Section 9 Lease Mines
Western Abandoned Uranium Mine Region
Coconino County, Arizona

Final

Section 9 Lease Mines
Engineering Evaluation/Cost Analysis

November 2024

TETRA TECH

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Response, Assessment, and Evaluation Services 2

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Submitted by

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ACRONYMS AND ABBREVIATIONS

§	Section
µR/hr	Microroentgen per hour
APE	Area of potential effect
ARAR	Applicable or relevant and appropriate requirement
AUM	Abandoned uranium mine
Babbitt Ranches	Babbitt Ranches, LLC
bgs	Below ground surface
BLM	Bureau of Land Management
BTV	Background threshold value
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
COC	Contaminant of concern
COEC	Contaminant of ecological concern
COPC	Contaminant of potential concern
COPEC	Contaminant of potential ecological concern
EA	Engineering Analytics, Inc.
EE/CA	Engineering evaluation/cost analysis
ERA	Ecological risk assessment
ET	Evapotranspiration
EU	Exposure unit
HDPE	High-density polyethylene
HHRA	Human health risk assessment
HPIC	High-pressure ionization chamber
IC	Institutional control
IL	Investigation level
LCR	Little Colorado River
LiDAR	Light detection and ranging
LLRW	Low-level radioactive waste
LUC	Land use control
mg/kg	Milligram per kilogram
Murchison Ventures	Murchison Ventures, Inc.
NAUM	Navajo abandoned uranium mine
NCP	National Contingency Plan
NORM	Naturally occurring radioactive material
NPV	Net present value

ACRONYMS AND ABBREVIATIONS (CONTINUED)

PA	Preliminary assessment
pCi/g	Picocurie per gram
PERG	Preliminary ecological removal goal
PRG	Preliminary removal goal
Ra-226	Radium-226
RAG	Removal action goal
RAO	Removal action objective
Rare Metals	Rare Metals Corporation of America
RCRA	Resource Conservation and Recovery Act
RSE	Removal site evaluation
SE	Secular equilibrium
SI	Site inspection
SLERA	Screening-level risk assessment
SWCA	SWCA Environmental Consultants
TBC	To be considered
TENORM	Technologically enhanced naturally occurring radioactive material
Tetra Tech	Tetra Tech, Inc.
U-238	Uranium-238
UMTRCA	Uranium Mill Tailings Radiation Control Act
UPL95	95 percent upper prediction limit
USEPA	U.S. Environmental Protection Agency
UTL95-95	95 percent upper tolerance limit with 95 percent coverage
Weston	Weston Solutions, Inc.
WRS	Wilcoxon rank sum

1.0 INTRODUCTION

This engineering evaluation/cost assessment (EE/CA) **develops and evaluates alternatives for addressing the risks to human health and the environment** associated with mine waste and contaminated soils remaining at the Section 9 Lease Mines. The alternatives presented in this EE/CA were developed and evaluated in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The U.S. Environmental Protection Agency (USEPA) will solicit input from stakeholders before selecting an alternative.

1.1 SITE CHARACTERIZATION

The Section 9 Lease Mines is located along the west side of the Little Colorado River (LCR) approximately 40 air miles north of Flagstaff, Arizona. The Navajo Nation surrounds the site from the north and east, and the abandoned uranium mines (AUM) on the site are classified as part of the Western AUM Region of the Navajo Nation (Figure 1). The Section 9 Lease Mines contains AUM 457, AUM 458, a small portion of AUM 459, and small portions of the adjacent property in Section 10 owned by the United States on which hazardous substances have come to be located (Figure 2). The full extent of AUM 459, which is primarily in Section 16 (State of Arizona land) to the south of Section 9, is not included in the scope of this EE/CA. AUMs 458 and 459 produced an estimated 386 tons of ore between 1957 and 1962. AUM 457 has no mine production features within its boundary. AUM features include pit areas, a former drainage pond, the foundation of an upgrader, and unreclaimed waste piles (Figure 3).

Gray Mountain, Arizona, is the nearest population center to the site and is 8 miles west of Section 9. The agricultural and residential community of Cameron, Arizona, is 10 miles north of the site. The nearest residential structure is on private land outside the Section 9 Lease Mine boundary and at approximately 2 miles northeast of AUM 458 and AUM 457. The Section 9 Lease Mines is not used for human, livestock, agricultural, or other purposes, and no structures are in use on the site. The likely future land uses at the Section 9 Lease Mines are:

- **Recreational (Trespasser) –** The easternmost portion of the site includes a small portion of AUM 457, which is on Section 10 land managed by the Bureau of Land Management (BLM). BLM staff, as well as recreators, have access to this portion of the site. However, the mines are largely on private land owned by Babbitt Ranches, LLC (Babbitt Ranches) and CO Bar, Inc. with a land use easement prohibiting residential use. Currently, Babbitt Ranches does not allow access in Section 9 and any recreational users are considered trespassers.
- **Periodic Work –** Employees of Babbitt Ranches visit the site periodically to complete inspections and maintenance. Users within Section 9 completing periodic inspections and maintenance are considered Periodic Workers.

The nature and extent of surface soil contamination at the site were assessed with various technologies during the preliminary assessment (PA), the site inspection (SI), Phase II and Phase III investigations, the removal site evaluation (RSE) completed in March 2021, and the data gaps investigation completed in February 2024. Most of the contaminated soil at the site is within the unreclaimed waste piles throughout the site and in the drainage downslope of the former upgrader at AUM 457. Areas with contamination outside the waste rock piles and AUM boundaries are present because of migration of alluvial material in drainage channels and debris from mining-related transportation along haul roads. In addition, mining activities exposed naturally occurring radioactive material (NORM) from bedrock and ore on the edges of the mine pits.

As part of this EE/CA, risk evaluations were completed at the Section 9 Lease Mines in accordance with Navajo Abandoned Uranium Mines (NAUM) program risk assessment methodology (USEPA 2024a). The results of the human health risk assessment (HHRA) indicate that risks are estimated at 8×10^{-4} for adult and child trespassers for surface soil and 5×10^{-4} for subsurface soil attributable to radium-226 (Ra-226). The noncancer hazard is below the target hazard index of 1 for all areas and all trespasser/periodic worker receptors. Ra-226 is a contaminant of concern (COC) for human health receptors. The ecological risk assessment (ERA) identified ecological risk at the site. Ra-226 is the only contaminant of ecological concern (COEC) recommended for removal action.

Removal action goals (RAG) were derived for COCs and COECs. The selected RAGs are the lesser of the human health preliminary removal goal (PRG) and the preliminary ecological removal goal (PERG) unless one of these values is less than background. For purposes of the final EE/CA, the Ra-226 RAG of 12 picocuries per gram (pCi/g) based on the human health PRG is used for delineating contaminated areas. Removal of contaminated soil above the Ra-226 RAG will mitigate the risks associated with the COCs and COECs. Protecting human health and the environment is the purpose of removal action activities at the Section 9 Lease Mines.

The removal action extent covers 6.5 acres based on the surficial extent of surficial Ra-226 above the RAG based on the site-specific gamma-radium correlation. An estimated total of 14,711 cubic yards of mine waste and contaminated soil will be addressed by removal action.

1.2 REMOVAL ACTION OBJECTIVES

The first step in developing removal alternatives is to establish removal action objectives (RAO). CERCLA does not allow removal action alternatives to require remediation of NORM or to remediate soil to concentrations below background levels. Taking current and potential future land uses into account at the site, the RAOs are to:

- Prevent exposure to soil with contaminants associated with past mining activities that would pose an unacceptable risk to human health with the reasonably anticipated future land use
- Prevent exposure to soil with contaminants associated with past mining activities that would pose an unacceptable risk to plants, animals, and other ecological receptors
- Prevent offsite migration of contaminants associated with past mining activities that would pose an unacceptable risk to human or ecologic health by soil, surface water, groundwater, or air

The anticipated current and future use will be by periodic workers and trespassing recreators because of the deed restricted designation of Section 9 and the open space recreation at Section

10. The scope of the removal action will be to address soil and sediment contamination within the site and to be the final action for solid media at the site.

1.3 IDENTIFICATION OF REMOVAL ACTION ALTERNATIVES

The following removal action alternatives were developed and evaluated as part of this EE/CA:

- **Alternative 1: No Action (this alternative must always be evaluated) –** No treatment or removal action would occur at the site. In this case, all threats would remain unchanged. Mine waste and contaminated soils would continue to threaten human and ecological receptors. Gamma radiation and physical hazards would still be present.
- **Alternative 2: Consolidate and Cap All Waste Onsite –** Reaches RAOs by excavating the waste rock piles, residual waste rock, and contaminated soils; and consolidating and capping the waste in the pit areas. The cap will require long-term maintenance. A protective evapotranspiration (ET) cap would be used that would control contaminant migration.
- **Alternative 3: Disposal of All Mine Waste at a Western AUM Regional Repository –** Reaches RAOs by excavating the waste rock piles, residual waste rock, and contaminated soils; and consolidating and capping the waste in a regional repository located on Section 9. The regional repository is located approximately 1 mile from AUM 457 and 0.6 mile from AUM 458. This location would provide for increased distance from drainages and floodplains. The cap and exposed bedrock areas will require long-term maintenance. A protective ET cap would be used that would control contaminant migration.
- **Alternative 4: Disposal of All Mine Waste in Offsite Resource Conservation and Recovery Act (RCRA)-Licensed Facility –** Reaches RAOs by excavating the waste rock piles, residual waste rock, and contaminated soils; hauling the waste 515 miles (one way) to the Energy Solutions LLRW facility in Clive, Utah; and disposing of the waste in the facility.

For the applicable removal action alternatives, plant life that matches the natural landscape would be planted on the installed covers of excavated material. All temporary roads built for construction would also be removed, and the site will be restored. The surface of excavation areas would be recontoured and revegetated to match the natural landscape.

1.4 ANALYSIS OF REMOVAL ACTION ALTERNATIVES

The removal action alternatives were evaluated individually and in relation to each other using three broad criteria: effectiveness, implementability, and cost. An overview of the comparative analysis is presented in Exhibit 1.

The draft final EE/CA was prepared without a recommended removal action alternative to provide an opportunity for public input on the removal action alternatives development and evaluation process. Following stakeholder and public input, the final EE/CA was prepared, including the recommended removal action alternative. A formal public comment period on the final EE/CA will follow.

Exhibit 1. Summary of Alternative Ratings

Alternative	Protective of Human Health and Environment	Effectiveness	Implementability	Cost Rating (2024 Million)[a]
Alternative 1: No Action	Poor	Short-Term: Average Long-Term: Very Poor	**Tech: Very Good** **Admin: Very Good**	**Very Good ($0)**
Alternative 2: Consolidate and Cap All Waste Onsite	Pass	Short-Term: Good Long-Term: Average	Tech: Good Admin: Good	Good ($3.6)
Alternative 3: Disposal of All Mine Waste at a Western AUM Regional Repository	Pass	Short-Term: Good **Long-Term: Very Good**	Tech: Good Admin: Good	Good ($4.0)
Alternative 4: Disposal of All Mine Waste in Offsite RCRA-Licensed Facility	Pass	Short-Term: Poor **Long-Term: Very Good**	Tech: Good Admin: Good	Very Poor ($12.8)

Notes:
Bold indicates the highest rating in the category.
[a] Estimated costs are net present value.
Admin Administrative feasibility
N/A Not applicable
RCRA Resource Conservation and Recovery Act
Tech Technical feasibility

2.0 SITE CHARACTERIZATION

This section presents a description and background of the Section 9 Lease Mines; previous reclamation and removal actions; previous site investigations; source, nature, and extent of contamination; and the risk assessment for AUMs 457 and 458.

2.1 SITE DESCRIPTION AND BACKGROUND

The Section 9 Lease Mines contains AUM 457, AUM 458, and a small northern portion of AUM 459. The following subsections describe the site location, type of mines and operational status, regulatory history, features and landscape, geology and hydrology, land use and populations, sensitive ecosystems and habitat, and meteorology and climate.

2.1.1 Site Location

The Section 9 Lease Mines is in the LCR valley in Coconino County, Arizona, on the west side of the LCR at 35.734 degrees latitude and -111.328 degrees longitude. A regional map is provided on Figure 1. The Navajo Nation surrounds the site from the north and east, and the site is classified as part of the Western AUM Region of the Navajo Nation. The boundaries for AUMs 457, 458, and 459 are based on historical documents and remnants from mining operations observed at the site (Weston Solutions, Inc. [Weston] 2012). The site is largely on land owned by Babbitt Ranches and CO Bar, Inc. in Section 9 with a small portion on federal land managed by BLM in Section 10. Land ownership and locations of mine boundaries established from historical records and observations during the PA are shown on Figure 4. These figures show the site location generally. Site features across Section 9 are shown in Figure 3 and subsequent sections in this EE/CA describe site features in more detail. In total, the APE (EA 2018) includes an area of 464 acres of Section 9 for which a total of 26 acres are covered by AUM 457, AUM 458, and AUM 459.

2.1.2 Type of Mine and Operational Status

Former open pit mining operation facilities are located on AUMs 457 and 458. Figure 4 and Figure 5 provide the locations of major site features for AUMs 457 and 458 as documented in the RSE report (Engineering Analytics, Inc. [EA] 2021) and field-verified during the data gaps investigation in 2024 (Appendix A).

A history of AUMs 457, 458, and 459 is summarized below from USEPA (2016a) and EA (2021). Uranium was first reported in the Cameron area in 1950, and mining ceased by 1963. Mining occurred on Section 9 from 1957 to 1962. In 1957, Arrowhead Uranium, a subsidiary of Rare Metals Corporation of America (Rare Metals), leased the rights to Section 9 from CO Bar Livestock Company (currently called CO Bar, Inc.) and began an open pit mining operation. In the first year, Rare Metals shipped 17.95 tons of low-grade ore from the site to the Rare Metals Mill in Tuba City and paid royalties to CO Bar Livestock Company. By 1958, Rare Metals ceased mining operations, and C.L. Rankin acquired the lease from CO Bar Livestock Company. C.L. Rankin shipped 87.21 tons of low-grade ore in 1958 and 234.32 tons of low-grade ore in 1959.

In 1959, Murchison Ventures, Inc. (Murchison Ventures), owned by John Milton Addison and others, acquired the lease of Section 9. Murchison Ventures built a small processing plant known as the Benson Upgrader in the northeast part of Section 9 near one of the former pits (AUM 457). Murchison Ventures claimed that the Benson Upgrader would separate the waste rock from previous mining activities into a “sellable” higher-grade slime fraction and a lower-grade sand fraction. Murchison Ventures sent a shipment of 10.76 tons of upgraded ore to the Tuba City Mill in 1959. In 1960, Murchison Ventures modified the plant and sent another shipment of 11.31 tons of ore to the mill. John Milton Addison was adjudicated bankrupt on June 27, 1960. On this date, all funds and assets—including the mining lease for the east half of Section 9—of John Milton Addison and various corporate entities with which he was affiliated came under the jurisdiction of the United States District Court for the Northern District of Texas (Dallas). The lease to Section 9 was conveyed to Arizona Title and Trust Company in June 1960. In 1961, John Milton Addison, along with six associates, were convicted of fraud, conspiracy, and federal security violations related to the upgrading operation.

In October 1960, a group of John Milton Addison’s investors incorporated as Milestone Hawaii assumed control over the Murchison Ventures operation on Section 9. During the summer of 1961, Milestone Hawaii demolished the original Benson Upgrader on Section 9 and replaced it with a larger upgrader. In March 1962, 23.9 tons of low-grade material was shipped to the Tuba City Mill. Mining operations ceased in 1961, and no known mining activities have occurred since that time. While operational, the Atomic Energy Commission estimated the uranium ore production volume at the site, including all three AUMs, as 386 tons. No uranium processing through chemical extraction (which would generate uranium tailings) is thought to have been performed at the Benson Upgrader or the larger upgrader installed in 1961.

2.1.3 Regulatory History

The primary landowners of the Section 9 Lease Mines Babbitt Ranches and CO Bar, Inc. entered an administrative settlement agreement and order on consent with USEPA in 2016. This agreement stipulates that the respondents conduct an RSE and removal action based on RSE findings (that is, removal of waste volumes above a specified concentration for a listed hazardous substance).

2.1.4 Site Features and Landscape

AUM 457 is 16.5 acres and is contained within Section 9 except for the easternmost boundary on the banks of the LCR, which is in Section 10 on federal land managed by BLM. As shown in Figure 4, AUM 457 includes a former borrow pit and pond. Concrete foundations and two 30-foot-tall walls from the Benson Upgrader (the ore processing plant demolished in 1961) are near the center of the AUM (Weston 2011). The main foundation covers a footprint of approximately 100 feet by 50 feet, and a smaller foundation south of the larger concrete pad measures 20 feet by 20 feet.

AUM 458 is 9.3 acres and is contained entirely within Section 9. As shown in Figure 5, AUM 458 is 0.25 mile west of the LCR and includes uranium waste rock, mining debris, and a recessed pit near the center of the AUM (Weston 2011). A regional drainage, Mays Wash, is east and south of the AUM boundary.

AUM 459 is not included in the scope of this EE/CA because it is mostly in Section 16 on State of Arizona land. However, a small area (0.42 acre) of this AUM is a part of the site in Section 9 and included in the revised technologically enhanced naturally occurring radioactive material (TENORM) extent for the Section 9 Lease Mines. AUM 459 includes an open pit area and piles of uranium waste rock (Weston 2011). Waste from AUM 459 appears to have migrated onto the Section 9 Lease Mines based on predicted surface Ra-226 from the site gamma-radium correlation (Tetra Tech, Inc. [Tetra Tech] 2022).

Outside of AUM 457, AUM 458, and AUM 459, the APE established during the Phase II RSE (EA 2018) consists of areas that have been disturbed by mining exploration and the creation of haul and access roads across the site.

2.1.5 Geology

The geology of the Cameron area is characterized by layered sedimentary units typical of the Colorado Plateau. The complex geologic history and long-term stability of the Colorado Plateau allowed for the mineralization of uranium, and the Cameron area contains abundant uranium ore deposits that are found primarily in the upper Triassic Chinle Formation. Quaternary-age materials, comprising sedimentary alluvium, sand, and gravel deposits, overlay the Triassic Chinle Formation. Fluvial sandstones in the lower part of the Petrified Forest Member of the Chinle Formation contain most of the uranium deposits around Cameron with lesser amounts found in the Shinarump Member of the Chinle Formation. The Moenkopi Formation underlies the Chinle Formation and is exposed in areas near the LCR and other washes where overlying deposits have been eroded (Chenoweth 1993). Ore bodies occur at the surface to a depth of 130 feet below ground surface (bgs) and vary in size from a single mineralized fossil log to hundreds of feet in length (Chenoweth and Malan 1973). General descriptions of the three relevant geological units are presented below in descending stratigraphic order (Bollin and Kerr 1958; Dubiel and others 1991):

- **Quaternary Alluvium (Holocene, 11,700 years ago to current): Includes** dune and fluvial sand/gravel deposits commonly found within washes (fluvial deposits) and on top (terrace gravel) of and along hill slopes (dunes).
- **Petrified Forest Member of the Chinle Formation (Late Triassic, 237 to 201 million years ago):** Red and brown fluvial sandstones and floodplain mudstone deposits. Also contains volcanic ash and carbonaceous material.
- **Shinarump Member of the Chinle Formation (Late Triassic, 237 to 201 million years ago):** White to yellow and gray sandstone and conglomerate with minor gray mudstone. Fluvial channel and valley fill deposits incised into underlying Moenkopi Formation. Sediments were deposited as lenticular beds that contain carbonaceous material.
- **Moenkopi Formation (Middle and Early Triassic, 252 to 237 million years ago):** Marine to marginal marine sediments, including red sandstones, shales, silts, mudstones, and limestones, that unconformably lie below the Shinarump Member of the Chinle Formation.

A map showing the geologic units for the site and vicinity are presented on Figure 6.

2.1.6 Hydrology

The Section 9 Lease Mines is in the Lower Little Colorado Watershed and adjacent to the LCR. The LCR is perennial between its headwaters and the Lyman Dam. Below the Lyman Dam, including the segment next to the site, the LCR is intermittent because of impoundments, diversions, and falling groundwater levels from well pumping (Arizona Department of Water Resources 2009).

Mays Wash, an ephemeral drainage, runs through the site near AUM 458 and drains to the LCR. Ephemeral drainage pathways out of AUMs 457 and 458 were documented in the RSE (EA 2021) based on the light detection and ranging (LiDAR) survey performed for the site, but flow directions were mapped differently than reported in the SI (Weston 2014). A desktop evaluation of the RSE LiDAR survey and the U.S. Geological Survey elevation data available for the site was performed to identify potential transport pathways leading out of the AUM areas at the site (Tetra Tech 2022). Drainages flowing through the site near and within the Atlas boundaries for AUMs 457 and 458 were field-verified with disturbance mapping during the 2024 data gaps investigation (Appendix A). Figure 7 and Figure 8 show the locations and flow directions of the drainages for AUM 457 and AUM 458, respectively, on Section 9.

Groundwater conditions within Section 9 are unknown because no monitoring wells are on or near the site.

2.1.7 Land Use and Populations

A land easement prohibiting residential use of Babbitt Ranches' land within Section 9 was established in 2019 (EA 2021). Accessing the site outside of maintenance of the main access road and inspection of the property is prohibited, and trespassing is in violation of State of Arizona law. The site is not currently used for human, livestock, agricultural, or other purposes. No structures are in use on the site, and no structures will be built on the site in the future.

The populations most likely to access the site in the future after removal actions are periodic workers, including employees of Babbitt Ranches and CO Bar, Inc., and possible trespassers.

Recreators on BLM land, as well as BLM staff, can access the portion of the site on Section 10. Signage is installed along the Section 9 and 10 boundary. However, no physical barriers limit movement between Sections 9 and 10; thus, a person legally accessing BLM-managed land on Section 10 could also trespass on Section 9.

The nearest population center to the site is the community of Gray Mountain, Arizona, 8 miles west of Section 9. The PA by Weston (2012) determined no active drinking water wells are within 4 miles of the site.

2.1.8 Sensitive Ecosystems and Habitat

The U.S Fish and Wildlife Service determined that no federally listed or proposed endangered or threatened species are present at or near the site and no critical habitats for such species exist at the site (SWCA Environmental Consultants [SWCA] 2016).

The biological resources survey assessed other special status plant and animal species identified by the State of Arizona and Navajo Nation as potentially relevant to the site and found a low likelihood of occurrence of these species at the site (SWCA 2016). Sparse vegetation at the site is not ideal for many ecological receptors and, thus, the potential for occurrence of Navajo endangered species and State of Arizona species of greatest conservation need at the site is low.

At the time of the biological survey, no aquatic vegetation in the dry channel of the LCR and no aquatic life in standing pools from recent rain events in the channel bed were observed. Further, wetland features previously identified by USEPA (2013) were not observed and are not present at the site (SWCA 2016).

2.1.9 Meteorology and Climate

The Section 9 Lease Mines is in a semi-arid region at high elevation (Arizona Department of Water Resources 2009). A summary of relevant climate and meteorological conditions for the site is presented in Table 1.

2.2 PREVIOUS RECLAMATION AND REMOVAL ACTIONS

No removal or reclamation actions have been completed at the site since mining operations ended in 1962. As observed in previous site investigations, waste rock piles at all three AUMs are unreclaimed and wood and metal mining debris remain throughout the site (Weston 2011).

2.3 PREVIOUS SITE INVESTIGATIONS

Previous environmental investigations for the site and the larger portion of AUM 459 that is not part of the site include:

- Weston (2011) performed a site screen of AUMs 457, 458, and 459 in 2011. An initial gamma radiation survey of the site was completed, and site features were documented.
- Weston (2012) completed a PA in 2012 that reviewed features and hazards for AUMs 457, 458 and 459.
- USEPA (2013) performed a wetlands evaluation at AUMs 457, 458, and 459 in 2013 that identified two potential wetland areas at the site, including within the boundaries of AUM 458 and partially within the riparian zone of the LCR that overlaps with the eastern boundary of AUM 457.
- Weston (2014) completed an SI in 2014 that included an initial background study, soil and sediment sampling, and a transect gamma radiation survey.
- SWCA (2016, 2017) performed biological and cultural resources surveys during Phase I of the RSE:
    - Completed a biological resources survey in 2016 that found no wetlands hydrology, hydric soils, obligate wetland vegetation, or other wetland species at AUMs 457 and 458, including at locations previously identified as potential wetland areas by USEPA in 2013 (SWCA 2016)

- Completed a cultural resources survey of the site in 2016 that identified two archeological sites adjacent to background study areas outside of the site boundaries (SWCA 2017)

- EA (2018) performed multiple tasks during Phase II of the RSE in 2018:
  - Established the area of potential effect (APE) as the primary study area at the site, including the full extents of AUM 457, AUM 458, and a small northern fraction of AUM 459
  - Performed a gamma radiation survey
  - Conducted a gamma correlation study that established a relationship between the gamma exposure rate and contaminant of potential concern (COPC) and contaminant of potential ecological concern (COPEC) concentrations
  - Performed a background characterization study
  - Delineated NORM and TENORM areas across the site

- EA (2020) performed additional tasks to characterize the site during Phase III of the RSE in 2020:
  - Excavated and sampled test pits at 21 locations across the site
  - Obtained high-resolution LiDAR topographic data to develop mine waste capacity estimates
  - Performed the HHRA and ERA to assess risks for human and ecological receptors based on environmental data collected during the Phase II and Phase III studies

- Tetra Tech (2024) performed site mapping and soil sampling in 2024 to update the risk assessment for the site to meet NAUM program requirements and improve development of removal action alternatives for onsite management of waste material. The activities and results of this data gaps investigation are summarized in Appendix A.

2.4 SOURCE, NATURE, AND EXTENT OF CONTAMINATION

The APE for the site, has a total surface area of 464 acres and encompasses all TENORM identified during the RSE (EA 2021). The extent of soil contamination within the APE was characterized during Phase II and Phase III of the RSE with high-density mobile gamma radiation surveys, surface soil and sediment sampling, and subsurface excavation and sampling (EA 2018, 2020). The TENORM boundary for the site was revised in 2024 following additional site mapping by Tetra Tech. The following subsections describe the methods used to characterize contamination at the site for the purpose of determining preliminary removal action extents for the EE/CA.

2.4.1 Western Abandoned Uranium Mine Regional Background and Site-Specific Background

Geology-specific background concentrations for major soil contaminants at AUMs in the Western AUM Region have been evaluated at regional scale for five of the geologic units present in the region: Quaternary Alluvium, Dunes, Terrace Gravels, Shinarump Member of the Chinle Formation, and Petrified Forest Member of the Chinle Formation (Tetra Tech 2024). Provisional regional statistics including background threshold values (BTV) based on the 95 percent upper tolerance limit with 95 percent coverage (UTL95-95) of each COPC or COPEC for each geologic unit were calculated using the Western AUM Region background dataset provided in Table 2 (Tetra Tech 2024). The UTL95-95 represents a 95 percent probability (or confidence) that 95 percent of samples from background are below that value.

Background radiation at the site was characterized through gamma radiation surveys at designated background study areas, including pooled background study area groups for three different land areas within the APE: LCR, drainage, and alluvial. The UTL95-95 for each grouping was calculated for Ra-226 based on the gamma-radium correlation developed for the site. The UTL95-95s for Ra-226 as calculated for the three different grouped landforms within the APE (EA 2020) are as follows:

- LCR: 1.52 pCi/g
- Drainage: 4.83 pCi/g
- Alluvial: 5.35 pCi/g

Site-specific BTVs for the metals COPCs and COPECs were not established in the RSE investigation.

2.4.2 Site Contaminants

The updated risk assessment (Section 2.5) and risk management analysis (Section 2.6) used soil data from the SI, RSE, and data gaps investigation to establish a comprehensive list of constituents of interest for the site. The metals assessed as soil constituents of interest in the risk assessment (Appendix B) are aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, uranium, vanadium, and zinc.

2.4.3 Source and Nature of Contamination

Elevated gamma radiation was identified by Weston (2011) at the site during a site screen in 2011. During the SI, the occurrence of elevated concentrations of radionuclides and metals in soil at the site were observed by Weston (2014). Waste rock across the site from historical mining activities is the primary source of radiological and metals contamination. Excavation of mining-related ore and waste rock from near-surface uranium deposits have dispersed metals and radionuclides into the local environment. The nature and extent of contamination at the site were assessed by EA (2021) during the RSE completed in March 2021.

Supplemental site mapping, including disturbance mapping, was completed at the site during the data gaps investigation. Disturbance mapping results included delineation of waste transport pathways, identification of site features, and waste pile mapping. Using this information, the Section 9 TENORM boundary was revised. The TENORM boundary includes all waste at the site within the boundaries of AUMs 457 and 458 and the unreclaimed waste piles in exploration areas across the APE. The revised TENORM boundary is shown on Figure 9.

2.4.3.1 Radiological Impacts

To evaluate radionuclide concentrations and metals and to assess risk to human health and ecological receptors at the site, the following activities were performed within the APE:

1. Gamma radiation surveys
2. Surface soil and sediment sampling (0 to 6 inches bgs)
3. Subsurface soil sampling (greater than 6 inches up to a maximum of 5 feet bgs)

Results from gamma radiation survey measurements within the APE are provided on Figure 10. Gamma radiation surveys allow for a more comprehensive site characterization compared to traditional soil sampling and laboratory analysis alone. Because of greater surface coverage and higher density of data points achievable compared to soil sampling and analysis, gamma radiation survey data were used to evaluate the extent of Ra-226 contamination at the site. A correlation between gamma exposure rate in microroentgen per hour (μR/hr) and Ra-226 activity in pCi/g (based on a high-pressure ionization chamber [HPIC] study completed during Phase II of the RSE) was developed to use existing gamma count readings to estimate the surficial extent of Ra-226 contamination. Ra-226 surface soil concentrations are shown with the interpolated Ra-226 surface based on gamma survey results on Figure 11. The gamma-radium correlation equation for the site is (EA 2021):

Equation 1 $$Exposure\ rate\ \left(\frac{\mu R}{hr}\right) = 4.5400457 + 0.0002339 * [Gamma\ count\ (cpm)]$$

Where:

μR = Microroentgen

hr = Hour

cpm = Counts per minute

Once converted to the gamma exposure rate, the data were converted again to predicted Ra-226 in pCi/g based on a linear regression and graphical analysis of soil Ra-226 concentrations (pCi/g) and HPIC measurements (μR/hr) as follows (EA 2021):

Equation 2 $${}^{226}Ra\ \left(\frac{pCi}{g}\right) = -4.206274 + 0.459266 * \left[Exposure\ rate\ \left(\frac{\mu R}{hr}\right)\right]$$

Where:

pCi = Picocurie

g = Gram

An alternative approach to converting gamma radiation measurements to soil Ra-226 is the 95 percent upper prediction limit (UPL95) of the radium-gamma exposure rate correlation. This approach is commonly applied to attain a desired confidence level at which the surficial contamination is adequately contained based on a cutoff level (that is, the RAG or cleanup goal for Ra-226) (Johnson, Meyer, and Vidyasagar 2006). Applying a UPL95 model to Equation 2, the linear regression of soil Ra-226 measurements and HPIC measurements, the resulting model is:

Equation 3 $$^{226}Ra\left(\frac{pCi}{g}\right) = -1.317193 + 0.476373 * \left[Exposure\ rate\ \left(\frac{\mu R}{hr}\right)\right]$$

In the APE, elevated radiological contamination as exhibited through the mobile gamma radiation survey results is mostly concentrated within the boundaries of AUMs 457 and 458. Elevated gamma radiation is present outside the mine boundaries within the TENORM boundary near roads and in the exploratory drilling area south of AUM 457 and with material that has migrated out of AUMs 457 and 458 and into the APE from AUM 459 as shown on Figure 10.

2.4.3.2 Metals Impacts

The COPCs carried through the HHRA are aluminum, arsenic, cadmium, chromium, cobalt, iron, manganese, mercury, molybdenum, thallium, uranium, and vanadium. The COPECs carried through the ERA are arsenic, barium, cadmium, chromium, cobalt, lead, manganese, mercury, molybdenum, nickel, selenium, thallium, uranium, vanadium, and zinc.

2.4.4 Extent of Contamination

Data characterizing the extent of contamination (collected through the measurement of radiation through walkover gamma scanning surveys and total metals and radionuclides soil concentrations in soil samples collected during the SI, RSE, and data gaps investigation) are used to identify contamination migration pathways, excluding groundwater and surface water, and support the risk assessment and removal decisions for the site. The waste at the site is the result of mining activities and is covered under the Bevill Amendment exemption to hazardous waste classification.

Site disturbance observations during the SI (Weston 2014), RSE (EA 2021), and 2024 data gaps investigation (Appendix A) were used to identify the extent of mining-related disturbance at the site, potential for transport of contaminated material, and transport pathways from the site. Areas of the site with remnants from mining operations, exploratory boring locations south of AUM 457, other visible ground disturbance, and roads buffered to 50 feet were categorized as TENORM areas in addition to the Atlas survey mine boundaries (EA 2021). Gamma scanning results and site mapping were reviewed to differentiate NORM from TENORM (defined as NORM that has been disturbed by human activity in a way that increases exposure or transport). The TENORM boundaries for the site were updated following field verification of site features during the data gaps investigation (Appendix A) and are shown on Figure 9.

Areas undisturbed by mining activity are considered NORM and may include land upslope of mining-disturbed areas, mineralized bedrock outcrops outside the area of mining activity, mineralized bedrock outcrops within an area otherwise disturbed by mining activity, and areas impacted by transport of material from undisturbed areas. Downwind transport or erosion and mass wasting from these NORM areas may contribute to elevated gamma levels and Ra-226 and metals concentrations downslope of these outcrops. USEPA does not consider NORM to be contamination and, thus, NORM areas are not considered for removal action.

2.5 RISK ASSESSMENT

The complete risk assessment is presented in Appendix B. The risk assessment uses laboratory sampling data from the Section 9 Lease Mines to identify the candidate COCs and COECs, provide an estimate of how and to what extent human and ecological receptors might be exposed to these contaminants, and describe whether the exposures pose unacceptable risk to the receptors. A conceptual site model is presented in Figure 12. Candidate COCs and COECs are those contaminants that contribute to unacceptable risk and are recommended for further evaluation in the risk management analysis (See Section 2.6). In Appendix B, Table B-1 provides a summary of the analytical data used in the risk assessment the Section 9 Lease Mines, Figure B-2 through Figure B-5 present the locations of the soil samples used in the risk assessment, and Attachment B-1 provides the full dataset used in the risk assessment. The following subsections present the purpose of the risk assessment, describe the exposure risk evaluations, and summarize the risk assessment methodology and results.

2.5.1 Purpose

The purpose of the risk assessment is to estimate current and future human health risk under appropriate reasonable maximum exposure scenarios and ecological risk focused on the known ecosystems for the region. This risk assessment was performed using procedures in the NAUM program risk assessment methodology (USEPA 2024a). The results of the risk assessment are used to assist in removal action decisions for a site. The HHRA estimates the risk posed to human health by contaminants at the site and identifies human health candidate COCs in each exposure unit (EU). The ERA identifies the risks posed to ecological receptors by contaminants at the site and candidate COECs on a site-wide basis.

2.5.2 Exposure Unit

An EU is a geographic area where receptors (a person or animal) may reasonably be assumed to move at random and where contact across the EU is equally likely over the course of an exposure duration. The risk assessment boundary was established via soil sampling and augmented through examination of gamma survey data. Areas of NORM, such as natural mineralized outcrops and nonimpacted areas, although not included in the TENORM boundary, were also included within the risk assessment boundary because a receptor would also be exposed to NORM areas when at the site.

The Section 9 Lease Mines risk assessment boundary is a 406-acre area that encompasses AUM 457, AUM 458, the small portion of AUM 459 within Section 9, and the portion of Section 10 between Section 9 and the LCR. Only the reasonable maximum exposed receptor is evaluated in NAUM HHRAs; for the Section 9 Lease Mines a trespasser was identified as the RME receptor. A single EU was used to evaluate the trespasser receptor at the Section 9 Lease Mines. In Appendix B, Table B-2 and Figure B-2 through Figure B-5 present the areas and samples at the site that were evaluated. Section 2.1.7 describes the land uses at the site.

