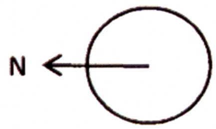
Dwelling Unit Location: CR-002-B

GPS Coordinates (UTM, Center-Front): x: 722162 y: 3945430 12N



Above DU (Front):

	CPM	pCi/g
50 ft.	-	-
40 ft.	-	-
30 ft.	-	-
20 ft.	-	-
10 ft.	2324	1.4
0 ft.	2131	1.3

Left of DU:

	50 ft.	40 ft.	30 ft.	20 ft.	10 ft.	0 ft.
CPM	2409	2585	2525	2470	2432	2274
pCi/g	1.5	1.6	1.5	1.5	1.5	1.4

Front

DU

Right of DU:

0 ft.	10 ft.	20 ft.	30 ft.	40 ft.	50 ft.	
2149	2235	2468	2524	2553	2660	CPM
1.3	1.3	1.5	1.5	1.6	1.6	pCi/g

Below DU:

	CPM	pCi/g
0 ft.	2516	1.5
10 ft.	2514	1.5
20 ft.	2552	1.6
30 ft.	2453	1.5
40 ft.	2486	1.5
50 ft.	2658	1.6

	CPM	pCi/g
Dwelling Unit Mean:	2446	1.5
Dwelling Unit Range:	529	0.4

Site Characterization Report
Old Church Rock Mine
McKinley County, New Mexico

Prepared for:

Uranium Resources Inc.
5041 Indian School Rd. NE
Albuquerque, NM 87110

Prepared by:

INTERA

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Albuquerque, New Mexico 87110

September 30, 2009

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LIST OF ACRONYMNS AND ABBREVIATIONS

μR/h	microroentgens per hour
AEA	Atomic Energy Act
AEC	Atomic Energy Commission
ASLBP	Atomic Safety and Licensing Board Panel
CFR	Code of Federal Regulations
cm^2	square centimeters
cpm	counts per minute
dpm	decays per minute
EPA	U.S. Environmental Protection Agency
INTERA	INTERA Incorporated
ISR	In-situ Recovery
GPS	global positioning system
HPIC	High Pressure Ionization Chamber
HRI	Hydro Resources Incorporated
mrem	millirem
NMEMNRD	New Mexico Energy, Minerals and Natural Resources Department
NMMA	New Mexico Mining Act
NNEPA	Navajo Nation Environmental Protection Agency
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
OCRM	Old Church Rock Mine
pCi/g	picocuries per gram
Phillips	Phillips Petroleum
R	Roentgen
Ra	Radium
rem	roentgen equivalent man
RSS	Radiological Scoping Survey
Santa Fe	Santa Fe Pacific Rail Road Company

UNC	United Nuclear Corporation
URI	Uranium Resources, Incorporated
USGS	U.S. Geological Survey
UTL	Upper Tolerance Limit
WCM	Westwater Canyon Member of the Morrison Formation

1.0 INTRODUCTION

The Old Church Rock Mine (OCRM) is located 7 miles north of Interstate 40 along State Highway 566 in Section 17, T16N, R16W (Figure 1) and is an inactive uranium mining facility. The OCRM is a portion of the area currently licensed by the Nuclear Regulatory Commission (NRC) for in-situ recovery operations in accordance with 10 Code of Federal Regulations (CFR) Part 20 and Part 40. The OCRM includes the approximate 75-acre fenced former mine facility (Site) which was owned and last operated by United Nuclear Corporation (UNC) and consists of a closed mine shaft, an empty ion-exchange building, 5 dry surface impoundments, former stockpile areas, and several concrete pads (Figure 2).

INTERA Incorporated (INTERA) performed Site characterization activities in accordance with a Draft Work Plan (INTERA, 2008), which was approved by the Navajo Nation Environmental Protection Agency (NNEPA), at OCRM May 18 through 22, 2009. The field activities were designed to address recommendations given by the NNEPA following a Radiological Scoping Survey (RSS) which was performed by the NNEPA at OCRM in March of 2007 (NNEPA, 2007).

