-4	37	33	65
P4 L10-5	12	13	28
P4 L10-6	6	7	15
P4 L10-7	7	7	15
P4 L1-1	7	7	14
P4 L11-1	23	18	35
P4 L11-2	10	11	23
P4 L11-3	7	8	17
P4 L11-4	7	6	15
P4 L11-5	6	7	15
P4 L1-2	5	6	13
P4 L12-1	13	15	29
P4 L12-2	13	23	45
P4 L1-3	5	5	13
P4 L13-1	9	9	16
P4 L14-1	12	15	30
P4 L14-2	11	11	18
P4 L2-1	11	11	25
P4 L2-2	9	9	18
P4 L2-3	6	6	13
P4 L2-4	5	6	13
P4 L2-5	5	5	13
P4 L2-6	13	17	35
P4 L2-7	10	11	25

Table 3 Summary of Gamma Radiation Survey Results			
Location ID	**Contact Shielded**	**1-Meter Shielded**	**1-Meter Unshielded**
P4 L2-8	7	8	16
P4 L3-1	11	11	25
P4 L3-2	6	6	14
P4 L3-3	7	6	13
P4 L3-4	6	7	14
P4 L3-5	31	22	35
P4 L3-6	26	26	30
P4 L3-7	23	23	40
P4 L3-8	26	24	43
P4 L4-1	9	10	28
P4 L4-10	5	5	15
P4 L4-2	9	11	24
P4 L4-3	7	8	19
P4 L4-4	6	6	14
P4 L4-5	5	6	13
P4 L4-6	6	7	15
P4 L4-7	15	15	30
P4 L4-8	8	10	24
P4 L4-9	9	9	21
P4 L5-1	11	12	36
P4 L5-10	15	15	27
P4 L5-11	10	11	25
P4 L5-2	9	10	27
P4 L5-3	20	16	30
P4 L5-4	9	11	31
P4 L5-5	7	9	17
P4 L5-6	6	6	14
P4 L5-7	8	7	18
P4 L5-8	24	27	55
P4 L5-9	5	7	17
P4 L6-1	22	24	60
P4 L6-2	9	9	26
P4 L6-4	8	9	22
P4 L6-5	7	7	18
P4 L6-6	20	17	34
P4 L6-7	27	23	40
P4 L7-1	25	25	55
P4 L7-2	18	19	38
P4 L7-3	9	10	24
P4 L7-4	22	22	42
P4 L7-4	26	27	55
P4 L7-5	24	25	58
P4 L7-6	36	34	60
P4 L7-7	22	21	41
P4 L7-8	12	12	26
P4 L8-1	26	30	65
P4 L8-10	10	16	32
P4 L8-11	7	8	16
P4 L8-2	22	21	45
P4 L8-3	13	13	30
P4 L8-4	7	10	21
P4 L8-5	7	8	19
P4 L8-6	9	9	19

Table 3 Summary of Gamma Radiation Survey Results			
Location ID	**Contact Shielded**	**1-Meter Shielded**	**1-Meter Unshielded**
P4 L8-7	7	7	18
P4 L8-8	9	9	20
P4 L8-9	36	30	55
P4 L9-1	13	14	34
P4 L9-2	14	15	32
P4 L9-3	7	7	17
P4 L9-4	7	7	16
P4 L9-5	6	7	17
P4 L9-6	7	8	17
P4 L9-7	7	7	16
P4 L9-8	5	5	13
SW P-4	23	23	50
Mean	**13**	**13**	**28**
Minimum	**5**	**5**	**13**
Maximum	**40**	**34**	**65**
Pile 5			
P5 L1-1	105	105	180
P5 L1-2	45	50	105
P5 L2-1	80	90	180
P5 L2-2	90	90	170
P5 L2-3	70	70	125
P5 L3-1	55	60	125
Mean	**74**	**78**	**148**
Minimum	**45**	**50**	**105**
Maximum	**105**	**105**	**180**
Pile 6			
P6-234	34	34	80
P6-235	35	38	85
P6-236	45	45	100
P6-237	40	45	95
P6-238	65	50	95
P6-239	30	32	70
P6-240	55	57	115
P6-241	30	30	70
Mean	**42**	**41**	**89**
Minimum	**30**	**30**	**70**
Maximum	**65**	**57**	**115**
Pile 7			
P7-229	60	55	135
P7-230	130	150	230
P7-231	65	65	130
P7-232	180	135	245
P7-233	410	320	600
Mean	**169**	**145**	**268**
Minimum	**60**	**55**	**130**
Maximum	**410**	**320**	**600**

Table 3 Summary of Gamma Radiation Survey Results			
Location ID	**Contact Shielded**	**1-Meter Shielded**	**1-Meter Unshielded**
West Disturbance Area			
WDA-242	320	200	300
WDA-243	160	160	300
WDA-244	300	290	440
WDA-245	205	165	290
WDA-246	140	135	235
WDA-247	150	150	245
WDA-248	35	45	105
WDA-249	55	70	190
WDA-250	120	115	235
WDA-251	150	145	295
WDA-252	230	230	370
WDA-253	90	85	165
WDA-254	125	120	210
WDA-255	70	70	140
WDA-256	135	100	170
WDA-257	115	140	280
WDA-258	115	105	185
WDA-259	105	105	190
WDA-260	195	165	250
WDA-261	100	90	150
WDA-262	100	90	170
Mean	**144**	**132**	**234**
Minimum	**35**	**45**	**105**
Maximum	**320**	**290**	**440**
Crusher/Stockpile Area			
CSA L1-1	33	32	75
CSA L1-2	25	25	65
CSA L1-3	28	32	79
CSA L1-4	23	28	75
CSA L1-5	35	35	85
CSA L1-6	60	62	105
CSA L2-1	120	125	190
CSA L2-2	40	45	105
CSA L2-3	90	85	175
CSA L2-4	70	90	195
CSA L2-5	95	100	195
CSA L2-6	105	105	205
CSA L2-7	65	70	140
CSA L3-1	65	65	135
CSA L3-2	45	45	120
CSA L3-3	110	115	220
CSA L3-4	175	175	320
CSA L3-5	110	110	220
CSA L3-6	125	130	240
CSA L3-7	185	180	265
CSA L4-1	165	160	280
CSA L4-2	470	330	490
CSA L4-3	80	75	175
CSA L4-4	115	110	215
CSA L4-5	435	460	800
CSA L4-6	210	210	350
CSA L4-7	235	210	330