2.5.3 Human Health Risk Evaluation

This subsection describes the key elements of the HHRA methodology. An HHRA is the process for evaluating how people are impacted by exposure to one or more environmental stressors, such as metals or radiation. Exposure is how a contaminant can enter a body, for example, by eating produce that absorbed contaminants, by breathing contaminated dust, by touching contaminated materials, or from radiation emanating from soil.

The HHRA evaluates whether site-related COPCs pose unacceptable risks to potential current and future people at a site under conditions at the time the EE/CA is prepared (unremediated conditions) (USEPA 1989, 1993). The HHRA includes the following components: data evaluation and selection of COPCs, exposure assessment, toxicity assessment, and risk characterization.

Any contaminant with a maximum detected value exceeding its COPC screening level is retained as a COPC for the HHRA risk calculations. The COPC screening levels are based on a 1×10^{-6} cancer risk and a hazard index of 0.1 for a default (non-Navajo) resident. In Appendix B, Table B-1 provides the COPC screening. Based on the screening, the following contaminants were identified as COPCs at the Section 9 Lease Mines and are included in the risk estimates in the HHRA: uranium-238 (U-238) in secular equilibrium (SE), aluminum, arsenic, cadmium, chromium, cobalt, iron, manganese, mercury, molybdenum, thallium, uranium, and vanadium.

The exposure assessment is the process of measuring or estimating the intensity, frequency, and duration of human exposure to a contaminant in the environment. The conceptual site model describes the exposure setting and identifies potentially complete exposure pathways by which receptors (both people and ecological) could contact site-related contaminants. Figure 7 and Figure 8 present the hydrologic transport pathways for the Section 9 Lease Mines.

For the HHRA, human health cancer risk and noncancer hazard were calculated for the receptor with the reasonable maximum exposure at the site for both current and future conditions. Trespassers were identified as the reasonable maximum exposure receptor for the Section 9 Lease Mines. The HHRA focuses on soil and sediment contamination only and does not include ingestion of surface water or groundwater by humans or animals. The specific exposure pathways and inputs for the receptors evaluated in the HHRA are provided in Appendix B, Table B-3.

The toxicity assessment identifies the toxicity parameters needed for the risk assessment. The toxicity values used in the HHRA are all standard values provided by USEPA. Risk characterization proceeds by combining the results of the exposure and toxicity assessments. For the NAUM HHRAs, the risk characterization process as described in Appendix B was used.

The intake factors used in the HHRA were calculated using the NAUM Risk Calculator (USEPA 2023b). The cumulative cancer risk for the age-adjusted adult and child, and noncancer hazard for the child receptor for each soil interval are provided in Appendix B, Table B-7.

Risks for combined adult and child trespassers (combined 26 years of exposure) exceeded the acceptable USEPA cancer risk range (defined as less than or equal to 1×10^{-6} to 1×10^{-4} risk). The cancer risk at the Section 9 Lease Mines is estimated to be 8×10^{-4} for surface soil and 5×10^{-4} for subsurface soil for the adult and child trespasser. The noncancer hazard is below the target hazard index of 1 for all areas for both the adult and child receptors. U-238 in SE is a candidate COC for the trespasser at the Section 9 Lease Mines in surface and subsurface soils.

2.5.4 Ecological Risk Evaluation

An ERA is the process for evaluating how likely the environment will be impacted from exposure to one or more environmental stressors, such as radionuclides or metals. The objective of the ERA is to evaluate whether ecological receptors may be adversely affected by exposure to contaminants. The ERA is intended to provide input for risk management decision-making at a site while maintaining a conservative approach protective of ecological populations and communities. This ERA follows the guidelines in the NAUM program risk assessment methodology (USEPA 2024a).

As described in USEPA (1993) EE/CA guidance, a risk assessment is used to help justify a removal action, identify what current or potential exposures should be prevented, and focus on the specific problem that the removal action is intended to address. NAUM ERAs include a screening-level risk assessment (SLERA) and SLERA refinement. The SLERA includes Steps 1 and 2 of USEPA's eight-step ERA process (USEPA 1997) and is intended to provide a conservative estimate using maximum site concentrations of potential ecological risks and compensate for uncertainty in a precautionary manner by incorporating conservative assumptions. The SLERA refinement includes a refinement of Steps 1 and 2 and is intended to provide additional information for risk managers. Candidate COECs are identified based on the results of the SLERA refinement for soil.

The ERA evaluated the Section 9 Lease Mines as a single site-wide EU. The SLERA COPECs for soil at the Section 9 Lease Mines are presented in Appendix B, Table B-8. Contaminants in soil for which the hazard quotient was greater than or equal to 1.0 were U-238 in SE (adjusted Ra-226), arsenic, barium, cadmium, chromium, cobalt, lead, manganese, mercury, molybdenum, nickel, selenium, thallium, uranium, vanadium, and zinc.

In Appendix B, the candidate COECs and the calculated hazard quotient risk estimates are listed in Table B-10 for plants and invertebrates, Table B-11 for birds, and Table B-12 for mammals. The candidate COECs are summarized in Exhibit 2.

2.5.5 Risk Assessment Results Summary

Candidate COCs and COECs were identified based on available laboratory data. The HHRA and ERA results for the Section 9 Lease Mines indicate risk is above a level of concern for the contaminants listed in Exhibit 3.

Exhibit 2. Site-Wide Candidate COECs

Receptor	Soil Interval	Candidate COEC												
		Uranium-238 in SE	Arsenic	Barium	Chromium	Cobalt	Lead	Manganese	Mercury	Molybdenum	Selenium	Thallium	Uranium	Vanadium
Plants	Surface Soil	X	X	X	X	X	X	X	X	X	X	X	X	X
	Subsurface Soil	X	X	X	X	X	--	X	X	X	X	--	X	--
Invertebrates	Surface Soil	X	X	X	X	--	--	X	X	--	X	--	--	--
Birds	Surface Soil	X	--	--	--	--	X	--	X	X	X	X	--	X
Mammals	Surface Soil	X	--	X	--	--	--	--	--	--	X	X	--	--
	Subsurface Soil	X	--	X	--	--	--	--	--	--	X	X	--	--

Notes:
-- Not a candidate COEC
X Candidate COEC
COEC Contaminant of ecological concern
SE Secular equilibrium

Exhibit 3. Candidate COCs and Candidate COECs Recommended for Further Evaluation

Receptor	Media	Contaminant												
		Uranium-238 in SE	Arsenic	Barium	Chromium	Cobalt	Lead	Manganese	Mercury	Molybdenum	Selenium	Thallium	Uranium	Vanadium
Trespasser	Surface/ Subsurface Soil	X	--	--	--	--	--	--	--	--	--	--	--	--
Ecological	Surface Soil	X	X	X	X	X	X	X	X	X	X	X	X	X
	Subsurface Soil	X	X	X	X	X	--	X	X	X	X	X	X	--

Notes:
-- Not a candidate COC or COEC; not recommended for further evaluation in this EE/CA.
X Candidate COC and/or COEC. Recommended for further evaluation in this EE/CA.
COC Contaminant of concern
COEC Contaminant of ecological concern
EE/CA Engineering evaluation/cost analysis
SE Secular equilibrium

2.6 RISK MANAGEMENT ANALYSIS

Risk management is a different process from risk assessment. The risk assessment establishes whether a risk is present and defines the magnitude of the risk. In risk management, the results of the risk assessment are integrated with other considerations to make and justify risk management decisions. Risk managers must understand the risk assessment, including its uncertainties and assumptions to evaluate the overall protectiveness of any response action (USEPA 1997). By understanding the potential adverse effects posed by candidate COCs and COECs and the removal actions themselves, risk managers can balance the costs and benefits of the available removal alternatives.

U-238 (and its decay products) is the only COC at the Section 9 Lease Mines. For risk management, site data for Ra-226 are used to represent the soil concentration of U-238; however, the human health PRGs and the NAUM PERG use toxicity values that include toxicity from the entire U-238 decay chain. Use of Ra-226 for risk management reduces the number of radionuclides evaluated when establishing the extent of radiological contamination.

The risk assessment for the Section 9 Lease Mines identified one candidate COC and several candidate COECs. Radiological contamination is the predominant risk driver at the Section 9 Lease Mines; thus, the extent of Ra-226 above the selected RAG will primarily be used to establish the extent of the removal action. In addition to Ra-226, candidate COECs are arsenic, barium, chromium, cobalt, lead, manganese, mercury, molybdenum, selenium, thallium, uranium, and vanadium. The risk management analysis is focused on understanding the excess risk from the metals identified as candidate COECs in soil.

The NAUM risk management process involves assessment of various lines of evidence for candidate COCs and COECs including:

- Refinement of candidate COCs and COECs:
  - Comparison of site concentrations to background concentrations (Table 3)—candidate COCs and COECs below background are removed from further analysis
  - Consideration of natural forms of chromium
  - Comparison of maximum detected concentrations with human health PRGs and NAUM PERGs (USEPA 2024c)
  - Assessment of co-location via a comparison of the metals distribution to the Ra-226 preliminary removal action extent—metal candidate COECs with concentrations above NAUM PERGs that are fully co-located with the Ra-226 preliminary removal action extent are removed from further analysis
- Refinement of candidate COECs only (if needed):
  - Potential impacts of site risks for candidate COECs based on a comparison of site-wide exposure point concentrations to NAUM PERGs (USEPA 2024c)
  - Analysis of contaminant distribution

- o Assessment of other uncertainties

Refinement of the exposures, inputs, and uncertainties for the ERA is warranted because the ERA was completed using literature-based assumptions and inputs. Section 2.6.1 presents the background comparison, Section 2.6.2 presents a discussion on chromium, Section 2.6.3 presents and describes the NAUM PERGs, and Section 2.6.4 presents the co-location analysis. For the Section 9 Lease Mines, the refinement of candidate COECs was unnecessary because all candidate COECs were determined to not warrant removal action. Section 2.6.5 presents a summary of risk management conclusions and decisions.

Table 4 presents the results of the risk management analysis and identifies the final analytes recommended for removal action, as well as the rationale for refinement of each candidate COEC not considered for removal action.

2.6.1 Comparison of Site Concentrations of Candidate Contaminant of Concern and Candidate Contaminants of Ecological Concern to Background Concentrations

The candidate COCs and COECs were compared to background concentrations to identify any contaminants present at background levels. For the Section 9 Lease Mines, the background comparison used the Quaternary Alluvium, Shinarump Member of the Chinle Formation, and Petrified Forest Member of the Chinle Formation results per the discussion in Section 2.4.1. Two-population statistical tests were performed to compare concentrations in soil at the site for candidate COCs and COECs. All methods followed USEPA (2002, 2010, 2022) statistical guidance for evaluating background concentrations of chemicals in soil. The background comparison results are presented in Table 3.

A tiered approach employing one or more statistical methods was used to conduct two-population tests. The first tier in this approach compares the median concentrations between the site and background populations using the Wilcoxon-Mann-Whitney test for datasets having all detected data. For datasets with nondetect results, Gehan's modification to the Wilcoxon rank-sum (WRS) test (Gehan test) and the Tarone-Ware test were used. These two-population tests are available in ProUCL (USEPA 2022a).

If the first-tier tests indicated site concentrations were greater than background concentrations, no further testing was conducted. If the first-tier tests indicated site concentrations were less than or equivalent to background concentrations, a second-tier test was used to compare the right-hand tails or upper quantiles of the site and background populations using the Quantile test (USEPA 1994, 2010). Two-sided statistical tests were used in all cases and employed a Type I error rate of 0.05 (5 percent).

The following null and alternative hypotheses were tested:

- **Null hypothesis:** The median metal concentration for the site is less than or equal to the median concentration in the background population.
- **Alternative hypothesis:** The median metal concentration for the site is greater than the median concentration in the background population.

The Quantile test (USEPA 1994, 2010) was conducted for all metals where the Gehan, Tarone-Ware, and Wilcoxon-Mann-Whitney tests did not reject the null hypothesis (that is, when the median site and background concentrations were not significantly different).

The Quantile test is a nonparametric two-population test developed for comparing the right-hand tails or upper quantiles of two distributions. The Quantile test can be used when some proportion of high-value measurements (rather than the entire distribution) of one population has shifted relative to a second population. The Quantile test is not as powerful as the WRS test when the distribution of site concentrations is shifted in its entirety to the right of the background distribution. However, the Quantile test is more powerful than the WRS test for detecting cases where only a small number of high-value measurements are present in the upper quantile of the site distribution. For this reason, USEPA (1994, 2002, 2010) guidance recommends the Quantile test be used in conjunction with the WRS test. When applied together, these tests have more power to detect true differences between two population distributions.

Exhibit 4 presents the background comparison results for the Section 9 Lease Mines. In addition to Ra-226, candidate COECs (arsenic, molybdenum, selenium, uranium, and vanadium) were found at concentrations greater than background at the Section 9 Lease Mines and are recommended for further evaluation. Additionally, two-population tests could not be conducted for barium, chromium, cobalt, lead, manganese, mercury, and thallium; therefore, these COECs are also recommended for further evaluation.

2.6.2 Consideration of Natural Forms of Chromium

The assumption used in the HHRA and ERA was that the measured chromium at the site is entirely hexavalent chromium. Trivalent chromium is the most common oxidation state and is an essential dietary element that aids normal glucose, protein, and fat metabolisms (Agency for Toxic Substances and Disease Registry 2012). Hexavalent chromium is the most toxic chromium ion and is a known human carcinogen.

Hexavalent chromium is almost exclusively produced from industrial processes and is not expected from natural sources at NAUM sites. Sources of compounds containing hexavalent chromium in the environment are discharged dye and paint pigments, wood preservatives, and chrome-plating liquid wastes. Prominent uses of hexavalent chromium are in processes for production of metal alloys such as stainless steel, protective coatings on metal, magnetic tapes, pigments for paints, cement, paper, rubber, and composition floor covering (Agency for Toxic Substances and Disease Registry 2012). These industrial processes or commercial products are not associated with NAUM sites. Hexavalent chromium is not expected to be elevated above naturally occurring levels at NAUM sites without an industrial process that created hexavalent chromium.

Exhibit 4. Background Comparison Results Summary

Exposure Unit	Candidate COC or COEC Background Comparison Result												
	Radium-226	Arsenic	Barium	Chromium	Cobalt	Lead	Manganese	Mercury	Molybdenum	Selenium	Thallium	Uranium	Vanadium
Western AUM Region Background Quaternary Alluvium													
Site-Wide (Trespasser)	**>BG**	--	--	--	--	--	--	--	--	--	--	--	--
Site-Wide (Ecological Risk)	**>BG**	**>BG**	NA	NA	NA	NA	NA	NA	**>BG**	**>BG**	NA	**>BG**	**>BG**
Western AUM Region Background Petrified Forest Member													
Site-Wide (Trespasser)	**>BG**	--	--	--	--	--	--	--	--	--	--	--	--
Site-Wide (Ecological Risk)	**>BG**	**>BG**	NA	NA	NA	NA	NA	NA	**>BG**	**>BG**	NA	**>BG**	<BG
Western AUM Region Background Shinarump													
Site-Wide (Trespasser)	**>BG**	--	--	--	--	--	--	--	--	--	--	--	--
Site-Wide (Ecological Risk)	**>BG**	**>BG**	NA	NA	NA	NA	NA	NA	**>BG**	<BG	NA	**>BG**	<BG

Notes:
The background comparison was conducted using site and background surface soil data only. The background comparisons for surface soil are assumed valid for subsurface soil. For analytes calculated to be less than background, site subsurface results were compared to site surface results to confirm that no subsurface areas with concentrations above surface concentrations warrant further evaluation.

--	Not a candidate COC or COEC for exposure unit/receptor combination.
<BG	Site concentrations are less than background concentrations. Candidate COC or COEC is not recommended for further evaluation in the EE/CA.
>BG	Site concentrations are greater than background concentrations. Candidate COC or COEC is recommended for further evaluation in the EE/CA.
AUM	Abandoned uranium mine
COC	Contaminant of concern
COEC	Contaminant of ecological concern
EE/CA	Engineering evaluation/cost analysis
NA	Identified as a candidate COEC, but background comparison results are not available.

Mineral forms of hexavalent chromium are rare in nature (Greenwood and Earnshaw 2012). Based on the documented mineralogy within the NAUM regions, these minerals are not present at NAUM sites. Oxidation of natural sources of trivalent chromium to hexavalent chromium in soil at NAUM sites is unlikely given typical site conditions—the sites do not contain ultramafic rock and serpentine soils, which are the most likely natural source of hexavalent chromium. Furthermore, weather conditions on the Navajo Nation are arid and ionic compounds containing chromium typically are not detected in the desert sandy loam soils present in the area. Trivalent chromium is typically found in soils with higher pH (more basic), aerobic conditions, low amounts of organic matter, and manganese and iron oxides. In contrast to hexavalent chromium, which does not interact significantly with clay or organic matter, trivalent chromium is cationic and adsorbs onto clay particles, organic matter, metal oxyhydroxides, and other negatively charged particles. Finally, desert sandy loam soils typically contain low amounts of organic matter. According to the Bureau of Indian Affairs (2020), pHs of the different soil types on the Navajo Nation range from 6 to 9.

The lines of evidence presented above suggest total chromium concentrations measured at the Section 9 Lease Mines is the less toxic trivalent form and, therefore, should be evaluated as trivalent chromium. From a risk management perspective for uranium mines, the presence of hexavalent chromium is expected to be minimal and the assumption that the chromium measured at the site is trivalent chromium is reasonable and supported by site conditions.

The maximum detected result for total chromium at the Section 9 Lease Mines is 17 milligrams per kilogram (mg/kg), which is below both the default residential regional screening level for trivalent chromium (8,500 mg/kg) (USEPA 2024d) and the lowest trivalent chromium no observed effect concentration in the ERA (26 mg/kg) (based on the avian ground insectivore). Thus, trivalent chromium would not be identified as either a COPC or COPEC and would not be included in the human health risk calculations or the SLERA refinement. Therefore, chromium is not recommended for removal action at the Section 9 Lease Mines.

2.6.3 Comparison of Maximum Detected Concentrations to Preliminary Removal Goals for Human Health and Ecological Health

Human health PRGs and NAUM PERGs were developed for use in risk management decision-making and determination of RAGs.

Human health PRGs are land-use specific and calculated using the NAUM Risk Calculator (USEPA 2024b) with the same target cancer and noncancer risk levels used to identify candidate COCs. PRGs for carcinogenic metals and radionuclides are based on a target cancer risk of 1×10^{-4}, and PRGs for noncarcinogenic metals are based on a target noncancer hazard quotient of 1.0.

PERGs for radionuclides and metals were developed for NAUM sites by USEPA (2024c). USEPA (1999) guidance recommends designing remedial actions to protect local populations and communities of biota rather than protect organisms on an individual basis except for threatened and endangered species. NAUM PERGs establish analyte-specific thresholds that correspond to minimal disruption on wildlife communities and populations. Reducing or maintaining site concentrations to levels below the PERG will support the recovery and maintenance of healthy local populations and communities of biota.

NAUM PERGs for radionuclides were based on dose assessments using the ERICA Tool (Brown and others 2008) for terrestrial animals and plants (USEPA 2024a, 2024c). NAUM PERGs for radionuclides were identified based on the radionuclide concentration corresponding to a dose rate where individuals have a higher probability to be adversely affected, but the population is still protected (USEPA 2024c). NAUM PERGs for metals were developed using average exposure parameters for food ingestion rates, toxicity reference values, soil intake factors, and body weights (USEPA 2024c).

To identify if candidate COCs or COECs should be considered for removal action at the Section 9 Lease Mines, the maximum detected concentrations of the candidate COCs and COECs remaining after the background comparison were compared to the human health PRGs and NAUM PERGs.

Exhibit 5 presents the Section 9 Lease Mines human health PRGs and NAUM PERGs for soil for candidate COCs and COECs greater than background and provides the maximum detected comparison to the PRGs and PERGs to establish whether the contaminant requires further risk management evaluation.

Exhibit 5. Human Health Preliminary Removal Goals and NAUM PERGs for Candidate COCs and COECs in Soil Above Background

Candidate COC/COEC	Unit	Human Health PRG Trespasser[1]	NAUM PERG[2]	Maximum Detected Concentration	Maximum Detected Concentration Exceeds PRG or PERG
Radium-226[3]	pCi/g	12	40	**945**	**Yes**
Arsenic	mg/kg	--	68	**230**	**Yes**
Barium	mg/kg	--	1,400	1,100	No
Cobalt	mg/kg	--	130	47	No
Lead	mg/kg		570	150	No
Manganese	mg/kg	--	1,100	540	No
Mercury	mg/kg	--	0.5	**8.7**	**Yes**
Molybdenum	mg/kg	--	430	**2,000**	**Yes**
Selenium	mg/kg	--	3.4	**37**	**Yes**
Thallium	mg/kg	--	0.5	**26**	**Yes**
Uranium	mg/kg	--	250	**970**	**Yes**
Vanadium	mg/kg	--	80	**390**	**Yes**

Notes:
Bold values exceed the human health PRG and/or the NAUM PERG for the contaminant.
1 The human health PRG was calculated using the NAUM Risk Calculator (USEPA 2024b) and is based on a target cancer risk of 1×10^{-4}. The human health PRG for radium-226 is based on uranium-238 in SE to include doses from all progeny of uranium-238 in SE as described in Appendix C of the NAUM risk assessment methodology (USEPA 2024a).
2 The radium-226 NAUM PERG is the minimum PERG for uranium-238 in SE for all feeding guilds (USEPA 2024c). The NAUM PERGs are applicable site-wide. The NAUM PERG for radium-226 is based on uranium-238 in SE to include doses from all progeny of uranium-238 in SE as described in Appendix F of the NAUM risk assessment methodology (USEPA 2024a).
3 Site data for radium-226 are used to evaluate the extent of radionuclides above the human health PRG and NAUM PERG.
-- Not a candidate COC
COC Contaminant of concern
COEC Contaminant of ecological concern
mg/kg Milligram per kilogram
NAUM Navajo abandoned uranium mine
pCi/g Picocurie per gram
PERG Preliminary ecological removal goal
PRG Preliminary removal goal
SE Secular equilibrium
USEPA U.S. Environmental Protection Agency

As shown in Exhibit 5, the maximum detected results for barium, cobalt, lead, and manganese do not exceed their NAUM PERGs. Thus, these candidate COECs are not recommended for removal action and are not discussed further in the risk management analysis.

2.6.4 Co-Location Assessment

The Ra-226 removal action extent encompasses a large portion of the TENORM areas in the Section 9 Lease Mines (see Figure 9). The source of the contamination is from historical uranium mining activities, and the mining waste and contaminated soil are expected to exhibit similar characteristics in all areas of contamination. Areas where estimated Ra-226 levels exceed BTVs is a strong indicator of areas with mine waste, and concentrations of other elevated metals are expected to be co-located in those areas. Section 2.6.4.1 defines the Ra-226 removal action extent, and Section 2.6.4.2 assesses whether candidate COCs and COECs are co-located with Ra-226 via a comparison of the metals distribution to the Ra-226 preliminary removal action extent.

2.6.4.1 Development of Radium-226 Removal Action Extent

The Ra-226 RAG is the lesser of the human health PRG and NAUM PERG unless either of the preliminary goals is less than the BTV. For all areas at the Section 9 Lease Mines, the Ra-226 RAG is based on the human health PRG for a trespasser and is 12 pCi/g. Table 4 provides the comparison of the human health PRG, NAUM PERG, and geology-specific BTVs for Ra-226 considered to establish the RAG. Exhibit 6 lists the RAG for each geologic unit present at the site.

Exhibit 6. Radium-226 Removal Action Goal Development

Geologic Unit	Radium-226 RAG[1] [pCi/g]	Basis for RAG
Quaternary Alluvium	12	Human health PRG
Petrified Forest Member of the Chinle Formation	12	Human health PRG
Shinarump Member of the Chinle Formation	12	Human health PRG

Notes:
1 Site data for radium-226 are used to evaluate the extent of radionuclides above PRGs.
pCi/g Picocurie per gram
PRG Preliminary removal goal
RAG Removal action goal

The estimated Ra-226 interpolated surface was generated using gamma survey data from the Section 9 Lease Mines as discussed in Section 2.4.3.1. Gamma survey results were converted from counts per minute to estimated Ra-226 concentrations in pCi/g. The Ra-226 preliminary removal action extent for the site was developed using geospatial tools based on the area estimated to exceed the RAG within the TENORM boundary. The proposed excavation areas for Ra-226 based on a RAG of 12 pCi/g is provided on Figure 13.

2.6.4.2 Assessment of Metals Co-Location with the Radium-226 Preliminary Removal Action Extent

The distributions of the remaining metal candidate COECs (arsenic, mercury, molybdenum, selenium, thallium, uranium, and vanadium) were compared with the Ra-226 preliminary removal action extent to identify whether concentrations of the remaining metal candidate COECs are co-located with the Ra-226 preliminary removal action extent. In Appendix C, Figure C-2 through Figure C-8 present the soil sample results for each metal candidate COEC above background overlain with the Ra-226 preliminary removal action extent with results screened against relevant BTVs and NAUM PERGs.

At the Section 9 Lease Mines, the extents of arsenic, mercury, molybdenum, selenium, thallium, uranium, and vanadium are all co-located within the preliminary Ra-226 removal action extent that is planned for removal. Further assessment of the extents of arsenic, mercury, molybdenum, selenium, thallium, uranium, and vanadium will not result in a change in the removal action extent and, therefore, arsenic, mercury, molybdenum, selenium, thallium, uranium, and vanadium will not be considered for further evaluation and are not identified as COECs recommended for removal action.

2.6.5 Risk Management Summary and Conclusions

Based on the HHRA and ERA for the Section 9 Lease Mines, the candidate COC for soil is Ra-226 and candidate COECs for soil are Ra-226, arsenic, barium, chromium, cobalt, lead, manganese, mercury, molybdenum, selenium, thallium, uranium, and vanadium. Following the lines of evidence considered in the risk management analysis in the previous subsections, the recommended removal action objective is:

- To address excess human health and ecological risk from Ra-226 contamination at the Section 9 Lease Mines by removal of Ra-226 above the applicable RAG

The conclusions for the candidate COC are based on the results of the risk assessment and background comparison. The conclusions for candidate COECs also include consideration of whether the maximum concentration of the COEC exceeds the NAUM PERG. In addition, the results of the co-location analysis comparing metal COEC concentrations exceeding their NAUM PERGs with the preliminary Ra-226 contamination extent to be addressed during the removal action. Table 5 presents the results of the risk management analysis and identifies the final COC and COEC recommended for removal action, as well as the rationale for refinement of each candidate COC or COEC not considered for removal action. Exhibit 7 lists the COCs and COECs recommended for removal action at the site.

Exhibit 7. COCs and COECs Recommended for Removal Action

Exposure Unit	Receptor	Surface Soil COC/COEC	Subsurface Soil COC/COEC
Site-Wide (Human Health Risk)	Trespasser	Radium-226	Radium-226
Site-Wide (Ecological Risk)	Plants, Invertebrates, Birds, and Mammals	Radium-226	Radium-226

Notes:
COC Contaminant of concern
COEC Contaminant of ecological concern

2.7 REMOVAL ACTION EXTENT

Multiple lines of evidence were used to develop the removal action extent at the site, including the extent of Ra-226 in surface soil based on soil and sediment samples and gamma-radium correlation, extent of contamination of other COCs and COECs, subsurface soil investigations, NORM and TENORM mapping, and risk management considerations.

2.7.1 Identification of Removal Action Goals

Based on the HHRA and ERA results, cleanup is recommended for surface and subsurface soils for Ra-226 at the Section 9 Lease Mines. RAGs were derived for each applicable receptor for each geologic unit. RAGs were not developed for surface water because removal actions at AUM sites are focused on removing soil as the source of contamination. Removal of contaminated soil should remove the source of contamination to surface water, including waterways such as the intermittent LCR and ephemeral Mays Wash.

Table 4 presents the human health PRGs, NAUM PERGs, BTVs for each geologic unit at the site, and the selected soil RAG for each COC and COEC recommended for removal action in the TENORM areas. The RAG is the lower value of the human health PRG and NAUM PERG unless either value is less than the BTV. If the human health PRG or NAUM PERG is less than the BTV, the cleanup goal is the concentration representative of background conditions. Exhibit 8 lists the RAG for each COC and COEC recommended for removal action.

Exhibit 8. Removal Action Goal

Exposure Unit	COC/COEC	Surface and Subsurface Soils	Basis for RAG
Site-Wide	Radium-226	12 pCi/g	Human Health PRG for Trespasser

Notes:
COC Contaminant of concern
COEC Contaminant of ecological concern
pCi/g Picocurie per gram
PRG Preliminary removal goal
RAG Removal action goal

2.7.2 Removal Action Extent Development

Because of greater coverage and density, gamma scan data are used as a surrogate to evaluate the extent of Ra-226 contamination within the APE. Gamma survey data (Figure 10) were evaluated and converted to estimated Ra-226 concentrations to calculate the Ra-226 removal action extent. Areas of the site with concentrations above the Ra-226 RAG of 12 pCi/g based on the UPL95 gamma-radium correlation model were included as part of the removal action extent. The removal action extent covers approximately 6.5 acres based on the extent of surficial Ra-226 above the RAG based on the site-specific gamma-radium correlation. An estimated total of 14,711 cubic yards of mine waste and contaminated soil would be addressed by the removal action. Figure 13 provides the estimated excavation area for the Ra-226 removal action extent.

Surficial contamination requiring a removal action was established for the site using Equation 3 in Section 2.4.3.1 and creating an interpolated surface using results from the gamma radiation survey and geostatistical analysis following methods in the NAUM program removal action extent development standard operating procedure (USEPA 2024e). The interpolated Ra-226 concentrations were assigned to a 10- by 10-foot grid system spanning the site, and grids within the revised TENORM boundary with estimated Ra-226 in surface soil exceeding the RAG were included in the removal action extent. In addition, 10- by 10-foot grids including soil samples measuring above the Ra-226 RAG but containing interpolated estimated Ra-226 concentrations below the RAG were added to the grid footprint to generate the complete removal action extent for the site. The removal action extent was also checked against the disturbance mapping results from the data gaps investigation to verify locations of waste piles, concrete structures, and other site features included in the resulting surface. The grid footprint was converted to 64 discrete, contiguous areas—areas within Section 9 and Section 10 are differentiated. The proposed excavation areas for the removal action extent based on the gamma-radium correlation, site soil samples, and field-verified site features within the TENORM boundaries are provided on Figure 13.

The method applied to generate the removal action extent, consistent with the NAUM program methodology, refines the methods previously used to characterize Ra-226 contamination at the site (Tetra Tech 2022). The original method included applying a 5-meter buffer to the surface raster of the same UPL95 model. However, the buffer is not applied to the updated removal action extent because of field verification of site features and improved NORM-TENORM delineation from the data gaps investigation (Appendix A).

Estimated volumes for the removal action extent were generated from the LiDAR survey contours, and the estimated depth of TENORM above the site investigation level was recorded in the RSE (EA 2021). The difference between the LiDAR survey contours and the TENORM depth contours was interpolated across each of the 64 discrete areas. In the RSE report, the TENORM depth contours used a minimum depth of TENORM of 1 inch. Because of the feasibility for future excavation under each of the removal action alternatives, the minimum excavation thickness was set at 6 inches as the minimum estimated depth of TENORM to estimate volumes in this analysis. For areas of the site included in the removal action extent not co-located with the LiDAR survey contours, the excavation thickness was based on the minimum excavation depth of 6 inches except where waste pile descriptions from disturbance mapping estimated waste pile heights.

At the Section 9 Lease Mines, the locations of waste piles, open pits, and former structures consistently have the highest Ra-226 and metals concentrations and exceed the RAG. These areas cover primary drainage pathways to the LCR and off site at AUMs 457 and 458 as shown on Figure 7 and Figure 8. The data collected indicate that metals and Ra-226 contamination in the soil and sediment is present and offsite migration is likely until the removal action is completed. However, based on the available data from the RSE, neither increased radiation nor elevated Ra-226 or metals COPCs and COPECs in soil and sediment samples have been observed in the APE adjacent to the LCR (Tetra Tech 2022). Removal action at the site would minimize the source of potential soil contamination migration to the LCR and regional drainages.

3.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

This section presents the site RAOs, statutory limits on removal actions, removal scope, and removal schedule.

3.1 REMOVAL ACTION OBJECTIVES

An early step in developing removal action alternatives is to establish RAOs. RAOs are a general description of what the removal action will accomplish. RAGs are separate numerical cleanup goal concentrations. CERCLA does not allow removal action alternatives to require remediation of NORM or to remediate soil to concentrations below background levels. Based on current and potential future land use at the site, the site RAOs are to:

- Prevent exposure to soil with contaminants associated with past mining activities that would pose an unacceptable risk to human health with the reasonably anticipated future land use.
- Prevent exposure to soil with contaminants associated with past mining activities that would pose an unacceptable risk to plants, animals, and other ecological receptors.
- Prevent offsite migration of contaminants associated with past mining activities that would pose an unacceptable risk to human or ecologic health by soil, surface water, groundwater, or air.

The anticipated current and future use of the site is deed restricted. While legal land use restrictions exist on Section 9, no physical barriers limit trespassing onto Section 9 from BLM land in Section 10. The cleanup goals are also protective for potential future migration of material from Section 9 onto public land.

The human health receptors evaluated were agreed to by Babbitt Ranches, BLM, and USEPA with acceptance of the "Babbitt Ranches, LLC – Milestone Hawaii Stewardship Project (Section 9 Lease Abandoned Uranium Mine) RSE Phase III Work Plan" (Engineering Analytics, Inc. and Integral Consulting, Inc. 2019). USEPA will update the document to describe the human health receptor as trespasser and clarify that the human receptor is not a recreator but a trespasser on Section 9 land. The scope of the removal action will be to address soil contamination within the site and to be the final action for solid media at the site. The COCs and the numeric RAGs at the site are listed in Table 5.

3.2 STATUTORY LIMITS ON REMOVAL ACTIONS

Pursuant to CERCLA Section (§) 104(c)(1), the normal statutory limits for CERCLA removal actions of $2 million and 12 months do not apply since the selected action will be funded by a responsible party and not by Superfund.

3.3 REMOVAL SCOPE

The scope of the removal action will be to address solid media contamination at the site under the assumption that this will be the final action regarding solid media at the site. Post-removal action site controls will be included under alternatives that do not specify complete removal of contaminants to an offsite location. Post-construction monitoring requirements will be defined in the post-closure plan.

3.4 REMOVAL SCHEDULE

The National Contingency Plan (NCP) requires a minimum public comment period of 30 days following release of the proposed final EE/CA by USEPA. USEPA will respond to comments received during the public comment period with the action memo. USEPA will provide public notification of the removal action schedule upon issuance of the action memorandum.

During implementation of the selected removal action alternative, several factors may affect the removal action schedule, including removal action planning and design, cultural and biological clearances and mitigation, seasonal weather-related restrictions, and access for construction equipment. Depending on the removal action alternative selected in the final EE/CA, design and implementation of the construction activities will likely require between 2 to 4 months, which are limited to March through November, depending on schedule-limiting factors such as truck availability, monsoon rains, and snowfall. Annual post-removal site controls (termed maintenance within this EE/CA for brevity) include 10 years of annual inspections and maintenance of graded and revegetated site surfaces. Annual inspections and maintenance of an onsite consolidation area cap, if selected, will occur as specified in a site-specific long-term surveillance plan with inspection frequencies adjusted based on cover or cap stability and inspection findings.

4.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section identifies and analyzes the removal action alternatives for the site. Section 4.1 summarizes the process of screening potential technologies and identifies the removal action alternatives that may be effective and implementable at the site, Section 4.2 describes in detail the retained removal action alternatives, and Section 4.3 provides a detailed analysis of the removal action alternatives based on the NCP evaluation criteria of effectiveness, implementability, and cost.

4.1 DEVELOPMENT AND SCREENING OF ALTERNATIVES

This subsection identifies general response actions, identifies and screens technologies, develops and describes potential removal action alternatives, and identifies applicable or relevant and appropriate requirements (ARAR).

4.1.1 Summary of Technology Identification and Screening

The removal action alternative development process involves identification of general response actions, technology types, and process options that may satisfy RAOs. General response actions were considered for all AUMs and include institutional controls (IC), engineering controls, disposal, and ex situ and in situ treatment. The initial screening below eliminates infeasible technologies and process options and retains potentially feasible technologies and process options.