1.1 Study Area

The Site Characterization activities described in this report address the recommendations provided by the NNEPA and focused on soils and sediments in the vicinity of the OCRM. The study area is illustrated in Figure 2. The rationale for defining the study area is as follows:

- Wind and water are primary transport agents that could potentially cause future off-site migration of radiological materials.
- Water in the form of surface runoff could potentially transport materials down the unnamed arroyo adjacent to the Site toward the channel of the Puerco River. The Puerco River is an intermittent stream that drains the Northeast Church Rock Mill and Mine sites which were subject to environmental investigation as a result of an unrelated 1979 tailings release from the Northeast Church Rock Mine. The Puerco River was chosen as the southern boundary for this investigation because the 1979 tailings release from the Northeast Church Rock Mill was a much larger event than any release that could have originated at the OCRM. The Puerco River serves as a natural investigative boundary.
- Alluvial materials at the OCRM Site are underlain by the Mancos Shale, a marine shale up to 700 feet thick, which is an aquitard with respect to the Dakota Sandstone, isolating any groundwater in the alluvial material from the Dakota Sandstone and deeper geologic units.

- Water in the form of infiltration could theoretically transport dissolved materials to shallow alluvial groundwater.

1.2 Site Characterization Components

The scope of work and methods for the Site Characterization field activities used to evaluate the extent of environmental impacts associated with past mining activities on Section 17 are described below.

1. **Global Positioning System (GPS)-Based Gamma Survey and Surface Soil Sampling.** A GPS-based gamma count-rate survey was conducted on surface soils across the study area for the purpose of identifying gamma-emitting radionuclide concentration anomalies. Based on the results of the GPS-based gamma count-rate survey, samples of surface soils were collected for use in developing correlations between gamma count rates, gamma exposure rates, and soil radionuclide concentrations. The design for this part of the characterization was based on the need to address concerns that contaminated material may have migrated off-site. A summary discussion of the gamma survey is included in Section 3.0. The gamma survey and soil sampling results are included in Section 4.0 and Appendix A. Gamma survey results are presented on Figure 3.

2. **Downgradient Soil Pits.** Twelve hand-dug pits were advanced to depth of 4 feet downgradient of the OCRM fence. Gamma count-rates were measured at the ground surface, the dune/ground interface, and each 1-foot depth intervals. This data collection approach was designed to address concerns that drifting sands and incipient dunes may potentially be obscuring off-site migration of radiological materials. Downgradient soil pit locations with gamma count rate measurements are presented in Figures 4 and 5. Results of the soil pit scans can be found in Section 4.0.

3. **Paleochannel and Groundwater Determination.** Four direct-push bore holes were advanced through the alluvial materials to the underlying Mancos Shale or until refusal was met, downgradient of OCRM fences, to define any paleochannel that might contain groundwater. This activity was performed to determine the presence or absence of groundwater in alluvial materials. Groundwater was not identified in alluvial materials at the four borehole locations. The soil bores were scanned for gamma count rates. A discussion of groundwater characterization results is included in Section 4.0.

4. **Report of Findings.** All data collected during Site characterization activities are presented in this Site Characterization Report and its attachments.

As discussed in more detail in the following subsections, the results of these activities address the key concerns of the NNEPA: 1) to evaluate whether there has been off-site migration of mining-related materials and 2) whether or not groundwater impacts have occurred. The Site conceptual model describing the Site history, regulatory history, and physical setting of the OCRM is presented in Section 2.0. A description of the field methods used for Site Characterization at the OCRM is included in Section 3.0. The results of the Site Characterization are presented in Section 4.0. Interpretations of the results are discussed in Section 5.0.

1.3 Deviations from the Work Plan

Additional work was requested by the NNEPA during the Site Characterization field events. This work consisted of residential gamma surveys at the houses located within Section 17 (Figure 2) and alpha surveys of possible mine-related equipment which have been removed from OCRM and now reside at personal residences in and around Section 17. The surveys were designed by Iinà Bà who was contracted by the NNEPA to perform residential gamma surveys at 34 houses within the vicinity of the OCRM. Iinà Bà did not have access to Section 17 and INTERA performed the surveys at three residences in that section. The results of the residential surveys are discussed in Section 4.0 and presented on Figures 6, 7, and 8.