Table 3 Summary of Gamma Radiation Survey Results			
Location ID	**Contact Shielded**	**1-Meter Shielded**	**1-Meter Unshielded**
CSA L5-1	125	140	250
CSA L5-2	220	200	330
CSA L5-3	105	105	200
CSA L5-4	85	90	175
CSA L5-5	200	240	410
CSA L5-6	85	85	210
CSA L5-7	110	115	220
CSA L6-1	25	35	95
CSA L6-2	115	120	240
CSA L6-3	140	130	240
CSA L6-4	65	80	160
CSA L6-5	35	45	125
CSA L6-6	135	120	215
CSA L6-7	145	135	245
CSA L7-1	70	70	155
CSA L7-2	410	330	450
CSA L7-3	70	75	155
CSA L7-4	85	85	180
CSA L7-5	110	115	235
CSA L8-1	25	35	80
CSA L8-2	100	90	180
CSA L8-3	34	35	100
Mean	**119**	**116**	**214**
Minimum	**23**	**25**	**65**
Maximum	**470**	**460**	**800**
Open Pit 1			
Pit1-165	58	50	95
Pit1-166	50	45	85
Pit1-167	38	35	70
Pit1-168	33	35	70
Pit1-169	20	25	62
Pit1-170	40	47	80
Pit1-171	29	39	70
Pit1-172	26	27	60
Pit1-173	28	34	80
Pit1-174	32	37	79
Pit1-175	63	72	138
Mean	**38**	**41**	**81**
Minimum	**20**	**25**	**60**
Maximum	**63**	**72**	**138**
Western Shaft Area			
Mine Dump			
MD-1	90	85	140
MD-2	175	140	225
MD-3	250	160	230
MD-4	140	135	215
MD-6	65	75	140
Mean	**144**	**119**	**190**
Minimum	**65**	**75**	**140**
Maximum	**250**	**160**	**230**

Table 3 Summary of Gamma Radiation Survey Results			
Location ID	**Contact Shielded**	**1-Meter Shielded**	**1-Meter Unshielded**
Shaft Pad			
SP-1	33	37	70
SP-2	48	40	70
SP-3	20	22	50
Mean	**34**	**33**	**63**
Minimum	**20**	**22**	**50**
Maximum	**48**	**40**	**70**
Storage Area			
SA-1	6	7	15
SA-2	7	7	15
Mean	**7**	**7**	**15**
Shaft Area Ponds			
SP1-1 (Pond 1)	260	210	300
SP2-2 (Pond 2)	140	150	260
SPM-6 (between Ponds 2 & 3)	7	8	22
SP3-3 (Pond 3)	45	50	95
SP4-4 (Pond 4)	280	260	390
P5-1 (Pond 5)	9	9	9
P5-2 (Pond 5)	24	24	24
Mean	**109**	**102**	**157**
Minimum	**7**	**8**	**9**
Maximum	**280**	**260**	**390**
Ore Storage Areas			
OS1-1	115	120	225
OS1-2	140	100	180
OS1-3	130	145	255
OS1-4	125	125	215
OS1-5	160	135	240
OS1-6	235	225	380
OS2-1	30	31	60
OS2-2	36	38	70
OS2-3	33	34	70
OS2-4	50	65	125
OS2-5	600	400	500
OS2-6	20	23	50
Mean	**140**	**120**	**198**
Minimum	**20**	**23**	**50**
Maximum	**600**	**400**	**500**
Shaft Area Access Road			
AR-01	13	12	24
AR-02	10	12	23
AR-03	20	17	30
AR-04	9	9	18
AR-05	7	7	17
AR-06	38	38	70
AR-07	270	210	270
AR-08	40	44	80
AR-10	27	27	49
AR-11	36	34	60
AR-12	26	24	43
AR-13	43	36	65
AR-14	50	45	75
AR-15	220	175	240

Table 3 Summary of Gamma Radiation Survey Results			
Location ID	**Contact Shielded**	**1-Meter Shielded**	**1-Meter Unshielded**
AR-16	40	40	35
AR-17	46	43	75
AR-18	70	80	135
AR-19	130	90	135
AR-20	60	70	125
AR-21	10	14	36
AR-22	90	90	140
AR-23	31	38	100
AR-24	75	50	100
AR-25	21	25	60
AR-26	10	12	30
AR-27	7	9	22
AR-28	8	9	20
AR-29	6	8	22
AR-30	10	14	33
AR-31	13	16	40
AR-32	9	9	24
AR-33	6	7	17
AR-34	70	60	75
Mean	**46**	**42**	**69**
Minimum	**6**	**7**	**17**
Maximum	**270**	**210**	**270**

Notes:

1. Measurements are gamma exposure rate in µR/hr.
2. Measurements collected in the open pit area of the mine, and the former borrow areas 1 and 2 were collected by UNC in April 2006; the remaining measurements from the western Shaft Area and the Lobo Tract parcel were collected in June-July 2007.

Table 4			
Descriptive Statistics, Gamma Measurements			
	Contact Shielded	**1-meter Shielded**	**1m Unshielded**
Background Means	**8**	**8**	**16**
Minimum	5	5	9
Maximum	600	460	800
Mean	58	55	100
Standard Error	5	4	6
Median	26	27	60
Mode	7	7	13
Standard Deviation	81	69	111
Sample Variance	6,600	4,742	12,310
Kurtosis	12	8	7
Skewness	3	2	2
Range	595	455	791
Count	309	309	309

Notes:
1. Measurements are gamma exposure rate in μR/hr.