A technology or process option can be eliminated from further consideration if it does not meet the effectiveness threshold criteria (protectiveness and compliance with ARARs) or substantive implementability criteria (technical, administrative, availability, and local acceptance), details of which are conveyed in Section 4.3. In addition, a technology or process option can be eliminated if its cost is substantially higher than other technologies or process options and at least one other technology or process option is retained that offers equal protectiveness.

Treatment technologies and process options considered for AUMs on the Navajo Nation have been identified, described, and initially screened in the following subsections. The initial screening eliminates infeasible technologies and process options and retains potentially feasible technologies and process options. Table 6 presents a summary of the detailed screening discussion below.

Land Use Controls. Land use controls (LUC) include the implementation of access restrictions to control current and future land use. LUCs would not reduce waste migration from a site but could be used to protect human health and the environment by administratively restricting access to affected areas. In addition, these restrictions may be used in conjunction with other technologies to protect an implemented action. Potentially applicable LUCs consist of land use and access restrictions are described below.

- **Zoning** – Zoning is a LUC that would be implemented to control current and future land uses on or around waste and source areas consistent with the potential hazards present, the nature of removal action implemented, and future land-use patterns. Zoning is not an effective control since zoning rules can be changed and exemptions can be granted.

- **Deed restrictions –** Deed restrictions are another form of LUC that could be used to prevent the transfer of property without notification of limitations on the use of the property or requirements related to preservation and protection of the effectiveness of the implemented removal action alternative. Deed restrictions only regulate future development of properties.
- **Environmental control easements –** Environmental control easements are a legal mechanism that could be used to restrict different land uses at a site. Such easements could be used to restrict access or development and land uses such as residential.

Engineering Controls. Engineering controls are used primarily to reduce exposure to contaminants. These goals are accomplished by removal of contaminants and offsite disposal or by creating a barrier that prevents direct exposure to or transport of waste from the contaminated sources to the surrounding lands. Engineering controls include surface controls, physical barriers, soil sorting, containment, consolidation and capping, onsite backfilling of pits and highwalls, backfilling of underground voids, and offsite disposal.

- **Surface Controls –** Surface control measures are used primarily to reduce contaminant mobility, direct exposure, and overall exposure area. Surface controls could be appropriate in more remote areas where direct human contact is not a primary concern or as a component of a containment alternative. Surface control process options include consolidation, grading, revegetation, and erosion controls. These process options are usually integrated with other technologies to various degrees based on site characteristics and are usually not effective as a standalone technology.
- **Physical Barriers –** Physical barriers may include installing site access controls such as earthen berms, fencing, and signage. These process options will usually be integrated with other technologies to various degrees based on site characteristics and are usually not effective as a standalone technology.
- **Sorting –** Soil and waste sorting is a standard process applied as an intermediate step between soil or waste excavation and onsite or offsite treatment or disposal methods. The process goal is to segregate highly contaminated material from less contaminated material, allowing for different treatment or disposal options. Sorting reduces waste volume requiring treatment or disposal, increases the volume of material that can remain on site with limited or no treatment or containment, and allows classification of waste to reduce volume requiring more costly treatment or disposal options.
- **Onsite Containment, Consolidation, and Capping –** Mine waste can be consolidated and capped on site to reduce leaching and erosion. Waste from all areas of a site is gathered together or consolidated and then capped. Typically, the cap is an ET cover designed to minimize waste infiltration and leaching of contaminants, control erosion, control radon emissions, and prevent exposure to contaminants.

- **Offsite Disposal at a Radiological Waste Accepting Facility –** This standard disposal method involves the transport and disposal of waste at a RCRA C licensed hazardous waste landfill or low-level radioactive waste (LLRW) facility. Licensed or permitted facilities are constructed to prevent release of hazardous or radioactive materials and include engineered cells and liners that exceed the typical requirements for mine waste. Mine waste would be hauled to the offsite facility using off-road and on-highway haul trucks to transfer waste. The long trucking distances (approximately 600 miles) from the mines to the licensed disposal facilities in Clive, Utah, or Andrews, Texas is the primary drawback.

Treatment. CERCLA and the NCP express a preference for treatment that significantly and permanently reduces the toxicity, mobility, or volume of contaminants in selecting remedial actions where such treatments are practicable. See CERCLA § 121(b) and 40 *Code of Federal Regulations* (CFR) § 300.430(a)(1)(iii). See also USEPA (1991) guidance describing how to identify wastes that may be appropriate for treatment. Principal threat wastes are those source materials considered to be highly toxic or mobile that generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur.

USEPA considered whether the site contains any principal threat waste, whether the waste could safely be contained using engineering controls, and what treatment options could be practicable for the waste at the site. As a result of its investigation and analysis, USEPA concluded that, while some individual samples at the site contain higher levels of contaminants, the waste at the site is variable and heterogeneous and no distinct areas of waste rock were distinguishable as meeting the definitions of principal threat waste in USEPA (1991) guidance. However, to be consistent with USEPA's preference for treatment, USEPA did evaluate a complete range of treatment options. A summary of the treatment evaluation is discussed below.

Ex Situ Treatment. Excavation and treatment involve removal of waste from a source area and subsequent treatment using processes that chemically, physically, or thermally reduce contaminant mobility or volume. Treatment processes have the primary objective of either (1) removing contaminants from the soil for separate disposal or additional treatment, or (2) reducing the mobility of the chemicals. A short summary of different ex situ treatment classes is described below. A short summary of different ex situ treatment options is presented in Table 6. Ex situ treatments are not considered as viable alternatives because the treatments will not reduce the amount of radiation, treated materials will still require containment, volumes may be increase, and treatments will require significant amounts of water to implement.

- **Physical and Chemical Treatments –** Physical treatment processes use physical characteristics of materials to concentrate constituents into a relatively smaller volume for disposal or further treatment. Chemical treatment processes act by adding a chemical reagent that either removes contaminants from the material or fixates contaminants within the material matrix. Different types of physical and chemical treatments include milling or reprocessing, soil washing or acid extraction, ablation, and stabilization or solidification.

- **Thermal Treatments –** Thermal treatment technologies apply very high levels of heat to the excavated soil in a reactor to oxidize contaminants and render them amenable to additional processing. Thermal treatment is typically used for organic contaminants and is not effective for the radionuclides and metals at the site.

In Situ Treatment. In situ treatment involves treating the contaminated medium where it is located. In situ technologies remove the contaminants or reduce the mobility of the contaminated medium and may reduce exposure to the contaminated materials; however, they allow a lesser degree of control, in general, in comparison to ex situ treatment options. In situ treatments can include physical, chemical, thermal, and vegetative uptake methods. A short summary of different in situ treatment options is presented in Table 6. In situ treatments are not considered as viable alternatives because the treatments will not reduce the amount of radiation, treated materials will still require containment, volumes may be increased, treatments will require significant amounts of water to implement, and maintenance may be significant.

If the treatments discussed in Table 6 or any other treatment methods are shown to be effective and practicable before selection of a response action, USEPA will amend this analysis and consider such treatments.

4.1.2 Summary of Alternative Development

After an initial screening of general response actions and technologies, containment, consolidation, and capping along with various disposal process options were the only technologies identified as being fully protective, effective, and implementable for the site. ICs, surface controls, and access controls are feasible but not effective as standalone responses and may be combined with containment and disposal options. A list of analyzed but excluded disposal process options for the site is included below and is followed by a list of retained alternatives comprising excavation and other disposal process options.

The following site-specific disposal alternatives were removed from consideration as infeasible during development of this EE/CA:

- **Excavation and Disposal at Uranium Mill Tailings Radiation Control Act (UMTRCA) Sites.** Several UMTRCA sites, including the nearby Shiprock Mill, were assessed for disposal of the waste, but considered infeasible because those sites were closed and transferred to the U.S. Department of Energy legacy management program, had insufficient capacity to receive the waste, or had groundwater contamination issues that could prohibit disposal under the CERCLA Off-Site Rule. The United Nuclear Corporation Church Rock Mill was also considered, but the property owner and the U.S. Nuclear Regulatory Commission objected to receiving any waste from mine sites other than the Northeast Church Rock Mine. This option was eliminated because the many legal, administrative, and implementation hurdles would likely add years to the process.
- **Excavation and Disposal at the White Mesa Mill.** The White Mesa Mill facility was considered for extraction of uranium from waste rock and subsequent disposal in the adjacent tailings facility. However, disposal at the tailings facility was determined to be currently infeasible because of potential groundwater contamination issues that would

prohibit disposal under the CERCLA Off-Site Rule. This may be an option in the future if compliance with the CERCLA Off-Site Rule can be documented and concurrence is obtained from USEPA.

- **Disposal at a Local Municipal Solid Waste Landfill.** The closest municipal solid waste landfill is in Flagstaff, Arizona. The landfill will not accept uranium mine waste.

Retained Removal Action Alternatives. Removal action alternatives for AUMs on the Navajo Nation were developed as described in the "NAUM Program Navajo Nation AUM Technology Evaluation and Alternative Development Technical Memorandum" (USEPA 2022b). The memorandum is also valid for the AUMs at the site. Retained removal action alternatives for the site also considered site-specific conditions and other local requirements. The following alternatives were retained for further evaluation in this EE/CA and have been tailored to address site-specific conditions and other local requirements:

- **Alternative 1: No Action (this alternative must always be evaluated) –** No treatment or removal action would occur at the site. In this case, all threats would remain unchanged. Mine waste and contaminated soils would continue to threaten human and ecological receptors. Gamma radiation and physical hazards would remain.
- **Alternative 2: Consolidate and Cap All Waste Onsite –** Achieves RAOs by excavating the waste rock piles, residual waste rock, and contaminated soils; and consolidating and capping the waste in the onsite pit areas. A protective ET cap would be used that would control contaminant migration and require long-term maintenance. Details of Alternative 2 are shown in Figure 15.
- **Alternative 3: Disposal of All Mine Waste at a Western AUM Regional Repository –** Achieves RAOs by excavating the waste rock piles, residual waste rock, and contaminated soils; and consolidating and capping the waste in a regional repository. This location would provide for increased distance from major drainage pathways and floodplains. A protective ET cap would be used to control contaminant migration and along with the exposed bedrock require long-term maintenance. Details of Alternative 3 are shown in Figure 16.
- **Alternative 4: Disposal of All Mine Waste in Offsite RCRA-Licensed Facility –** Achieves RAOs by excavating the waste rock piles, residual waste rock, and contaminated soils; hauling the waste 515 miles (one way) for disposal at the Energy Solutions LLRW facility in Clive, Utah. Details of Alternative 2 are shown in Figure 17.

The retained removal action alternatives listed above are described in Section 4.2.2 and carried through a detailed analysis in Section 4.3.

4.1.3 Applicable or Relevant and Appropriate Requirements

Pursuant to NCP at 40 CFR § 300.415(j), USEPA has promulgated a requirement that removal actions attain federal and state ARARs to the extent practicable considering the exigencies of the situation. The ARARs evaluation completed for the site was comprehensive, and no ARARs were rejected based on the exigencies of the situation. The site mines are located on land within

Arizona. The identification of ARARs is an iterative process; therefore, ARARs are referred to as potential until the final determination is made by USEPA in the action memorandum.

NCP at 40 CFR § 300.5 identifies ARARs and "to be considered" (TBC) requirements as follows:

- **Applicable requirements** are defined as "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance found at a CERCLA site."
- **Relevant and appropriate requirements** are defined as "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitation promulgated under federal or state environmental facility siting laws that, while not 'applicable' address problems or situations sufficiently similar to those encountered at the CERCLA site and that is well suited to the particular site."
- **TBC criteria** consist of advisories, criteria, or guidance that were developed by USEPA, other federal agencies, or states that may be useful in developing CERCLA remedies and include non-promulgated guidance or advisories that are not legally binding and that do not have the status of potential ARARs. TBCs generally fall within three categories: health effects information with a high degree of credibility, technical information on how to perform or evaluate site investigations or response actions, and policy.

ARARs apply to onsite actions completed as part of a removal action. Compliance with ARARs requires compliance only with the substantive requirements contained within the statute or regulation and, pursuant to CERCLA § 121I(1), does not require compliance with procedural requirements, such as permitting or recordkeeping. ARARs do not apply to offsite response actions. Instead, offsite response actions must comply with independently applicable requirements (not relevant and appropriate) and must comply with both substantive and procedural components of the requirements.

USEPA, as the lead agency, is responsible for identifying potential federal ARARs and evaluating potential Arizona ARARs. For a state of Arizona requirement to be identified as a potential ARAR, the requirement must be more stringent than federal ARARs.

USEPA has divided ARARs into three categories: chemical specific, location specific, and action specific. The three categories are described below:

- **Chemical-Specific ARARs** are usually health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment.
- **Location-Specific ARARs** apply to the geographical or physical location of a site. These requirements limit where and how the response action can be implemented.

- **Action-Specific ARARs** include performance, design, or other controls on the specific activities to be performed as part of the response action for a site.

The potential ARARs for all alternatives are presented and analyzed in Table 7.

4.2 DESCRIPTION OF ALTERNATIVES

This subsection describes the retained removal action alternatives for the site. Section 4.2.1 provides a summary of common site construction and restoration elements applicable to all alternatives. A detailed description of removal action alternatives and associated costs, which focuses on the different waste disposal options, is presented in Section 4.2.2.

4.2.1 Common Elements

To reduce repetitive discussion in the detailed alternative analyses, common removal action elements for Alternatives 2, 3, and 4 are provided in the following subsections.

4.2.1.1 Common Elements for Construction and Restoration

Common removal action elements at the site for construction and restoration for Alternatives 2, 3, and 4 are described below.

Site Preparation. Laydown areas would be established on the site after biological and cultural resource clearances. Laydown areas may include port-a-potties, wash water, refuse pickup, decontamination station, temporary offices, radiation scanning equipment, personal protective equipment, first aid supplies, temporary Wi-Fi and radio, and potentially a construction water well and tank stand. The laydown areas would also include security personnel and temporary security fencing and signage for access controls. Laydown areas would remain until completion of the removal action.

A sufficient water supply is not available for construction near the site. Purchase of water from Flagstaff, Arizona, or construction of a new construction supply well would be needed for the project. If an onsite water supply were developed, well depths would likely range from 500 to 1,000 feet bgs. Diesel generators would be used to run the well pumps and provide power for the temporary work site (laydown area). and well site location (if constructed). The diesel generators would require bulk fuel storage at the laydown area. A secondary containment area would be constructed around generators, storage tanks, and the fueling area. A water storage tank for the water trucks would also be required.

Cultural and Biological Exclusion and Timing. Cultural resource investigations may be conducted at the site. The results of these surveys would be reviewed and used where possible for planning and removal design. Additional surveys would be performed after design, and USEPA would specify compliance requirements for cultural resources. For the purposes of this EE/CA and consistent with other CERCLA actions in this area, cultural resources would be avoided or protected during site work activities and no special status plant or animal species would be identified that would limit site work activities.

Natural resource surveys (for example, biological and botanical) for special status species would be required to verify the current land use for each area, mapped habitat and vegetation cover types, and recorded locations of potential special status species resources. No threatened or endangered species have been identified at the site.

Previous site surveys would be consulted where possible, and new surveys would be conducted if necessary. Furthermore, if new action areas are identified as part of the selected removal action, these areas would be surveyed before earthmoving activities. If any natural resources are found, ARARs would be identified.

The removal actions would involve widening access roads for haul roads and establishing an overall larger work area than the previous investigations. Therefore, additional field surveys and reports of both natural and cultural resources in the proposed work areas may be required. The surveys must conclude the proposed removal action project area would not affect natural and cultural resources before design and construction can proceed.

An environmental protection plan would be developed for monitoring protocols during the work activities and include a review and evaluation of potential impacts to historic properties and locations. Natural resource (for example, biological and botanical) inspections would be conducted at the site, and information from these inspections would be included in the environmental protection plan. Environmental protection would include a review and evaluation of potential impacts on government-protected species and critical habitats.

Site Access. The site is accessed by taking Indian Route 6728 from U.S. Route 89 approximately 40 miles north of Flagstaff, Arizona. Indian Route 6728 leads to Section 9 approximately 8 miles to the east.

During the response and restoration activities, site access would be restricted by signage, temporary fencing at access points, and security maintained during all non-working hours while site work is occurring. The laydown area will be completely fenced. The site foreperson and the health and safety officer would be responsible for personnel while on the site. USEPA and its authorized representatives, including its contractors, and representatives of Babbitt Ranches; CO Bar, Inc.; BLM; and the State of Arizona would have access to the site at all times. A site access and security plan would describe the activities used to monitor and control access to the site during implementation of the response actions and the period of work performance.

The alternatives being considered require hauling soil and water over the construction period and may require widening, grading, and installation of culverts along the 8-mile Indian Route 6728.

During transport of waste off site, traffic controls would be necessary. A traffic control plan would be developed and followed throughout operations. Even with precautions, nearby roads would require maintenance to protect the roadway and road users. To maintain road load limits, temporary scales would be used to weigh the trucks that navigate Arizona roadways. Observing road load limits would help reduce roadway wear and maintain the local roadways in a safe operating condition. Equipment and materials would be available to restore the roadways as needed.

Air Monitoring. A sampling and analysis plan would be prepared that describes the methods and procedures for collecting, analyzing, and evaluating air samples within and at the perimeter of work zones. Air monitoring stations would be positioned and operated to monitor dust and airborne contaminant concentrations during excavation, stockpiling, loading of trucks, hauling, waste compaction, and site restoration. Air monitoring would be used to document that offsite migration of contaminants at unacceptable concentrations does not occur, maintain compliant air quality conditions and a safe working environment, and protect the health of workers, the general public, and the environment. Water spraying would be used during soil-moving activities at all work zones and for dust suppression. Alternate engineering controls may be used on haul roads to limit water application needs. Water would be sourced as described under Site preparation.

Dust Control. Off-road haul routes and site excavation, waste transfer, waste compaction, and restoration areas would be wetted to minimize dust generation. Water spraying would be used during soil-moving activities for dust suppression. Rock fields and grating would be used to reduce the track out of dirt onto paved surfaces. To maintain the haul routes as laid out, signs and barriers would be provided, as necessary, to contain traffic along the designated route. Water used for dust control and cleaning of paved surfaces would be imported as described under site preparation. Alternate methods of dust control, such as chemical polymers, gravel cover, recycled asphalt, and paving of access and haul roads, will be considered to reduce the water required. Dust control would be used to maintain compliant air quality conditions and a safe working environment and to protect the health of nearby residents, workers, the general public, and the environment.

Stormwater Control. Excavated areas would be graded to pre-mining contours when possible and oriented to reduce scouring with low-energy flow rates and patterns. The drainage system would be integrated with the topography and existing geomorphology to the extent possible. Activities at the site must be evaluated for potential impacts on federally listed species and critical habitat and for certification to meet the substantive requirements of the National Pollutant Discharge Elimination System Multi-Sector General Permit. Once the site has been stabilized, post-removal action site controls would be initiated.

Excavation Approach. Waste rock piles and contaminated soils containing metals and radionuclides above RAGs are within 64 identified removal areas of concern within the TENORM boundary (Figure 13). An estimated 14,711 cubic yards of contaminated soil exceed the Ra-226 RAG (12 pCi/g) in Sections 9 and 10. Although land ownership may differ between Section 9 and Section 10, the identification and screening of the response action and the conclusions are independently evaluated. Section 16, including AUM 459, has been excluded from the APE.

Figure 14 summarizes the locations, average estimated depth, and average estimated volume for each of the 64 removal areas by 7 individual TENORM boundary areas. The excavation volumes were estimated using limited depth contours corresponding to soil exceeding 12 pCi/g Ra-226. The contours and extent of each area were used to create a computer-generated surface and estimated excavation volume. Depths shown on Figure 14 are the area-weighted average depth that approximates the computer-generated estimated excavation volume. Detailed excavation cross-sections for each of the 64 excavation areas will be prepared in the remedial design.

Site removal areas include:

- The removal area within Section 9 has an estimated volume of 13,478 cubic yards (Figure 14).
- The removal area within Section 10 has an estimated volume of 1,233 cubic yards (Figure 14).
- The removal areas attributable to mining activities at AUM 459 are included in the Section 9 estimated removal volume (Figure 14).

The waste is accessible with standard construction equipment, including excavators and bulldozers. Waste rock and contaminated soils would be loaded into 16.7-cubic-yard articulated haul trucks for hauling to onsite consolidation locations or loaded into 25-ton trucks for hauling to the offsite RCRA-licensed facility.

Waste would be removed to a native soil interface and excavation would proceed in lifts using field screening techniques such as gamma scanning and X-ray fluorescence measurements until RAGs are attained. Confirmation sampling and a final status gamma survey would be conducted to verify attainment of RAGs. Borrow material would first be obtained on site and then additional borrow material would be imported from nearby.

Waste Handling and Transfer. For cost-estimating purposes, 16.7-cubic-yard articulated dump trucks were assumed for onsite transport (Alternatives 2 and 3) and 25-ton covered on-highway trucks were assumed for offsite transport to the offsite RCRA-licensed facility (Alternative 4). Controls would be used to ensure contamination is not released from the site and may include radiological scanning of tires and equipment, dry brushing truck beds and wheels, and power spraying equipment.

Cap Design Assessment. Consolidation and capping on site (Alternatives 2 and 3) would involve the construction of an engineered cap over the consolidated mine waste. Two types of engineered caps were evaluated through infiltration and radon flux modeling: (1) a soil ET cap and (2) a soil cap containing an integral high-density polyethylene (HDPE) layer (Tetra Tech 2021).

Approximately 36 inches of cover would be required for an ET cap to limit infiltration of precipitation and snowmelt, control radon gas flux, and reduce gamma activity to background. A cap with an HDPE liner would require less soil cover; however, at least 24 inches of cover would still be needed to protect the liner from frost heave, burrowing animals, and plant roots. Biodegradable matting and wattles would be placed on the cover top and side slopes to limit erosion. Surface controls would involve directing run-on water around the capped area using berms and ditches.

Both engineered cap types would minimize the vertical migration of precipitation and snowmelt to the underlying mine waste. However, an ET cap would be stable on slopes less than 3:1 while the smooth surface of an HDPE liner can create a slip plane, which carries risks such as instability during seismic or heavy precipitation events. An ET cap would allow for slow dissemination of radon gas while a soil cap with an HDPE liner would tend to trap radon gas, which may find preferential pathways for a point of release at higher concentrations. A bottom liner under the waste would not be needed because the evaporation rate far exceeds the precipitation rate and volume in the region and an ET cap is sufficient to limit infiltration into the waste. A bottom liner would not provide any additional protectiveness. Ventilation would not be required for radon-222 as the modeled flux within the waste is below 20 picocuries per meter squared per second. ET covers are widely used throughout the United States and have been shown to be especially effective in the Southwest (Tetra Tech 2021). The average annual precipitation in Cameron, Arizona, is 5.57 inches while the pan evaporation rate is 80.57 inches (Table 1). Thus, given that ET covers work with nature to provide similar or better protectiveness than a cap with an HDPE liner, the ET cover with no liners would be used for the alternatives analysis.

Waste would be placed and consolidated to mimic surrounding topography and blend into the landscape. Nearby sources of borrow soil for cap construction would be identified, as well as the potential import of clayey soil from the Chinle Formation and gravel for including in the cap to improve erosion resistance. Sandstone rock would be excavated from local bluffs to face the terrace slopes of a cap.

CERCLA Off-Site Rule. Alternatives that involve transportation off site for disposal would require compliance with the CERCLA Off-Site Rule. In general, the CERCLA Off-Site Rule requires facilities accepting contaminated or hazardous wastes from a CERCLA site must follow all applicable regulations and laws (that is, they must be approved to take those wastes and comply with the applicable federal, state, and local requirements). The licensed disposal facilities considered for any alternatives involving offsite disposal would be required to have existing approval under the CERCLA Off-Site Rule.

Site Restoration Activities. Details regarding site features are shown on Figure 18, Figure 19 and Figure 20, and areas requiring surficial restoration are described below:

- ***Main Haul Roads.*** Haul roads from Section 9 to U.S. Route 89 (8 miles) would be improved to facilitate construction and removal of the waste. Water control bars and rolling dips would be used on portions of the road that have an extended length and a slope greater than 5 percent. Drainage swales would be covered with rock to reduce erosion. The road would be maintained as needed for at least 10 years to provide access to the mine sites during restoration. If an onsite cap is selected as a removal action alternative, the haul road would be maintained as needed for at least 30 years to provide access for monitoring and maintenance.
- ***Temporary Access Roads to Mine Pits and Waste Piles.*** To facilitate construction, haul roads may be constructed between Indian Route 6728 and AUMs 457 and 458 (Figure 15 and Figure 16). The route of road construction would be monitored to minimize the production of TENORM. When work is complete, the temporary access roads would be obliterated. Those portions of the road pathway on benches below highwalls would be covered with rock. The road pathways would be restored by pulling overbank materials back onto the road surface, contour grading to match surrounding grade, covering with biodegradable matting and coir logs, and seeding using local grasses and forbs. Upslope berms and drainage ditches would be constructed to divert water away from the disturbed road pathway. Drainage swales would be covered with rock to reduce erosion.

Soil berms would be used to block vehicular access to the temporary access roads from the haul road.

- ***Stabilizing Pits.*** Pits would be backfilled with waste or clean fill (depending on the alternative) to provide positive drainage through waste consolidation or backfill. Soil and rock berms and drainage ditches would be constructed upslope to divert run-on water away from unstable areas. Rock outfalls would be constructed at the end of ditch systems and benches to reduce the erosive force of water that could impact restored areas further downslope.
- ***Run-on and Runoff Controls.*** Rock berms, rock-lined drainage ditches, biodegradable matting and coir logs, and rock fields and covers are discussed within the respective surficial restoration area type above.
- ***Slope Downhill from Upgrader at AUM 457.*** The area of waste removal downhill from the upgrader would be covered with 1 foot of soil and revegetated (Figure 15 and Figure 16). Following construction, the drainage would be restored. The drainage would be graded to restore a natural energy grade line, boulders and gabion weirs may be placed strategically in the drainage for energy dissipation, and biodegradable matting and coir logs would be added along with planting shrubs and forbs within the riparian zone.
- ***Access Roads to AUMs 457 and 458.*** To facilitate equipment access and removal of waste from AUMs 457 and 458, temporary access roads may be constructed (Figure 15 and Figure 16) between Indian Route 6728 and the mine and consolidation sites. A 0.4-mile-long temporary haul road from Indian Route 6728 to AUM 457 and a 0.35-mile-long temporary haul road from Indian Route 6728 to AUM 458 would be constructed and maintained for 10 years.
- ***Waste Consolidation or Removal Areas.*** The disturbed areas would be backfilled with waste, cap soil, or clean fill; contour graded; and revegetated. Rock-lined channels may be constructed where slopes are greatest with rock selected to best match the natural colors in the area. Cover soil and rock may be imported from existing and future local quarries while rock required to meet engineering specifications would be imported from outside the region. Capped areas would be fenced.

4.2.1.2 Common Elements for Maintenance

Common elements for the maintenance of site and restoration features are described below.

Short-Term Maintenance of Site and Restoration Features. Maintenance would be performed for up to 10 years for the restored areas of the site outlined in Section 4.2.1.1. Annual maintenance will include:

- Vegetation surveying in late spring
- Erosion control inspection and maintenance surveying after the monsoon season(s)
- Vegetation maintenance, including reseedings, replanting, and removing weeds

- Access road maintenance prior to site visits and until vegetation and restored areas have stabilized
- Repairs to fences, erosional features, rock outfalls, and water control berms
- Erosion control maintenance on the caps including removing decayed biodegradable matting and wattles to minimize rills and gullies and clearing sediment from berms and ditches to direct run-on and runoff water around the onsite consolidation area cap
- Temporary range fencing maintenance including repairing damaged fencing installed around the onsite cap areas during the revegetation period to stop recreational vehicles or livestock from disturbing the soil cover and revegetation efforts

Onsite Cap Long-Term Maintenance. Activities for Alternatives 2 and 3 include:

- Final grading, surface erosion controls, and revegetation of the onsite caps would be needed to limit the visual impact by mimicking local terrain and using local soils and vegetation (Appendix E). Maintenance would include repairing erosional features and ongoing establishment of vegetative cover. Maintenance would include repairing erosional features and ongoing establishment of vegetative cover.
- LUCs would be required to restrict activities that could damage the cap. The form of the LUCs would likely be an environmental covenant, such as the land easement currently in place for Babbitt Ranches' land within Section 9 that restricts future residential use (EA 2021) or activities that would disturb the cap.

Inspection and maintenance of the onsite caps would be conducted as specified in a long-term surveillance plan with inspection frequencies adjusted based on the cover stability and inspection findings. Maintenance would consist of repairing eroded surfaces or damages to caps, clearing accumulated erosion materials, replanting vegetation, and repairing access roads. Periodic, 10-year maintenance costs were developed based on a 30-year period for cost estimate comparisons. Additional maintenance costs may be incurred beyond 30 years depending on inspection results and updates to the long-term surveillance plan.

4.2.1.3 Potential Unavoidable Impacts

Except for Alternative 1 (no action), each of the removal action alternatives would result in an overall improvement to the local environment. However, for Alternatives 2, 3, and 4, unavoidable impacts are expected and include:

- Vegetation coverage on the site currently includes scrub brush and grasses. Mining-disturbed areas are generally devoid of vegetation or are covered with grasses. Construction activities would generally be limited to areas of mining disturbance. Disturbed areas would be reclaimed, but existing grasses and forbs would take up to 10 years to reestablish. Areas with shallow slopes would be contour-graded and revegetated. Areas with moderate to steep slopes would be covered with rock where accessible. Areas with exposed bedrock may not be covered at all.
- New temporary access and haul roads to the site would be constructed to provide access for construction equipment and to haul out waste. Construction of the new roads may

disturb mineralized rock and generate additional TENORM that must be addressed. When work is complete, the roads would be removed and the disturbed slopes and drainages would be restored to the extent possible.

- Local populations using U.S. Route 89 would be inconvenienced for the duration of the construction period by increased truck traffic. Generation of dust on access and haul roads would be minimized through spraying with water or other engineering controls during construction and hauling activities.
- While no sensitive species and habitat are known present on the site, any later found may be disturbed during construction activities.
- While no cultural resources have been identified at the site (SWCA 2017), cultural resource monitors would be on site during construction activities to clear any work areas beyond those already cleared.
- Range fencing would be used at entry points for up to 10 years after completion of site work to help establish vegetation.
- Risk of traffic accidents, fatalities, and greenhouse gas emissions would increase because of the trucking of fill, cover material, and waste. As the offsite haul distance increases, the potential risks also increase.
- Water and other engineering controls would be used for dust control during excavation, waste compaction, and restoration, and on roads during waste hauling.

4.2.2 Description of Removal Action Alternatives

The following subsections present descriptions of the three removal action alternatives identified in Section 4.1.2. All haul roads, laydown areas, and truck and access roads needed for the removal actions are shown on Figure 15 and Figure 16.

4.2.2.1 Alternative 1: No Action

Under Alternative 1, radionuclide and metal COCs and COECs in the waste piles and surrounding contaminated soils would not be addressed. No LUCs, signage, range fencing, or barriers would be used to limit access to the site. No removal or site stabilization activities would occur.

4.2.2.2 Alternative 2: Consolidate and Cap All Waste Onsite

Under Alternative 2, RAOs would be accomplished through excavation, hauling, sorting, and consolidation of waste on the site; containment of waste under an ET cap; and implementation and short-term maintenance of site restoration measures and land use and access controls to protect the cap and site restoration process (Figure 15 and Figure 18). Site excavation and restoration elements common to alternatives are described in Section 4.2.1.1.

An estimated 1,233 of 14,711 cubic yards (about 8.6 percent) of all contaminated soils in Sections 9 and 10 are in Section 10. An estimated 14,711 cubic yards of waste from the AUMs would be consolidated and capped on site (Figure 15). The proposed consolidation areas were previously disturbed by mining. The consolidation area for AUM 457 is south and west of the former concentrator. The topography is gently sloping to the west with steeper slopes to the east. No headwater areas exist that could direct surface water to the capped area. The consolidation area for AUM 458 is the location of the excavated area. The consolidation areas have year-round access for maintenance. Design considerations to limit visual impact include reduced height, grading and contouring into an existing hillslope, and use of local soils and small rocks within the cap to better blend in with the surroundings. Criteria used in the design phase may limit the amount of material placed near the steeper slopes to the east but would likely fill any west-to-east depressions. The cap would comprise native soil and a gravel admixture and be revegetated using native plants to blend in with the landscape. Post-removal visualizations of the onsite consolidation are included in Appendix E.

Site restoration activities include access roads; backfilling and grading of waste excavation areas; controlling runoff from above the mine sites; covering slopes with rocks where possible; covering mining-disturbed areas with soil, rock, or gravel where possible; and restoring the minor drainage channels within and below the excavation sites (Figure 18). Roads required for maintenance activities would be reclaimed once the site has stabilized (after 10 years). Site restoration activities are described further in Section 4.2.1.1. Post-removal visualizations of the restored site are included in Appendix E.

Multiple Repository Conceptual Design

The repositories and surface treatments would be designed to blend in with the surrounding landscape as much as possible. Exhibit 9 shows the existing conditions where Repository 1 in AUM 458 would be placed. Exhibit 10 shows the existing conditions where Repository 2 in AUM 457 would be placed. These locations partially comprise existing topographical depressions. These existing topographical depressions would be used to the greatest extent possible to accommodate consolidated waste. The existing site conditions are sparse grasses and shrubs with an undulating topography.

The onsite consolidation areas are moderately steep with bedrock at more than 6 feet bgs. Outcrops and bedrock encountered during placement of consolidated waste and construction of the repository would be covered along with the waste and repository ET cap system. Any remaining outcrops and bedrock at the surface would not be disturbed and not considered TENORM.

The onsite capped consolidation areas would be constructed by rough grading the base of the consolidation area to allow for vehicular traffic and waste placement. An average of 3 feet of waste would be placed in Consolidation Area 1 and an average of 9 feet of waste would be placed in Consolidation Area 2. For the repository, the immediate slope(s) of surrounding grade would govern first. Where the repository is higher in elevation than surrounding grades, the repository slopes would have no more than 10:1 slope. The final 6 inches of cap material would be furrowed along contours at 6- to 12-inch intervals to promote capture of water and growth of native grasses. Polyacrylamide crystals would be mixed in with the final 6 inches of soil to enhance water retention and slow release. The site would be seeded with a mixture of native grasses. Native shrub species would be seeded at discrete locations across the site. Coir rolls would be installed along contours and would degrade in 5 to 10 years. Bonded fiber matrix (hydroseeded) or crimped straw may also be used to increase germination rates. These features will increase the likelihood the finished repository will blend in with the natural landscape as much as possible while limiting erosion of the repository cap.

Exhibit 9. Existing Conditions at Consolidation Area 1 (AUM 458)

Source: Photo 31 in Appendix B of the preliminary assessment report by Weston Solutions, Inc. (2012).

Exhibit 10. Existing Conditions at Consolidation Area 2 (AUM 457)

Source: Photo 14 in Appendix C of the site inspection report by Weston Solutions, Inc. (2014).

The 36-inch-thick ET cap, requiring approximately 11,900 cubic yards of borrow soil for Consolidation Area 1 and 2,300 cubic yards of borrow soil for Consolidation Area 2, would be constructed on top of the waste. Borrow and cover soil are expected to be obtained within 0.5 mile of the repository. Borrow areas will be located outside TENORM boundaries, and any outcrops or bedrock exposed as a result of borrow excavation will still be considered NORM. Cover soil will be selected from the top 6 inches of borrow areas.

Removal Action Components

Additional information regarding common construction elements is provided in Section 4.2.1.1.

- Excavation of waste and contaminated soil from the 64 excavation areas on the north and south side of Indian Route 6728; rework in situ (and not excavation) of excavation areas co-located with the consolidation area locations
- Excavation of borrow soil for caps and surficial and site restoration
- Construction of the waste consolidation areas, transport of waste to the consolidation area, and placement of waste in the consolidation area
- Closure of the consolidation area with ET caps
- Installation of short-term erosion and stormwater controls, grading, and revegetation

- Implementation of access controls, such as range fencing and signage to allow for successful revegetation on the ET caps and installation of gates to allow rotational grazing once vegetation becomes established
- Surficial and site restoration of excavation locations and laydown areas
- Implementation of access controls, such as temporary fencing and signage, berms, or barricades on temporary access roads to reduce ease of access for livestock over the short term, to allow for successful revegetation on the site
- Long-term maintenance of the consolidation area cap as described in Section 4.2.1.2
- Maintenance of surficial and site restoration areas as described in Section 4.2.1.2

4.2.2.3 Alternative 3: Disposal of All Mine Waste at a Western AUM Regional Repository

Under Alternative 3, RAOs would be accomplished through excavation, hauling, sorting, and consolidation of waste at a regional repository; containment of waste under an ET cap; and implementation and short-term maintenance of site restoration measures and land use and access controls to protect the cap and site restoration process (Figure 16 and Figure 19). Site excavation and restoration elements common to alternatives are described in Section 4.2.1.1.