2.0 SITE CONCEPTUAL MODEL

The OCRM is an inactive uranium mining and processing facility located approximately 10 miles north east of Gallup, New Mexico (see Figure 1). The approximate 75-acre fenced former mine facility, which was owned and last operated by UNC, consists of a closed mine shaft, an empty ion-exchange building, 5 dry surface impoundments, former stockpile areas, and several concrete pads (NNEPA, 2007) (Figure 2).

As described above, this investigation was performed on Section 17 and covered an area of approximately 500 acres, which is larger than the fenced Site facility boundaries and larger than the area included in NNEPA's RSS. OCRM consists primarily of undeveloped range land and includes an adjacent arroyo that is approximately 3,000 feet in length.

2.1 Site History

This Section summarizes the history of land use, mining activities, and environmental regulation at OCRM.

2.1.1 Land Use

In 1929, the Santa Fe Pacific Railroad Company (Santa Fe) conveyed Section 17 (southeast quarter of the northwest and northeast quarter, including OCRM) to the United States of America, In Trust for the Navajo Tribe, reserving to itself surface and subsurface mineral rights. In 1959, the Navajo Tribe granted Santa Fe surface use and entry rights to the property to prospect for, mine, store, and remove uranium and associated materials, and authorized any means or methods of mining, stripping, quarrying, drilling, or other processes to extract minerals in exchange for certain royalties. Santa Fe leased the OCRM property to Phillips Petroleum (Phillips) which evolved into UNC through several business transactions. UNC in turn leased the property to Uranium Resources, Inc. (URI). In 1997, Santa Fe conveyed all of its interest in OCRM to Uranco, a wholly-owned subsidiary of URI.

The Site is currently regulated by the NRC and subject to reclamation oversight by the State of New Mexico Energy, Minerals and Natural Resources Department (NMEMNRD), which has determined that reclamation obligations for OCRM are subject to, and controlled by, the license issued by NRC to Hydro Resources Incorporated (HRI) (January 5, 1998) a wholly owned subsidiary of URI. The Site is located on a property currently licensed by the NRC for in-situ recovery of uranium.

2.1.2 Mining History

In the years after World War II, uranium was determined to be essential to the national defense. Because of this, Congress passed the Atomic Energy Act of 1946, creating the

U.S. Atomic Energy Commission (AEC). The Commission launched a uranium procurement program that encouraged exploration, primarily in the Colorado Plateau region. The AEC laid the foundation for the work of the uranium industry and trained many uranium experts. It performed research, provided technical assistance to industry in exploring, mining, and milling uranium, encouraged property development and uranium marketing, and secured sufficient uranium stockpiles to meet defense requirements well into the future (Energy Information Administration, 1995). The AEC constructed mills and roads into the back country and helped with hauling and geologic data collection.

Church Rock uranium mineralization was discovered in 1957 by Phillips (URI, 2009). Phillips began drilling in the Church Rock areas in 1957 and continued until 1959 when Phillips sunk a circular 10.5-foot diameter 2-compartment concrete shaft into the Westwater Canyon Member of the Morrison Formation (WCM) to a depth of 865 feet. Phillips began production in 1960. Blackrock Mining Company, under contract to Phillips, leased the property until 1961. Quinta Corporation acquired the mining contract in 1961 and operated the mine until the parent company of UNC, Sabre Piñon, took over the company. Sabre Piñon operated the mine until 1962. In 1963, Sabre Piñon and Quinta merged and formed UNC (UNC, 1982). Excessive water, difficult mining conditions, and unfavorable market conditions (AEC stopped purchasing uranium in 1962) closed the mine prematurely in 1963. Total production during this time was 302,607 pounds of U_3O_8 (UNC, 1978).

A second phase of mining began in November of 1979 after an extensive dewatering and drift rehabilitation program. Total production during this second phase of mining was 358,505 pounds of U_3O_8.

During the second phase of mining, the water produced as a result of mine dewatering was pumped into a series of five ponds, treated with barium chloride, and allowed to settle. After the water made its way through the five ponds, it was polished in an ion exchange column and discharged into an unnamed arroyo adjacent to OCRM.

A depressed uranium market and economic recession caused the mine to close again with the last day of production being April 30, 1982. The mine has remained inactive since that date.