Table 5 Soil Analytical Results, Radionuclides						
Sample ID	**Depth (ft bgs)**	**Facility**	**Radium-226 pCi/G**	**Uranium mg/kg**	**Thorium-230 pCi/g**	**Gross Alpha pCi/g**
Background Area						
BG-TP1-124	0-2	Test pit	3.2	6.49	1.1	17.6
BG-TP1-125	2-4	Test pit	1.2	1.52	0.3	6.4
BG-TP2-126	0-2	Test pit	1	2.63	0.5	10.2
BG-TP2-127	2-4	Test pit	<1	0.95	0.3	11.3
BG-TP3-120	0-2	Test pit	<1	0.67	0.4	10.1
BG-TP3-310	0-2	Test pit	<1	0.67	0.4	5.7
BG-TP3-121	2-4	Test pit	1.2	1.47	0.3	7.7
BG-TP4-122	0-2	Test pit	3.4	9.18	2.2J	23.4
BG-TP4-123	2-4	Test pit	2	7.2	1.9	15.5
		Minimum	<1	0.67	0.3	6.4
		Maximum	3.4	9.18	2.2	23.4
		Mean	1.6	3.8	0.9	12.8
Borrow Areas						
BS-TP1-041/042	0-6	Borrow Area South	<1	0.69	0.7	5.8
BS-TP2-069/070	0-6	Borrow Area South	<1	0.74	0.3	5.8
BS-TP2-305	0-6	Borrow Area South	<1	0.74	0.2	5.8
LOBO-TP1-130/131	0-6	Lobo Tract	<1	7.79	0.2	9.8
LOBO-TP2-132	0-2	Lobo Tract	<1	1.25	0.3	12.7
LOBO-TP2-133	2-6	Lobo Tract	1.5	1.44	0.3	13.6
LOBO-TP3-134	0-6	Lobo Tract	1.3	1.74	0.4	9
LOBO-TP3-135	0-6	Lobo Tract	1.2	1.67	0.3	8.6
LOBO-TP4-136	0-6	Lobo Tract	<1	1.06	0.3	8.9
		Minimum	<1	0.69	0.2	5.8
		Maximum	1.5	7.79	0.7	13.6
		Mean	0.8	2.1	0.4	9.4
Topsoil Stockpiles						
TO-TP1-015/016	0-2	Topsoil/Overburden	<1	1.02	0.3	6.6
TO-TP1-017	2-4	Topsoil/Overburden	<1	0.83	0.2	7.8
TO-TP1-018	10	Topsoil/Overburden	<1	0.64	<0.2	4.6
TO-TP1-019	15	Topsoil/Overburden	<1	0.79	0.3	9.8
TN-TP1-071	0-2	Topsoil Pile North	<1	0.6	<0.2	7.4
TN-TP1-072	0-2	Topsoil Pile North	<1	0.63	0.2	5.6
TN-TP1-073	2-4	Topsoil Pile North	<1	0.63	<0.2	9.2
TN-TP1-074	10	Topsoil Pile North	<1	0.65	0.3	8.3
TN-TP1-075	15	Topsoil Pile North	<1	0.51	0.2	8.8
TS-TP1-064/065	0-2	Topsoil Pile South	1	1.1	0.3	5.8
TS-TP1-066	2-4	Topsoil Pile South	<1	0.84	0.3	6.2
TS-TP1-067	10	Topsoil Pile South	<1	0.91	0.2	8.5
TS-TP1-068	13	Topsoil Pile South	<1	0.58	<0.2	9.5
		Minimum	<1	0.51	<0.2	4.6
		Maximum	1	1.1	0.3	9.8
		Mean	0.5	0.7	0.2	7.5

Table 5 Soil Analytical Results, Radionuclides						
Sample ID	**Depth (ft bgs)**	**Facility**	**Radium-226 pCi/G**	**Uranium mg/kg**	**Thorium-230 pCi/g**	**Gross Alpha pCi/g**
Non-Economic Material Storage Piles						
Pile 3						
P3-DH7-002	2-4	Pile 3	34.6	125	28	197
P3-DH7-015	100-108	Pile 3	12.5	31.4	7.4	98.4
P3-DH8-005	20-28	Pile 3	11.9	27.4	7.6	69.6
P3-DH8-007	36-44	Pile 3	16.1	71.7	7.6	89.3
P3-DH8-301	36-44	Pile 3	16.1	71.7	6	79.6
P3-DH8-010	60-68	Pile 3	21.1	97.5	16	142
P3-DH8-302	60-68	Pile 3	20	78.5	9.3	112
		Minimum	11.9	27.4	7.4	69.6
		Maximum	34.6	125	28	197
		Mean	19.2	70.6	13.3	119.3
Pile 4						
P4-DH1-013	84-92	Pile 4	3.3	5.53	0.5	16.5
P4-DH1-015	100-108	Pile 4	20	36.5	4.4	63.6
P4-DH2-010	60-68	Pile 4	7.9	36.1	5.7	39
P4-DH2-011	68-76	Pile 4	17.7	69.9	15	98.4
P4-DH3-004	12-20	Pile 4	6.7	17.2	3.8	37.5
P4-DH3-005	20-28	Pile 4	3.2	11.5	0.9J	30.4
P4-DH3-300	20-28	Pile 4	2.5	8.7	1.4J	19.2
P4-DH4-012	76-84	Pile 4	20.7	32.2	6.4	50.3
P4-DH4-014	92-100	Pile 4	47.7	125	21	115
P4-DH5-007	36-44	Pile 4	7.9	37.6	4.1	62.6
P4-DH5-016	108-116	Pile 4	12.7	43.5	11	57.8
P4-DH6-007	36-44	Pile 4	24.9	49.9	6.9	56.7
P4-DH6-008	44-52	Pile 4	29.8	84.8	10	79.2
		Minimum	3.2	5.53	0.5	16.5
		Maximum	47.7	125	21	115
		Mean	16.9	45.8	7.5	58.9
Pile 5						
P5-TP1-010	0-2	Pile 5	70.7	143	27	225
P5-TP1-011/012	2-4	Pile 5	55.1	182	45	243
		Mean	62.9	162.5	36	234
Pile 6						
P6-TP1-028	0-2	Pile 6	41.3	75.5	26	262
P6-TP1-030	10	Pile 6	32.3	80.9	23	169
P6-TP1-301	10	Pile 6	32.3	80.9	23	161
		Minimum	32.3	75.5	23	161
		Maximum	41.3	80.9	26	262
		Mean	36.8	78.2	24.5	215.5

Table 5 Soil Analytical Results, Radionuclides						
Sample ID	**Depth (ft bgs)**	**Facility**	**Radium-226 pCi/G**	**Uranium mg/kg**	**Thorium-230 pCi/g**	**Gross Alpha pCi/g**
West Disturbance Area						
P6-TP2-032/033	0-2	West Disturbance Area[1]	79.7	343	74	491
P6-TP2-035	10	West Disturbance Area[1]	106	421	99	695
P6-TP3-037/038	0-2	West Disturbance Area[1]	65.8	201	47	365
P6-TP3-039	2-4	West Disturbance Area[1]	123	214	136	888
P6-TP3-302	2-4	West Disturbance Area[1]	112	172	136	608
P6-TP4-043/044	0-2	West Disturbance Area[1]	590	1660	602	2490
P6-TP4-047	15	West Disturbance Area[1]	383	1420	574	1640
P6-TP5-057/058	0-2	West Disturbance Area[1]	44.5	46.1	25	165
P6-TP5-059	2-4	West Disturbance Area[1]	24.8	70.2	21	148
P6-TP6-060	0-2	West Disturbance Area[1]	93.8	233	87	501
P6-TP6-304	0-2	West Disturbance Area[1]	89.3	233	63	386
P6-TP6-061	2-4	West Disturbance Area[1]	115	174	104	683
		Minimum	24.8	46.1	21	148
		Maximum	590	1660	602	2490
		Mean	162.6	478.2	176.9	806.6
Pile 7						
P7-TP2-020/021	0-2	Pile 7	26.9	137	19	163
P7-TP2-300	0-2	Pile 7	26.9	87.4	18	163
P7-TP2-022	2-4	Pile 7	23.6	108	21	148
		Mean	25.3	122.5	20	155.5
Crusher Stockpile Area						
P7-TP1-001/002	0-2	Crusher Stockpile Area[1]	10	20.9	5.3	58.6
P7-TP1-005	10	Crusher Stockpile Area[1]	44.2	136	29	218
P7-TP3-023/024	0-2	Crusher Stockpile Area[1]	35.6	175	28	186
P7-TP3-026	10	Crusher Stockpile Area[1]	65.5	332	65	555
P7-TP4-048/049	0-2	Crusher Stockpile Area[1]	119	385	107	706
P7-TP4-050	2-4	Crusher Stockpile Area[1]	98.1	302	54	498
P7-TP4-303	2-4	Crusher Stockpile Area[1]	98.1	302	54	441
P7-TP5-053/054	0-2	Crusher Stockpile Area[1]	39.8	182	34	196
P7-TP5-055	2-4	Crusher Stockpile Area[1]	47.4	154	21	261
		Minimum	10	20.9	5.3	58.6
		Maximum	119.0	385	107	706
		Mean	57.5	211	42.9	334.8
Western Shaft Area						
Mine Dump						
MD-DH9-002	2-4	Mine Dump	39.9	127	38	260
MD-DH9-003	4-12	Mine Dump	28.9	139	26	289
MD-DH10-002	2-4	Mine Dump	74.4	288	71	599
MD-DH10-303	2-4	Mine Dump	74.4	214	71	599
MD-DH10-004	12-20	Mine Dump	38.1	138	31	248
		Minimum	28.9	127	26	248
		Maximum	74.4	288	71	599
		Mean	45.3	173	42	349