An estimated 13,478 cubic yards (about 92 percent) of all contaminated soils are in Section 9 and 1,233 cubic yards (about 8 percent) are in Section 10. An estimated 14,711 cubic yards of waste from the AUMs would be consolidated and capped in the Western AUM Region repository. The proposed consolidation area for AUMs 457 and 458 is in the northwest corner of Section 9 on top of a low mesa (Figure 16). The topography is flat with nearby drainage sloping to the east. No headwater areas exist that could direct surface water to the capped area. The consolidation area has year-round access for maintenance. Design considerations to limit visual impact include reduced height, grading and contouring into an existing hillslope, and use of local soils and small rocks within the cap to better blend in with the surroundings. Criteria used in the design phase may limit the amount of material placed near the steeper slopes to the east but would likely fill any west-to-east depressions. The cap will comprise native soil and a gravel admixture and will be revegetated using native plants to blend in with the landscape. Post-removal visualizations of the onsite consolidation are included in Appendix E.

Regional Repository Conceptual Design

The repository and surface treatments are designed to blend in with the surrounding landscape as much as possible. Design and environmental considerations will be evaluated to determine the location, elevation, and topography of the repository.

The onsite repository would be constructed by rough grading the base of the consolidation area to allow for vehicular traffic and waste placement. An average of 8 feet of waste will be placed in the consolidation area. For the repository, the immediate slope(s) of surrounding grade will govern first. Where the repository is higher in elevation than surrounding grades, the repository slopes will have no more than 10:1 slope. The final 6 inches of cap material will be furrowed along contours at 6- to 12-inch intervals to promote capture of water and growth of native grasses. Polyacrylamide crystals will be mixed in with the final 6 inches of soil to enhance water retention and slow release. The site will be seeded with a mixture of native grasses. Native shrub species will be seeded at discrete locations across the site. Coir rolls will be installed along contours and will degrade in 5 to 10 years. Bonded fiber matrix (hydroseeded) or crimped straw may also be used to increase germination rates. These features will increase the likelihood that the finished repository will blend in with the natural landscape while limiting erosion of the repository cap.

The 36-inch-thick ET cap, requiring approximately 7,400 cubic yards of borrow soil, would be constructed on top of the waste. Borrow and cover soil are expected to be selected from adjacent land. No TENROM or NORM have been identified at the location. Cover soil will be selected from the top 6 inches of borrow area.

Removal Action Components

Additional information regarding common construction elements is provided in Section 4.2.1.1.

- Construction of a 0.35-mile-long haul road from Indian Route 6728 to the consolidation area (Figure 16)
- Excavation of waste and contaminated soil from the 64 excavation areas on the north and south side of Indian Route 6728
- Excavation of borrow soil for caps and surficial and site restoration
- Construction of the waste consolidation area, transport of waste to the consolidation area, and placement of waste in the consolidation area
- Closure of the consolidation area with ET caps
- Installation of short-term erosion and stormwater controls, grading, and revegetation
- Implementation of access controls on ET caps, such as the installation of range fencing and signage to allow for revegetation and the installation of gates to allow rotational grazing once vegetation becomes established
- Surficial and site restoration of excavation locations, backfill sites, and laydown areas
- Implementation of access controls on temporary access roads, such as the installation of temporary fencing and signage, berms, or barricades to reduce ease of access for livestock over the short term to allow for revegetation on the site
- Long-term maintenance of the consolidation area cap as described in Section 4.2.1.2
- Maintenance of backfill, surficial, and site restoration areas as described in Section 4.2.1.2

4.2.2.4 Alternative 4: Disposal of All Mine Waste in Offsite Resource Conservation and Recovery Act-Licensed Facility

Under Alternative 4, RAOs would be accomplished through excavation, transport, and offsite disposal of mine waste and contaminated soil at a RCRA facility licensed to accept LLRW (Figure 17). Although land ownership may differ between Section 9 and Section 10, the identification and screening of the response action is not affected and the conclusions were independently evaluated. Section 16 has been excluded from the APE. The site would be reclaimed through implementation of site restoration measures followed by the short-term maintenance of restored features and use of access controls to protect the site restoration process. Site excavation and restoration elements common to alternatives are described in Section 4.2.1.1.

An estimated 14,711 cubic yards of waste from the site would be hauled approximately 9 miles via an unpaved road to Indian Route 6728 and then to one of the facilities with the necessary permits and CERCLA Off-Site Rule approvals listed below. Indian Route 6728 is assumed passable for 25-ton on-highway haul trucks so waste transfer is not included. The hauling of waste would comply with applicable Navajo and state permitting requirements for the transport of radioactive materials.

The following facilities have licenses or permits that allow for acceptance of uranium mine waste:

- US Ecology, Grand View, Idaho: RCRA C hazardous waste disposal facility located 800 miles from the site
- Clean Harbors, Deer Trail, Colorado: RCRA C hazardous waste disposal facility located 690 miles from the site
- Energy Solutions, Inc. (Clive Operations), Clive, Utah: LLRW facility located 515 miles from the site.
- Waste Control Specialists, Andrews, Texas: LLRW facility located 730 miles from the site

The Clive Operations LLRW facility was identified as the most cost-effective disposal facility and is located near Clive, Utah, approximately 515 miles from the site (Figure 17). The disposal facility could be changed in the action memorandum stage if necessary.

Disposal at a licensed LLRW or RCRA C hazardous waste facility is a standard disposal method involving transport to and disposal at the applicable waste disposal facility. Licensed or permitted facilities are generally constructed to prevent the release of hazardous or radioactive materials and include engineered cells and liners that exceed requirements for municipal or commercial solid waste disposal facilities.

Site restoration activities include obliterating access roads on the site; backfilling and grading waste excavation areas; controlling runoff from above the mine sites; covering slopes with rocks where possible; covering mining-disturbed areas with soil, rock, or gravel where possible; and restoring the minor drainage channels within and below the excavation sites (Figure 20). Roads required for maintenance activities will be reclaimed once the site has stabilized (after 10 years). Site restoration activities are described further in Section 4.2.1.1. Post-removal visualizations of the restored site are included in Appendix E.

Removal Action Components

Additional information regarding common construction elements is provided in Section 4.2.1.1.

- Improvement of segments of the existing 9-mile-long Indian Route 6728 to access the laydown areas
- Excavation of waste and contaminated soil from the 64 excavation areas
- Excavation and stockpiling of borrow soil for surficial and site restoration
- Backfill of excavated areas and exposed bedrock with clean fill
- Hauling and offsite disposal of waste by 25-ton on-highway haul trucks to the Clive Operations LLRW disposal facility near Clive, Utah
- Restoration of each excavation area, certain haul roads, and all laydown areas with short-term erosion and stormwater controls, grading, and revegetation
- Implementation of access controls, such as temporary fencing and signage, berms, or barricades on temporary access roads to reduce ease of access for livestock over the short term to allow for revegetation
- Maintenance of surficial and site restoration areas as described in Section 4.2.1.2

4.3 ANALYSIS OF ALTERNATIVES

As required by NCP and described in the “Guidance on Conducting Non-Time Critical Removal Actions under CERCLA” (USEPA 1993), retained removal action alternatives are evaluated individually against three broad criteria: effectiveness, implementability, and cost. The individual alternative analysis ranks the three criteria of each alternative qualitatively as **Very Poor**, **Poor**, **Average**, **Good**, or **Very Good**.

In addition, based on USEPA (2016b) guidance, five key elements in greener cleanup activities should be considered throughout the response action selection process:

- Minimize total energy use and maximize renewable energy use
- Minimize air pollutants and carbon dioxide equivalent emissions
- Minimize water use and negative impacts to water resources
- Improve materials management and waste reduction efforts by reducing, reusing, or recycling whenever feasible
- Protect ecosystem services

The evaluation criteria and qualitative rating ranges are described below.

Effectiveness Criterion

This criterion evaluates protectiveness, compliance with ARARs, short-term effectiveness, long-term effectiveness and permanence, and reduction in toxicity, mobility, or volume of waste.

- **Overall Protection of Human Health and the Environment –** This threshold criterion evaluates whether each alternative provides adequate protection of human health and the environment. The assessment of overall protection focuses on whether a specific alternative achieves adequate protection and how site risks posed through each pathway addressed by the EE/CA are eliminated, reduced, or controlled through treatment, engineering, or LUCs. Alternatives are either considered protective or not protective.
- **Compliance with ARARs –** This threshold criterion evaluates whether each alternative would meet the identified ARARs. Alternatives are either in compliance with ARARs or not in compliance.
- **Short-Term Effectiveness (during Removal Action) –** This criterion evaluates the effects that the alternative would have on human health and the environment under current conditions prior to the action and during its construction and implementation phase. The evaluation includes both radiation risks from exposure to the contaminated soils and risks to the workers and communities under current conditions and from construction work, pollution, and traffic during implementation, and also takes into account the time necessary to complete the action. A qualitative greener cleanups analysis was completed for each alternative to evaluate energy requirements, emissions, water resources, materials management, land management, and ecosystem protection. Short-term effectiveness was rated from very poor to very good.
- **Long-Term Effectiveness and Permanence (after Removal Action) –** This criterion evaluates the results of the removal action in terms of the risk remaining at the site after response objectives have been met. The primary focus of this evaluation is on the extent and effectiveness of the controls used to manage the risk posed by wastes remaining at the site. Long-term effectiveness and permanence was rated from very poor to very good.
- **Reduction of Toxicity, Mobility, or Volume through Treatment –** This criterion addresses the statutory preference for remedies that employ treatment as a principal element by assessing the relative performances of treatment technologies for reducing toxicity, mobility, or volume of the contaminated media. Specifically, the analysis should examine the magnitude, significance, and irreversibility of each estimated reduction. None of the retained alternatives include treatment, so this is not applicable.

Implementability Criterion

This criterion evaluates the technical and administrative feasibility of implementing an alternative and the availability of required services and materials.

- **Technical Feasibility –** This criterion takes into account construction considerations, demonstrated performance, adaptability to environmental conditions, and timing. Technical feasibility was rated from very poor to very good.
- **Availability of Required Services and Materials –** This criterion evaluates whether staff, equipment services, disposal locations, and any other required services and materials are available in the necessary time frames for construction and maintenance activities. This criterion was combined with technical feasibility for this EE/CA.

- **Administrative Feasibility –** This criterion considers regulatory approval and scheduling constraints. Administrative feasibility was rated from very poor to very good.
- **Supporting Agency and Community Acceptance –** This criterion will be addressed in the final EE/CA after initial input from Babbitt Ranches; CO Bar, Inc.; BLM; and supporting agencies. Community acceptance will be addressed in the action memorandum after the public review and comment period on the final EE/CA.

Cost Criterion

The types of costs assessed include the following:

- Capital costs, including both direct and indirect costs
- Annual post-removal site control costs (termed maintenance within this EE/CA for brevity)
- Net present value (NPV) of capital and maintenance costs

In accordance with USEPA (1993, 2000) guidance, engineering costs are estimates within plus 50 to minus 30 percent of the actual project cost (based on year 2024 dollars).

Cost Estimating Process

Cost estimates were prepared in accordance with USEPA (2000) guidelines using engineer's estimates, RSMeans 2024 cost-estimating software (Gordian 2024), and vendor quotes. Flagstaff, Arizona, was used as the reference city in the RSMeans software to estimate costs for labor, equipment, and supplies where applicable. Only the rolled-up construction and capital costs, short-term maintenance costs for site restoration, long-term maintenance costs for repositories, and NPVs are presented for each alternative. Cost details and assumptions are presented in Appendix D. Cost estimating was conducted using a crew time and materials approach, which uses the time required for a crew to accomplish an activity based on a realistic production rate for site conditions. A unit cost approach uses RSMeans unit costs for construction based on cubic yard, linear feet, and square foot quantities, which would not be realistic because of the specific equipment needs and low production rates in remote, steep slope work areas.

Other construction-related costs were identified and included in the cost approach, including mobilization and demobilization, contractor site overhead, travel and lodging, third-party oversight, 5.6 percent Arizona state sales tax, and a 20 percent contingency. Non-construction-related costs required before and during construction activities were also identified and included in the cost approach, including design, planning, resource surveys, confirmation sampling, and reporting.

Contingency costs for construction are based on the extra time, equipment, and personnel required to safely work with radioactive materials; remote location of the site; differences in labor pool costs between RSMeans estimating software reference cities and the project area; and potential for changes in material and transportation costs. Changes in the cost elements are likely as commodity prices change and new information and data are collected during the engineering design and construction pre-bid and walk-through meetings.

The need for short- and long-term maintenance costs were identified, including the short-term need for site restoration for a period of 10 years to address any erosion and revegetation efforts and the long-term need for cap maintenance for a period of 30 years for the onsite consolidation alternatives. Project duration varies depending on the alternative (10 years versus 30 years) and will be addressed in the cost discussion for each alternative.

Common capital and maintenance costs for each removal action alternative include access road construction, access road reclamation, site restoration, and annual site restoration over 10 years.

The NPV of each removal action alternative provides the basis for the cost comparison. The NPV represents the amount of money that, if invested in the initial year of the removal action at a given interest rate, would provide the funds required to make future payments to cover all maintenance costs associated with the removal action over its planned life.

To assess the required funds to be set aside for implementing maintenance activities in the future, this EE/CA uses a 3.5 percent discount rate, which is the 30-year rolling average of the annual discount rates for varying streams of payments as provided by the Office of Management and Budget (2022). The 3.5 percent discount rate would require more money to be set aside for future maintenance costs than the historic average of 7 percent referenced in USEPA (1993) guidance.

4.3.1 Alternative 1: No Action

Under Alternative 1, no actions would be performed at the site. The conditions currently found at the site would remain unchanged. Alternative 1 would not achieve RAOs. This alternative would not minimize potential exposure to or transport of COCs or COECs from the site or control radiation and physical hazards at the site. This alternative would not reduce risk to human health or the environment. Therefore, overall protection of human health and the environment would not be achieved under Alternative 1. Since the overall protection of public health and the environment is a threshold criterion that is not met, evaluation of effectiveness, implementability, and cost are not applicable but presented here for comparison purposes.

4.3.1.1 Effectiveness

Effectiveness for Alternative 1 is based on the following discussion.

Overall Protection of Public Health and the Environment – Alternative 1 would not achieve RAOs. This alternative would not minimize potential exposure to or transport of COCs or COECs from the site or control radiation and physical hazards at the site. This alternative would not reduce risk to human health or the environment. Therefore, protection of human health and the environment would not be achieved under Alternative 1.

Compliance with ARARs – Under Alternative 1, no ARARs would exist with which to comply per CERCLA § 121(d). ARARs are triggered by an action and are, therefore, not pertinent if no cleanup occurs.

Short-Term Effectiveness (Rating: Average) – Alternative 1 has no action, so no short-term risks would exist for the community or workers from construction activities. However, threats to human and ecological receptors would persist in the short term. Because no construction activities would occur, no additional energy use, air pollution, water use, waste and materials management, and ecosystem protection requirements would be triggered. No additional traffic volume or potential accidents and fatalities associated with construction would occur.

Long-Term Effectiveness and Permanence (Rating: Very Poor) – No controls or long-term measures would be implemented to control COCs or COECs at the site under Alternative 1. Under this alternative, waste would continue to be accessible by humans and animals and subject to potential migration to uncontaminated or less contaminated areas. Risks at the site are currently unacceptable and would continue to be unacceptable under Alternative 1. Over time, the site risks may increase, decrease, or remain the same as exposure to and migration of waste would not be controlled.

Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative 1 employs no treatment, so no reductions in toxicity, mobility, or volume through active treatment would occur.

4.3.1.2 Implementability

Alternative 1 is implementable based on the following discussion.

Technical Feasibility and Availability of Services and Materials (Rating: Very Good) – Alternative 1 is readily implementable because no construction is involved. This alternative would not impact the ability to conduct removal or remedial actions in the future. No services or materials would be needed to implement Alternative 1.

Administrative Feasibility (Rating: Very Good) – Alternative 1 is administratively feasible as taking no action is always feasible.

State Acceptance – Acceptance by Arizona, BLM, and supporting agencies is an additional criterion that will be addressed in the final EE/CA report and action memorandum after stakeholder comments have been received on the draft EE/CA.

Community Acceptance – Acceptance by any interested nearby communities is an additional criterion that will be addressed in an action memorandum after public comments have been received on the final EE/CA.

4.3.1.3 Costs

The cost for Alternative 1 is **Very Good** as it involves no removal activities and no legal or administrative activities.

4.3.2 Alternative 2: Consolidate and Cap All Waste Onsite

Alternative 2 involves the excavation and consolidation of mine waste and contaminated soil into capped, onsite waste repositories.

4.3.2.1 Effectiveness

The effectiveness rating for Alternative 2 is **Good** based on the following discussion.

Overall Protection of Public Health and the Environment (Rating: Protective) – Alternative 2 is protective because soil and mine waste containing radionuclide and metal COCs and COECs will be excavated and consolidated and capped on site. The potential for direct contact, ingestion, inhalation, and external irradiation of human and ecological receptors will be eliminated where waste has been contained. Maintenance of the cap will prevent long-term risk to human and ecological receptors. Alternative 2 will be protective of public health and the environment.

Compliance with ARARs (Rating: In Compliance) – Federal and state ARARs identified in Table 7 would be met for the site under Alternative 2.

Short-Term Effectiveness (Rating: Good) – The short-term impacts to the community, workers, and environment under Alternative 2 are described below.

- **Protection of the Community during Removal Action –** No communities exist at or near the site and excavation, waste consolidation, waste compaction, and capping of the waste would occur on site and be away from the nearest potentially affected communities of Cameron (10 miles) and Gray Mountain (8 miles). Trucks hauling equipment and supplies would add incremental noise. However, the access roads and Indian Route 6728 do not pass through populated areas. U.S. Route 89 passes through the communities of Cameron, Grey Mountain, and Flagstaff, but the anticipated truck volume and cycle time would not be detected over normal traffic. Alternative 2 does not include offsite disposal, so no waste would be hauled on public roads.

  Alternative 2, therefore, has low potential impact to the community from construction activity or traffic. Statistically, the incremental on-highway construction traffic related to the project would result in 0.001 deaths and 0.033 accidents (based on 68,500 miles). Risks to the community remain low because waste hauling between the mine sites and onsite waste consolidation areas is only on unpaved haul roads rather than on the highway.

- **Protection of Workers –** Short-term risks of physical injury would exist for site workers under Alternative 2 during construction primarily related to operating equipment during access road construction, waste excavation, site restoration, and waste consolidation area and cap construction. Worker commuter miles are estimated at 47,600 miles.

  Short-term impacts to air quality in the surrounding environment may occur during excavation and loading of waste for transfer to the onsite consolidation area. However, exposures to workers would be within acceptable safe limits because of dust suppression and air monitoring.

  Worker exposure to radiation and contaminants would be maintained within allowable levels with health and safety measures described in Section 4.2.1.

- **Environmental Impacts –** Short-term environmental impacts that could occur from the excavation and consolidation and capping of waste on site are estimated to be low. These environmental impacts may include sedimentation of local drainages, residual track-in and track-out effects of soil and mud, noise, disturbed vegetation, and dust generation. Disturbance of the potential riparian area in the eastern portion of AUM 457 could adversely impact the ecosystem, but the size of the riparian area is small and, therefore, the impact of its potential loss to the surrounding ecosystem is also small. Fuel use and resultant emissions and climate impacts would be relatively low because no offsite hauling would be required. The overall threat to the environment is low because the waste rock could be consolidated and capped on site within one to two field seasons. In addition, revegetation would expedite the return of native flora once cleanup actions are complete. However, revegetation may not occur immediately.

The short-term threat posed by ecological exposure to uranium and radionuclides would be minimal and result in reduced long-term impacts through waste consolidation and isolation. Green remediation considerations are discussed below.

- **Greener Cleanups Analysis** – This analysis determined the mass of different emissions, including greenhouse gases, nitrogen oxides, sulfur oxides, particulate matter, and listed air pollutants, generated by different construction activities. For all categories, Alternative 2 was assessed as having a **small** environmental footprint.

  - *Energy and Emissions* – Alternative 2 has a **small** energy and emissions footprint because all waste hauling would be on site for consolidation.
  - *Water Resources* – Alternative 2 requires use of imported water or installation of a water supply well for waste compaction and dust control during excavation, loading, backfilling, and grading on local access roads. Overall, because of the small construction area and minimal waste hauling, Alternative 2 would have a **small** water resource footprint. The amount of water required during the construction phase of the project is estimated at 643,000 gallons.
  - *Materials Management* – Alternative 2 requires import of rock for onsite drainage stabilization and sediment detention basin construction, as well as import of clayey soil and gravel for cap construction. Borrow soil for site restoration and most of the cap construction will be from nearby the mine sites. No waste would leave the site. Alternative 2 would have a **small** material management footprint because of the short transport distance, small onsite waste consolidation areas, and limited quantity of imported materials.
  - *Land Management and Ecosystems Protection* – Alternative 2 has a **small** footprint because future land use would be only partially limited by the capped waste area and the capped waste area is only 5 acres out of 26 acres in AUM 457 and AUM 458 and the APE comprises 464 acres. Minimizing the capped waste aerial extent could be considered to reduce land use impacts. Land use at the site would not likely be limited in the long term after restoration. Use of geomorphic grading for the waste consolidation areas and cap and site restoration would minimize visual impacts. Disturbance of the potential riparian area in the eastern portion of AUM 457 could adversely impact the ecosystem, but the size, health, and contribution of the potential riparian area to the ecosystem is low. Waste removal and drainage channel restoration will provide a positive ecosystem impact.

- **Time Until Removal Action Objectives Are Achieved –** Excavation, consolidation, and containment of waste on site would meet preliminary RAOs in the short term. The construction time required to achieve preliminary RAOs for Alternative 2 would be several months at the site with intermittent maintenance afterwards. Construction may be extended depending on schedule-limiting factors such as monsoon rains and snowfall.

Long-Term Effectiveness and Permanence (after Removal Action) (Rating: Average) – Alternative 2 would safely and reliably contain all waste on site under an ET cap, and RAOs would be achieved at all contaminated areas at the site. Although the onsite consolidated waste with ET cap is expected to be fully protective in the short and long term, the caps will require long-term inspection and maintenance.

Over the long term, accidents and fatalities could result from SIs and long-term maintenance of the onsite capped waste but would be consistent with typical inspection and maintenance crews anywhere. Although the cost estimate is limited to 30 years of activities, long-term maintenance for Alternative 2 would be in perpetuity. However, the intensity of the maintenance regime is expected to have **low** long-term energy and greenhouse gas footprints from fuel consumption and emissions. Statistically, the incremental on-highway construction traffic related to long-term maintenance of the project would result in 0.001 deaths and 0.033 accidents (based on 68,500 miles).

LUCs would be necessary to limit access to and disturbance of capped waste during restoration. A long-term surveillance plan would be implemented after construction to ensure compliance with LUCs and cover integrity.

Alternative 2 would not require replacement of components because their lifespan is indefinite under an inspection and maintenance regime as described above. Force majeure events, such as earthquakes, climate change, or large floods, could impact the response action or waste left in place, but design criteria for the removal action would take these into account to the extent practicable. The capped wastes location near the LCR decreases the overall resilience to force majeure events and reduces design flexibility, which contributes to a long-term effectiveness rating of **average**.

Finally, the uncertainties of capping waste onsite under Alternative 2 are considered low and the effectiveness good because of the stable nature of the waste, design of waste consolidation areas and ET caps, use of conventional materials and methods, and long track record of capped waste consolidation areas as an accepted response action. Capping waste is standard practice for landfills and mine sites.

Reduction of Toxicity, Mobility, or Volume through Treatment (Rating: Not Applicable) – Alternative 2 employs no treatment, so no reductions in toxicity, mobility, or volume through active treatment would occur.

4.3.2.2 Implementability

The implementability rating for Alternative 2 is **Good** based on the following discussion.

Technical Feasibility and Availability of Services and Materials (Rating: Good) – Alternative 2 consists of earthwork and material consolidation and capping. The equipment required for the work is readily available and consists of conventional and specialty excavators, scrapers, loaders, crushing and screening plants for borrow materials, and articulated haul trucks.

Construction and environmental monitoring equipment and services are all readily available. Although somewhat distant, labor and equipment would be available in the regional Cameron and Flagstaff markets. A sufficient volume of water for onsite dust suppression and waste and cap compaction may be obtained by importing from the Flagstaff area. Drought considerations may require alternate methods of dust control such as binders, gravel cover, or pavement.

Sources of local borrow material can easily be developed to meet the needs for fill, topsoil, clayey soil, and gravel for capping options under all potential cap designs and for site restoration after excavation. Riprap would be imported from Flagstaff, Arizona, to meet engineering specifications for armoring drainage channels. Alternate materials such as local volcanic materials would be evaluated to potentially reduce delivered riprap pricing.

The expertise and equipment needed for long-term monitoring and maintenance of the onsite cap, erosional features and controls, and revegetation are and will be available. Alternative 2 would not require replacement of components because their lifespan is indefinite (at least 200 years per design requirements) under an inspection and maintenance regime as described above.

Administrative Feasibility (Rating: Good) – Alternative 2 is administratively implementable and would require coordination between USEPA; Arizona; Babbitt Ranches; CO Bar, Inc.; and BLM. While such coordination and agreements take time, no difficulties are expected.

Federal and state permits for onsite actions under CERCLA and the proposed onsite waste consolidation areas and cap are not required because this is an onsite location in a mining-disturbed area. Environmental reviews may be required from Arizona, which is a standard practice and would be included in removal action planning. Negotiations are not expected to be difficult with Babbitt Ranches or other landowners concerning potential offsite soil borrow sources.

The entity responsible for the long-term surveillance plan would maintain various plans and conduct periodic inspections and reviews, including:

- A stormwater pollution prevention plan implemented by Babbitt Ranches (to verify that site restoration is protective of surface water quality)
- A long-term surveillance plan implemented after waste consolidation area cap construction and overseen by Babbitt Ranches; CO Bar, Inc.; BLM; and USEPA

LUCs for waste placed in the waste consolidation areas would require coordination with Babbitt Ranches; CO Bar, Inc.; and BLM.

State and Community Acceptance – Acceptance by Babbitt Ranches; CO Bar, Inc.; BLM; the State of Arizona; the community; and other stakeholders will be addressed in the final EE/CA report and action memorandum after stakeholder comments have been received on the draft EE/CA.

4.3.2.3 Costs

The cost rating for Alternative 2 is **Good**. Overall, Alternative 2 has the lowest costs of all the alternatives (besides Alternative 1) primarily because of lower transportation and disposal costs than offsite disposal (Alternative 4).

The total NPV for consolidating and capping on site of 14,711 cubic yards of waste is $3.6 million. This includes capital costs of $3.5 million, NPV 10-year SI and maintenance of $78,000, and NPV 30-year onsite cap maintenance of $95,000. Site operation and maintenance costs reflect annual activities for the first 10 years and then one maintenance operation every 10 years for 30 years thereafter. Activities include:

- SI
- Travel and lodging for inspection and maintenance crews
- Mobilization and demobilization of crew and equipment
- Rental and labor for excavators, front-end loaders, and articulated dump trucks
- Hydroseed and mulch materials
- Range fencing repair
- Riprap material and hauling

A breakdown of the major cost categories associated with implementing Alternative 2 is presented in Exhibit 11. Detailed cost estimates are provided in Appendix D in Table D-7 with underlying assumptions shown in detail in Table D-5.

Exhibit 11. Alternative 2 Cost Breakdown

Component	Section 9 Lease Mines Totals	
Excavated Surface Area (SF)	283,000	
Excavated Volume (LCY)	15,000	
Capital Costs		
Access Road Construction	$	74,000
Waste Excavation and Hauling	$	258,000
Site and Road Restoration	$	315,000
Onsite Consolidation and Cap Construction	$	1,467,000
Subtotal Construction	**$**	**2,113,000**
Non-Construction	$	1,338,000
Total Capital Costs	**$**	**3,451,000**
NPV Costs (3.5% discount rate)[1]		
Capital Costs	$	3,451,000

Component	Section 9 Lease Mines Totals
10-Year Site Inspection	$ 28,000
10-Year Maintenance	$ 50,000
30-Year Onsite Cap	$ 95,000
Total NPV Costs	**$ 3,623,000**

Notes:

1 Present worth analysis produces a single figure representing the amount of money that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the alternative. For projects of less than 1 year (generally, projects that do not require O&M), the present worth is simply the one-time cost of performing the action.

LCY Loose cubic yard
NPV Net present value
O&M Operation and maintenance
SF Square foot

4.3.3 Alternative 3: Disposal of All Mine Waste at a Western AUM Regional Repository

Alternative 3 involves the excavation and consolidation of mine waste and contaminated soil into a regional waste repository.

4.3.3.1 Effectiveness

The effectiveness rating for Alternative 3 is **Good** based on the following discussion.

Overall Protection of Public Health and the Environment (Rating: Protective) – Alternative 3 is protective because soil and mine waste containing radionuclide and metal COCs and COECs will be excavated, transported, and consolidated and capped at the regional repository. The potential for direct contact, ingestion, inhalation, and external irradiation of human and ecological receptors will be eliminated where waste has been contained. Maintenance of the cap will prevent long-term risk to human and ecological receptors. Alternative 3 will be protective of public health and the environment.

Compliance with ARARs (Rating: In Compliance) – Federal and state ARARs identified in Table 7 would be met under Alternative 3.

Short-Term Effectiveness (Rating: Good) – The short-term impacts to the community, workers, and environment under Alternative 3 are described below.

- **Protection of the Community during Removal Action –** No communities exist at or near the site and excavation, waste consolidation, waste compaction, and capping of the waste would occur at the regional repository and away from the nearest potentially affected communities of Cameron (10 miles) and Gray Mountain (8 miles). Trucks hauling equipment and supplies would add incremental noise. However, the access roads and Indian Route 6728 do not pass through populated areas. U.S. Route 89 passes through the communities of Cameron, Grey Mountain, and Flagstaff, but the anticipated truck volume and cycle time would not be detected over normal traffic. The regional repository is located adjacent to the site; therefore, no waste would be hauled on public roads.

Alternative 3, therefore, has low potential impact to the community from construction activity or traffic. Statistically, the incremental on-highway construction traffic related to the project would result in 0.001 deaths and 0.033 accidents (based on 68,500 miles). Risks to the community remain low because waste hauling between the mine sites and regional repository is only on unpaved haul roads rather than on the highway.

- **Protection of Workers** – Short-term risks of physical injury would exist for site workers under Alternative 3 during construction primarily related to operating equipment during access road construction, waste excavation, site restoration, and waste consolidation area and cap construction. Worker commuter miles are estimated at 47,600 miles.

  Short-term impacts to air quality in the surrounding environment may occur during excavation and loading of waste for transfer to the onsite consolidation area. However, exposures to workers would be within acceptable safe limits because of dust suppression and air monitoring.

  Worker exposure to radiation and contaminants would be maintained within allowable levels with health and safety measures described in Section 4.2.1.

- **Environmental Impacts** – Short-term environmental impacts that could occur from the excavation and consolidation and capping of waste on site are estimated to be low. These environmental impacts may include sedimentation of local drainages, residual track-in and track-out effects of soil and mud, noise, disturbed vegetation, and dust generation. Disturbance of the potential riparian area in the eastern portion of AUM 457 could adversely impact the ecosystem, but the size of the riparian area is small and, therefore, the impact of its potential loss to the surrounding ecosystem is also small. Fuel use and resultant emissions and climate impacts would be relatively low because no offsite hauling would be required. The overall threat to the environment is low because the waste rock could be consolidated and capped on site within one to two field seasons. In addition, revegetation would expedite the return of native flora once cleanup actions are complete. However, revegetation may not occur immediately.

  The short-term threat posed by ecological exposure to uranium and radionuclides would be minimal and result in reduced long-term impacts through waste consolidation and isolation. Green remediation considerations are discussed below.

- **Greener Cleanups Analysis** – This analysis determined the mass of different emissions, including greenhouse gases, nitrogen oxides, sulfur oxides, particulate matter, and listed air pollutants, generated by different construction activities. For all categories, Alternative 3 was assessed as having a **small** environmental footprint.

  - *Energy and Emissions* – Alternative 3 has a **medium** energy and emissions footprint because all waste hauling would occur locally for consolidation.

  - *Water Resources* – Alternative 3 requires use of imported water or installation of a water supply well for waste compaction and dust control during excavation, loading, backfilling, and grading on local access roads. Overall, because of the small construction area and minimal waste hauling, Alternative 3 would have a **small** water resource footprint. The amount of water required during the construction phase of the project is estimated at 643,000 gallons.

- *Materials Management* – Alternative 3 requires import of rock for onsite drainage stabilization and sediment detention basin construction, as well as import of clayey soil and gravel for cap construction. Borrow soil for site restoration and the cap construction will be from a nearby repository location. No waste would leave the site. Alternative 3 would have a **medium** material management footprint because of the longer transport distance, **medium** regional repository waste consolidation area, and limited quantity of imported materials.
- *Land Management and Ecosystems Protection* – Alternative 3 has a **small** footprint because future land use would be only partially limited by the areas where the removal of waste will occur. Land use at the site would not likely be limited in the long term after restoration. Use of geomorphic grading for the waste removal areas and site restoration would minimize visual impacts. Disturbance of the potential riparian area in the eastern portion of AUM 457 could adversely impact the ecosystem, but the size, health, and contribution of the potential riparian area to the ecosystem is low. Waste removal and drainage channel restoration will provide a positive ecosystem impact.

- **Time Until Removal Action Objectives Are Achieved** – Waste excavation, transportation, and consolidation at the regional repository would meet preliminary RAOs in the short term. The construction time required to achieve preliminary RAOs for Alternative 3 would be several months at the site with intermittent maintenance afterwards. Construction may be extended depending on schedule-limiting factors such as monsoon rains and snowfall.

Long-Term Effectiveness and Permanence (after Removal Action) (Rating: Very Good) – Alternative 3 would safely and reliably contain all waste at the regional repository under an ET cap, and RAOs would be achieved at all contaminated areas at the site. Although the regional repository with ET cap is expected to be fully protective in the short and long term, the cap would require long-term inspection and maintenance.

Over the long term, accidents and fatalities could result from SIs and long-term maintenance of the capped waste at the regional repository but would be consistent with typical inspection and maintenance crews anywhere. Although the cost estimate is limited to 30 years of activities, long-term maintenance for Alternative 3 would be in perpetuity. However, the intensity of the maintenance regime is expected to have **low** long-term energy and greenhouse gas footprints from fuel consumption and emissions. Statistically, the incremental on-highway construction traffic related to long-term maintenance of the project would result in 0.001 deaths and 0.033 accidents (based on 68,500 miles).

LUCs would be necessary to limit access to and disturbance of waste removal footprints during restoration. A long-term surveillance plan would be implemented after construction to ensure compliance with LUCs and cover integrity.

Alternative 3 would not require replacement of components because their lifespan is indefinite under an inspection and maintenance regime as described above. Force majeure events, such as earthquakes, climate change, or large floods, could impact the response action, but design criteria for the removal action would take these into account to the extent practicable. Alternative 3 provides protection from force majeure events by capping the waste 1.0 mile away from the LCR (compared with 0.10 mile away for AUM 457 and 0.5 mile away for AUM 458 under Alternative 2).

The Alternative 3 waste consolidation location has abundant space for the storage volume of waste with abundant nearby borrow, which would increase long-term effectiveness and design flexibility.

Finally, the uncertainties of capping waste at the regional repository under Alternative 3 are considered low and the effectiveness good because of the stable nature of the waste, design of waste consolidation areas and ET caps, use of conventional materials and methods, and long track record of capped waste consolidation areas as an accepted response action. Capping waste is standard practice for landfills and mine sites.