In September of 1991, prior to the title transfer to HRI, UNC removed mine dewatering by-product from the ponds. By-product was removed and transported by UNC to the Northeast Church Rock Mine ponds. Areas to be cleared were outlined using gamma detectors. By-product materials having a reading greater than 15 microroentgens per hour (μR/h) were removed. Water trucks were used for dust suppression and wetting material on the trucks for prevention of fly-off material during transit.

Since pond by-product has been removed, the only remaining materials that could potentially constitute a source of mining-related environmental impacts are residual materials from waste rock and ore storage areas and debris from the demolition of Site facilities.

2.2 Regulatory History

The NRC is the primary regulatory authority over uranium recovery operations, including conventional mills and In-situ Recovery (ISR) operations.[1] In 1954, Congress, through the Atomic Energy Act of 1954 (AEA), empowered the AEC, now NRC, to regulate AEA materials (i.e., source, by-product, and special nuclear materials). Under its AEA authority, the AEC/NRC promulgated 10 CFR Part 40 and, later, Appendix A to Part 40 to implement a regulatory program for uranium recovery operations.

URI initiated the License Application process on April 13, 1988 by submitting an Environmental Report to the NRC. The Environmental Report was also provided to the Bureau of Land Management, the Bureau of Indian Affairs, and others. On April 25, 1988, URI submitted an application to the NRC for a Source Material License to produce uranium commercially using ISR recovery at its Church Rock property. URI amended its application on May 8, 1989 to include uranium recovery processing at an existing facility in Crownpoint and again on April 23, 1992 to include ISR recovery on Unit 1, west of the existing facility at Crownpoint. Finally, on July 31, 1992, URI amended its application to include ISR recovery on lands associated with the existing facility in Crownpoint. URI's Application to conduct ISR recovery and processing at the Church Rock, Unit 1, and Crownpoint sites is referred to collectively as the Crownpoint Uranium Project.

Information on regulatory history prior to URI acquiring the property is sparse. Authorization for OCRM (under UNC) to discharge from the mine facility to an "unnamed arroyo to the Puerco River (in Pipeline Canyon) a tributary in the Colorado River Basin" was issued under the National Pollutant Discharge Elimination System (NPDES) Permit Number NM0028550 effective September 10, 1978 through September 30, 1980. This Permit included effluent limitations and monitoring requirements, reporting requirements, management requirements and responsibilities, and other requirements.

A prior reclamation inspection report and recommendation for release of permit requirements for URI was issued by the NMEMNRD in partial fulfillment of New Mexico Mining Act Section 69-36-7 U, prior reclamation on September 18, 1995. This report

[1] An exemption is given for possession or using ore which is unrefined or unprocessed (that is, ore prior to any processing such as grinding, roasting, beneficiation, or refining). Thus, a source material license is not required for conventional mining but is required to start up a uranium mill to process the ore.

consisted of a summary of the visual 'prior reclamation' inspection of the property and commended URI on their efforts to comply with the New Mexico Mining Act (NMMA). The report concluded that all areas of the mine appeared natural with the exception of the ion exchange building, concrete slabs where mine buildings had been removed, and five large dry ponds. The report concluded that the ion exchange building is under the jurisdiction of the NRC and recommended additional reclamation activities at the foundations and concrete slabs of the mining buildings and ponds. It was understood that URI intended to keep the ion exchange building and the ponds in order to facilitate potential future in-situ mining at the OCRM.

On January 5, 1998, HRI, a wholly-owned subsidiary of URI, was issued a source material license (SUA-1508) for the Crownpoint Uranium Project, which included the property at OCRM. This was followed by a letter dated April 6, 1999, NMEMNRD concluded:

> "...that the site in its entirety will fall under the regulatory authority of the NRC. Section IO7.X of the Rules, which defines "mining" states that "mining does not mean....byproduct materials or wastes or other activities regulated by the federal Nuclear Regulatory Commission". It is not always MMD's position to release a mine site from any obligation under the Act, if an NRC license is involved. However, in this case because the license does cover the entire site and the eventual reclamation of the site, MMD has determined that it is exempt from regulation under the Act."

2.3 Physical Setting

2.3.1 Physiography and Climate

The OCRM is located in the southeastern part of the Colorado Plateau Physiographic Province, which is characterized by large regions of folding with broad uplifts and intervening basins. The Site is located at the juncture of several of these major structures: the San Juan Basin, the Zuni Uplift, and the Defiance Uplift, at an elevation of about 6,800 feet above mean sea level.