Table 5 Soil Analytical Results, Radionuclides						
Sample ID	**Depth (ft bgs)**	**Facility**	**Radium-226 pCi/G**	**Uranium mg/kg**	**Thorium-230 pCi/g**	**Gross Alpha pCi/g**
Shaft Pad						
SP-TP2-086/087	0-1	Shaft Pad	40.1	76.4	13	115
SP-TP2-088	0-1	Shaft Pad	33.9	50.0	11	110
		Mean	37.0	63.2	12	113
Ponds						
PO1-TP1-099/100	0-2	Pond 1	611	578	200	1200
PO1-TP1-308	0-2	Pond 1	520	525	199	1080
PO1-TP1-103	0-2	Pond 1	498	525	221	797
PO2-TP2-105/110	0-2	Pond 2	242	721	144	733
PO2-TP2-309	0-2	Pond 2	49.7	448	63	419
PO2-TP2-106	2-4	Pond 2	42.3	269	31	133
PO2-TP2-108	6	Pond 2	<1	7.5	0.3	10.1
PO3-TP3-114/115	0-2	Pond 3	221	364	99	622
PO3-TP3-116	0-2	Pond 3	161	674	280	1140
PO4-TP4-111/112	0-2	Pond 4	352	1090	243	1170
PO4-TP4-113	0-2	Pond 4	266	809	155	985
PO5-TP5-117/118	0-2	Pond 5	2.3	7.59	0.9	16
PO5-TP5-119	0-2	Pond 5	8.3	18	4.7	26.9
		Minimum	<1	7.5	0.3	10.1
		Maximum	611	1090	280	1200
		Mean	218.6	460.3	125.4	621.2
Ore Storage Areas						
OS1-TP1-081	2-4	Ore Storage Area 1	13	47.9	6.7	59.7
OS1-TP6-079/080	0-2	Ore Storage Area 1	15.7	295	22	168
OS1-TP6-306	0-2	Ore Storage Area 1	15.7	295	22	168
OS1-TP6-082	6	Ore Storage Area 1	9.7	32.4	5.9	59
OS2-TP5-092/093	0-2	Ore Storage Area 2	181	573	123	653
OS2-TP5-094	2-4	Ore Storage Area 2	8.3	19	8.1	37.7
OS2-TP5-096	6	Ore Storage Area 2	2.4	7.48	1.3	16.4
OS2-TP5-098	0-2	Ore Storage Area 2	43.9	105	28	151
		Minimum	2.4	7.48	1.3	16.4
		Maximum	181	573	123	653
		Mean	39.1	154.3	27.9	163.5
Access Road						
AR7-TP1-076	0-1.5	Access Rd	94.3	286	71	530
AR15-TP1-077	0-1.5	Access Rd	42.7	99.1	50	181
AR19-TP1-078	0-1.5	Access Rd	52.2	254	39	230
AR24-TP1-083	0-1.5	Access Rd	7.2	17.8	4.2	45.1
AR34-TP1-084	0-1.5	Access Rd	14.3	90.7	13	61.5
		Minimum	7.2	17.8	4.2	45.1
		Maximum	94.3	286	71	530
		Mean	42.1	149.5	35.4	209.5
Storage Area						
SA-TP1-089	0-1	Storage Area	1.1	1.91	0.5	8
SA-TP1-090	0-1	Storage Area	1.1	2.85	0.5	3.9
SA-TP1-307	0-1	Storage Area	<1	1.44	-0.2	3.6
		Mean	1.1	2.4	0.5	6.0

Table 5
Soil Analytical Results, Radionuclides

Sample ID	Depth (ft bgs)	Facility	Radium-226 pCi/G	Uranium mg/kg	Thorium-230 pCi/g	Gross Alpha pCi/g
Site-Wide Statistics						
		Minimum	<1	0.51	<0.2	3.9
		Maximum	611	1660	602	2490
		Average	58.4	159.6	44.1	242.8
		Standard Deviation	114.5	280.6	95.8	393.8

Notes:

J - estimated

1. Test pits in the West Disturbance Area were labeled in the field as Pile 6, and those in the Crusher Stockpile Area were labeled in the field as Pile 7.
2. Replicate samples, which are included in this table, were not included in the statistical summaries.

Table 6				
Descriptive Statistics - Soil Radionuclide Analytical Results				
Statistical Parameter	**Radium-226**	**Uranium**	**Thorium-230**	**Gross Alpha**
	pCi/g	mg/kg	pCi/g	pCi/g
Reporting Limits	**1**	**0.2**	**0.2**	**2**
Background Means	**1.6**	**3.8**	**0.9**	**12.8**
Minimum	<1	0.51	<0.2	4.6
Maximum	611	1,660	602	2,490
Mean	59.9	164.2	45.3	248.4
Standard Error	11.8	29.0	9.9	40.6
Median	18.85	49.95	10.5	84.25
Mode	0.5	182	0.3	5.8
Standard Deviation	115.9	283.7	97.0	398.1
Sample Variance	13,443.2	80,463.6	9,413.0	158,462.8
Kurtosis	11.2	11.9	19.8	11.2
Skewness	3.3	3.2	4.1	2.9
Range	610.5	1,659.5	601.9	2,485.4
Count	96	96	96	96

Notes:

