1.0 INTRODUCTION

This Removal Site Evaluation Report describes the objectives, scope of work, and results of the Removal Site Evaluation (RSE) conducted at the Northeast Church Rock (NECR) Mine (the Site), and nearby areas between August 14, 2006 and December 5, 2006. The RSE consisted of investigating surface and subsurface soils and sediments at various areas within and near the Site. The Site is located approximately 16 miles northeast of Gallup, McKinley County, New Mexico, as shown on Figure 1-1, *Site Location.* The RSE was conducted in accordance with the *Removal Site Evaluation Work Plan* (MWH, 2006a) (RSEWP) and the modifications described herein.

This section summarizes the objectives, site history, land use and the regulatory history of the Site. References in this report to site history, past operations, and the title status are asserted by UNC to be correct, and are subject to verification by EPA and the Navajo Nation.

1.1 PROBLEM STATEMENT AND OBJECTIVES

The NECR Mine is an inactive uranium mine site. The bulk of the mining lease is located on Navajo surface trust lands that are administered by the Navajo Regional Office Bureau of Indian Affairs. UNC owns the remaining portion of the Site through a patented mining claim. The Mine is subject to the New Mexico Mining Act (NMMA), as well as other statutory and regulatory requirements detailed below. UNC had submitted a closeout plan to the New Mexico Mining and Mineral Division (MMD) on January 30, 2004, received comments from MMD on June 23, 2004, incorporated those comments and responded on July 30, 2004. On November 10, 2004 the MMD supplemented their closeout plan comments with a request for UNC to submit a Materials Characterization Work Plan. UNC submitted the plan in December 2004. On February 15, 2005, MMD conditionally-approved the plan along with some comments, which UNC responded to on March 11, 2005.

On March 22, 2005, the Navajo Nation Environmental Protection Agency (NNEPA) requested that EPA Region 9 assume primary oversight of the NECR Mine in coordination with the NNEPA, the State of New Mexico and the Bureau of Indian Affairs. On November 7, 2005, EPA Region 9 agreed to act as the lead regulatory agency for the Site. On December 16, 2005, MMD informed UNC that it would defer further permitting action at the mine pending successful completion of the EPA process.

EPA requested that UNC, the former operator of the mine, undertake an environmental evaluation of the Site for purposes of determining whether a CERCLA removal action is warranted. Based on prior radiological surveys conducted by the EPA Las Vegas Radiation Laboratory in coordination with NNEPA, EPA noted the potential that several residences located north of the Site may be impacted by hazardous substances that were transported there by wind or stormwater runoff, and requested that the removal evaluation encompass these areas. UNC representatives met with federal, state and tribal agencies on February 28, 2006, March 27-28, 2006, and May 23, 2006.

The final RSEWP was approved by the EPA on August 14, 2006. Collection of background and gamma level to soil concentration correlation samples (see Section 2.2.3) was conducted on August 17 and 18, 2006 and submitted to Energy Laboratories, Inc. (ELI) of Casper, Wyoming for chemical analysis. These data were reported in the *Results of the Background and Radium Correlation Sampling Technical Memorandum* (MWH, 2006b) and are presented here as well. The remaining field activities were conducted between November 6 and December 5, 2006.

The main objective of the investigation was to conduct an RSE that was consistent with the National Contingency Plan (NCP), Title 40, Code of Federal Regulation 300.410 – 415. The NCP lists several

factors to be considered in determining the appropriateness of a removal action in 300.415 (b)(2), as discussed in the RSEWP.

In order to comply with the NCP (see the RSEWP, MWH, 2006a), the following RSE objectives were fulfilled:

- Conducted an RSE in conformance with the NCP;
- Characterized the nature and extent of releases of radionuclides in soil and sediment;
- Characterized the nature and concentrations of releases of metals in soil and sediment;
- Collected data to determine the appropriate response;
- Identified exposure pathways in accordance with the RSEWP;
- Evaluated baseline human health risks;
- Preliminarily defined survey areas and boundaries;
- Defined potential range of removal actions that are consistent with current and reasonably anticipated future land uses; and
- Evaluated soil for the reestablishment of a self sustaining ecosystem.