The temperature in Gallup, 10 miles southwest of the OCRM, ranges between an average of 29 degrees Fahrenheit in January to an average of 68 degrees Fahrenheit in July. Gallup receives an average of 0.8 inches of precipitation in January and 2 inches in August with a total annual average precipitation of 11 inches. Daily extremes reach as high as 100 degrees Fahrenheit in summer and as low as -34 degrees Fahrenheit in winter. Potential evaporation in New Mexico is much greater than average precipitation. The annual net pan evaporation is approximately 54 inches. Wind speeds over the state are usually moderate, although relatively strong winds often accompany occasional frontal activity during late winter and spring months. Based on data (1992-2002) from the Gallup airport, winds predominate from the west to southwest 11 months out of the year (Figure 9). A predominant direction from the south is reported for the month of August (NRC, 1997).

2.3.2 Geology

The soils beneath the Site are predominantly comprised of alluvial materials while the soils on the low hills to the north of the Site are an admixture of alluvial-colluvial materials that grade into weathered Mancos Shale toward the tops of the hills near the base of the cliffs. The alluvial soils beneath the Site result from waterborne deposition of sediments transported from sediment source areas exposed in the catchment feeding the un-named arroyo that passes through the Site. Alluvial materials underlying the Site reflect the fine-grained nature of the sedimentary rocks exposed in the sediment source area, generally consisting of clay, silt, sand, and rare fine gravel deposited in interfingering, lense-like layers. Where alluvial materials are exposed in the arroyo walls, mudstone, siltstone, and fine sand predominate.

North of the Site where colluival materials interfinger with alluvial materials, the clay content of surface soils is higher. Colluvium is the name for loose bodies of sediment that have been deposited or built up at the bottom of a low-grade slope or against a barrier on that slope, transported by gravity. Because the Mancos Shale outcrops near the bottom of the cliffs to the north, the bulk of colluvial material is clay derived from the Mancos Shale unit. That fact may have implications for the gamma survey performed as part of this study because black marine shales such as the Mancos are known to have an ability to adsorb and concentrate heavy metals and radionuclides.

The alluvial and colluvial material is underlain by the Cretaceous Mancos Shale, which is in turn underlain by the Dakota Sandstone. The Mancos is comprised of 500-800 feet of mudstone and shale in the vicinity of OCRM and is considered to be a major aquitard, preventing surface recharge to the underlying Dakota Sandstone. Beneath the Dakota, approximately 180 feet of interfingered mudstone and siltstone aquitard assigned to the Brushy Basin Member of the Morrison Formation provides confining conditions for groundwater in the WCM. The primary uranium ore body mined at OCRM is present within the WCM. The mine shaft and vent holes provide a hydraulic connection between the Dakota and the WCM; together, these units produced about 900 gallons per minute during mine dewatering operations.

Mineral resources present at OCRM are contained in roll fronts and elongated tabular deposits (U.S. Geological Survey [USGS], 1975). Mineralization varies in thickness but averages 9 feet thick in each zone. Because individual ore bodies are stacked, they have a combined thickness of about 80 feet. Overall dimensions of the ore body are 5,300 feet long and up to 1,000 feet wide (NRC, 1997).

2.3.3 Hydrology

The primary aquifer at the Site is the WCM, which is generally of good quality, usually meeting the New Mexico Water Quality Control Commission Standards (NRC, 1997). However, groundwater in ore bodies within the WCM is generally not potable due to high levels of uranium and Radium-226 (Ra-226) (NRC, 1997). Judge Peter Bloch noted in the August 20, 1999 NRC Atomic Safety and Licensing Board Panel (ASLBP) Partial Initial Decision Concluding Phase I that the subsurface water in this part of the WCM is not potable today; it does not meet U.S. Environmental Protection Agency (EPA) standards. It also should be recognized that the Westwater is extensive, so that it can tolerate relatively small toxic areas like the Section 17's old mine workings and still provide high quality drinking water. The water near the old mine workings is undrinkable yet the aquifer as a whole has not suffered because toxic elements that migrate out of this area are affected by both precipitation and dilution. These natural mechanisms help to protect the quality of water in the aquifer as a whole from the toxicity contained in small areas (NRC ASLBP No. 95-706-01-ML, 1999).