Reduction of Toxicity, Mobility, or Volume through Treatment (Rating: Not Applicable) – Alternative 3 employs no treatment, so no reductions in toxicity, mobility, or volume through active treatment would occur.

4.3.3.2 Implementability

The implementability rating for Alternative 3 is **Good** based on the following discussion.

Technical Feasibility and Availability of Services and Materials (Rating: Good) – Alternative 3 consists of earthwork and material consolidation and capping. The equipment required for the work is readily available and consists of conventional and specialty excavators, scrapers, loaders, crushing and screening plants for borrow materials, and articulated haul trucks.

Construction and environmental monitoring equipment and services are all readily available. Although somewhat distant, labor and equipment would be available in the regional Cameron and Flagstaff markets. A sufficient volume of water for onsite dust suppression and waste and cap compaction may be obtained by importing from the Flagstaff area. Drought considerations may require alternate methods of dust control such as binders, gravel cover, or pavement.

Sources of local borrow material can easily be developed to meet the needs for fill, topsoil, clayey soil, and gravel for capping options under all potential cap designs and for site restoration after excavation. Riprap would be imported from Flagstaff to meet engineering specifications for armoring drainage channels. Alternate materials such as local volcanic materials would be evaluated to potentially reduce delivered riprap pricing.

The expertise and equipment needed for long-term monitoring and maintenance of the regional repository, erosional features and controls, and revegetation are and will be available. Alternative 3 would not require replacement of components because their lifespan is indefinite (at least 200 years per design requirements) under an inspection and maintenance regime as described above.

Administrative Feasibility (Rating: Good) – Alternative 3 is administratively implementable and would require coordination between USEPA; State of Arizona; Babbitt Ranches; CO Bar, Inc.; and BLM. While such coordination and agreements take time, no difficulties are expected.

Federal and state permits for onsite actions under CERCLA and the proposed onsite waste consolidation area and cap are not required because this is an onsite location in a mining-disturbed area. Environmental reviews may be required from Arizona, which is a standard practice and would be included in removal action planning. Negotiations are not expected to be difficult with Babbitt Ranches or other landowners concerning potential offsite soil borrow sources.

The entity responsible for the long-term surveillance plan would maintain various plans and conduct periodic inspections and reviews, including:

- A stormwater pollution prevention plan implemented by Babbitt Ranches (to verify that site restoration is protective of surface water quality)
- A long-term surveillance plan implemented after waste consolidation area cap construction and overseen by Babbitt Ranches; CO Bar, Inc.; BLM; and USEPA

LUCs for waste placed in the waste consolidation areas would require coordination with Babbitt Ranches; CO Bar, Inc.; and BLM.

State Acceptance and **Community Acceptance** – Acceptance by Babbitt Ranches; CO Bar, Inc.; BLM; the State of Arizona; the community; and other stakeholders will be addressed in the final EE/CA report and action memorandum after stakeholder comments have been received on the draft EE/CA.

4.3.3.3 Costs

The cost rating for Alternative 3 is **Good**. Overall, Alternative 3 has the third lowest costs of all the alternatives (besides Alternative 1) primarily because of lower transportation and disposal costs than offsite disposal (Alternative 4).

The total NPV for consolidating and capping on site of 14,711 cubic yards of waste is $4.0 million. This includes capital costs of $3.8 million, NPV 10-year SI and maintenance of $101,000, and NPV 30-year onsite cap maintenance of $95,000. Site operation and maintenance costs reflect annual activities for the first 10 years and then one maintenance operation every 10 years for 30 years thereafter. Activities include:

- SI
- Travel and lodging for inspection and maintenance crews
- Mobilization and demobilization of crew and equipment
- Rental and labor for excavators, front-end loaders, and articulated dump trucks

- Hydroseed and mulch materials
- Range fencing repair
- Riprap material and hauling

A breakdown of the major cost categories associated with implementing Alternative 3 is presented in Exhibit 12. Detailed cost estimates are provided in Appendix D in Table D-13 with underlying assumptions shown in detail in Table D-11.

4.3.4 Alternative 4: Disposal of All Mine Waste in Offsite Resource Conservation and Recovery Act-Licensed Facility

Alternative 4 involves the excavation of mine waste and contaminated soil and transport and disposal of waste at an LLRW-licensed or RCRA C-licensed facility. Clive Operations currently has the appropriate licensing, bonding, and CERCLA Off-Site Rule approvals.

4.3.4.1 Effectiveness

The effectiveness rating for Alternative 4 is **Average** based on the following discussion.

Overall Protection of Public Health and the Environment (Rating: Protective) – Under Alternative 4, overall protectiveness is achieved because soil and mine waste that contain radionuclide and metal COCs and COECs would be disposed of at an offsite hazardous waste disposal facility. Therefore, potential direct contact, ingestion, inhalation, and external irradiation by human and ecological receptors would be eliminated where waste has been removed. Alternative 4 would be protective of public health and the environment.

Compliance with ARARs (Rating: In Compliance) – Federal and state ARARs identified in Table 7 would be met under Alternative 4.

Exhibit 12. Alternative 3 Cost Breakdown

Component	Section 9 Lease Mines Totals	
Excavated Surface Area (SF)	268,000	
Excavated Volume (LCY)	15,000	
Capital Costs		
Access Road Construction	$	109,000
Waste Excavation and Hauling	$	347,000
Site and Road Restoration	$	415,000
Onsite Consolidation and Cap Construction	$	1,466,000
Subtotal Construction	**$**	**2,337,000**
Non-Construction	$	1,484,000
Total Capital Costs	**$**	**3,821,000**
NPV Costs (3.5% discount rate)[1]		
Capital Costs	$	3,821,000
10-Year Site Inspection	$	37,000

Component	Section 9 Lease Mines Totals
10-Year Maintenance	$ 65,000
30-Year Onsite Cap	$ 95,000
Total NPV Costs	**$ 4,018,000**

Notes:

1 Present worth analysis produces a single figure representing the amount of money that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the alternative. For projects less than 1 year (generally, projects that do not require O&M), the present worth is simply the one-time cost of performing the action.

LCY Loose cubic yard
NPV Net present value
O&M Operation and maintenance
SF Square foot

Short-Term Effectiveness (Rating: Poor) – Alternative 4 involves excavation of all waste for offsite disposal at a RCRA-licensed facility. The short-term impacts to the community, workers, and environment under Alternative 4 are described below.

- **Protection of the Community** – The increased truck traffic required to haul waste offsite to the Clive Operations LLRW disposal facility would have a minimal impact on traffic safety. Trucks transporting waste material from the site on U.S. Route 89 would be indistinguishable from regular truck traffic. No communities are between the site and U.S. Route 89. The total number of round trips for trucks transporting waste to Clive, Utah, is about 2,660.

  Alternative 4 also has a low potential impact to the community from construction activity and traffic. Statistically, the incremental on-highway construction traffic related to the project would result in 0.032 deaths and 1.054 accidents (based on 2,170,000 million miles), stemming from the 515-mile on-highway travel distance between the site and the Clive Operations LLRW disposal facility. Most of the miles traveled will occur outside of the immediate community; therefore, impacts to the community are considered low. Off-road hauling between U.S. Route 89 and the site are not included in the traffic safety analysis as the public would not be impacted.

- **Protection of Workers** – Short-term risks of physical injury would exist for site workers under Alternative 4 during construction primarily related to operating equipment during access road construction, waste excavation, site restoration, loading waste into on-highway haul trucks, and long-distance transport of waste to the Clive Operations LLRW disposal facility. Short-term impacts to air quality in the surrounding environment may occur during excavation and loading of waste for transfer to the onsite consolidation area. However, exposures to workers would be within acceptable safe limits because of dust suppression and air monitoring. Because at least half of the statistical risk of injury or death from on-highway truck traffic would be experienced by the truck drivers, the short-term risk to workers from on-highway hauling would be medium when compared to Alternatives 2 and 3. However, when compared to the routine risks of truck drivers, workers experience no incremental additional risk. Worker commuter miles are estimated at 60,000 miles.

- **Environmental Impacts** – Short-term environmental impacts that could occur from the excavation, hauling, and offsite disposal of waste are estimated to be medium. Under

Alternative 4, the impacts would be similar to Alternatives 2 and 3 (consolidate and cap on site) but with significant fuel use, noise, and emissions from haul truck traffic off site. Fuel consumption and greenhouse gas emissions would be large. Disturbance of the potential riparian area in the eastern portion of AUM 457 could adversely impact the ecosystem, but the size, health, and contribution of the potential riparian area to the ecosystem is low. Similar to Alternatives 2 and 3, the threat to the local environment is moderate because of the longer project duration (11 months) associated with offsite hauling.

- **Greener Cleanups Analysis –** This analysis determined the mass of different emissions, including greenhouse gases, nitrogen oxides, sulfur oxides, particulate matter, and listed air pollutants, generated by different construction activities. For all categories, Alternative 4 was assessed as having a **very large** environmental footprint.

  - *Energy and Emissions* – Alternative 4 has a **very large** short-term energy and emissions footprint because all waste will be hauled 515 miles to the LLRW facility in Clive, Utah, for disposal.
  - *Water Resources* – Alternative 4 does not involve consolidation area construction and would not require water for waste compaction. Alternative 4 requires use of imported water or installation of a water supply well for dust control during excavation, loading, backfilling, grading, and hauling on haul roads. Overall, because of the volume of waste, Alternative 4 would have a **medium** water resource footprint. The estimated amount of water for the project construction phase is estimated at 1,296,000 gallons.
  - *Materials Management* – Alternative 4 requires hauling waste from the site and import of rock for onsite drainage stabilization. Borrow soil for site restoration will be from nearby the mine sites. Alternative 4 would have a **large** material management footprint from both onsite waste removal and offsite waste hauling.
  - *Land Management and Ecosystems Protection* – Alternative 4 has a **small** footprint because of negative ecosystem impacts. Excavation of contaminated material, including disturbance of the potential small riparian area in the eastern portion of AUM 457, is not likely to adversely impact the ecosystem. Use of geomorphic grading for site restoration would minimize visual impacts. Land use would not be limited in the long term after has been restored under CERCLA LUCs. However, elevated concentrations of NORM will remain on site. Waste removal and drainage channel restoration will provide a positive ecosystem impact.

- **Time Until Removal Action Objectives Are Achieved –** Excavation, offsite hauling, and disposal of waste at the Clive Operations LLRW disposal facility would meet preliminary RAOs in the short term. The construction time required to achieve preliminary RAOs for Alternative 4 would be two to three field seasons because of the 3-day truck cycle time between the site and the waste disposal facility. Construction may be extended depending on schedule-limiting factors such as truck availability, monsoon rains, and snowfall.

Long-Term Effectiveness and Permanence (after Removal Action) (Rating: Very Good) – Alternative 4 would safely and reliably contain all waste off site in a RCRA-licensed disposal facility, and RAOs would likely be achieved at all areas at the site. Although the RCRA-licensed disposal facility is expected to be fully protective in the short and long term, the facility will require long-term inspection and maintenance by the operators.

Minimal maintenance of restored areas is required for Alternative 4. Therefore, Alternative 4 has a substantial advantage over onsite actions, which would require cap inspections and maintenance.

LUCs would be necessary to limit access to and disturbance of during restoration. For the areas at where all waste will be removed, short-term monitoring and repair of revegetation and erosion controls would also be required for up to 10 years.

Because no waste would remain on site, force majeure events, such as earthquakes, climate change, or large floods, that could impact waste left in place do not need to be considered.

Finally, the uncertainties of disposing of waste off site under Alternative 4 are considered low because of the use of conventional materials and methods and the long track record of hazardous waste disposal facilities as an accepted response action.

Reduction of Toxicity, Mobility, or Volume through Treatment (Rating: Not Applicable) – Alternative 4 employs no treatment, so no reductions in toxicity, mobility, or volume through active treatment would occur.

4.3.4.2 Implementability

The implementability rating for Alternative 4 is **Good** based on the following discussion.

Technical Feasibility and Availability of Services and Materials (Rating: Good) – Similar to Alternatives 2 and 3, this alternative consists of earthwork and material consolidation. Offsite and on-highway hauling are also required. Construction equipment requirements are the same. Offsite disposal is less complicated than consolidation and capping onsite.

Equipment, services, and labor market availability are the same as Alternatives 2 and 3. Sources and availability of borrow materials, including riprap, are the same as Alternatives 2 and 3. Alternate materials such as local volcanic materials should be evaluated to potentially reduce delivered riprap pricing. The local trucking market is difficult to predict. This EE/CA estimates a fleet of 20 trucks servicing the site with a 1,030-mile round-trip distance. Each truck can complete the round trip in about 3 days.

Long-term monitoring and maintenance would not be required; however, short-term maintenance of erosional controls and revegetation efforts for removal area restorations would be required.

Administrative Feasibility (Rating: Good) – Similar to Alternatives 2 and 3, this alternative is administratively implementable and would require coordination between USEPA; Babbitt Ranches; CO Bar, Inc.; and BLM. While such coordination and agreements take time, no difficulties are expected.

As previously discussed, federal and state permits for onsite actions under CERCLA are not required. Environmental reviews may be required from Arizona, which would be included in removal action planning. Since waste would be disposed of offsite, Arizona and Utah Department of Transportation requirements and permits for hauling radioactive waste would be applicable but easily attainable and complied with. The Clive Operations LLRW disposal facility is currently in compliance with its operating permit and the CERCLA Off-Site Rule.

Long-term surveillance would not be required as no waste would remain on site. No LUCs would be required. Babbitt Ranches and CO Bar, Inc. would oversee stormwater pollution prevention plan periodic inspections during site restoration.

State Acceptance – Acceptance by Arizona and supporting agencies is an additional criterion that will be addressed in the final EE/CA report and action memorandum after stakeholder comments have been received on the draft EE/CA.

State and Community Acceptance –Acceptance by Babbitt Ranches; CO Bar, Inc.; BLM; the State of Arizona; the community; and other stakeholders will be addressed in the final EE/CA report and action memorandum after stakeholder comments have been received on the draft EE/CA.

4.3.4.3 Costs

The cost rating for Alternative 4 is **Very Poor**. Overall, Alternative 4 has the highest costs of all the alternatives because of the high cost of hauling waste long distance off site to the Clive Operations LLRW disposal facility in Clive, Utah. Transportation and tipping costs for the Clive Operations LLRW disposal facility are based on costs of $424 per ton and $636 per band cubic yard. Cost use conversion factors of 1.5 tons per bank cubic yard and 1.25 loose cubic yards per bank cubic yard were used in the costs determination.

The total NPV for the transportation and offsite disposal of approximately 18,500 cubic yards of waste at the Clive Operations LLRW disposal facility in Clive, Utah, is $12.8 million. This includes a capital cost of $12.7 million and NPV 10-year SIs and maintenance of $78,000. A breakdown of the major cost categories associated with implementing Alternative 4 is presented in Exhibit 13. Detailed cost estimates are provided in Appendix D in Table D-19 with detailed underlying assumptions shown in Table D-17.

Exhibit 13. Alternative 4 Cost Breakdown

Cost Component	Section 9 Lease Mines Totals	
Excavated Surface Area (SF)	283,000	
Excavated Volume (LCY)	15,000	
Capital Costs		
Access Road Construction	$	74,000
Waste Excavation and Loading	$	1,049,000
Site and Road Restoration	$	249,000
Waste Hauling to LLRW Facility	$	2,975,000

Cost Component	Section 9 Lease Mines Totals	
Disposal at LLRW Facility	$	6,431,000
Subtotal Construction	**$**	**10,779,000**
Non-Construction	$	1,898,000
Total Capital Costs	**$**	**12,676,000**
NPV Costs (3.5% discount rate)[1]		
Capital Costs	$	12,676,000
10-Year Site Inspection	$	28,000
10-Year Maintenance	$	50,000
Total NPV Costs	**$**	**12,754,000**

Notes:

1 Present worth analysis produces a single figure representing the amount of money that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the alternative. For projects less than 1 year (generally, projects that do not require O&M), the present worth is simply the one-time cost of performing the action.

LCY Loose cubic yard
LLRW Low-level radioactive waste
NPV Net present value
O&M Operation and maintenance
SF Square foot

5.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section presents the approach for the comparative analysis of alternatives and a summary of the analysis. The comparative analysis includes evaluation of the relative effectiveness, implementability, and cost between alternatives.

5.1 COMPARATIVE ANALYSIS APPROACH

The final step of the EE/CA is to conduct a comparative analysis of the removal action alternatives. This analysis discusses each alternative's strengths and weaknesses relative to the other alternatives with respect to the three criteria and in achieving RAOs. An explanation of the evaluation and ranking criteria is presented in Section 4.3.

5.2 SUMMARY OF ANALYSIS

All alternatives except Alternative 1 meet the threshold criterion of protectiveness of public health and the environment. Exhibit 14 summarizes the comparative rating of alternatives.

5.2.1 Effectiveness

Effectiveness comprises two threshold criteria—protectiveness and compliance with ARARs—and includes short-term effectiveness (during removal action) and long-term effectiveness and permanence (after removal action). Overall effectiveness ratings are shown in Exhibit 14. Individual criteria and ratings contributing to the overall ratings are discussed in the following subsections.

5.2.1.1 Overall Protectiveness of Human Health and the Environment

All alternatives except Alternative 1 are protective of public health and the environment.

5.2.1.2 Compliance with ARARs

All action alternatives would be performed in compliance with the federal and state ARARs identified in Table 7.

5.2.1.3 Short-Term Effectiveness (during Removal Action)

Short-term effectiveness comprises four criteria: protection of the community, protection of workers, environmental impacts, and time to meet RAOs. Overall short-term effectiveness is rated higher for Alternative 2 and 3, than for Alternative 4.

Exhibit 14. Analysis of Alternatives for the Section 9 Lease Mines

Alternative		Threshold Criteria		Effectiveness		Implementability		Cost Rating[a]
		Protective of Human Health and the Environment	Compliance with ARARs	Short Term (during Action)	Long Term (after Action)	Technical Feasibility/ Availability of Services and Materials	Administrative Feasibility	2024 Million Dollars
1	No Action	Not Protective	Not Compliant	Not Compliant	Not Compliant	Not Compliant	Not Compliant	Not Compliant
2	Consolidate and Cap All Waste Onsite	Protective	In Compliance	**Good**	Average	**Good**	**Good**	**Good $3.6 M**
3	Disposal of All Mine Waste at a Western AUM Regional Repository	Protective	In Compliance	**Good**	**Very Good**	**Good**	**Good**	Good $4 M
4	Disposal of All Mine Waste in Offsite RCRA-Licensed Facility	Protective	In Compliance	Poor	**Very Good**	**Good**	**Good**	Very Poor $12.8 M

Notes:
Bold indicates the highest rating in the category.
[a] Estimated costs are net present value.
ARAR Applicable or relevant and appropriate requirement
RCRA Resource Conservation and Recovery Act

Protection of the Community

Alternatives 2 and 3 create the least traffic and dust impacts to the community as truck traffic would only be increased on the main access road to transport equipment and construction materials for onsite area construction. Alternatives 2 and 3 would require about 630 truck trips. No excavated waste would be hauled through the community. Dust impacts would be limited to site construction and the dirt haul road to the onsite waste consolidation areas with no impacts to the community.

Alternative 4 (offsite RCRA-licensed facility disposal) has the highest impact on local and regional traffic, largest increase in haul truck emissions, and largest increase in potential traffic accidents and fatalities. Excavated waste would be hauled on local and state highways to an offsite disposal facility located 515 miles away, resulting in the highest miles traveled. Alternative 4 has much higher impacts to the community than Alternatives 2 and 3 because of the 2,660 truck trips to haul waste.

Protection of Workers

Worker protection primarily involves radiation exposure, dust inhalation hazards, physical injury, and traffic accidents. All action alternatives would involve the same degree of excavation work; therefore, all action alternatives have equal amounts of potential radiation exposure, potential dust inhalation hazards, and potential for injury to workers. However, Alternatives 2 and 3 involve construction of waste consolidation areas, which introduces an additional level of threat to workers because of additional handling activities and duration of exposure during consolidation and capping. Alternative 4 involves higher volumes because of the intermediate steps to load haul trucks from consolidation stockpiles; under Alternative 2 and 3, this step is unnecessary. Also, an additional 5 acres (comprising the repository sites in AUMs 457 and 458) are excavated and restored under Alternatives 3 and 4, but not under Alternative 2.

Even though Alternatives 2 and 3 pose an additional hazard associated with the handling of and exposure to waste during consolidation and capping on site, the long-haul distances for offsite disposal (presented in Alternative 4) pose the greatest accident threat to truck drivers. Therefore, Alternative 4 with a 515-mile haul distance poses a much higher risk to workers than Alternatives 2 or 3. Alternative 1 poses no risk to workers as no removal activities would occur that could impact workers.

Environmental Impacts

All alternatives involve the excavation of waste and substantial site disturbance. Shorter haul distances and construction durations for Alternatives 2 and 3 minimize the potential for construction-related environmental impacts to both on public roads and off road and in the construction areas that would require mitigation compared to Alternative 4. These impacts may include residual track-out effects of soil and mud, noise, nuisance, and soil spills during waste hauling; excavation in and sedimentation of local drainages; and harmful emissions. However, construction of onsite capped areas or repositories (Alternatives 2 and 3) would increase the amount of construction activities and, therefore, increase environmental impacts. Offsite disposal (Alternative 4) would increase fuel consumption and greenhouse gas emissions. The long-term maintenance required for cap maintenance is expected to have an increased environmental impact on the Alternative 2 and 3 footprints. Long-term maintenance of closure systems now or in the future at Clive Operations (Alternative 4) are external to this EE/CA.

Water import or installation of a water supply well would also have an environmental impact depending on the water source, import distance, and volume required for dust control and waste compaction. Onsite consolidation and capping under Alternatives 2 and 3 would use less water than offsite hauling because of less frequent haul road watering and shorter project duration compared to Alternative 4. An environmental footprint analysis is summarized below under greener cleanups analysis.

In summary, the short-term environmental impacts of the large haul distance under Alternative 4 are significantly larger than the impacts of waste consolidation, onsite repository construction, and 30-year repository maintenance under Alternatives 2 and 3.

Greener Cleanups Analysis. A qualitative environmental footprint analysis was conducted for the removal action elements common to all action alternatives. The analysis focused on the environmental footprint associated with five main categories: energy use, air pollutants and greenhouse gas emissions, water use and impacts to water resources, materials management and waste reduction, and land management and ecosystems protection.

- *Energy and Emissions.* Among the common elements applicable to all action alternatives, road construction, waste excavation, and site restoration activities resulted in a moderate amount of energy use and generated emissions. Alternative 4 has a very large footprint because of the longest offsite haul distance even after the relatively short (10-year) inspection visits for site restoration are considered. Alternatives 2 and 3 have a small energy and emissions footprint because of the short distances to the onsite waste consolidation area.
- *Water Resources.* Among the common elements applicable to all alternatives, water use is required for dust control during road work, waste excavation and loading, backfilling, and site restoration. Alternatives 2 and 3 require water for waste compaction and restoring removal areas while Alternative 4 requires water for restoring removal areas and for dust control on haul roads within the APE. Alternatives 2 and 3 require water for waste compaction and dust control. Alternatives 2, 3, and 4 would require use of imported water.
- *Materials Management.* Alternative 2 has a small materials management footprint, requiring hauling of waste locally to the onsite repository locations and import of gravel and clayey soil and use of nearby borrow soil for cap construction. Alternative 3 has a medium materials management footprint, requiring hauling of waste locally to a single location and import of gravel and clayey soil and use of nearby borrow soil for cap construction. Alternative 4 has a large materials management footprint because of the required hauling of waste off site for disposal.
- *Land Management and Ecosystems Protection.* All alternatives have a small footprint because of disturbance in drainage channels, and adjacent riparian habitat and noise and activity disturbance of potential sensitive biological species during construction. Alternative 2 and 3 have a small footprint because of the small size of the repositories

compared to the size of the AUMs and APE. Minimal loss of grazing land is expected over the long term if vegetation of the cap becomes established. Alternative 4 has a small land management and ecosystems protection footprint because all waste would be hauled off site and no land uses would be impacted.

Greener Cleanups Summary. Under all action alternatives, restoration of any disturbed drainage channels and adjacent riparian habitat could result in better ecosystem quality than exists currently. Onsite disposal and capping of waste under Alternatives 2 and 3 would not limit land uses significantly. Alternatives 2 and 3 use less water than Alternative 4. Fuel consumption and emissions generation are the driving factors when evaluating an energy and greenhouse gas footprint. Though not evaluated, Alternative 4 may have higher greenhouse gas and pollution emissions than Alternatives 2 and 3 because of higher resource use. Alternative 4 has the largest footprint of the alternatives because of the long-haul distance to the offsite disposal facility in Clive, Utah. Alternative 1 has no footprint as no removal action would be performed.

Annual inspections and maintenance of the onsite waste consolidation areas under Alternatives 2 and 3 would also result in increased cumulative fuel consumption and emissions over the long term (30 years). However, because the inspection and maintenance activities would only occur over 1 month each year, the annual environmental footprint would be small. Furthermore, these cumulative impacts would be dwarfed by the fuel consumption and emission footprint of long-distance hauling to Clive, Utah, under Alternative 4.

A summary of resource use and greener cleanups quantities is summarized in Exhibit 15.

Exhibit 15. Summary of Quantities for Resource Use and Greener Cleanups

Item	Quantity Alternative 2	Quantity Alternative 3	Quantity Alternative 4
On-highway truck travel, trips	630	630	2,660
On-highway travel (includes worker commutes), miles	67,500 (46,600)	69,000 (47,600)	2,170,000 (60,000)
Transportation-related diesel fuel, gallons	6,700	8,000	356,400
Dust control water, gallons	643,000	675,000	1,296,000
On-highway injuries	0.033	0.034	1.054
On-highway fatalities	0.001	0.001	0.032

Time until Removal Action Objectives Are Achieved

A summary of the construction completion time for each alternative is presented in Exhibit 16. The action alternatives would be completed in two or three field seasons, depending on the alternative selected and schedule-limiting factors such as truck availability, monsoon rains, and snowfall.

Exhibit 16. Construction Completion Time for Alternatives

Alternative	Construction Completion Time
Alternative 1: No Action	0 month (baseline)
Alternative 2: Consolidate and Cap All Waste Onsite	2 months
Alternative 3: Disposal of All Mine Waste at a Western AUM Regional Repository	2 months
Alternative 4: Disposal of All Mine Waste in Offsite RCRA-Licensed Facility	15 months

Note:
RCRA Resource Conservation and Recovery Act

5.2.1.4 Long-Term Effectiveness and Permanence (after Removal Action)

For all action alternatives, waste removal from or containment at source areas would reduce the magnitude of residual risk to background levels for radionuclides. Noncancer hazards would be reduced or removed, and risk to ecological receptors would be reduced or removed to levels below known effects concentrations or background levels. None of the alternatives reduce the toxicity, mobility, or volume through treatment.

Alternative 4 is effective in the long term and permanent as sources of risk would be removed and waste would be disposed of off site. The cap at the LLRW facility would eliminate exposure pathways. Alternative 4 would also allow for future use of for recreation and onsite workers. Removing waste eliminates the long-term surveillance requirements associated with onsite consolidated and capped waste under Alternatives 2 and 3.

Permanence of risk reduction for Alternatives 2 and 3 would rely on the cap and consolidation area design, construction, and maintenance to prevent future risk at the site. Replacement of consolidation area components would not be required because their lifespan is indefinite, especially under a monitoring and maintenance regime. Alternatives 2 and 3 are permanent because the capped waste would be located on flat, gentle slopes and permanence would be attained.

Alternative 3 provides greater protection against force majeure events and reduced design costs because of its location away from the LCR and its associated floodplains and drainage areas. Additionally, Alternative 3 provides increased design flexibility compared to Alternative 2 because of a larger area for capping design and repository depths.

5.2.2 Implementability

Implementability comprises two criteria: technical feasibility and availability of services and materials, and administrative feasibility. Overall implementability ratings are shown in Exhibit 14. Individual criteria and ratings contributing to the overall ratings are discussed in the following subsections.

5.2.2.1 Technical Feasibility and Availability of Services and Materials

Action alternatives consist mainly of earthwork and material hauling. The alternatives are technically feasible with labor available through the local and regional markets, as well as equipment and materials.

The action alternatives would be completed as a single phase, and no future remedial actions are anticipated. Short-term monitoring (10 years) of site restoration features will occur under all action alternatives while long-term monitoring and maintenance, particularly the inspection and repair of erosional features and controls and revegetation, would be required for the caps in Alternative 2 and the single cap in Alternative 3. Experienced contractors, construction equipment, and materials are available within the region.

Alternative 4 is technically feasible to implement as all waste is removed from the site. However, the long-distance hauling of waste in Alternative 4 involves greater effort than that in Alternative 2 or 3.

Alternatives 2 and 3 are technically feasible to implement as waste is consolidated and capped on site. Design methods, construction practices, and engineering requirements are well documented and understood. Under Alternatives 2 and 3, maintenance of the caps involves greater effort than that in Alternative 4.

In summary, no significant difference in the technical feasibility and availability of materials exists between Alternatives 2, 3, and 4.

5.2.2.2 Administrative Feasibility

Alternatives 2, 3, and 4 are comparable administratively to implement, and differences are unremarkable. The alternatives have no significant barriers.

5.2.2.3 State, Tribal, and Community Acceptance

Acceptance by the State of Arizona, BLM, communities, and other stakeholders will be addressed in the final EE/CA report after stakeholder comments have been received on the draft EE/CA.

5.2.3 Projected Costs

A summary of the NPV cost for each alternative is presented in Exhibit 17. Although the cost estimate is limited to 30 years of activities, long-term maintenance would be in perpetuity. Costs are presented as NPV, including capital, periodic maintenance costs at 10-year intervals, and periodic maintenance costs at 1-year intervals for the first 10 years. The 30-year rolling average discount rate is 3.5 percent (Office of Management and Budget 2022).

Alternative 2 and 3 costs are based on the overall costs for construction and 30-year maintenance of the onsite caps. Alternative 4 has a NPV of $11.7 million, which is 3.3 times that of Alternative 2. Alternative 4 has the highest cost because of the long hauling distance (1,030 miles round trip).

Exhibit 17. Alternative Costs and Ratings

Alternative	Cost Rating	Total Estimated NPV Cost (2024 Million Dollars)
Alternative 1: No Action	N/A	$0.0
Alternative 2: Consolidate and Cap All Waste Onsite	Good	$3.6
Alternative 3: Disposal of All Mine Waste at a Western AUM Regional Repository	Good	$4.0
Alternative 4: Disposal of All Mine Waste in Offsite RCRA-Licensed Facility	Very Poor	$12.8

Notes:
Higher cost alternatives rate lower in cost ratings, which is consistent with the rating scheme where higher is less desirable.
N/A Not applicable
NPV Net present value
RCRA Resource Conservation and Recovery Act

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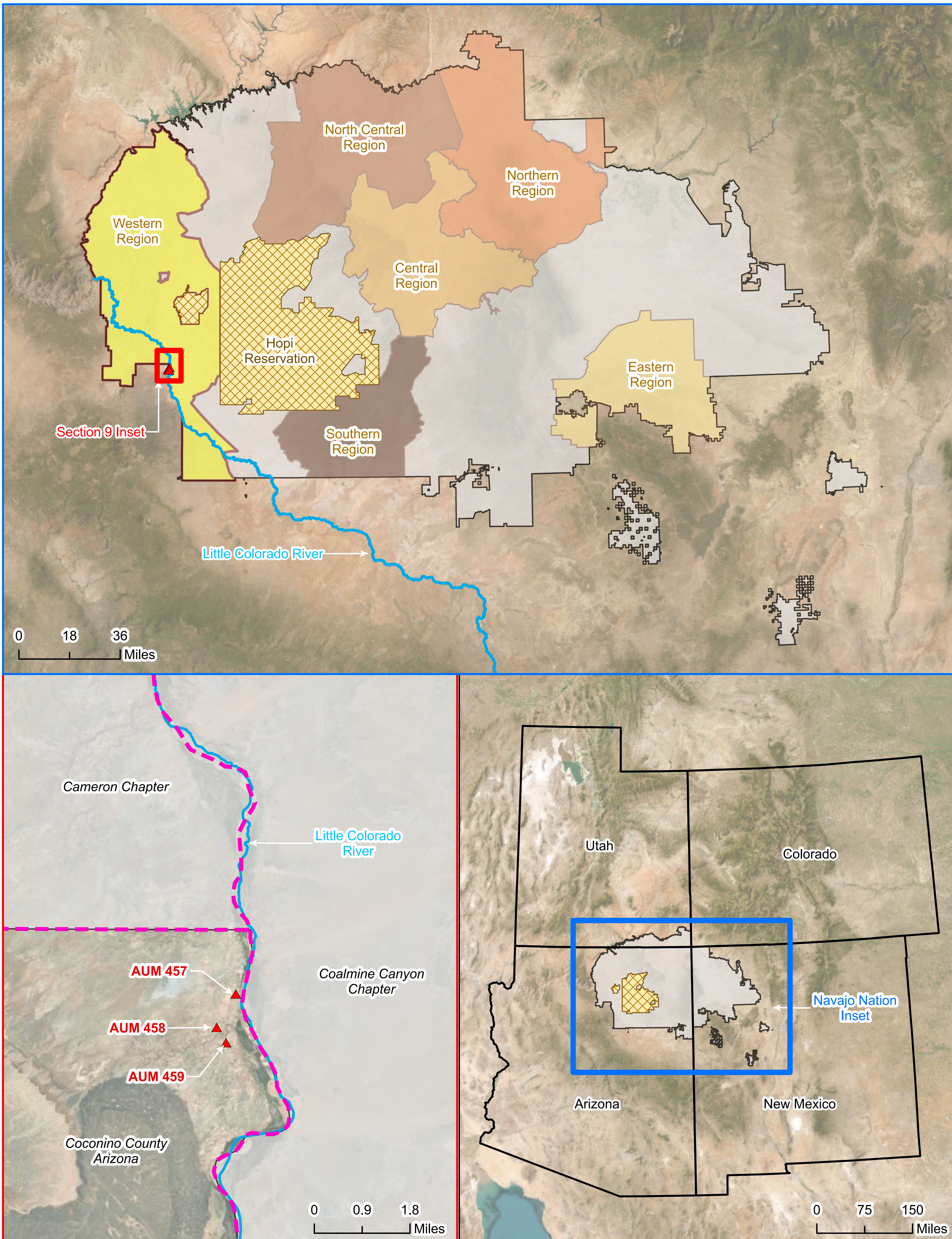
FIGURES



Section 9 Lease Mines
Little Colorado River
Chapter Boundaries
Navajo Nation
Hopi Reservation

Navajo Nation AUM Regions

Western Region
Northern Region
North Central Region
Central Region
Eastern Region
Southern Region