1. One-half the detection limit was used in this statistical analysis for non-detect results.

Table 7
Soil Analytical Results, Synthetic Precipitation Leaching Procedure

			Radionuclides				Metals											
			Gross Alpha	Radium 226	Radium 228	Uranium	Aluminum	Arsenic	Barium	Calcium	Lead	Magnesium	Manganese	Molybdenum	Potassium	Selenium	Sodium	Vanadium
Loc ID	Area	Type	pCi/L	pCi/L	pCi/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Non-Economic Material Storage Areas																		
P3-DH7-009	Pile 3	Drill Hole	10.3	1	<1.4	0.0165	<0.1	<0.001	<0.01	27.9	<0.04	12.8	<0.01	<0.001	<3	<0.002	<5	<0.005
P3-DH8-005	Pile 3	Drill Hole	3.3	<1	5.4	0.0009	<0.1	<0.001	0.01	1.7	<0.04	0.58	<0.01	<0.001	<3	<0.002	6	<0.005
P4-DH1-015	Pile 4	Drill Hole	43.1	3.5	4.3	0.0473	<0.1	<0.001	<0.01	68.8	<0.04	19.1	0.07	<0.001	<3	<0.002	13	<0.005
P4-DH2-011	Pile 4	Drill Hole	2.7	<1	<1.4	0.0005	<0.1	<0.001	<0.01	6	0.05	1.6	0.04	<0.001	<3	<0.002	22	0.005
P4-DH3-004	Pile 4	Drill Hole	56.2	9.2	3.1	0.0651	0.5	<0.001	0.03	25	<0.04	10.4	0.53	<0.001	<3	0.0030	12	<0.005
P4-DH4-014	Pile 4	Drill Hole	133	3.9	3.1	0.087	<0.1	0.002	<0.01	2.1	<0.04	0.29	<0.01	<0.001	<3	<0.002	18	0.006
P4-DH5-016	Pile 4	Drill Hole	33.1	<1	3.3	0.0215	1.5	<0.001	<0.01	2.9	0.07	0.49	<0.01	<0.001	<3	<0.002	18	0.007
P4-DH6-008	Pile 4	Drill Hole	10.6	4.9	1.9	0.0016	<0.1	<0.001	0.01	32.2	<0.04	8.89	0.38	<0.001	<3	<0.002	21	<0.005
P5-TP1-010	Pile 5	Test Pit	23.4	2.4	<1.4	0.0308	2.0	<0.001	<0.01	1.8	<0.04	0.33	<0.01	<0.001	<3	<0.001	9	0.011
P6-TP1-030	Pile 6	Test Pit	18.3	2.7	<1.4	0.0235	0.3	<0.001	<0.01	0.5	<0.04	0.21	<0.01	<0.001	<3	<0.001	7	<0.005
P6-TP2-035	Pile 6	Test Pit	34.3	4	<1.4	0.0189	0.4	<0.001	<0.01	4.4	<0.04	2.72	<0.01	<0.001	<3	<0.001	13	0.007
P6-TP3-039	Pile 6	Test Pit	234	42.2	<1.4	0.204	<0.1	<0.001	0.03	7.7	<0.04	5.16	0.03	<0.001	<3	<0.001	6	<0.005
P6-TP4-047	Pile 6	Test Pit	2,060	385	<1.4	0.719	0.3	<0.001	0.02	24.1	<0.04	6.78	0.08	0.001	<3	<0.001	<5	<0.005
P7-TP1-005	Pile 7	Test Pit	90.6	35.3	<1.4	0.0262	<0.1	<0.001	0.02	9.8	<0.04	3.08	0.14	<0.001	<3	<0.001	10	<0.005
P7-TP2-022	Pile 7	Test Pit	48.3	2	<1.4	0.0886	0.2	<0.001	<0.01	30.6	<0.04	4.62	<0.01	0.001	<3	<0.001	17	<0.005
P7-TP3-026	Pile 7	Test Pit	48.2	17	<1.4	0.0101	<0.1	<0.001	0.01	11.9	<0.04	3.12	0.09	<0.001	<3	<0.001	14	<0.005
P7-TP4-050	Pile 7	Test Pit	85.9	9.2	<1.4	0.0346	0.5	0.002	<0.01	<0.2	<0.04	0.08	<0.01	<0.001	<3	<0.001	27	0.013
P7-TP5-055	Pile 7	Test Pit	199	4.4	<1.4	0.204	0.7	0.002	<0.01	0.8	<0.04	0.3	<0.01	<0.001	<3	<0.001	27	0.014
		Minimum	2.7	<1	<1.4	0.0005	<0.1	<0.001	<0.01	<0.2	<0.04	0.08	<0.01	<0.001	nd	<0.001	<5	<0.005
		Maximum	2,060	385	5.4	0.719	2.0	0.002	0.03	68.8	0.07	19.1	0.53	0.001	nd	0.0030	27	0.014
		Mean	#NAME?	29.3	1.6	0.1	0.4	0.001	0.010	14.4		4.5	0.1	0.0006	nd	0.0008	13.6	0.0050
Topsoil Stockpiles																		
TN-TP1-073	Topsoil North	Test Pit	<1	<1	<1.4	0.0002	0.9	<0.001	<0.01	6	<0.04	4.36	<0.01	<0.001	<3	<0.001	13	<0.005
TS-TP1-066	Topsoil South	Test Pit	<1	4.5	<1.4	0.0005	<0.1	<0.001	<0.01	18.8	<0.04	8.8	<0.01	0.002	<3	<0.001	11	<0.005
		Mean	<1	2.5	<1.4	0.0	0.5	<0.001	<0.01	12.4	<0.04	6.6	<0.01	0.0013	nd	<0.001	12.0	nd
Shaft Area Mine Dump & Pad																		
MD-DH10-001	Mine Dump	Drill Hole	246	25.7	<1.4	0.001	0.3	0.003	<0.01	4.7	<0.04	0.62	<0.01	0.003	<3	0.002	<5	0.006
MD-DH9-003	Mine Dump	Drill Hole	158	2.7	<1.4	0.14	5.2	0.001	<0.01	3.2	<0.04	0.54	<0.01	0.005	<3	<0.002	14	0.038
MD-SPLP-COMP	Mine Dump	Drill Hole	554	1.7	<1.4	0.694	0.9	<0.001	<0.01	14.1	<0.04	2.02	<0.01	0.009	<3	0.004	35	0.008
SP-TP2-088	Shaft Pad	Test Pit	26.7	<1	<1.4	0.0368	0.7	0.002	<0.01	6.5	<0.04	1.88	<0.01	0.003	<3	0.001	24	0.007
SP-SPLP-COMP	Shaft Pad	30-pt Composite	216	8.3	<1.4	0.19	2.3	0.002	<0.01	7.4	<0.04	0.8	<0.01	0.023	<3	<0.001	8	0.032
		Minimum	26.7	<1		0.001	0.3	<0.001	<0.01	3.2	<0.04	0.54	<0.01	0.003	nd	<0.001	<5	0.006
		Maximum	554	25.7		0.694	5.2	0.003	<0.01	14.1	<0.04	2.02	<0.01	0.023	nd	0.004	35	0.038
		Mean	240.1	7.8		0.2	1.9	0.002		7.2	<0.04	1.2	<0.01	0.009	nd	0.002	16.7	0.018
Shaft Ore Storage Areas																		
OS1-TP1-081	Ore Storage 1	Test Pit	47.5	5.8	<1.4	0.063	<0.1	<0.001	0.02	27	<0.04	4.57	0.03	<0.001	<3	<0.001	12	<0.005
OS2-TP5-094	Ore Storage 2	Test Pit	95.7	6	<1.4	0.156	14.4	<0.001	0.02	62.1	<0.04	42.4	1.22	<0.001	<3	0.001	6	<0.005
		Mean	71.6	5.9	nd	0.1	7.2	nd	0.0	44.6	nd	23.5	0.6	nd	nd	0.00075	9.0	nd
Shaft Area Ponds																		
PO1-SPLP-COMP	Pond 1	30-pt Composite	1,100	9.5	<1.4	1.32	1.7	0.003	0.02	14.4	<0.04	1.85	<0.01	0.032	4	0.002	9	0.015
PO2-TP2-106	Pond 2	Test Pit	224	5.2	<1.4	0.473	2.6	0.003	<0.01	4.3	<0.04	0.65	<0.01	0.026	<3	<0.001	33	0.018
PO2-SPLP-COMP	Pond 2	30-pt Composite	1,990	10.2	<1.4	2.7	3.2	0.004	<0.01	8	<0.04	1.26	<0.01	0.081	5	0.003	22	0.034
PO3-TP3-116	Pond 3	Test Pit	205	12.1	<1.4	0.155	1.7	0.003	<0.01	4.5	<0.04	1.03	<0.01	0.016	<3	0.001	21	0.099
PO 3-SPLP-COMP	Pond 3	30-pt Composite	226	7.1	<1.4	0.247	1.6	0.002	<0.01	9.2	<0.04	1.76	<0.01	0.006	3	<0.001	8	0.008
PO4-TP4-113	Pond 4	Test Pit	1,900	48.2	<1.4	1.54	1.5	0.007	<0.01	2	<0.04	0.56	<0.01	0.068	<3	0.003	58	0.095
PO 4-SPLP-COMP	Pond 4	30-pt Composite	1,640	5.6	<1.4	2.56	3.8	0.004	<0.01	7.3	<0.04	1.81	<0.01	0.102	4	0.004	32	0.027
PO5-TP5-119	Pond 5	Test Pit	7	1.1	<1.4	0.0051	1.7	0.002	<0.01	2.8	<0.04	0.6	<0.01	0.002	<3	<0.001	19	<0.005
PO 5-SPLP-COMP	Pond 5	30-pt Composite	11.5	1.2	<1.4	0.0107	1.4	0.003	<0.01	8.4	<0.04	1.71	<0.01	0.003	<3	<0.001	10	<0.005
		Minimum	7	1.1	nd	0.0051	1.4	0.002	<0.01	2	<0.04	0.56	<0.01	0.002	<3	<0.001	8	<0.005
		Maximum	1,990	48.2	nd	2.7	3.8	0.007	0.02	14.4	<0.04	1.85	<0.01	0.102	5	0.004	58	0.099