URI conducted pump tests in the WCM to determine the hydraulic properties of ore-bearing sandstone and to determine the degree of hydraulic communication that exists between the mineralized zone and perimeter monitoring points. Results indicated that transmissivities ranged from 926 to 1,326 gallon per day per foot, and there was no interconnection detected between the Westwater Canyon aquifer and the Dakota Sandstone or Brushy Basin wells (HRI, 1993). Groundwater in the WCM at the Site is traveling northeast at approximately 8.7 feet per year (Reed, 1993).

3.0 SITE CHARACTERIZATION FIELD METHODS

The approach for OCRM characterization field activities presented in the Work Plan (INTERA, 2008) is based on meeting the following key study objectives:

- Evaluate the potential for off-site migration of mining-related materials.
- Evaluate the potential for groundwater impacts.
- Collect necessary data to design the Phase II characterization.

Field methods and data collection were performed in accordance with the Work Plan with the exception of additional work requested while INTERA was on Site.

3.1 Health and Safety

A site-specific health and safety plan was prepared by INTERA for the field work included in the Site Characterization field activities. An additional health and safety presentation was given by Mark Pelizza of URI, which included the following information: all personnel entering the fenced mine facility area were issued dosimeter badges, which were worn on lapels at all times while in the fenced area of the mine facility. All personnel working within the fenced mine facility were alpha scanned at the end of each work day. At the end of the Site Characterization field work all personnel that worked within the fenced mine facility submitted a urine sample for analyses. Dosimeter badges and urine samples were collected upon completion of the project and shipped to Laundauer Laboratories. The health and safety meeting sign-in sheet, alpha frisk sign-out sheet, badge assignments, and badge sampling results are included in Appendix B.

3.2 GPS-Based Gamma Surveys

The GPS-based gamma survey was comprised of three main components, which are described below. Results of the GPS-based gamma surveys are discussed in Section 4.0 and Figure 3. The GPS-based gamma radiation survey report is included as Appendix A.

3.2.1 Background Gamma Survey

Areas used for background surveys were selected by the NNEPA and INTERA. A background GPS-based gamma survey was performed over three areas as shown in Figure 2. The two western-most areas were selected by the NNEPA. The third area to the east was selected by INTERA to confirm background readings that INTERA personnel collected during field screening of soil pits and soil borings. The surveys were performed on foot. The GPS and ratemeter/scalers were carried in backpacks with the detectors held at approximately 18 inches above the ground surface. Data were collected at 1-second intervals with the surveyors traveling at an approximate speed of 1 meter per second.

3.2.2 Site Gamma Survey

GPS-based gamma surveys were performed over approximately 500 acres within the Section 17 study boundary. The study boundary included the fenced OCRM facility and surrounding areas including nearby residences within Section 17 (Figure 2). The area within the study boundary was surveyed as described above in Section 3.2.1. Data were downloaded to a laptop computer at the end of each day for processing. Based on these data, 15 locations spanning the total range of gross gamma count-rate values were chosen to correlate High Pressure Ionization Chamber (HPIC) dose measurements. An additional 15 locations were chosen for surface soil sample collection.

3.2.3 Surface Soil Sampling

Soil sample locations were determined using the data from the gamma survey. In areas of the Site where gamma readings were found to be in excess of 110,000 counts per minute (cpm), impacts from mining activities were assumed. For the remainder of the Site where gamma readings were found to be less than 110,000 cpm, soil samples were collected in order to correlate gamma readings with actual soil concentrations. With this approach, a more accurate determination of the extent of mine-related impacts in these areas could be determined.

Soil samples were collected from the top 6 inches of soil using a shovel and a bucket. A 1-minute count was taken from each soil sample. Soil was bagged and shipped to ALS Laboratory[2] for analysis. Soil samples were analyzed for natural uranium and Ra-226. The results of the soil analyses were used to convert the gross gamma survey data into Ra-226 concentrations in soil for the survey area.