N
W E
S

Note:
AUM Abandoned uranium mine

Prepared for: U.S. EPA Region 9

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

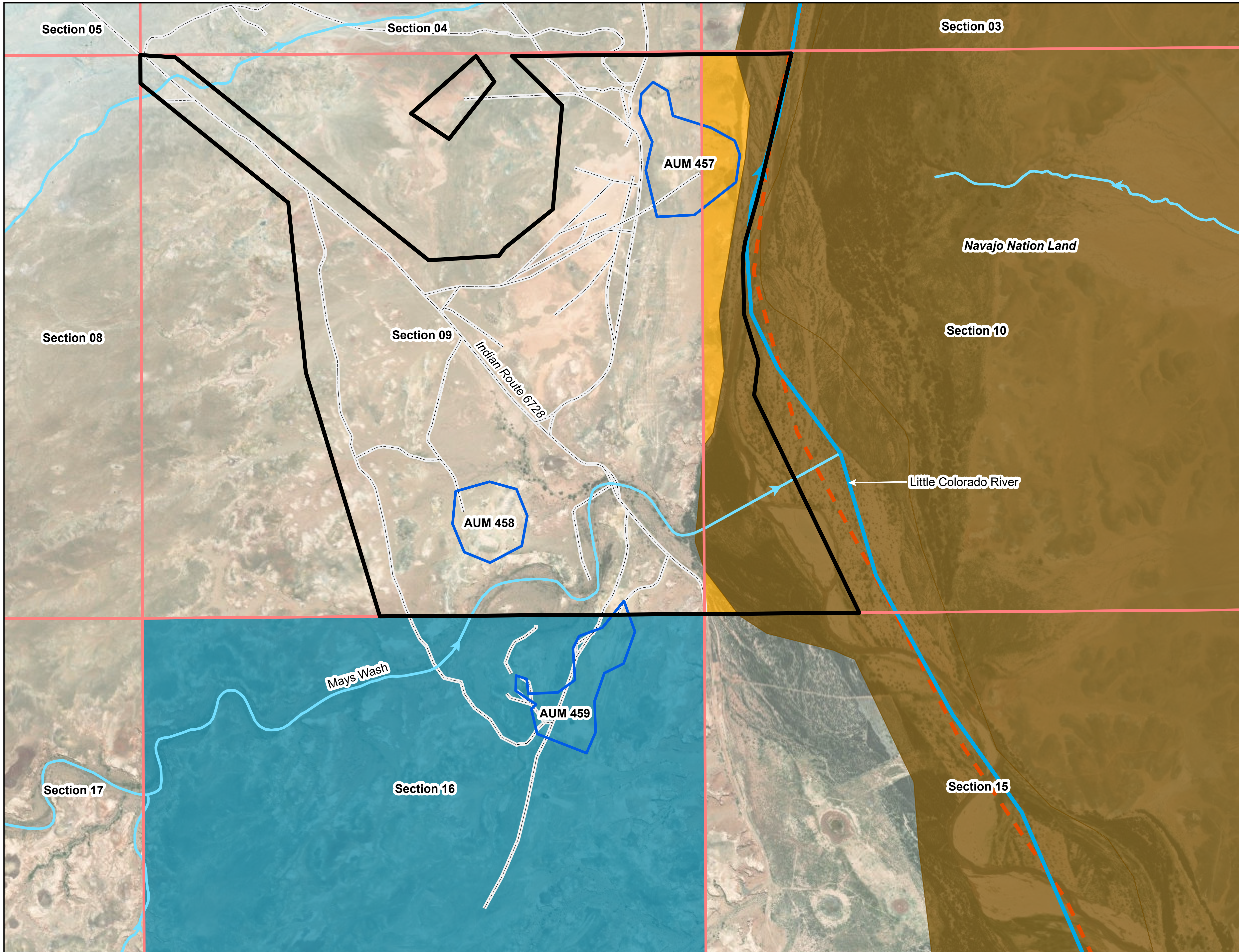
SECTION 9 LEASE MINES REGIONAL LOCATION

Prepared By:

TETRA TECH
1999 Harrison Street, Suite 500
Oakland, CA 94612

Task Order No.:	Contract No.:	Figure No.:
020	68HE0923D0002	1
Location: COCONINO COUNTY, AZ	Date: 10/8/2024	

Reference:
NAD 1983 State Plane Arizona Central FIPS 0202 Feet Transverse Mercator



AUM Boundary
APE Boundary
PLSS Section Boundary

Land Ownership Types

Bureau of Indian Affairs *Navajo Nation Land*
Bureau of Land Management
Arizona State Land
Navajo Nation Boundary
Road
Little Colorado River
Drainage

Notes:

APE	Area of potential effect
AUM	Abandoned uranium mine
PLSS	Public Land Survey System

1 inch = 900 Feet

1:10,800

N W E S

900 450 0 900 Feet

SECTION 9 LEASE MINES ABANDONED URANIUM MINE LOCATIONS

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612

Task Order No.: 020

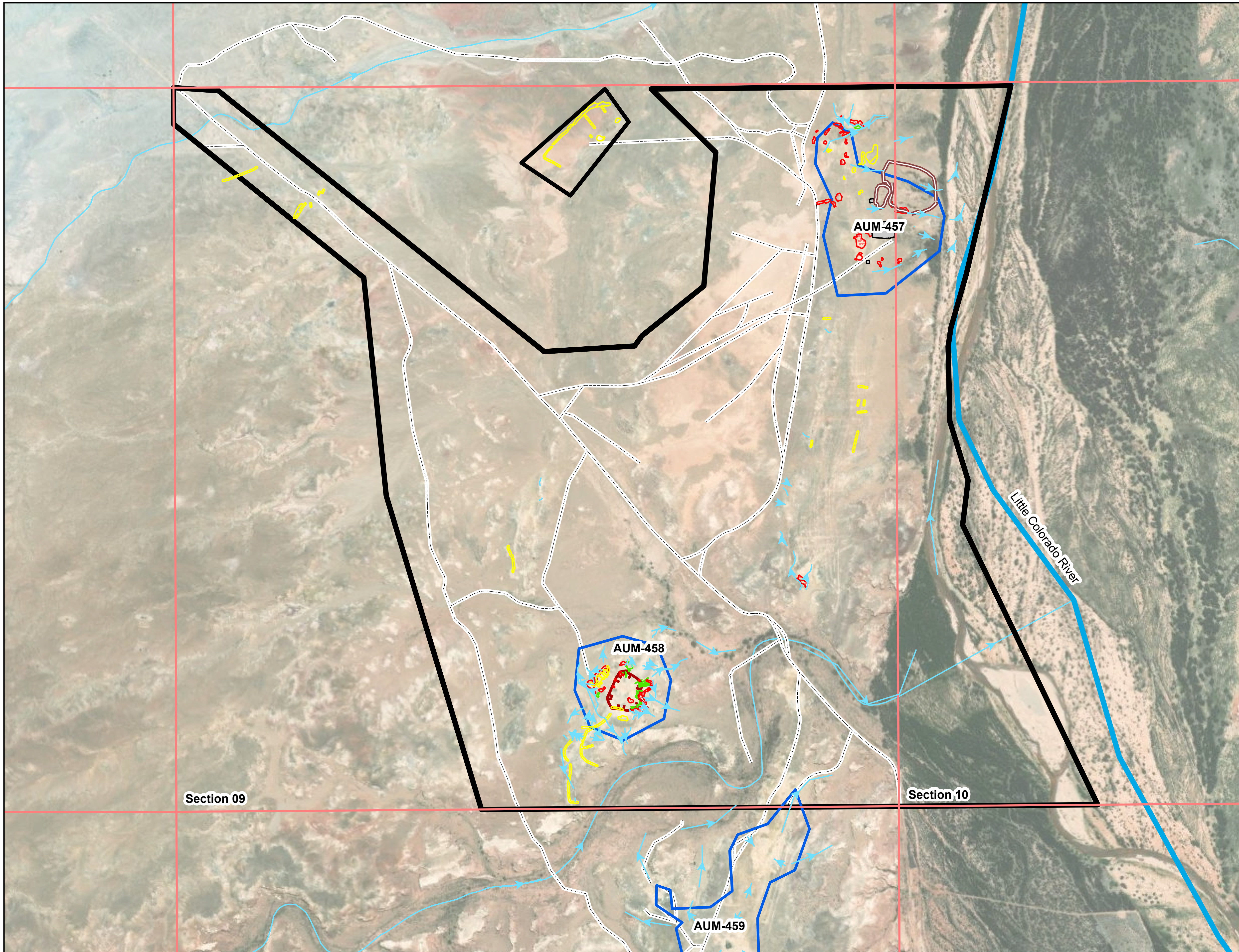
Contract No.: 68HE0923D0002

Location: COCONINO COUNTY, AZ

Date: 10/8/2024

Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator

Figure No.: 2



Site Features

- Berm
- Concrete Pad
- Dozer Cut
- Pit
- Shallow Mine Waste
- Waste Pile
- AUM Boundary
- APE Boundary
- PLSS Section Boundary
- Road
- Drainage
- Little Colorado River

Notes:

APE	Area of potential effect
AUM	Abandoned uranium mine
PLSS	Public Land Survey System

1 inch = 700 Feet

1:8,400

700 350 0 700 Feet

N S E W

SECTION 9 LEASE MINES SITE INSPECTION AND REMOVAL SITE EVALUATION FEATURES

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612

Task Order No.: 020

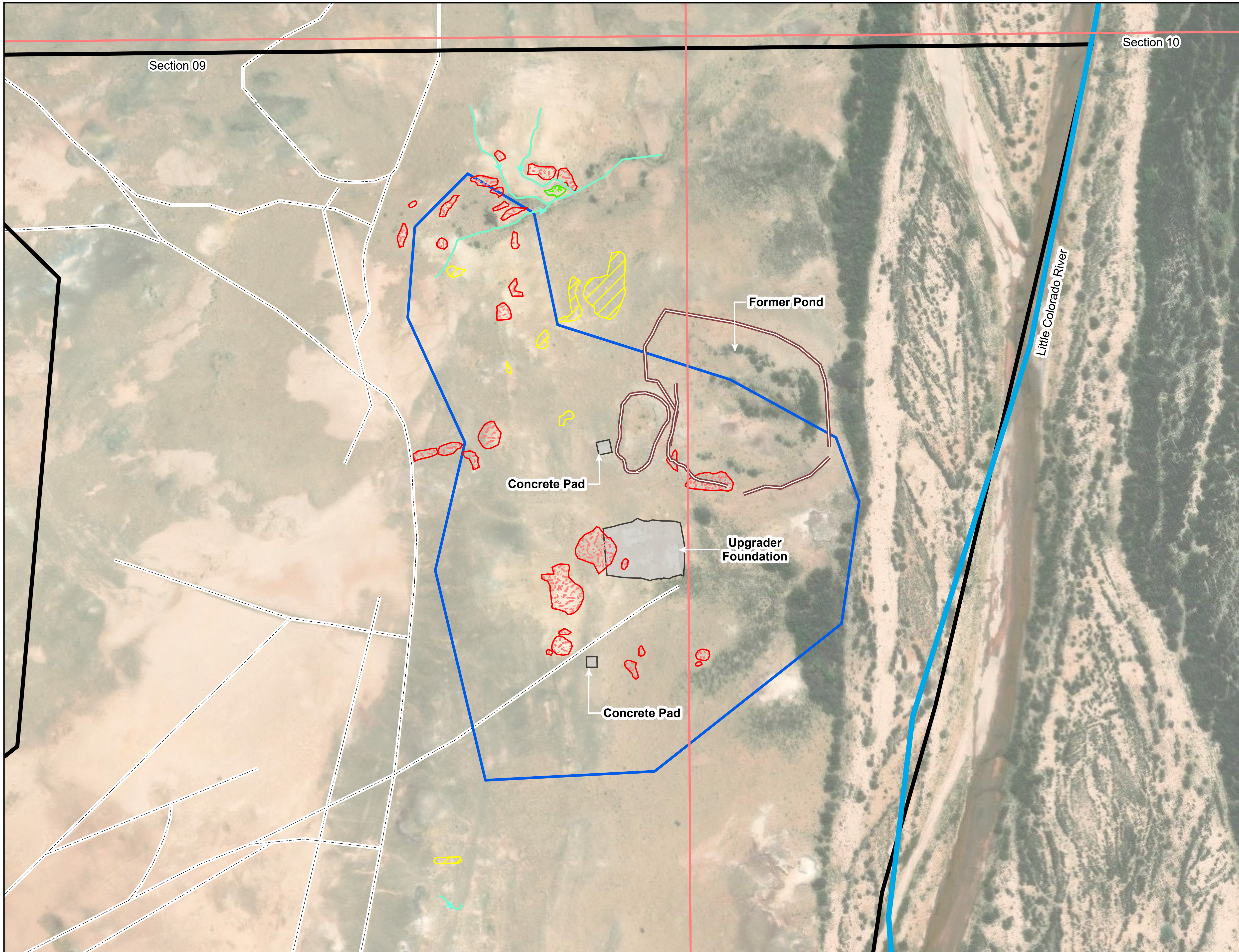
Contract No.: 68HE0923D0002

Location: COCONINO COUNTY, AZ

Date: 11/3/2024

Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator

Figure No.: 3



Site Features

- Berm
- Surface Water Drainage Pathway
- Concrete Pad
- Dozer cuts
- Shallow Mine Waste
- Waste Pile
- AUM Boundary
- APE Boundary
- PLSS Section Boundary
- Roads
- Little Colorado River

Notes:

APE	Area of potential effect
AUM	Abandoned uranium mine
PLSS	Public Land Survey System

1 inch = 200 Feet

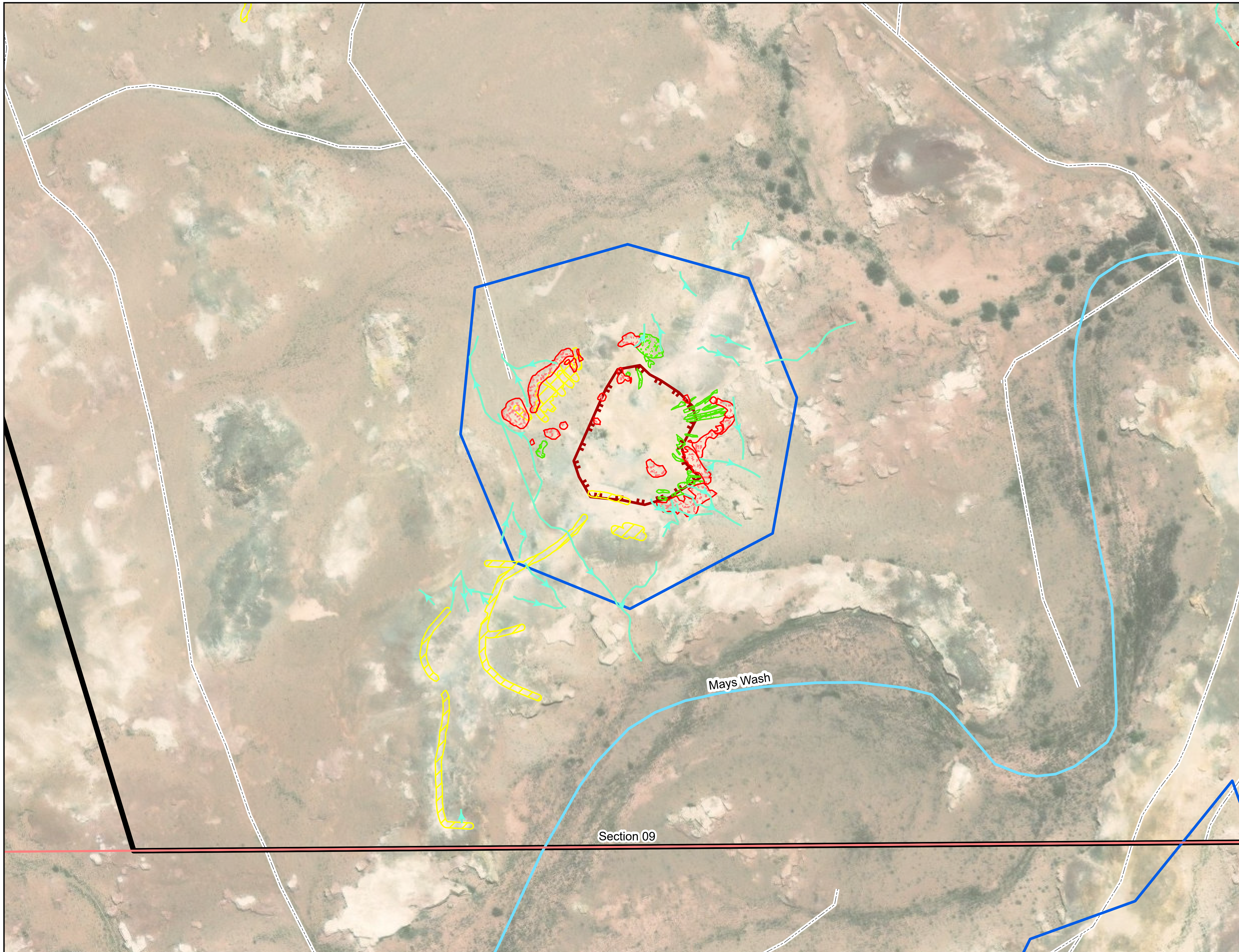
1:2,400

200 100 0 200 Feet

N W E S

SECTION 9 LEASE MINES AUM 457 SITE INSPECTION AND REMOVAL SITE EVALUATION FEATURES

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 10/14/2024
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 4



Site Features

- Surface Water Drainage Pathway
- Dozer Cut
- Excavated Area
- Shallow Mine Waste
- Waste Pile
- AUM Boundary
- APE Boundary
- PLSS Section Boundary
- Road
- Drainage

Notes:

APE	Area of potential effect
AUM	Abandoned uranium mine
PLSS	Public Land Survey System

1 inch = 200 Feet

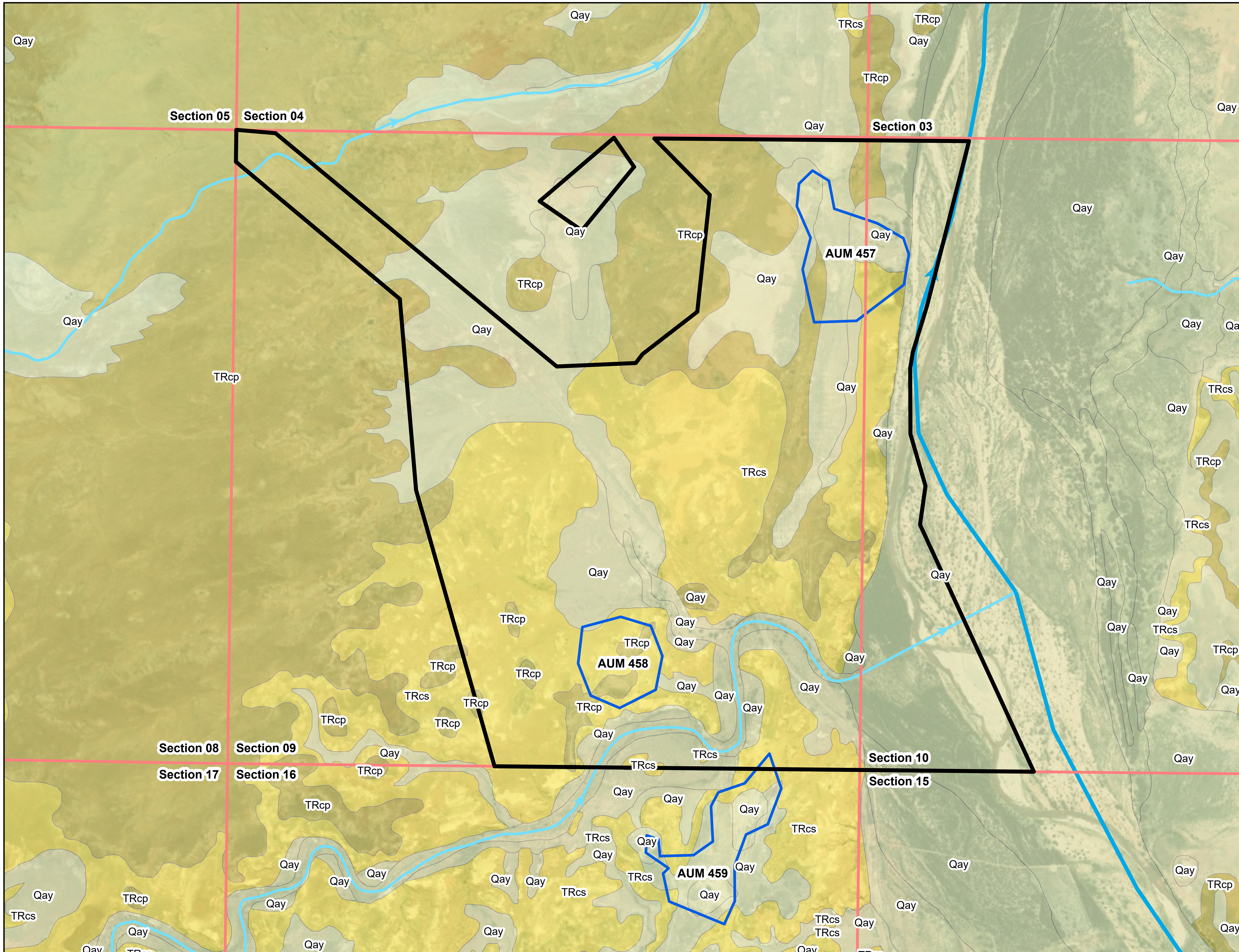
1:2,400

N W E S

200 100 0 200 Feet

SECTION 9 LEASE MINES AUM 458 SITE INSPECTION AND REMOVAL SITE EVALUATION FEATURES

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 11/8/2024
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 5



Geologic Units[1]

- Qay - Quaternary Alluvium
- TRcp - Chinle Formation (Petrified Forest)
- TRcs - Shinarump Member
- APE Boundary
- AUM Boundary
- PLSS Section Boundary
- Little Colorado River
- Drainage

Notes:
[1]Geologic unit map from USGS (2007).

APE	Area of potential effect
AUM	Abandoned uranium mine
PLSS	Public Land Survey System
USGS	U.S. Geological Survey

1 inch = 800 Feet

1:9,600

N W E S

800 400 0 800 Feet

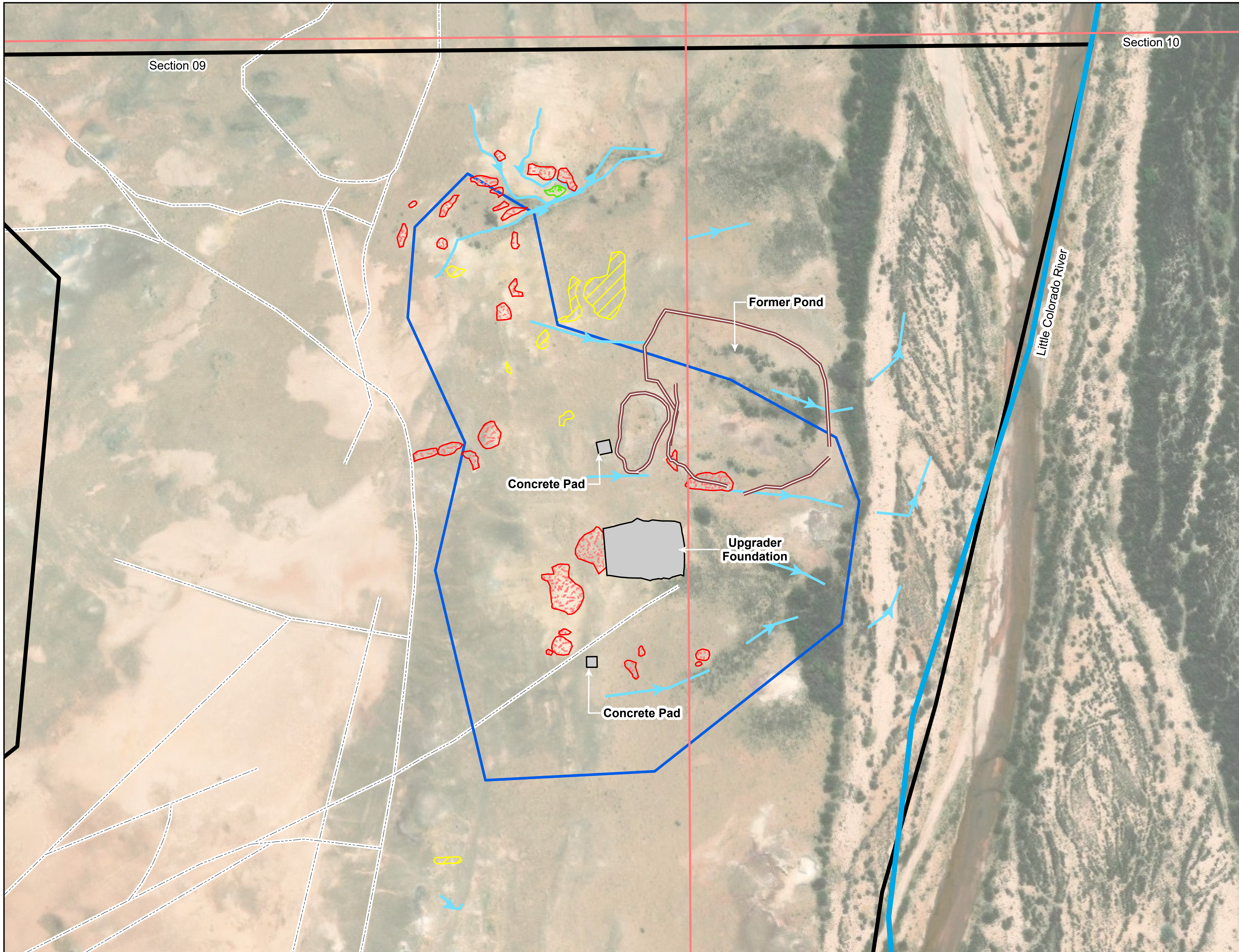
SECTION 9 LEASE MINES

GEOLOGY

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612

Task Order No.:	Contract No.:
020	68HE0923D0002
Location:	Date:
COCONINO COUNTY, AZ	10/14/2024
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 6



Site Features

- Berm
- Concrete Pad
- Dozer cuts
- Shallow Mine Waste
- Waste Pile
- APE Boundary
- Abandoned Uranium Mine
- APE Boundary
- PLSS Section Boundary
- Roads
- Drainage
- Little Colorado River

Notes:

APE	Area of potential effect
AUM	Abandoned uranium mine
PLSS	Public Land Survey System

1 inch = 200 Feet

1:2,400

200 100 0 200 Feet

N W E S

SECTION 9 LEASE MINES AUM 457 HYDROLOGY

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612

Task Order No.: 020

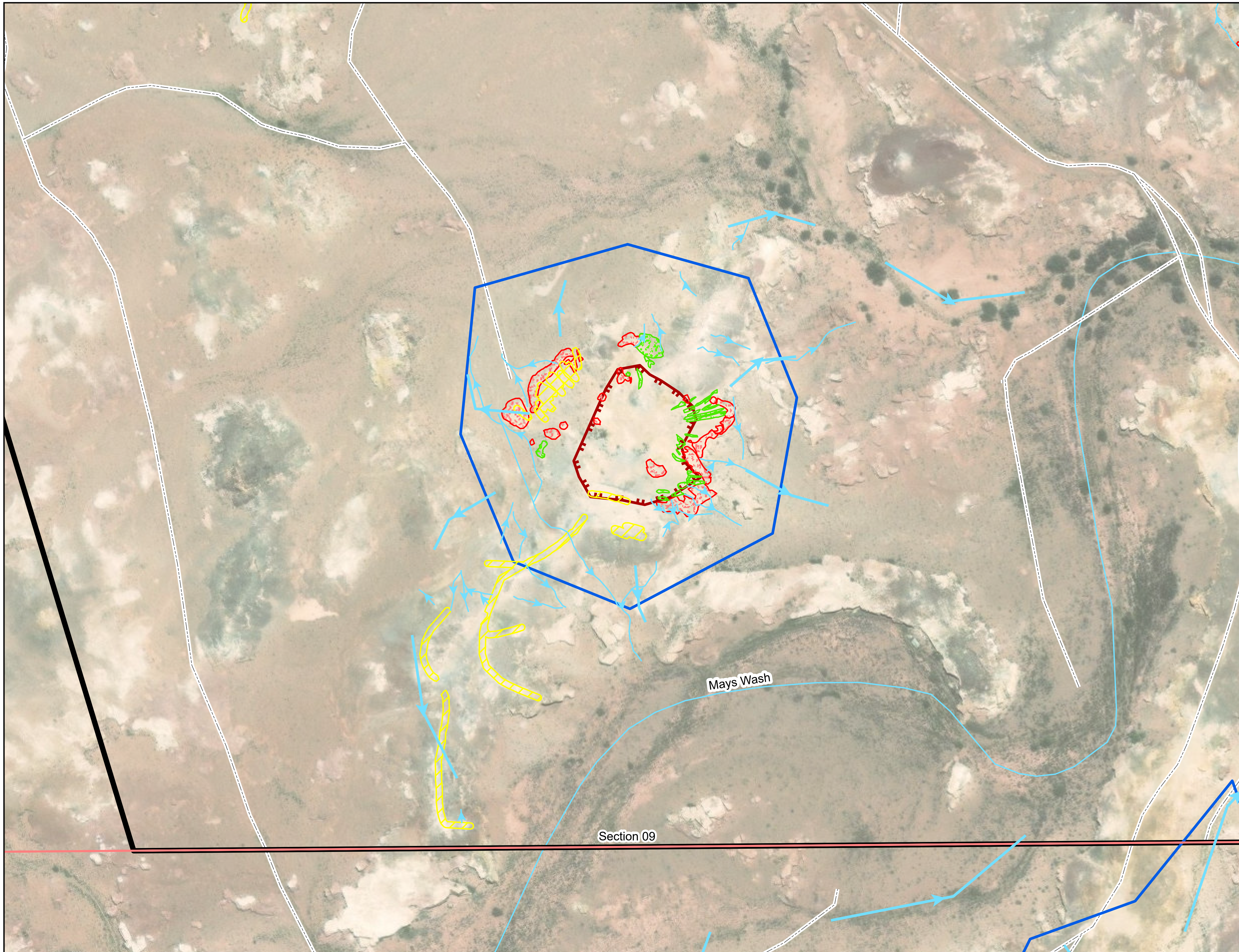
Contract No.: 68HE0923D0002

Location: COCONINO COUNTY, AZ

Date: 10/14/2024

Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator

Figure No.: 7



Site Features

- Berm
- Concrete Pad
- Dozer Cut
- Pit
- Shallow Mine Waste
- Waste Pile
- AUM Boundary
- APE Boundary
- PLSS Section Boundary
- Road
- Drainage
- Little Colorado River

Notes:

APE	Area of potential effect
AUM	Abandoned uranium mine
PLSS	Public Land Survey System

1 inch = 200 Feet

1:2,400

200 100 0 200 Feet

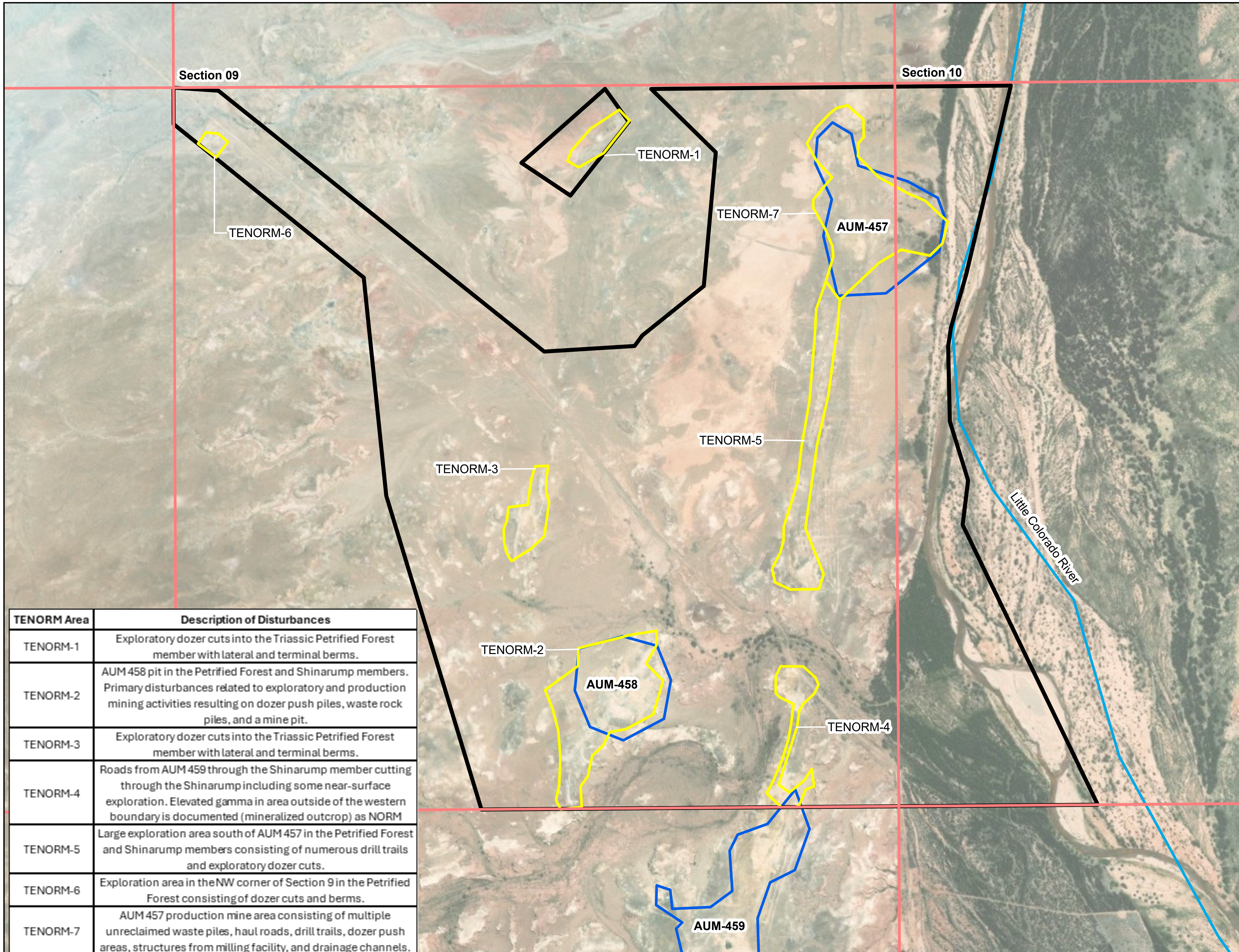
N W E S

SECTION 9 LEASE MINES AUM 458 HYDROLOGY

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612

Task Order No.: 020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 11/3/2024
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 8



TENORM Area	Description of Disturbances
TENORM-1	Exploratory dozer cuts into the Triassic Petrified Forest member with lateral and terminal berms.
TENORM-2	AUM 458 pit in the Petrified Forest and Shinarump members. Primary disturbances related to exploratory and production mining activities resulting on dozer push piles, waste rock piles, and a mine pit.
TENORM-3	Exploratory dozer cuts into the Triassic Petrified Forest member with lateral and terminal berms.
TENORM-4	Roads from AUM 459 through the Shinarump member cutting through the Shinarump including some near-surface exploration. Elevated gamma in area outside of the western boundary is documented (mineralized outcrop) as NORM
TENORM-5	Large exploration area south of AUM 457 in the Petrified Forest and Shinarump members consisting of numerous drill trails and exploratory dozer cuts.
TENORM-6	Exploration area in the NW corner of Section 9 in the Petrified Forest consisting of dozer cuts and berms.
TENORM-7	AUM 457 production mine area consisting of multiple unreclaimed waste piles, haul roads, drill trails, dozer push areas, structures from milling facility, and drainage channels.