Table 7
Soil Analytical Results, Synthetic Precipitation Leaching Procedure

			Radionuclides				Metals											
			Gross Alpha	Radium 226	Radium 228	Uranium	Aluminum	Arsenic	Barium	Calcium	Lead	Magnesium	Manganese	Molybdenum	Potassium	Selenium	Sodium	Vanadium
Loc ID	Area	Type	pCi/L	pCi/L	pCi/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Non-Economic Material Storage Areas																		
		Mean	811.5	11.1	nd	1.0	2.1	0.0	0.0	6.8	<0.04	1.2	<0.01	0.0	2.6	0.002	23.6	0.033
Shaft Storage Area																		
SA-TP1-091	Storage Area	Test Pit	<1	<1	<1.4	0.001	1.3	0.001	<0.01	10.8	<0.04	0.86	<0.01	0.001	<3	<0.001	26	<0.005
SA-SPLP-COMP	Storage Area	30-pt Composite	1.8	<1	<1.4	0.0025	2.1	0.002	0.01	10.6	<0.04	0.76	<0.01	0.002	5	<0.001	5	0.008
		Mean	1.15	nd	nd	0.00175	1.7	0.0015	0.0075	10.7	nd	0.81	nd	0.0015	3.3	nd	15.5	0.00525
Site-Wide Statistics																		
		Minimum	<1	<1	<1.4	0.0002	<0.1	<0.001	<0.01	0.1	<0.04	0.08	<0.1	<0.001	<3	<0.001	2.5	0.0025
		Maximum	2,060	385	5.4	2.7	14.4	0.007	0.03	68.8	0.07	42.4	1.22	0.102	5	0.004	58	0.099
		Mean	310.1	18.0	1.1	0.3	1.4	0.002	0.009	12.9	0.0	4.2	0.1	0.01	1.9	0.001	16.1	0.013
		Standard Deviation	588.0	62.2	1.1	0.7	2.5	0.001	0.007	15.4	0.0	7.6	0.2	0.02	1.0	0.001	11.2	0.022