1.2 SITE HISTORY AND LAND USE

1.2.1 Ownership and Surrounding Land Use

Figure 1-2, *Local Land Use*, illustrates the property interests that encompass the Site and the surrounding lands that are of potential interest to the RSE. Surface ownership for Section 35 of T17N, R16W and Section 3 of T16N, R16W, which includes the majority of the NECR mine permit area, is held in trust by the Bureau of Indian Affairs for the Navajo Nation. The mineral rights are owned by Newmont USA, Ltd, successor to Santa Fe Pacific Gold Corporation. A small portion of the permit area is located on lands owned by UNC in the eastern part of Section 34, T17N, R16W. The remainder of Section 34 to the west of the NECR mine permit area is controlled by the Bureau of Land Management and is used for grazing, and potentially for mining. The NECR mine permit area encompasses approximately 125 acres.

UNC owns Section 36, T17N, R16W to the east, and Section 2, T16N, R16W to the southeast of the Site. These parcels are part of the Church Rock mill and tailings storage facility that is maintained under a Source Material License in compliance with Nuclear Regulatory Commission (NRC) requirements. Upon termination of the license, and to comply with Title II of the Uranium Mill Tailings Radiation Control Act (UMTRCA), these lands will be deeded to the Department of Energy, and will be held in perpetuity in the Legacy Monitoring Program. The Church Rock tailings storage facility is an EPA Region 6 National Priority List Site that is operated and maintained primarily through a NRC Source Materials License.

All lands to the north of the Site are part of the Navajo Indian Reservation. From the late 1960's into the early 1990's, the part of the reservation immediately adjacent to the Site was mined by Kerr-McGee Corporation (Quivera Mining Company) through a lease with the Navajo Nation (these mines were referred to as Church Rock I, IA and II). Kerr McGee's subsurface mining operations extended to near the underground workings of the Northeast Church Rock Mine. Based upon aerial photographs, by 1997 the Quivera Mine had been closed. In 1990, the Department of Interior, Bureau of Land Management (BLM) issued Quivera Mining Company a conditional approval letter of their Abandonment and Reclamation Plan for the Quivera Mine (BLM, 1990). One of the conditions imposed by the BLM was that the Quivera Mine surface be cleaned up so that gamma radiation as measured one meter above the ground surface does not exceed 50 uR/hr above background at roadways, fence lines, vent holes protore storage areas, and mine ponds and 57 uR/hr at mine spoils areas above background (see Abandonment and Reclamation Plan, Quivera, 1987). Between 1997

and 2004, it appears that between six and nine home sites had been developed on the land located south of the Quivera Mine. The area is also used for grazing. Historical aerial photographs reveal some prior disturbances surrounding the home sites that appear to be related to the mining activity at the Quivera Mine. Because natural water supplies are high in dissolved minerals content, potable and livestock water is supplied to the reservation via Navajo utilities. Two wells in the area, NR-1 and Friendship Well, are located northwest of the home sites. Both wells appear to have been unused for several years and the NR-1 well is locked by UNC.

The mine site is currently inactive and is fully fenced to prevent access by unauthorized visitors as well as livestock. However, there is a current grazing permit for the site issued by the Department of Interior Bureau of Indian Affairs (see Appendix A), and the Site was used for grazing previously prior to construction of the new property fence. The surrounding area is largely undeveloped land and is used primarily for livestock grazing. Wildlife are also present in the area. Adjacent to the northern permit boundary (north side of NECR-1) is Navajo Reservation Land. Approximately 800 feet to the north of NECR-1 are the home sites mentioned above; the land around the home sites used in connection with residential occupancy.

1.2.2 NECR Mining Practices

The majority of the NECR mine property (i.e., that part which lies on lands held in trust by the Bureau of Indian Affairs for the Navajo Nation) was operated by UNC under the terms of a mineral lease with the predecessors of what is now Newmont USA, Ltd. Active mine operations at the Site took place between 1968 and 1982 at which time the mine was placed on stand-by status. Mining was conducted by underground methods. The infrastructure included two main shafts (NECR-1 and NECR-2), several vent holes, support buildings, roads, and water treatment facilities, as shown on Figure 1-3, *Site Layout.* Reviews of historical aerial photographs and Site reconnaissance have indicated that portions of the Site are located within an arroyo.