Notes:

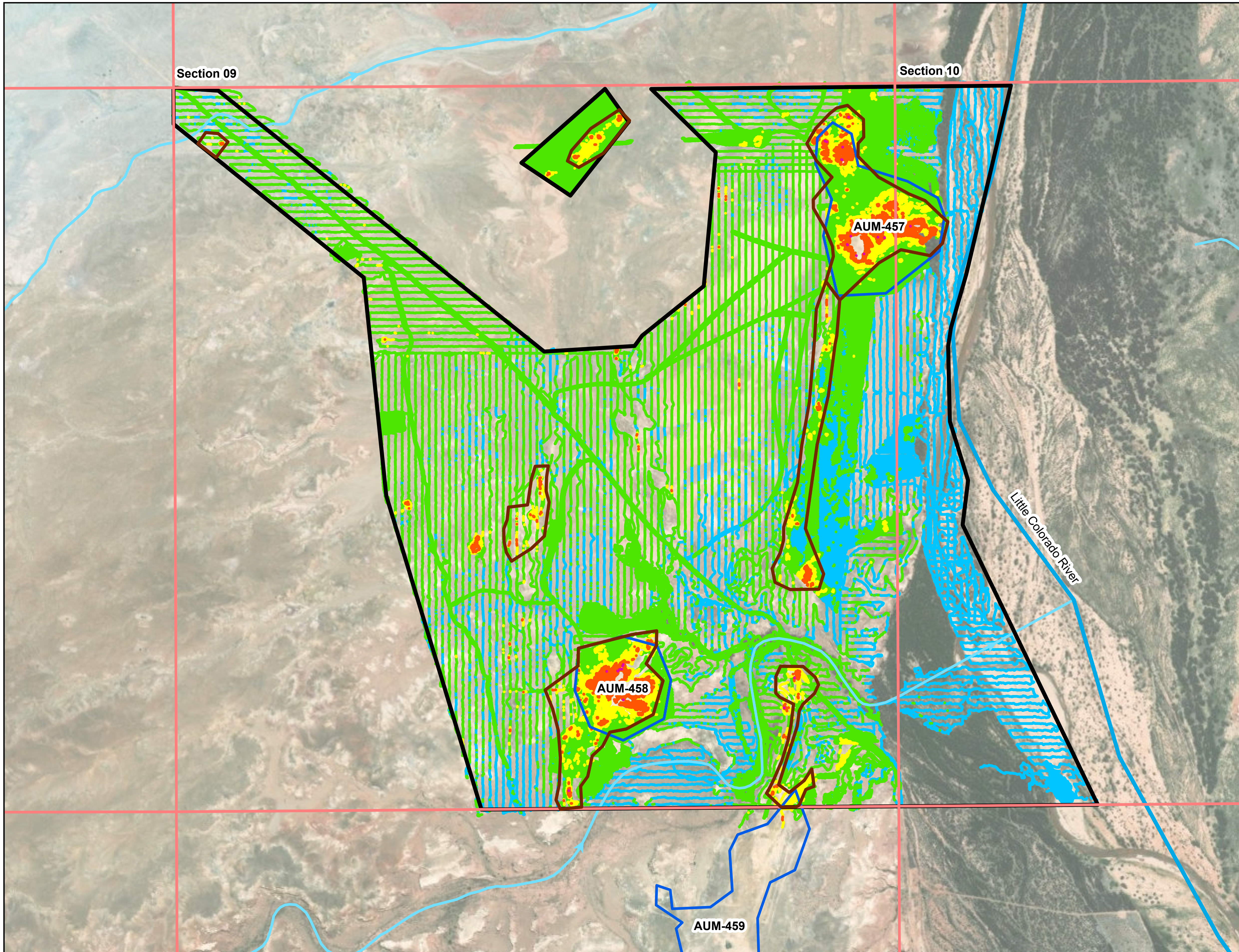
APE	Area of potential effect
AUM	Abandoned uranium mine
PLSS	Public Land Survey System
TENORM	Technologically enhanced naturally occurring radioactive material

SECTION 9 LEASE MINES TENORM AREA

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612

Task Order No.: 020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 11/3/2024
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 9



Gamma Reading (cpm)[1]

- ≤ 38,364
- 38,364 - 66,291
- 66,291 - 299,018
- 299,018 - 578,289
- > 578,289
- TENORM Area
- APE Boundary
- AUM Boundary
- PLSS Section Boundary
- Little Colorado River
- Drainage

Notes:
[1]The mobile gamma radiation survey was performed using 3-inch by 3-inch sodium iodide detectors (Ludlum 44-20) (EA 2018).

APE	Area of potential effect
AUM	Abandoned uranium mine
cpm	Counts per minute
EA	Engineering Analytics, Inc.
PLSS	Public Land Survey System

1 inch = 700 Feet

1:8,400

700 350 0 700 Feet

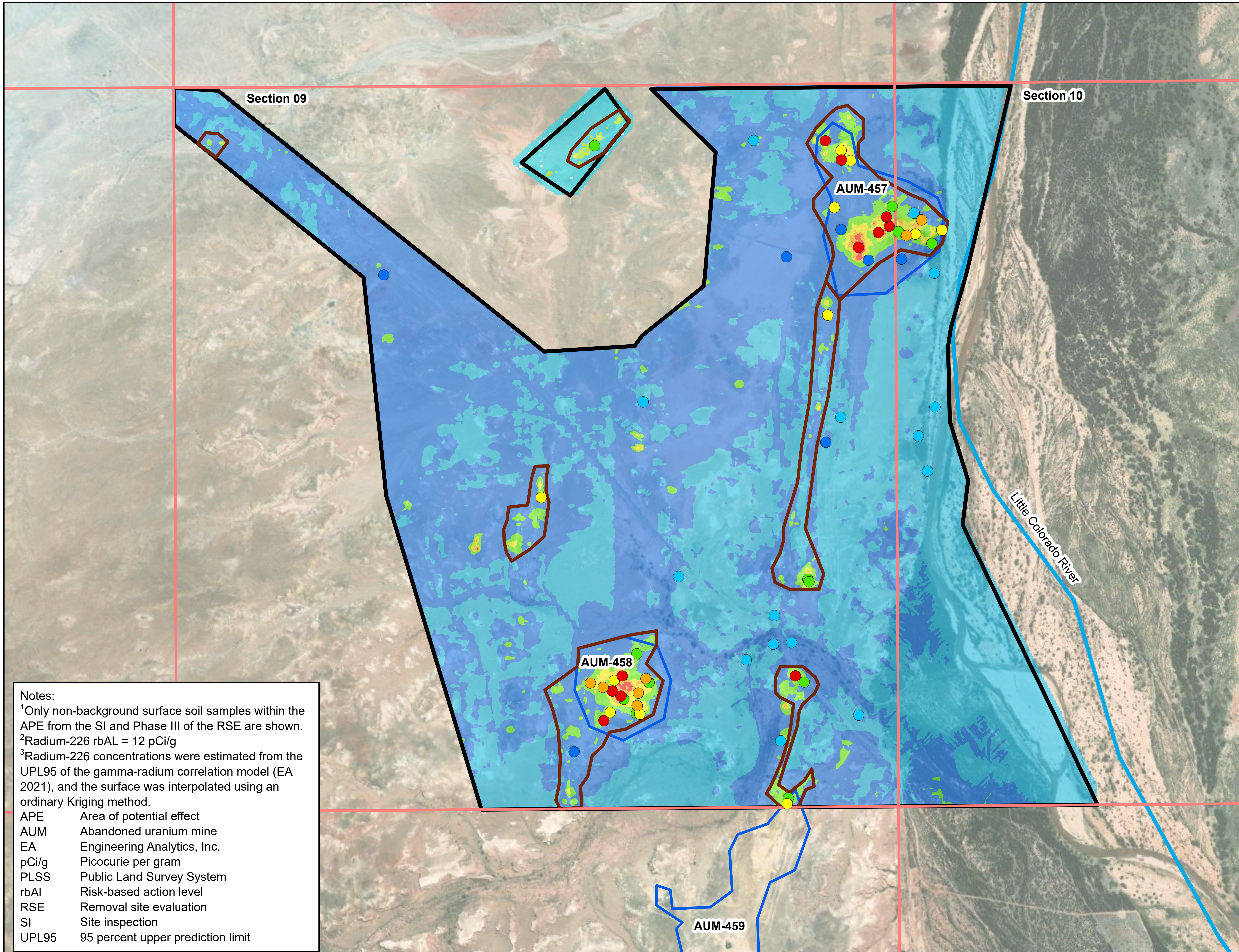
N W E S

SECTION 9 LEASE MINES GAMMA RADIATION SURVEY

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612

Task Order No.: 020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 11/3/2024
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 10



Radium-226 Surface Soil Concentration (pCi/g)[1,2]

- < 2
- 2 - 5
- 5 - 12
- 12 - 30
- 30 - 60
- > 60

Interpolated Estimated Radium-226 (pCi/g)[2,3]

- < 2
- 2 - 5
- 5 - 12
- 12 - 30
- 30 - 60
- > 60

- TENORM Area
- APE Boundary
- AUM Boundary
- PLSS Section Boundary
- Little Colorado River

1 inch = 700 Feet

1:8,400

700 350 0 700 Feet

N W E S

Notes:
[1]Only non-background surface soil samples within the APE from the SI and Phase III of the RSE are shown.
[2]Radium-226 rbAL = 12 pCi/g
[3]Radium-226 concentrations were estimated from the UPL95 of the gamma-radium correlation model (EA 2021), and the surface was interpolated using an ordinary Kriging method.

APE	Area of potential effect
AUM	Abandoned uranium mine
EA	Engineering Analytics, Inc.
pCi/g	Picocurie per gram
PLSS	Public Land Survey System
rbAl	Risk-based action level
RSE	Removal site evaluation
SI	Site inspection
UPL95	95 percent upper prediction limit

SECTION 9 LEASE MINES MEASURED AND ESTIMATED RADIUM-226 SURFACE SOIL CONCENTRATIONS

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH
1999 Harrison Street, Suite 500
Oakland, CA 94612

Task Order No.: 020

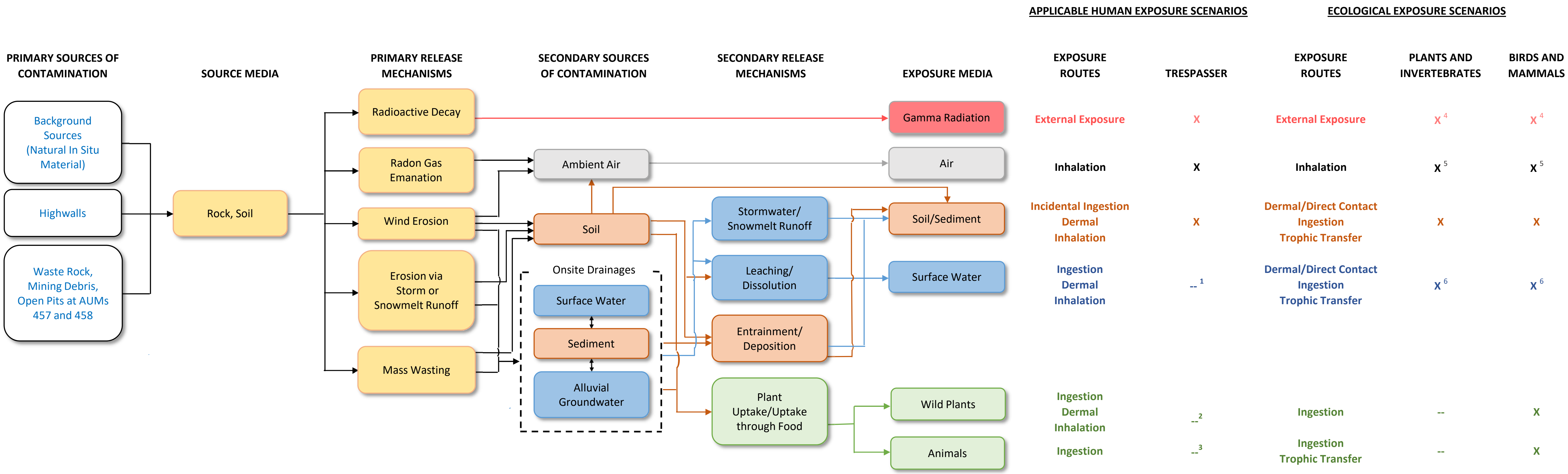
Contract No.: 68HE0923D0002

Location: COCONINO COUNTY, AZ

Date: 11/3/2024

Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator

Figure No.: 11



(red)	Gamma Radiation
(grey)	Air
(peach)	Soil/Sediment
(blue)	Water
(green)	Plants/Animals

Notes:

X Indicates the exposure pathway is potentially complete and is evaluated in the risk assessment except as noted.

-- Indicates the exposure pathway is not complete or *de minimus* and is not evaluated in the risk assessment

[1] The human health risk evaluation does not include ingestion of surface water or groundwater by humans.

[2] The human health risk evaluation does not include ingestion, dermal (metals only), and inhalation of wild plants by this receptor.

[3] The human health risk evaluation does not include ingestion of home-raised animals (meat, milk, and eggs) and hunted animals (meat only) for this receptor.

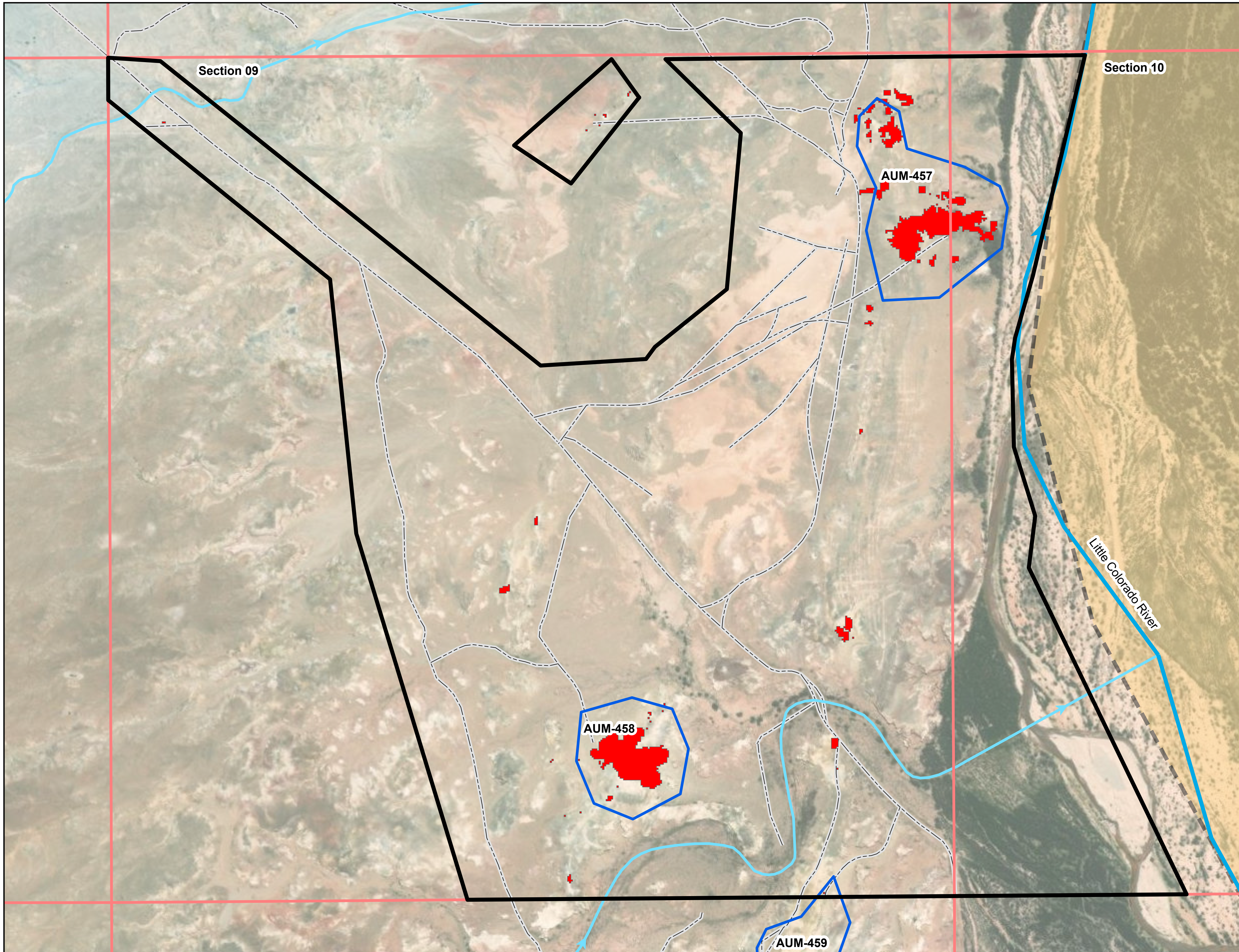
[4] The ecological risk evaluation does not include evaluation of external exposure to gamma radiation.

[5] Potential exposures include inhalation of ambient air and air in burrows. The ecological risk evaluation does not include evaluation of the inhalation pathway.

[6] The ecological risk evaluation does not include evaluation of direct contact with or ingestion of surface water.

AUM Abandoned uranium mine

Figure 12. Section 9 Lease Mines Conceptual Site Model Wire Diagram



- Proposed Excavation Area
- APE Boundary
- Navajo Nation Boundary
- PLSS Section Boundary
- Road
- Little Colorado River
- Drainage

Notes:

APE Area of potential effect

PLSS Public Land Survey System

1 inch = 600 Feet

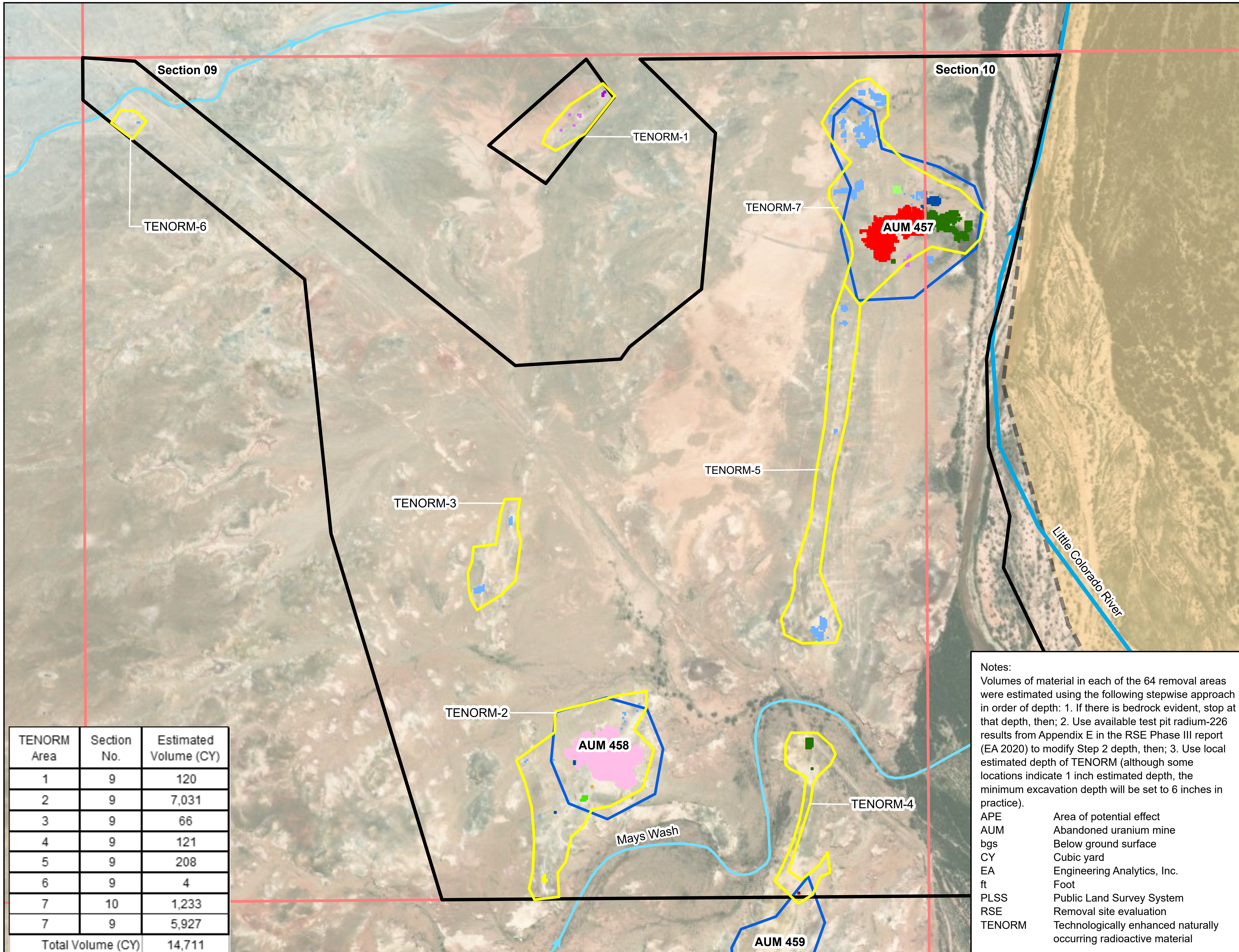
1:7,200

600 300 0 600 Feet

N E S W

SECTION 9 LEASE MINES PROPOSED EXCAVATION AREA

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 10/14/2024
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 13



TENORM Area	Section No.	Estimated Volume (CY)
1	9	120
2	9	7,031
3	9	66
4	9	121
5	9	208
6	9	4
7	10	1,233
7	9	5,927
Total Volume (CY)		14,711

Notes:
Volumes of material in each of the 64 removal areas were estimated using the following stepwise approach in order of depth: 1. If there is bedrock evident, stop at that depth, then; 2. Use available test pit radium-226 results from Appendix E in the RSE Phase III report (EA 2020) to modify Step 2 depth, then; 3. Use local estimated depth of TENORM (although some locations indicate 1 inch estimated depth, the minimum excavation depth will be set to 6 inches in practice).

APE	Area of potential effect
AUM	Abandoned uranium mine
bgs	Below ground surface
CY	Cubic yard
EA	Engineering Analytics, Inc.
ft	Foot
PLSS	Public Land Survey System
RSE	Removal site evaluation
TENORM	Technologically enhanced naturally occurring radioactive material

SECTION 9 LEASE MINES REMOVAL VOLUMES

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612

Task Order No.: 020

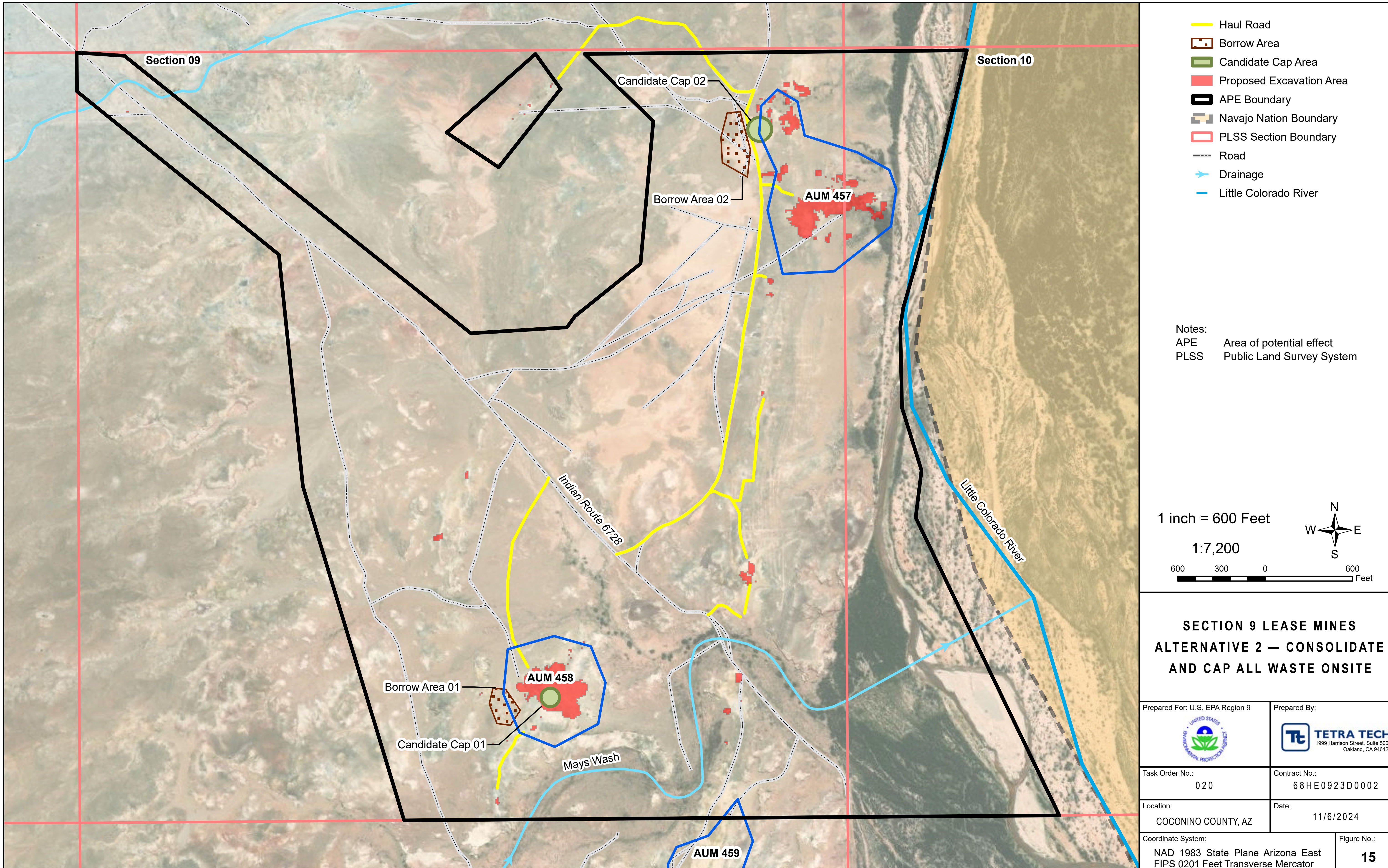
Contract No.: 68HE0923D0002

Location: COCONINO COUNTY, AZ

Date: 10/14/2024

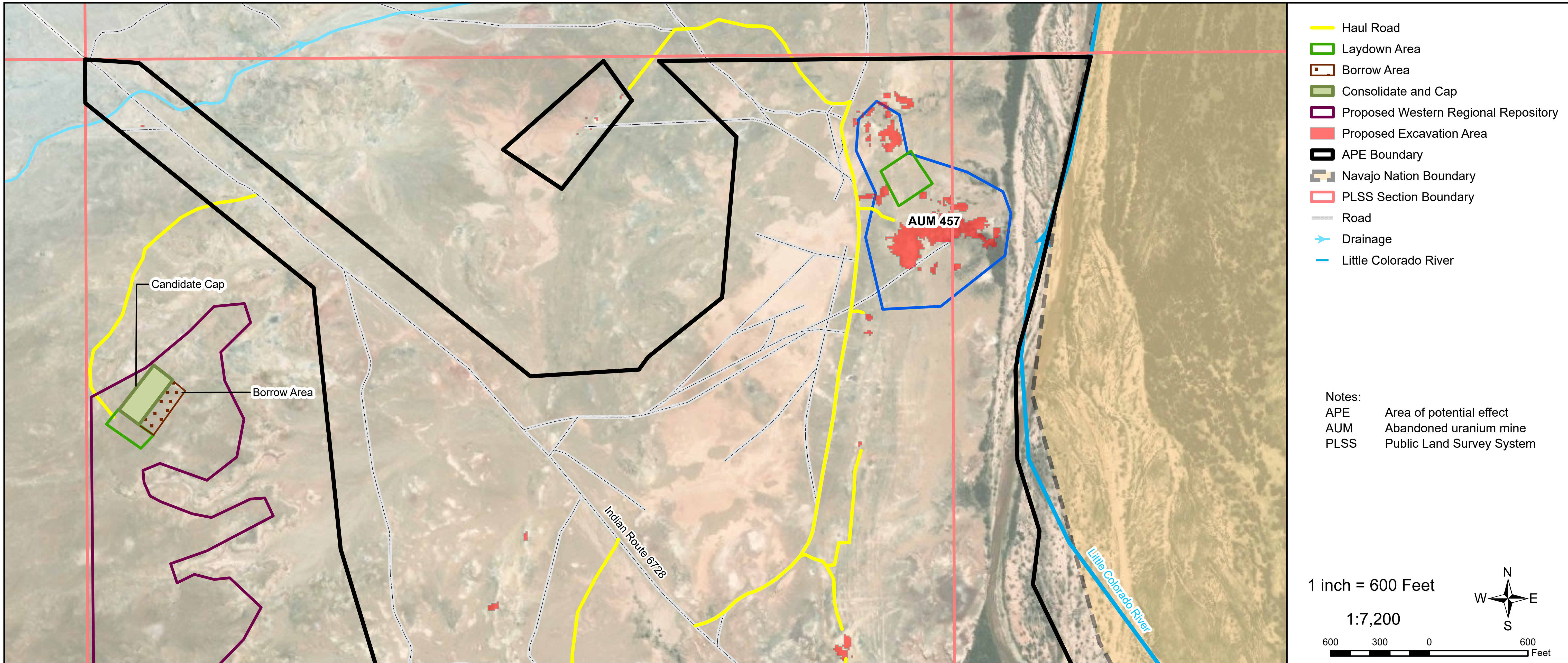
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator

Figure No.: 14



SECTION 9 LEASE MINES
ALTERNATIVE 2 — CONSOLIDATE AND CAP ALL WASTE ONSITE

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612
Task Order No.: 020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 11/6/2024
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 15



SECTION 9 LEASE MINES ALTERNATIVE 3 — DISPOSAL OF ALL MINE WASTE AT A WESTERN AUM REGIONAL REPOSITORY

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 11/11/2024
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 16

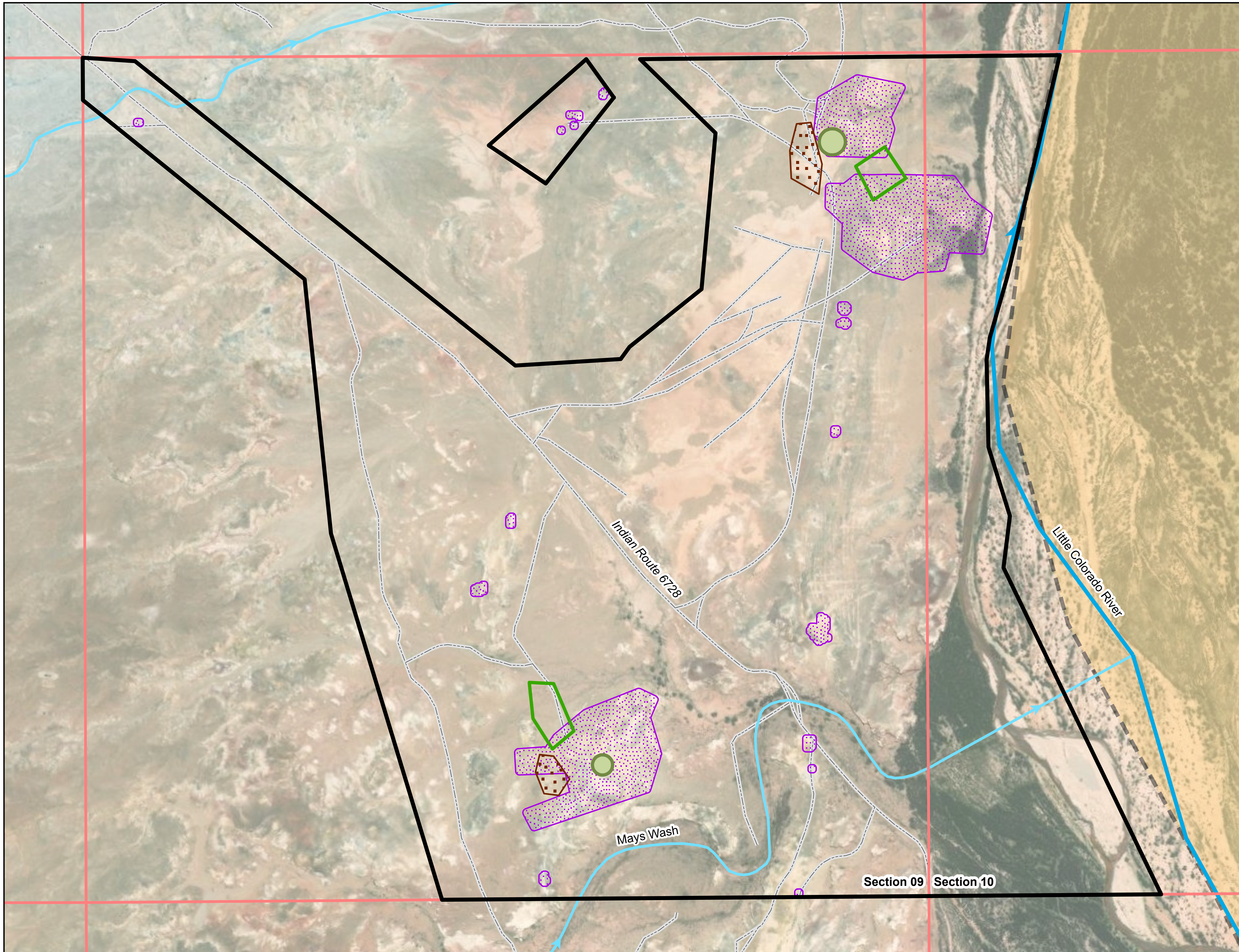
Section 9 Lease Mines
Proposed Disposal Facility
Proposed Haul Road

1 inch = 40 Miles
1:2,534,400
40 20 0 40 Miles

N E S W

SECTION 9 LEASE MINES ALTERNATIVE 4 - DISPOSAL OF ALL MINE WASTE IN OFFSITE CONSERVATION AND RECOVERY ACT (RCRA)-LICENSED FACILITY

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 11/6/2024
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 17



- Surficial Restoration[1]
- Borrow Area
- Candidate Cap Area[2]
- Laydown Area[3]
- APE Boundary
- Navajo Nation Boundary
- PLSS Section Boundary
- Road
- Drainage
- Little Colorado River

Notes:
[1]The restoration areas will be graded to a natural contour (shallow removal < 1 foot) or backfilled (depth > 2 feet) with clean fill; contour graded for drainage; and revegetated with native seed and planted shrubs in selected locations.
[2]Evapotranspiration cap constructed of 36 inches of clean fill and local gravel as required by final design. Grading for drainage and top cap layer may include a soil layer for revegetation and protective desert gravel surface depending on location and surrounding conditions.
[3]Laydown area will be ripped to remove compaction graded to contour and revegetated.