Table 8
Agronomic Analytical Results

Table 8
Agronomic Analytical Results

Location ID	Type	Heavy Metals													Inorganic Parameters			
		Arsenic	Cadmium	Calcium, paste	Chloride, soluble	Chromium	Conductivity, paste	Copper	Lead	Magnesium, paste	Mercury	Nickel	Selenium	Zinc	Nitrogen, NO2 + NO3 as N	TOC	pH, sat. paste	Phosphorus, Olsen
		mg/kg	mg/kg	meq/l	mg/kg	mg/kg	mmhos/cm	mg/kg	mg/kg	meq/l	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%		mg/kg
Borrow Areas																		
BS-TP1-041/042	Test Pit	0.022	<0.7	1.5	<5	8.7	0.33	<0.6	0.3	0.93	<0.05	<3	<0.005	0.13	1.4	0.26	8.2	6
BS-TP2-069/070	Test Pit	0.045	<0.3	31	<5	13.8	2.64	<0.5	0.4	4.7	<0.05	<3	<0.005	0.14	3.1	0.3	7.7	<5
LOBO-TP1-130/131	Test Pit	0.034	<0.3	2.7	12.5	13.5	0.66	<0.6	0.3	3.4	<0.05	<3	0.007	0.1	1.2	0.3	8.1	<5
Topsoil Stockpiles																		
TN-TP1-071	Test Pit	0.028	<0.3	3.4	8.5	12.7	0.79	<0.5	0.3	3	<0.05	<0.9	0.005	0.1	1.1	0.24	8	11
TN-TP1-072	Test Pit	0.028	<0.3	3.7	9.1	12.3	0.76	<0.5	0.3	3	<0.05	<3	0.007	0.11	<1	0.25	8.1	8
TO-TP1-015/016	Test Pit	0.037	<0.7	27	19	20.4	3.86	<0.5	0.6	16	<0.05	<3	0.009	0.18	<1	0.15	7.4	7
TS-TP1-064/065	Test Pit	0.034	<0.7	26	13.4	14	5.46	0.7	0.6	39	<0.05	<3	0.036	0.31	1.1	0.22	7.4	<5
Non-Economic Material Storage Areas																		
P3-DH7-002	Drill Hole	0.129	<0.3	6.6	<5	5.1	1.12	0.2	1.2	6	<0.05	<3	<0.005	0.7		0	7.7	<5
P3-DH8-001	Drill Hole	0.018	<0.3	9.8	<5	2.7	1.35	<0.6	0.3	4.7	<0.05	<0.9	<0.005	1.45	2.1	0.05	7.2	<5
P3-DH8-014	Drill Hole	0.018	<0.3	28	11.4	8.4	4.84	1.7	2.2	29	0.05	0.76	<0.005	2.18	3.6	0.05	5.4	<5
P4-DH1-001	Drill Hole	0.152	<0.3	27	<5	13	4.49	1.4	<0.2	35	<0.05	1.3	0.007	2.12	4.1	0.28	6.2	9
P4-DH2-001	Drill Hole	0.041	<0.3	28	<5	14.3	3.29	<0.6	0.3	15	<0.05	<3	<0.005	6.46	2.4	0.24	7.7	<5
P4-DH3-001	Drill Hole	0.054	<0.3	5.2	<5	3.6	0.8	<0.6	1.1	1.5	<0.05	<3	<0.005	1.15	2.1	0.07	7.8	<5
P4-DH4-001	Drill Hole	0.027	<0.3	29	<5	7.7	3.19	0.7	<0.2	13	<0.05	<3	<0.005	1.9	4.1	0.29	5.7	5
P4-DH5-001	Drill Hole	0.031	<0.3	25	<5	10.2	4.25	0.8	<0.2	24	<0.05	<3	0.009	1.35	6.5	0.39	6.3	7
P4-DH6-001	Drill Hole	0.04	0.06	27	<5	12.1	3.78	0.4	0.3	19	<0.05	<3	<0.005	2.36	2.7	0.32	7.2	5
P5-TP1-011/012	Test Pit	0.054	<0.7	0.74	<5	4.9	0.34	<0.6	1.1	0.21	<0.05	<0.9	<0.005	0.73	1.6	0.28	8.1	<5
P6-TP2-032/033	Test Pit	0.328	<0.7	1.1	<5	5	0.57	<0.6	0.9	1.4	<0.05	<3	0.016	0.59	1.7	0.09	5.3	13
P6-TP3-037/038	Test Pit	0.084	<0.7	21	<5	3.7	2.77	<0.5	0.7	15	<0.05	<0.9	0.006	1.02	1.6	0.09	4	10
P6-TP4-043/044	Test Pit	0.817	<0.7	27	<5	4.6	2.67	1.7	0.7	4	0.06	<0.9	0.167	0.56	1.9	0.54	4.6	12
P6-TP5-057/058	Test Pit	0.346	<0.7	0.78	<5	2.2	0.19	1.1	<0.2	0.27	<0.05	<0.9	0.031	0.32	1.6	0.42	4.7	<5
P6-TP6-061	Test Pit	0.378	<0.3	23	<5	4.7	3.87	2.7	<0.2	25	<0.05	<0.9	0.049	1.07	1.4	0.49	4.3	7
P7-TP1-001/002	Test Pit	0.111	<0.3	0.94	<5	5.6	0.31	1.5	0.6	0.52	<0.05	<0.9	0.006	1.27	1.7	0.22	4	9
P7-TP2-020/021	Test Pit	0.02	<0.7	16	<5	2.2	2.13	<0.6	1.5	6.9	<0.05	<3	<0.005	0.48	1.7	0.15	4.5	6
P7-TP3-023/024	Test Pit	0.104	<0.7	3.3	<5	3.3	1.12	<0.5	3.2	3.7	<0.05	<0.9	<0.005	0.3	2	0.09	5.2	<5
P7-TP4-048/049	Test Pit	0.019	<0.3	11	<5	1.6	1.7	<0.6	0.7	2.8	<0.05	<3	<0.005	0.24	<1	0.1	4	6
P7-TP5-053/054	Test Pit	0.04	<0.7	0.21	<5	4.9	0.8	<0.6	1	0.11	<0.05	<3	<0.005	0.89	4.9	0.12	8.8	<5
Mine Dump & Shaft Pad																		
MD-DH10-004	Drill Hole	0.051	<0.3	1.5	7	4.7	1.52	0.9	6.7	0.36	<0.05	<3	0.01	3.33	2.7	0	8.4	<5
MD-DH9-002	Drill Hole	0.164	<0.3	0.4	<5	4.7	0.8	<0.6	4.3	0.16	<0.05	<3	0.011	0.92	3.8	0	8.6	<5
SP-TP2-086/087	Test Pit	0.043	<0.7	9.7	42.9	5.2	3.43	1	1.4	5	<0.05	<0.9	0.027	0.99	5.5	0.26	8.3	<5
Ore Storage Areas																		
OS1-TP6-079/080	Test Pit	0.068	<0.7	24	<5	4.8	2.68	<0.6	0.5	11	<0.05	<3	0.006	0.67	<1	0.18	5.9	20
OS2-TP5-092/093	Test Pit	0.134	<0.3	28	7	7.8	4.92	1.3	2.2	45	<0.05	<0.9	0.037	2.83	1.6	0.59	6.2	9
Shaft Storage Area																		
SA-TP1-089	Test Pit	0.038	<0.7	8.5	8	15.5	0.82	<0.5	0.4	0.98	<0.05	<3	0.005	1.06	2	0.82	7.7	12
SA-TP1-090	Test Pit	0.04	<0.7	6.2	6.4	13.7	0.6	<0.5	0.4	0.68	<0.05	<3	0.006	1.05	1.9	0.81	7.8	12
Shaft Area Ponds																		
PO1-TP1-099/100	Test Pit	0.323	<0.7	2.8	7.1	11.4	0.54	1.6	4.1	0.94	<0.05	<0.9	0.036	3.08	4.1	0.9	8.2	5
PO2-TP2-105/110	Test Pit	0.14	<0.7	1.4	5.2	14.6	0.88	<0.6	1.3	0.34	<0.05	<3	0.014	0.98	3.5	0.58	8.5	7
PO3-TP3-114/115	Test Pit	0.121	<0.7	1	<5	13.8	0.29	1.7	3.3	0.43	<0.05	<0.9	0.024	3.08	1.8	0.88	8.4	10
PO4-TP4-111/112	Test Pit	0.17	<0.7	0.89	11.4	14.6	0.97	1.2	3.7	0.29	<0.05	<3	0.062	3.02	4.7	0.64	8.8	13
PO5-TP5-117/118	Test Pit	0.049	<0.7	5.6	6.3	13.3	1.6	<0.5	0.5	2	<0.05	<0.9	<0.005	0.22	1.3	0.47	7.7	<5
Site-Wide Statistics																		
	Minimum	0.018	<0.3	0.21	<5	1.6	0.19	0.2	<0.2	0.11	0.025	0.15	<0.005	0.1	0.5	0	4	<5
	Maximum	0.817	0.35	31	42.9	20.4	5.46	2.7	6.7	45	0.06	1.3	0.167	6.46	6.5	0.9	8.8	20
	Mean	0.11	0.06	12.2	6	8.7	2.0	1.2	1.2	8.8	<0.05	1.0	0.02	1.3	2.6	0.3	6.9	6.4