3.3 Downgradient Soil Pit Screening

Twelve soil pits were hand-dug adjacent to the fenced area of OCRM. The pits were arranged according to Figure 2. Pits were dug using shovels, digging rods, and post hole tools by individuals contracted through the Churchrock Chapter House. At each soil pit location, field notes were recorded by INTERA personnel to describe the sediment from each depth interval. A gamma reading was taken at the surface before digging and at the interface between incipient dune deposits and alluvial materials. The pits were advanced with a shovel to a depth of 4 feet below the dune-alluvium interface. At each pit location, a GPS waypoint was recorded. A gamma screening was performed on the ground surface

[2] ALS Laboratory of Salt Lake City, Utah is accredited by the National Environmental Laboratory Accreditation Conference (NELAC) and licensed by the NRC.

before digging, the dune/soil interface, and each foot interval. The results of the soil pit screening are presented in Section 4.0 and Figures 4 and 5.

3.4 Paleochannel and Groundwater Determination

A GeoProbe® was used to define the presence or absence of groundwater in the alluvium underlying the arroyo downgradient of the mine facility. Four direct-push holes were advanced in a transect at right angles to the main direction of flow in the unnamed arroyo approximately 150 feet downgradient of the of the southwestern OCRM boundary fence (Figure 2). The Geoprobe locations were chosen to be directly downgradient from the Site and to provide a complete cross section of information across the arroyo.

At each soil boring location, a GPS reading and soil descriptions were recorded. Gamma scans of the 4 foot boring sleeves were also recorded. The data collected during the soil borings is presented in Section 4.0 and Appendix C.

3.5 Residential Survey

Residential gamma surveys were conducted at the 3 residences located within Section 17, nearest to the Site (Figure 2). The residential surveys were designed by Iinà Bà, Inc. and consisted of measuring a 50-foot transect in 4 directions (generally north, south, east, and west) from each structure. Structures included in the survey were houses, hogans, garages, and sheds. A 1-minute gamma count reading was recorded at the base of the structure and again in 10-foot intervals to 50 feet unless an obstruction was encountered. Iinà Bà performed residential surveys outside of Section 17 at approximately 32 residences in the vicinity of the Site and are submitting a separate report of their findings directly to the NNEPA.

Also part of the residential surveys, at the request of the residents, was an alpha survey performed on equipment that was been removed from OCRM and now resides at the residential areas.

The results of the residential surveys are included in Section 4.0 and in Figures 6, 7, and 8.

4.0 SITE CHARACTERIZATION RESULTS

Site Characterization field data have been collected and compiled as described in Section 3.0. The results of each field task are summarized below. The gamma radiation survey report is included as Appendix A.

4.1 GPS-Based Background Gamma Survey

The GPS-Based gamma surveys resulted in the collection of 106,752 readings over approximately 500 acres of land on and surrounding the OCRM facility. The background gamma survey was conducted in areas selected by the NNEPA. These areas are presented in the Figure 2. Background results are also presented in Table 1 and on Figure 3 and in Appendix A.

Table 1: Background Area Gross Gamma Radiation Survey Data Statistics

Survey	Number of Records	Average Reading	Standard Deviation	Maximum Reading	Minimum Reading	Upper Tolerance Limit (UTL)
Gross Gamma Radiation (cpm)	6,483	15,535	1,130	20,191	11,644	17,429
External Exposure Rate (µR/hr)	6,483	13.83	0.68	16.63	11.5	14.97
Ra-226 Concentration (pCi/g)	6,483	4.09	0.57	6.42	2.15	5.05
NNEPA Static Radiological Surface Measurements Background Grid						
Gross Gamma Radiation (cpm)	24	13,800	448	15,100	13,100	14,828
External Exposure Rate (µR/hr)	24	14.15	0.30	15.01	13.69	14.84
Ra-226 Concentration (pCi/g)	24	4.33	0.24	5.02	3.96	4.88

The background survey provided information on the range of gamma radiation levels in the natural background. Data collected during the Site survey were compared to the natural background in order to provide a basis for evaluating the extent of impacts from past activities associated with the OCRM.

The method used to arrive at a representative gamma value from this range of background values, which were obtained from the locations chosen by NNEPA, is important because the number of individual points where background data was collected is large and requires visual presentation to be meaningful. Methods for selecting a value to visually screen impacted from unimpacted areas of the Site include:

- Use two times the average background gamma radiation exposure rate.
- Use the highest observed value in the range of background data.