Beginning in 1979 and ending when the mine went on standby status, pursuant to a permit from the New Mexico Environmental Improvement Division (NMEID), UNC used coarse tailings sands from the mill to provide roof support for critical mined-out portions of the NECR mine. The tailings sands were temporarily staged at the three locations shown on Figure 1-3 (see Sandfill areas), and then were pumped underground into specified areas using a sand slurry. Backfill preparation within the underground mine consisted of building bulkheads equipped with drains around the area to be backfilled. The entrained slurry water drained into the mine drainage system, where it mixed with mine water that was collected and pumped to the surface.

Dewatering operations continued into 1983. The water was treated in three constructed ponds to reduce suspended solids and radionuclide concentrations before being discharged into what is referred to as the Unnamed Arroyo. Upon passage of the Clean Water Act (CWA), discharges were released pursuant to a National Pollutant Discharge Elimination System (NPDES) permit. Treatment processes were added or changed over the years, principally to meet revisions to discharge requirements as dictated by the CWA. Even prior to the time that permitting requirements became effective ponds were used to settle suspended solids. Thus mine water was never directly discharged to the Unnamed Arroyo without some type of treatment.

The individual ponds were used as follows: Pond 1 functioned as a surge tank to allow for homogenization and sand settling. A flocculant was also added to remove suspended solids. The clarified water then flowed into Pond 2. Between Pond 2 and Pond 3a, sulfuric acid and barium chloride were added, resulting in the removal of radium through precipitation as radium sulfate in Pond 3/3a. Water from Pond 3 was fed to an ion exchange (IX) plant for the recovery of uranium and then discharged into the Unnamed Arroyo. The IX Plant was added to the Site's NRC license in 1977 and operated until dewatering operations ceased, at which point UNC closed the IX Plant, mine

water treatment ponds, and tailings sand backfill areas in accordance with its NRC Source Materials License.

UNC undertook various closure activities at the NECR Mine between 1986 and 1994 pursuant to NRC requirements and the mining lease. In addition to removing the IX Plant and sludge-contaminated soils from the treatment ponds, closure actions included: removal of equipment and some buildings; backfilling and sealing the two shafts (NECR-1 and NECR-2) and associated vent holes with reinforced concrete caps; regrading, covering and revegetation of the non-economic materials storage area (NEMSA). The only remaining structural features include the main office, power poles, building foundations and other concrete platforms. The concrete pads were left standing at the request of the Pinedale Navajo Chapter house. A disposal area is located on that part of Section 34 owned by UNC (the Boneyard). The Boneyard was used to store old equipment, tires, wood pallets, and other miscellaneous materials. This material was either removed from the Site or buried at the Boneyard area. The area was covered with one foot of soil and reseeded as part of the closure activities.

1.2.3 Regulatory History

The NECR Mine has been regulated under various permits during active and post-closure operations, as listed below.

- A NPDES permit for the treatment and discharge of mine water.
- An amendment to the radioactive materials license from the State of New Mexico for the operation of the IX Plant.
- A discharge permit and radioactive materials license from the State of New Mexico for backfilling coarse tailings sand into the mine.
- A source materials license with NRC following the June 1986 return of the State's licensing authority to the NRC for the closure of the sand backfill staging areas and the IX Plant and water treatment ponds.
- A mining permit issued by the State of New Mexico in 2004 to conduct additional mine closeout activities under the NMMA.
- A storm water discharge permit with EPA in 2005.

The NPDES permit covered the discharge of treated mine water into the arroyo downstream of NECR-1. The water was monitored for flow rate, pH, suspended solids, radionuclides, and trace metals; and was reported to the State of New Mexico and EPA in quarterly reports. The permit was inactive after mine dewatering ceased in 1983, and the permit was allowed to lapse at the end of 1993, at the same time that the mineral lease expired.

On June 23, 1977, UNC's State-issued radioactive materials license (UN-UNC-ML) was amended to allow for the operation of the IX Plant, and on January 29, 1979, the license was again amended to govern radiological aspects for the backfilling of coarse tailings sands into the mine workings for structural control. (During this period, New Mexico had agreement state status and was authorized to administer the license.) The NMEID issued discharge permit DP-63 to govern water quality aspects of the tailings sand backfill. As a basis for the permit, Battelle (1982) investigated potential impacts from the sand backfill areas on groundwater quality, and concluded that degradation would

not occur. The permit required groundwater monitoring to verify the conclusions reached by Battelle.