Table 8
Agronomic Analytical Results

		Table 8 Agronomic Analytical Results									
		Inorganic Parameters, cont.				Physical Parameters					
		Potassium, soluble	SAR	Sodium, paste	Sulfate, soluble	Clay	Coarse Frags	Sand	Silt	Moisture	Saturation
Location ID	Type	mg/kg		meq/l	mg/kg	%	%	%	%	%	%
Borrow Areas											
BS-TP1-041/042	Test Pit	2.1	1.27	1.4	23.7	19	0	63	18	2.6	54.8
BS-TP2-069/070	Test Pit	9	0.13	0.54	856	24	0	46	30	3.6	54
LOBO-TP1-130/131	Test Pit	8.6	0.67	1.2	184	20	0	54	26	3.9	79.6
Topsoil Stockpiles											
TN-TP1-071	Test Pit	4.8	1.31	2.3	146	17	2.4	59	24	3.5	51.7
TN-TP1-072	Test Pit	5.9	1.12	2	176	20	2.3	65	15	3.7	63.5
TO-TP1-015/016	Test Pit	7.2	2.26	10	1370	33	13	40	27	6.1	61
TS-TP1-064/065	Test Pit	8.8	2.74	15	2320	27	8.4	47	26	6.2	66.4
Non-Economic Material Storage Areas											
P3-DH7-002	Drill Hole	3.8	0.56	1.4	220	16	1.5	67	17	7.7	38.4
P3-DH8-001	Drill Hole	4	0.39	1.1	204	12	18	83	5	4.1	32.5
P3-DH8-014	Drill Hole	13.6	1.24	6.6	1420	21	2.5	62	17	10.5	49.4
P4-DH1-001	Drill Hole	3.5	0.76	4.2	1160	24	41	57	19	7.6	43.2
P4-DH2-001	Drill Hole	5.6	0.65	3	886	23	18	45	32	3.5	42.2
P4-DH3-001	Drill Hole	4.4	0.79	1.4	116	15	26	73	12	4.2	34.5
P4-DH4-001	Drill Hole	6.1	0.29	1.3	786	20	23	68	12	6.6	41.7
P4-DH5-001	Drill Hole	5.8	1.95	9.6	1060	23	55	58	19	8	43.6
P4-DH6-001	Drill Hole	6.6	1.21	5.8	965	23	53	55	22	5	41.1
P5-TP1-011/012	Test Pit	3.6	3.39	2.3	38.2	13	1.5	78	9	7.5	48.6
P6-TP2-032/033	Test Pit	5	2.75	3	141	14	4.6	74	12	6.5	51.7
P6-TP3-037/038	Test Pit	24.1	0.21	0.87	1000	13	3.3	78	9	7.9	54.7
P6-TP4-043/044	Test Pit	4.2	0.04	0.16	989	16	1.9	73	11	5.3	55.6
P6-TP5-057/058	Test Pit	2.6	0.1	0.07	34.5	10	1.3	86	4	5.3	45.6
P6-TP6-061	Test Pit	6.3	0.07	0.32	1320	17	3.3	75	8	3.4	47
P7-TP1-001/002	Test Pit	4.7	0.36	0.3	104	15	3.4	73	12	6.8	72.3
P7-TP2-020/021	Test Pit	6.2	0.54	1.8	569	14	2	79	7	3.6	43.1
P7-TP3-023/024	Test Pit	3.9	1.85	3.5	278	16	1.7	77	7	4.6	45.9
P7-TP4-048/049	Test Pit	7.3	1.45	3.9	526	11	2.1	81	8	6.1	55.4
P7-TP5-053/054	Test Pit	4.7	19.1	7.6	183	14	1.6	78	8	5.9	71.5
Mine Dump & Shaft Pad											
MD-DH10-004	Drill Hole	3.8	13.9	13	227	14	1.4	77	9	8	36.6
MD-DH9-002	Drill Hole	1.7	14.4	7.5	81.9	12	2.1	79	9	3.9	31.5
SP-TP2-086/087	Test Pit	7.6	8.32	23	807	15	0	71	14	3.7	49.5
Ore Storage Areas											
OS1-TP6-079/080	Test Pit	5.7	0.4	1.7	803	6	2	89	5	5.6	49.8
OS2-TP5-092/093	Test Pit	8.5	1.1	6.6	2590	22	0	49	29	7.2	77.7
Shaft Storage Area											
SA-TP1-089	Test Pit	11.4	0.16	0.36	194	27	2.3	42	31	5.9	64.8
SA-TP1-090	Test Pit	9.9	0.16	0.3	117	34	2.5	41	25	5.5	63.7
Shaft Area Ponds											
PO1-TP1-099/100	Test Pit	12.7	1.45	2	227	29	0	27	44	15	122
PO2-TP2-105/110	Test Pit	3.4	8.12	7.5	158	56	0	21	23	11.7	62.1
PO3-TP3-114/115	Test Pit	11.6	1.79	1.5	101	44	0	21	35	21.7	177
PO4-TP4-111/112	Test Pit	6.1	12.6	9.6	240	59	0	7	34	19.1	91
PO5-TP5-117/118	Test Pit	10.2	5.14	9.9	405	26	0	49	25	5.5	65.2
Site-Wide Statistics											
	Minimum	1.7	0.04	0.07	23.7	6	0	7	4	2.6	31.5
	Maximum	24.1	19.1	23	2590	59	55	89	44	21.7	177
	Mean	6.8	2.9	4.5	590.4	21.4	8	60.69	17.9	6.7	58.4

FIGURES

APPENDICES

APPENDIX A

RADIATION SURVEY FIELD FORMS

APPENDIX B

LABORATORY ANALYTICAL DATA AND DATA VALIDATION RESULTS

APPENDIX C

FIELD NOTES, BORING LOGS AND TEST PIT LOGS