In June 1986, the State of New Mexico returned its licensing authority for uranium recovery facilities to the NRC. UNC therefore closed the IX Plant, mine water treatment ponds, and tailings sand backfill areas in accordance with its NRC Source Materials License. This included the removal of radionuclide contaminated soils and process equipment, which were disposed of at the mill site in conjunction with mill decommissioning and reclamation activities. NRC certified the completion of the NECR cleanup activities in October 1989 in their letter to UNC dated October 1989. The letter stated: "Based on the equilibrium ration and the U-nat date provided by the licensee, the staff concludes that UNC has adequately removed remaining byproduct material from the mine site. Therefore no further action is necessary." (NRC, 1989).

UNC halted on-site activities at NECR in December 1993 after its lease expired. In September 2002, the New Mexico Appellate Court held that NECR was subject to the NMMA (New Mexico Mining Com'n v. United Nuclear, 133 NM 8, 57 P.3d 862, 2002). UNC submitted a mine permit application in July 2003 and a Closeout Plan in January 2004 (MWH, 2004a) to the MMD. UNC worked with MMD to complete work plans for site characterization and mine closure through March 2005. The State of New Mexico issued a letter in June 2004 for UNC to prepare a groundwater abatement plan. At roughly the same time that UNC received conditional approval to execute the Materials Characterization Work Plan (MWH, 2004b), the NNEPA requested that EPA assume jurisdiction for mine cleanup. On November 7, 2005, EPA agreed to the NNEPA's request, and in a December 16, 2005 letter from MMD to UNC, MMD deferred further permit action for NECR to EPA on the presumption that an EPA-led cleanup would result in compliance with the NMMA and address NMMA reclamation requirements. MMD reserved its right to make a determination of NMMA compliance following EPA's release of the mine site.

On May 13, 2005, UNC submitted a complete Notice of Intent (NOI) form seeking coverage under EPA's Multi-Sector General Permit for storm water discharges. There have been no discharge events to trigger any monitoring events since the permit has been in place, nor has there been continuous flow into the arroyos adjacent to the Site. UNC has implemented and maintains the best management practices that are contained in the Stormwater Pollution Prevention Plan (MWH, 2005).

1.2.4 Previous Work

Previous work that has been conducted at the Site is documented in serveral historical documents. These documents include those listed below.

- Closeout Plan (MWH, 2004a)
- Material Characterization Work Plan (MWH, 2004b)
- Groundwater Quality in the Westwater Canyon Member at the Northeast Church Rock Mine (MWH, 2004c)
- Northeast Church Rock Mine Site Assessment (MWH, 2003)
- Tailings Sand Backfill Cleanup Verification Report (UNC, 1989a)
- Kerr-McGee (Quivera Mine) Operations and Closure Report (date unknown)

Additionally, data concerning the results of the EPA field radiological scan that was conducted in 2005 (see Section 1.1) was conveyed to the project team by personal communication (EPA, personal communication, 2006).

1.3 PHYSICAL SETTING

1.3.1 Physiography

The Site 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.

The NECR Mine site is located in an arroyo that drains to the northeast downstream of NECR-1 into another arroyo that drains to the east into Pipeline Canyon. For the purposes of the RSE, the arroyo that drains along the north side of the mine site and then between NECR-1 and Red Water Pond Road is hereafter referred to as the Unnamed Arroyo. Elevations at the Site range from 7,100 to 7,200 feet. Pipeline canyon is a northeast-southwest trending alluvial valley that drains intermittently to the southwest, eventually emptying into the Rio Puerco. Surface water flow from the Site discharges intermittently into the Unnamed Arroyo that empties into Pipeline Canyon via the other arroyo.

1.3.2 Climate

The average temperature in Gallup, 16 miles south of the Site, 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 average 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. Blowing dust and serious soil erosion is a problem during dry spells. Based on data (1992-2002) from the Gallup airport, winds predominate from the west to southwest 11 months out of the year. A predominant direction from the south is reported for the month of August (http://www.wrcc.dri.edu).

1.3.3 Geology and Groundwater Quality

The surface of the Site, beneath the soil or colluvium layers (see Section 1.3.4) consists of alluvium along the axes of the drainages and bedrock in other areas. The alluvium present generally consists of clay, silt, sand, and gravel deposited in interfingering layers. The alluvium is very thin or absent at the mine, and is unsaturated. Approximately one mile southeast of the Site, in the valley bottom along the axis of Pipeline Canyon, the alluvium attains sufficient thickness and continuity to be a mappable geologic unit. Similarly, the alluvium becomes partially saturated only along the axis of Pipeline Canyon, in large part if not entirely due to infiltration of mine water discharge from the two upstream mines. Water levels in the alluvium have been gradually lowering ever since mine water discharges ceased.

The Site is underlain by the upper Cretaceous Crevasse Canyon Formation. The cliffs that rim the Site are comprised of white, medium- to coarse-grained sandstone of the Dalton Sandstone Member of the Crevasse Canyon Formation, while much of the Site permit area is underlain by unsaturated

mudstones, sandstones, and coal beds of the Crevasse Canyon Formation. Underlying the Crevasse Canyon Formation are the Gallup and Mancos Shale formations, also of Cretaceous age. Groundwater is first encountered in the Gallup Formation; during the drilling of the NECR-1 area mine shaft an approximately 30 gpm yield was reported. The Mancos is a very effective confining layer being comprised of 500-800 feet of shale.

Underlying the Cretaceous sediments, are the Jurassic Morrison Formation and Dakota Formation. The primary uranium ore body mined at the Site is present within the Westwater Canyon Sandstone Member of the Morrison Formation. The NECR-1 and NECR-2 mine shafts at the Site extended to a depth of approximately 1,500 to 1,800 feet into the Westwater Canyon Sandstone Member. The Dakota and Morrison Formations may be hydraulically connected; together they constitute a productive aquifer, and produced about 1,500 gpm during mine dewatering operations.

A discussion of the background concentrations of COPCs is included in Section 2.5.

Groundwater quality data at the Site was presented in the document *Groundwater Quality in the Westwater Canyon Member at the Northeast Church Rock Mine* (MWH, 2004c). Maximum concentrations for background mine water quality exceeded NMED standards for iron, manganese, nitrate, and radium-226 (Ra-226). A sample collected from the NECR-1 area well on May 17, 2004 exceeded New Mexico Environment Division (NMED) standards for pH, total dissolved solids and boron.

1.3.4 Soils

Native soils at the Site boundary consist of well-drained silty sands and inorganic silts and clays, characteristic of a semi-arid pinyon-juniper region. Soils in the areas surrounding the nine home sites are expected to be similar. Coarser, poorly sorted alluvial deposits containing gravel and cobbles are found along the Unnamed Arroyo. The NECR-1 pad was constructed of non-economic mine materials consisting of sandstone and clay shale fragments, while the NECR-2 pad was constructed primarily of native soils. The NEMSA and the Boneyard were seeded in 1994, after being covered with one foot of native topsoil. Currently, areas of the Site have supported a variety of native vegetation, but revegetation of some areas has had little success due to livestock grazing.

The water treatment ponds (Pond 1, Pond 2, and Pond 3/3a) were originally filled with water and sediments settled in them from storm water runoff that drained the tailings sand backfill areas, as well as water from mine operations (see Section 1.2.2). The sediments were periodically removed and placed on the Sediment Pad for temporary storage prior to being transported off-site for processing at the mill. Residual tailings were removed from the ponds and the Sediment Pad as part of the 1986 cleanup pursuant to Condition 33 of NRC Permit License No. SUA-1475 (UNC, 1989a). Currently, the ponds and the Sediment Pad consist primarily of native materials.

As stated above, the sand backfill areas originally were used to store tailings from the mill. As discussed in Section 1.0, the tailings were removed and used to backfill the mine workings. The sand backfill areas were then included in the 1986 cleanup pursuant to Condition 33 of NRC Permit License No. SUA-1475 (UNC, 1989a). As such, the sand backfill areas now consist primarily of native materials.