APE Area of potential effect
PLSS Public Land Survey System

1 inch = 600 Feet

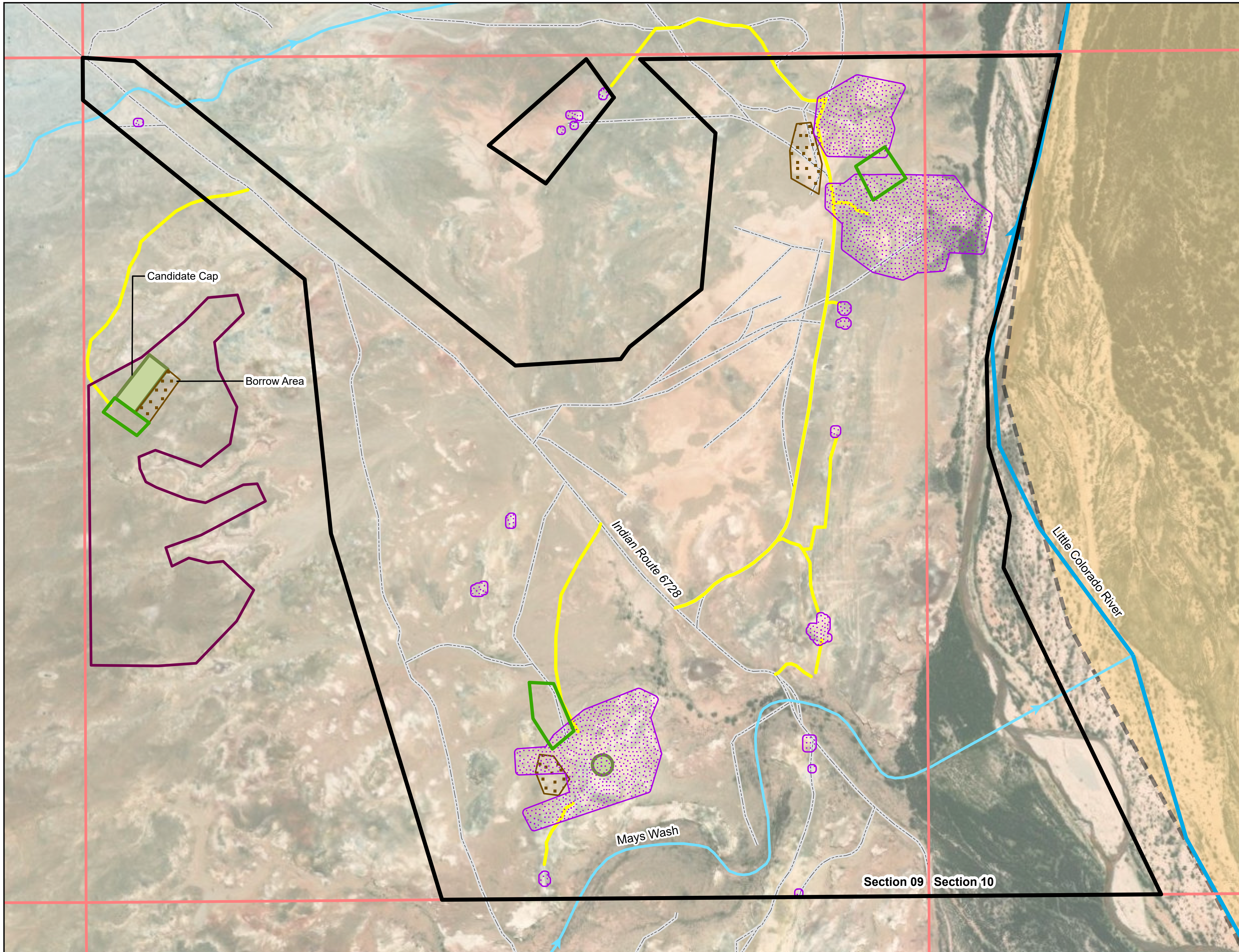
1:7,200

600 300 0 600 Feet

N S W E

SECTION 9 LEASE MINES ALTERNATIVE 2 PROPOSED SURFICIAL RESTORATION ACTIVITIES

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 11/4/2024
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 18



Surficial Restoration[1]
Borrow Area
Cap[2]
Laydown Area[3]
APE Boundary
PLSS Section Boundary
Navajo Nation Boundary
Road
Drainage
Little Colorado River

Notes:
[1]The restoration areas will be graded to a natural contour (shallow removal < 1 foot) or backfilled (depth > 2 feet) with clean fill; contour graded for drainage; and revegetated with native seed and planted shrubs in selected locations.
[2]Evapotranspiration cap constructed of 36 inches of clean fill and local gravel as required by final design. Grading for drainage and top cap layer may include a soil layer for revegetation and protective desert gravel surface depending on location and surrounding conditions.
[3]Laydown area will be ripped to remove compaction graded to contour and revegetated.
APE Area of potential effect
PLSS Public Land Survey System

1 inch = 600 Feet

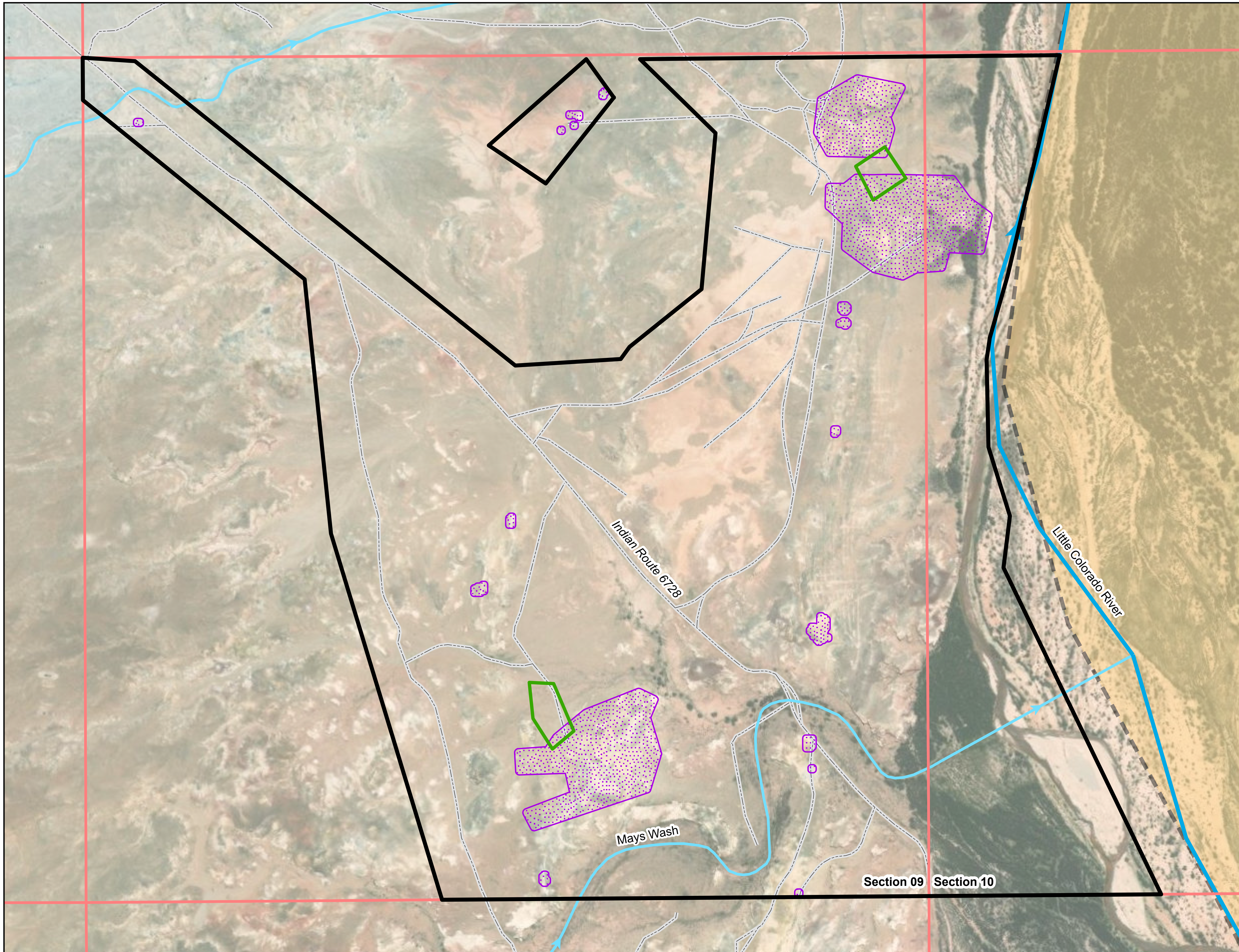
1:7,200

600 300 0 600 Feet

N W E S

SECTION 9 LEASE MINES ALTERNATIVE 3 PROPOSED SURFICIAL RESTORATION ACTIVITIES

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 11/4/2024
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 19



Surficial Restoration[1]
Laydown Area[2]
APE Boundary
Navajo Nation Boundary
PLSS Section Boundary
Road
Drainage
Little Colorado River

Notes:
[1]The restoration areas will be graded to a natural contour (shallow removal < 1 foot) or backfilled (depth > 2 feet) with clean fill; contour graded for drainage; and revegetated with native seed and planted shrubs in selected locations.
[2]Laydown area will be ripped to remove compaction, graded to contour, and revegetated.
APE Area of potential effect
PLSS Public Land Survey System

1 inch = 600 Feet
1:7,200
600 300 0 600 Feet
N W E S

SECTION 9 LEASE MINES ALTERNATIVE 4 — PROPOSED SURFICIAL RESTORATION ACTIVITIES

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 11/4/2024
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: 20

TABLES

Table 1. Cameron, Arizona Summary of Climate and Meteorology

Parameter	Value
Annual Low Temperature	43 °F
Annual High Temperature	75 °F
Annual Average Precipitation	5.57 inches
Range of Monthly Average Precipitation	0.08 inch in June 0.83 inch in August
Average Wind Speed in Page, Arizona[a]	5 miles per hour
Prevailing Wind Direction in Page, Arizona[a]	West
Annual Average Pan Evaporation in Page, Arizona[a]	80.57 inches

Notes:
Values are from U.S. Climate Data (2023).
[a] The closest site with wind speed, wind direction, and pan evaporation data is Page, Arizona (Western Regional Climate Center 2023a, 2023b, 2023c).
°F Degree Fahrenheit

References:

U.S. Climate Data. 2023. "Climate Cameron - Arizona and Weather Averages Cameron." https://www.usclimatedata.com/climate/cameron/arizona/united-states/usaz0025.

Western Regional Climate Center. 2023a. "Average Wind Speeds – MPH." https://wrcc.dri.edu/Climate/comp_table_show.php?stype=wind_speed_avg.

Western Regional Climate Center. 2023b. "Evaporation Stations." https://wrcc.dri.edu/Climate/comp_table_show.php?stype=pan_evap_avg.

Western Regional Climate Center. 2023c. "Prevailing Wind Direction." https://wrcc.dri.edu/Climate/comp_table_show.php?stype=wind_dir_avg.

Table 2. Western AUM Region Regional BTVs

Geologic Unit	Radium-226 (pCi/g)	Arsenic (mg/kg)	Molybdenum (mg/kg)	Uranium (mg/kg)	Vanadium (mg/kg)
Alluvium	3.2	5.9	2.6	3.9	83
Petrified Forest Member	3.9	4.2	1.8	7.7	56
Shinarump Member	1.5	18	0.7	1.5	62

Notes:
The BTV is the UTL95-95 of the Western AUM Region background dataset grouped by geologic unit (Tetra Tech, Inc. 2024). Only BTVs for geologic units present at the Section 9 Lease Mines are shown.

AUM	Abandoned uranium mine
BTV	Background threshold value
mg/kg	Milligram per kilogram
pCi/g	Picocurie per gram
UTL95-95	95 percent upper tolerance limit with 95 percent coverage

References:
Tetra Tech, Inc. 2024. “Navajo Abandoned Uranium Mines Regional Background Methodology.” Interim Final. May 13.

Table 3. Background Comparison

COC/COEC	Section 9 Lease Mines Quaternary Alluvium (0-6 inch bgs)			Western Regional Background Quaternary Alluvium (0-6 inch bgs)			Two-Population Statistical Tests				Final Conclusion for Background Screen
	Sample Size		Detection Frequency (Percent)	Sample Size		Detection Frequency (Percent)	Gehan[a]	Tarone-Ware[a]	Wilcoxon-Mann-Whitney[b]	Quantile[c]	
	Detected	Total		Detected	Total		Site > Background?	Site > Background?	Site > Background?	Site > Background?	Site > Background?
Radium-226	23	23	100%	283	286	99%	Yes	Yes	--	--	**Yes**
Arsenic	18	23	78%	275	276	100%	Yes	Yes	--	--	**Yes**
Molybdenum	18	23	78%	103	276	37%	Yes	Yes	--	--	**Yes**
Selenium	11	23	48%	130	276	47%	Yes	Yes	--	--	**Yes**
Uranium	12	23	52%	276	276	100%	Yes	Yes	--	--	**Yes**
Vanadium	22	23	96%	276	276	100%	Yes	Yes	--	--	**Yes**
COC/COEC	Section 9 Lease Mines Petrified Forest Member Soil Samples (0-6 inch bgs)			Western Regional Background Petrified Forest Member (0-6 inch bgs)			Two-Population Statistical Tests				Final Conclusion for Background Screen
	Sample Size		Detection Frequency (Percent)	Sample Size		Detection Frequency (Percent)	Gehan[a]	Tarone-Ware[a]	Wilcoxon-Mann-Whitney[b]	Quantile[c]	
	Detected	Total		Detected	Total		Site > Background?	Site > Background?	Site > Background?	Site > Background?	Site > Background?
Radium-226	11	11	100%	105	105	100%	--	--	Yes	Yes	**Yes**
Arsenic	11	11	100%	105	105	100%	--	--	Yes	Yes	**Yes**
Molybdenum	11	11	100%	63	105	60%	Yes	Yes	--	--	**Yes**
Selenium	7	11	64%	65	105	62%	Yes	No	--	--	**Yes**
Uranium	9	11	82%	105	105	100%	Yes	Yes	--	--	**Yes**
Vanadium	9	11	82%	105	105	100%	No	No	--	No	No
COC/COEC	Section 9 Lease Mines Shinarump Member Soil Samples (0-6 inch bgs)			Western Regional Background Shinarump Member (0-6 inch bgs)			Two-Population Statistical Tests				Final Conclusion for Background Screen
	Sample Size		Detection Frequency (Percent)	Sample Size		Detection Frequency (Percent)	Gehan[a]	Tarone-Ware[a]	Wilcoxon-Mann-Whitney[b]	Quantile[c]	
	Detected	Total		Detected	Total		Site > Background?	Site > Background?	Site > Background?	Site > Background?	Site > Background?
Radium-226	28	28	100%	63	63	100%	--	--	Yes	Yes	**Yes**
Arsenic	26	28	93%	60	63	95%	Yes	Yes	--	--	**Yes**
Molybdenum	27	28	96%	5	63	8%	Yes	Yes	--	--	**Yes**
Selenium	12	28	43%	52	63	83%	No	No	--	*	No
Uranium	16	28	57%	63	63	100%	Yes	Yes	--	--	**Yes**
Vanadium	24	28	86%	63	63	100%	No	No	--	No	No

Notes:
Bold indicates site soil concentrations are greater than background concentrations for the geologic unit.
a Gehan and Tarone-Ware are tests of central tendency and are only used when multiple nondetect results are present in the dataset (USEPA 2022a).
b Wilcoxon-Mann-Whitney is a test of central tendency and can only be used when all data are detected or a single detection limit is identified for the nondetected results.
c Quantile is a test performed to confirm the conclusion that the upper tails of site concentrations are less than those for background. Quantile tests were not performed in cases where the two-population tests for central tendency indicated that the site concentrations are greater than background. Quantile tests were performed using ProUCL Version 4.1.01 (USEPA 2010).

Table 3. Background Comparison

Notes (Continued):

*	Quantile test could not be performed because there are non-detect values in the in the highest quantile.
--	Not applicable
bgs	Below ground surface
COC	Contaminant of concern
COEC	Contaminant of ecological concern
USEPA	U.S. Environmental Protection Agency

References:

U.S. Environmental Protection Agency (USEPA). 2010. “ProUCL Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observation.” Version 4.1.01. Prepared by A. Singh and A.K. Singh. EPA/600/R-07/041. May.

USEPA. 2022. “ProUCL Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations.” Version 5.2. June 14.

Table 4. Risk Management Summary

Exposure Unit	Land Use / Receptor	Soil Interval	Candidate COC or COEC												
			Radium-226	Arsenic	Barium	Chromium	Cobalt	Lead	Manganese	Mercury	Molybdenum	Selenium	Thallium	Uranium	Vanadium
Site-Wide	Trespasser	Surface	**COC**	--	--	--	--	--	--	--	--	--	--	--	--
		Subsurface	**COC**	--	--	--	--	--	--	--	--	--	--	--	--
	Plants, Invertebrates, Birds, Mammals	Surface	**COEC**	Co-Loc	MDC< PERG	Cr(III) not a COPEC	MDC< PERG	MDC< PERG	MDC< PERG	Co-Loc	Co-Loc	Co-Loc	Co-Loc	Co-Loc	Co-Loc
	Plants, Mammals	Subsurface	**COEC**	Co-Loc	MDC< PERG	Cr(III) not a COPEC	MDC< PERG	--	MDC< PERG	Co-Loc	Co-Loc	Co-Loc	Co-Loc	Co-Loc	--

Notes:
Bold indicates an identified final COC or COEC recommended for removal action.

--	Contaminant is not a candidate COC or COEC in the exposure unit and depth interval.
<	Less than
Co-Loc	Co-located with radium-226 preliminary removal action extent
COC	Contaminant of concern
COEC	Contaminant of ecological concern
COPEC	Contaminant of potential ecological concern
Cr(III)	Trivalent chromium
MDC	Maximum detected concentration
PERG	Preliminary ecological removal goal

Table 5. Selected Soil RAG for Each COC and COEC

COC / COEC	Units	Human Health PRG[1]	NAUM PERG[2]	BTV[3]	Removal Action Goal[4]	Basis for Removal Action Goal
Quaternary Alluvium						
Surface Soil (0-6 inches bgs) and Subsurface Soil (0-60 inches bgs)						
Radium-226[5]	pCi/g	12	40	3.2	12	Human Health PRG
Western Regional Background Petrified Forest Member						
Surface Soil (0-6 inches bgs) and Subsurface Soil (0-60 inches bgs)						
Radium-226[5]	pCi/g	12	40	3.9	12	Human Health PRG
Western Regional Background Shinarump						
Surface Soil (0-6 inches bgs) and Subsurface Soil (0-60 inches bgs)						
Radium-226[5]	pCi/g	12	40	1.5	12	Human Health PRG

Notes:

1 The human health PRG is based on a trespasser scenario and calculated using the NAUM Risk Calculator (USEPA 2024b).

2 Development of PERGs is described in USEPA (2024c).

3 The BTVs for soil are UTL95-95s for the Western Abandoned Uranium Mine Region (Tetra Tech, Inc. 2024).

4 The RAG is the lesser of the human health PRG and NAUM PERG unless either risk-based preliminary removal goal is less than the BTV. If the BTV is higher than the human health PRG or NAUM PERG, the RAG is based on the BTV to address material distinguishable from background. The BTV is used to represent background for delineating contaminated areas.

5 Assumption of secular equilibrium for radium-226 is protective for the calculation of risk-based screening levels. Adjusted toxicity values are used to incorporate all toxicity for the entire uranium-238 decay chain in the development of the PRG. Site data for radium-226 are used to evaluate the extent of radionuclides above RAGs.

bgs	Below ground surface
BTV	Background threshold value
COC	Contaminant of concern
COEC	Contaminant of ecological concern
NAUM	Navajo abandoned uranium mine
pCi/g	Picocurie per gram
PERG	Preliminary ecological removal goal
PRG	Preliminary removal goal
RAG	Removal action goal
UTL95-95	95% upper tolerance limit with 95% coverage
USEPA	U.S. Environmental Protection Agency

References:

Tetra Tech, Inc. 2024. “Navajo Abandoned Uranium Mines Regional Background Methodology.” Interim Final. May 13.

U.S. Environmental Protection Agency (USEPA). 2024b. “Navajo Abandoned Uranium Mine Risk Calculator." Version 1.03. March

USEPA. 2024c. "Navajo Abandoned Uranium Mines Program Preliminary Ecological Removal Goals for Metals and Radionuclides in Soil for Navajo Abandoned Uranium Mine Sites.” Draft. March.

Table 6. General Response Actions, Technologies, and Process Options Screening Summary

General Response Actions	Response Action Technology	Process Options	Description	Screening Comment
No Action	None	Not applicable	No action	Not applicable
Institutional Controls	Access Restrictions	Land Use Controls	Implement administrative restrictions to control current and future land use.	Potentially effective in conjunction with other technologies; reduces opportunities for community exposure during typical land use activities. Protective in areas of a site with mineralized bedrock that cannot be addressed under CERCLA. Requires implementing authorities.
Engineering Controls	Access Restrictions	Physical Barriers	Install gate at road, signs and fence around waste piles and mine shafts, and berms to limit vehicle access.	Potentially effective in conjunction with other technologies; limits access to physical hazards and direct exposure to radionuclides and radon gas; however, would require annual inspection and repair for vandalism.
	Surface Controls	Consolidation, Grading, Revegetation, and Erosion Protection	Combine mine waste in a smaller common area. Return waste to mine openings, benches, and pits. Grade waste piles to reduce slopes for managing erosion and runoff. Add amendments and seed to revegetate and establish an erosion-resistant ground surface. Install sedimentation basins, run-on and runoff controls, and diversion ditches.	Effective in conjunction with other technologies; reduces physical hazards through backfilling of mine openings and pits; limits exposed waste surface area through consolidation; limits erosion of soil and migration to drainages; reduces stormwater run-on and runoff; effective for material impinging on drainages; readily implementable. Does not fully address direct exposure, leaching, or potential wind erosion and migration off site.
		Soil Binder	Apply a chemical binder to soil to reduce wind and water erosion of soil.	Potentially effective in conjunction with other process options; limits mobility of metals and radionuclides to downwind receptors; does not address direct exposure, leaching, or stormwater erosion; not protective over long term; readily implementable.

Table 6. General Response Actions, Technologies, and Process Options Screening Summary

General Response Actions	Response Action Technology	Process Options	Description	Screening Comment
Engineering Controls	Sorting	Sorting	Soil and waste sorting is a standard process applied as an intermediate step between soil or waste excavation and onsite or offsite treatment or disposal methods. The process goal is to segregate highly contaminated material from less contaminated material, allowing for different treatment or disposal options.	Sorting reduces waste volume requiring treatment or disposal, increases the volume of material that can remain on site with limited or no treatment or containment, and allows classification of waste to reduce volume requiring more costly treatment or disposal options. A cost analysis is necessary to determine if sorting is beneficial. Sorting is not retained because it is not effective when waste is relatively homogeneous.
	Containment	Earthen Cover (Evapotranspiration)	Apply soil cover over in situ or consolidated mine waste; establish vegetation to stabilize surface; waste materials are consolidated or left in place. Reduces gamma and suspected radon gas exposure.	Limits direct exposure and reduces gamma irradiation and radon gas flux; surface water infiltration would be reduced; should be combined with surface controls; implementable but would require a somewhat flat area and regrading. Earthen covers on moderate to steep slopes are not successful without benching. Retained for remote areas where access is limited and direct exposure and gamma irradiation reduction through soil shielding is the primary goal.
		Earthen Cover with Upper HDPE or Geosynthetic Clay Liner	Install clay layer, HDPE, or geosynthetic clay liner within cover over mine waste to reduce rainwater infiltration and radon flux; establish vegetation to stabilize surface; waste materials are consolidated or left in place. Reduces gamma and radon exposure.	Limits direct exposure and reduces gamma irradiation; surface water infiltration and radon flux would be eliminated; should be combined with surface controls; implementable but would require a somewhat flat area and regrading. Earthen covers on steep slopes are not successful without benching. Not retained because of the increased cost and time required for a negligible increase in effectiveness relative to an earthen cap.

Table 6. General Response Actions, Technologies, and Process Options Screening Summary

General Response Actions	Response Action Technology	Process Options	Description	Screening Comment
Engineering Controls	Offsite Disposal	Class A LLRW or RCRA C Hazardous Waste Disposal Facility	Excavate mine waste, sort, transport, and dispose of waste at an offsite Class A LLRW or RCRA C hazardous waste disposal facility; leachate generation characteristics may require stabilization.	Removes onsite direct exposure and gamma irradiation by isolating waste at an offsite LLRW or hazardous waste disposal facility where waste is covered or encapsulated; readily implementable. However, transport, any pretreatment, and disposal costs may be cost prohibitive because of the long haul distances required. Transportation costs should be weighed against long-term O&M costs associated with onsite disposal.
Excavation and Treatment	Physical/ Chemical Treatment	Milling/ Reprocessing	Excavate mine waste, sort, transport, and process waste at an operating mill for economic recovery of uranium; dispose of tailings at a mill tailings disposal facility.	Removes onsite direct exposure and gamma irradiation by processing waste at an off-Navajo Nation mill; processed waste (tailings) is covered or encapsulated in a disposal cell; readily implementable. Not retained because a mill in compliance with the CERCLA Off-Site Rule is not currently available.
		Soil Washing/ Acid Extraction	Excavate mine waste, sort, and screen waste to increase percentage of fines for acid digestion. Solubilize uranium and other metals via dissolution or acid leaching and recover by precipitation. Dispose of fines, process solutions, and oversize of materials.	Treatability testing required. Not retained because effectiveness is questionable; increases mobility by partial dissolution of contaminants; difficulty encountered because of gravel-to-rock-sized waste rock and disseminated nature of uranium; increases toxicity of fines; requires disposal of treated fines and oversize material; cost prohibitive.

Table 6. General Response Actions, Technologies, and Process Options Screening Summary

General Response Actions	Response Action Technology	Process Options	Description	Screening Comment
Excavation and Treatment	Physical/ Chemical Treatment	Ablation	Excavate mine waste and screen to segregate oversized materials for crushing or disposal. Mix waste with makeup water to form a slurry. Inject opposing slurry streams to impact one another, causing collisions between particles resulting in disassociation of fine-grained, intergranular, and mineralized material (uranium minerals) from coarser-grained sands. Dewater and reuse bulk of material on site. Concentrates disposed of on or off site.	Treatability testing required; implementable but full scale not demonstrated for uranium; effectiveness depends on the form of mineral deposition (surface or within the particle), the number of passes through collision chamber, and feed concentration. Pilot-scale studies began in summer 2022 to test the feasibility of the technology for uranium at three sites on the Navajo Nation. Ablation technologies have not demonstrated sufficient throughput to address a large volume of waste rock. One of the goals of the pilot studies is to evaluate scale up designs and economics. If ablation is determined to be successful and scalable after the pilot study, a future draft of the EE/CA may incorporate ablation as an alternative.
		Stabilization/ Solidification	Excavate mine waste and screen waste to remove oversized materials. Mix waste with solidifying agents to facilitate a physical or chemical change in leachability and mobility of contaminants. Cure material and dispose of on or off site.	Readily implementable. Not retained because treatability testing is required; waste would still require disposal following stabilization; increases volume; requires a significant amount of water; cost prohibitive. Containment is equally effective.
In-Place Treatment	Physical/ Chemical Treatment	Stabilization	Stabilize waste constituents in situ when combined with injected stabilizing agents.	Not retained because treatability testing is required; more difficulty encountered because of gravel-to-rock-sized waste rock; does not reduce gamma irradiation; potentially implementable but requires a large amount of stabilizing agents and water; cost prohibitive. Containment is equally effective.

Table 6. General Response Actions, Technologies, and Process Options Screening Summary

General Response Actions	Response Action Technology	Process Options	Description	Screening Comment
In-Place Treatment	Physical/ Chemical Treatment	Solidification	Uses solidifying agents in conjunction with deep soil mixing techniques to facilitate a physical or chemical change in the mobility of contaminants.	Not retained because treatability testing is required; more difficulty encountered in gravel-to-rock-sized waste rock; does not reduce gamma irradiation; potentially implementable but requires a large amount of solidifying agents and water; cost prohibitive. Containment is equally effective.
	Thermal Treatment	Vitrification	Uses extremely high temperature to melt and volatilize all components of the solid media; the molten material is cooled and, in the process, vitrified into a non-leachable form.	Not retained because extensive treatability testing is required; difficulties may be encountered in establishing adequate containment; does not reduce gamma irradiation; not implementable because of the remoteness of the site (no high-voltage electrical infrastructure); cost prohibitive.
	Vegetative Treatment	Phytoextraction/ Phytostabilization	Uptake of contaminants by plant roots and accumulation of contaminants within plant shoots and leaves. Immobilization of contaminants at interfaces of roots and soil by absorption or adsorption; precipitation or complexation in root zone binding to humic matter in the root zone.	Extensive treatability testing is required for phytostabilization of radionuclides; phytoextraction requires harvesting and disposing of vegetative growth containing radionuclides and fencing to exclude livestock and wildlife to prevent vegetative bioaccumulation. May require irrigation in arid environments. Long-term protectiveness has not been demonstrated, and O&M costs may be prohibitive.

Notes:

Eliminated process options are shaded.

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
EE/CA	Engineering evaluation/cost analysis
HDPE	High-density polyethylene
LLRW	Low-level radioactive waste
O&M	Operation and maintenance
RCRA	Resource Conservation and Recovery Act

Table 7. Applicable or Relevant and Appropriate Requirements and To Be Considered Requirements for Section 9 Lease Mines

Table 7a, Table 7b, and Table 7c list the federal and State of Arizona chemical-, location-, and action-specific applicable or relevant and appropriate requirements (ARAR) and to be considered (TBC) materials, respectively, that have been identified for all the alternative response actions described in the draft engineering evaluation/cost analysis (EE/CA) for the Section 9 Lease Mines. The U.S. Environmental Protection Agency (USEPA) did not identify federal chemical-specific ARARs or TBCs because potential federal chemical-specific ARARs are not as conservative as the risk-based cleanup standards developed for this action. Chemical-related requirements tied to an action such as cover design were included in the action-specific table. USEPA did identify a State of Arizona chemical-specific ARAR, which supports the human health removal action goal for radium-226. Identification and evaluation of ARARs is an iterative process that continues throughout the response process. As a better understanding is gained of site conditions, contaminants, and response alternatives, the lists of ARARs, TBCs, and their relevance to the removal action may change. ARARs and TBCs are finalized in the action memorandum for the selected response action.

Cleanup standards were derived through the USEPA risk assessment process, in accordance with the following USEPA guidance and the State of Arizona potential chemical-specific ARAR:

- Office of Solid Waste and Emergency Response (OSWER) Directive No. 9200.4-18, "Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination" (August 1997)
- OSWER Directive No. 9200.4-23, "Clarification of the Role of Applicable, or Relevant and Appropriate Requirements in Establishing Preliminary Remediation Goals under CERCLA" (August 1997)
- OSWER Directive No. 9200.4-25, "Use of Soil Cleanup Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA Sites" (February 1998)
- OSWER Directive No. 9200.4-40, "Radiation Risk Assessment at CERCLA Sites: Q&A" (May 2014)

The EE/CA for which the ARARs tables were prepared does not address groundwater; therefore, ARARs for groundwater are not included. If any groundwater contamination is found at the Section 9 Lease Mines, the related ARARs will be addressed at that time.

Table 7a. Chemical-Specific ARARs

Media	Requirement	Requirement Synopsis	Prerequisites, Status, and Rationale
Soil	STATE OF ARIZONA **Soil Remediation Standards** AAC R18-7-203(A)(3) and R18-7-206	Under R18-7-203(A), a person subject to Article 18 shall remediate soil so that any concentration of contaminants remaining in soil after remediation is equal to one of the following: (1) background; (2) pre-determined remediation standards; or (3) site-specific remediation standards. Under R18-7-206, a person may elect to remediate to a residential or a non-residential site-specific remediation standard derived from a site-specific human health risk assessment. A site-specific remediation standard may be used if it is based on: (1) a deterministic methodology; (2) a probabilistic methodology; or (3) an alternative methodology commonly accepted in the scientific community.	**Relevant and Appropriate** The State of Arizona soil remediation standards are applicable to a person legally required to conduct remediation under programs administered by the ADEQ. Since this site is being addressed pursuant to CERCLA, these requirements are not applicable. USEPA has identified a site-specific human health RAG for radium-226 that is protective of a recreational visitor, which was considered the reasonable maximum exposure scenario for the site. This RAG was derived using a deterministic methodology and is commonly accepted in the scientific community. This complies with the State of Arizona Soil Remediation Standards ARARs.

Notes:

AAC	*Arizona Administrative Code*
ADEQ	Arizona Department of Environmental Quality
ARAR	Applicable or relevant and appropriate requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
RAG	Removal action goal
USEPA	U.S. Environmental Protection Agency

Table 7b. Location-Specific ARARs

Media/Resource	Requirement	Requirement Synopsis	Prerequisites, Status, and Rationale
Cultural Resources	FEDERAL **The Native American Graves Protection and Repatriation Act** **25 U.S.C. §§ 3002(c) and (d)** 43 CFR §§ 10.3(b)-(c) and 10.4(b)-(e)	Protects Native American cultural items from unpermitted removal and excavation and requires the protection of such items in the event of inadvertent discovery. Excavation or removal of cultural items must be done under procedures required by this Act and the Archaeological Resources Protection Act (§ 3(c)(1)).	**Applicable.** This Act is identified as a potential ARAR because the site is near the Navajo Nation Reservation. Substantive requirements are applicable if cultural items (meaning human remains and associated or unassociated funerary objects, sacred objects, or cultural patrimony) are inadvertently discovered or are intentionally excavated or removed within the area to be disturbed. If cultural items are discovered, on-going activity in the area of discovery must stop, the relevant Indian tribe official must be notified immediately, and reasonable effort must be made to protect such cultural items.
Cultural Resources	FEDERAL **National Historic Preservation Act** **54 U.S.C. §§ 306101(a), 306102, 306107, and 306108** 36 CFR §§ 800.3(a) and (c); 800.4(a)-(c); 800.5(a)-(b); 800.6(a)-(b); 800.10(a); 800.13(b)-(d)	Federal agencies are required to consider the effects of federally funded (in whole or in part) activity on any historic property, minimize harm to any National Historic Landmark, and nominate qualifying historic property for inclusion on the National Register of Historic Places. Federal agencies may be required to identify historic properties, determine whether the proposed activity will have an adverse effect on historic properties, and develop alternatives or modifications to the proposed action that could avoid, minimize, or mitigate adverse effects through the National Historic Preservation Act Section 106 process.	**Applicable.** Substantive requirements are applicable if the federally funded activity could adversely affect historic property (meaning a prehistoric or historic district, site, building, structure, or object) included on, or eligible for inclusion on, the National Register of Historic Places. A cultural resource survey was completed in 2017. No cultural resources were identified on the site.

Table 7b. Location-Specific ARARs

Media/Resource	Requirement	Requirement Synopsis	Prerequisites, Status, and Rationale
Cultural Resources	FEDERAL **Preservation of Historical and Archaeological Data** **54 U.S.C. §§ 312502(a) and 312503**	Protects significant scientific, prehistorical, historical, and archaeological data. When a federal agency action may cause irreparable loss or destruction of significant data, the agency must notify DOI and either recover, protect, and preserve the data, or request DOI to do so.	**Applicable.** Substantive requirements are applicable if federal agency action may cause irreparable loss or destruction to significant scientific, prehistorical, historical, or archaeological data. A cultural resource survey was completed in 2017. No cultural resources were identified on the site.
Cultural Resources	FEDERAL **Archaeological Resources Protection Act of 1979** **16 U.S.C. §§ 470cc(a)-(c) and 470ee(a)** 43 CFR §§ 7.4(a), 7.5(a), 7.7, 7.8(a), 7.9(c), and 7.35	Prohibits the excavation, removal, damage, or alteration or defacement of archaeological resources on public or Indian lands unless by permit or exception.	**Applicable.** Substantive requirements are applicable if eligible archaeological resources are located within the area to be disturbed. A portion of the removal action will occur on public land (BLM). A cultural resource survey was completed in 2017. No cultural resources were identified on the site.
Biological Resources	FEDERAL **Migratory Bird Treaty Act** **16 U.S.C. § 703(a)** 50 CFR §§ 10.13 and 21.10	Prohibits the killing, capturing, taking, and incidental taking of protected migratory bird species, their parts, nests, and eggs without DOI's prior approval. The species of protected migratory birds are listed at 50 CFR § 10.13.	**Applicable.** Substantive requirements are applicable if migratory birds or their nests are present at or near the site.
Biological Resources	FEDERAL **Bald and Golden Eagle Protection Act** **16 U.S.C. §§ 668(a)** 50 CFR §§ 22.10; 22.80(a), (c)-(f); 22.85(a)-(b) and (d)-(e) 50 CFR § 13.21(b)	Prohibits the unpermitted taking, including the killing, disturbing, or incidental taking, of bald and golden eagles, their parts, nests, and eggs.	**Applicable.** Substantive requirements applicable if bald or golden eagles or their nests are identified at or near the site.

Table 7b. Location-Specific ARARs

Media/Resource	Requirement	Requirement Synopsis	Prerequisites, Status, and Rationale
Biological Resources	FEDERAL **Endangered Species Act** **16 U.S.C. §§ 1531(c); 1536(a)(2), (c)-(d), (g)-(h), and (l); 1538(a) and (g); 1539(a)** 50 CFR §§ 17.21(a)-(c); 17.22(b); 17.31(a) and (c);17.32(b); 17.82; and 17.94(a) 50 CFR §§ 402.09; 402.12 (a)-(b) and (i); 402.14(a); 402.15(a)	Federal agencies must ensure that any activities funded, carried out, or authorized by them do not jeopardize the continued existence of any threatened or endangered species nor result in the destruction or alteration of such species' habitats. The list of endangered and threatened species can be found at 50 CFR Part 17, Subpart B.	**Applicable.** Substantive requirements applicable if endangered or threatened species are identified at the site. A biological survey was completed and no endangered or threatened species were identified on the site.

Notes:

§	Section
§§	Sections
ARAR	Applicable or relevant and appropriate requirement
BLM	Bureau of Land Management
CFR	*Code of Federal Regulations*
DOI	U.S. Department of the Interior
TBC	To be considered
U.S.C.	*United States Code*

Table 7c. Action-Specific ARARs

Media	Requirement	Requirement Synopsis	Prerequisites, Status, and Rationale
Air	FEDERAL **Clean Air Act** **42 U.S.C. §§ 7401, *et seq.*** 40 CFR § 61.92	Emissions of radionuclides (other than radon) to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/yr.	**Relevant and appropriate.** This standard is applicable to a DOE facility. The NAUM sites are not DOE facilities; therefore, this standard is not applicable However, this standard has been determined to be relevant and appropriate during removal action activities because of potential emissions of radionuclides during excavation of the waste and movement of the waste.
Air	FEDERAL **Clean Air Act** **42 U.S.C. §§ 7401, *et seq.*** 40 CFR § 61.222(a)	Radon-222 emissions to the ambient air from a uranium mill tailings pile that is no longer operational shall not exceed 20 pCi/m^2-sec.	**Relevant and appropriate.** These requirements are applicable to nonoperational uranium mill tailings piles. The Site's waste to be disposed of is not uranium mill tailings. These requirements have been determined to be relevant and appropriate to the design of the engineered cover to be constructed in Alternative 2, which consists of onsite containment of the contaminated soil and uranium waste rock.
Water	FEDERAL **Clean Water Act** **33 U.S.C. § 1342(p)(3)(A)** NPDES– Stormwater Discharges 40 CFR § 450.21	Requires BMPs to abate discharges of pollutants from stormwater discharges and erosion and sediment control BMPs. All treatment and control systems and facilities will be properly operated and maintained.	**Applicable** The construction in Alternatives 2 and 3 would affect more than one acre. Therefore, stormwater controls are necessary.
Repository	FEDERAL **Uranium Mill Tailings Radiation Control Act** **42 USC §§ 7918 and 2022** 40 CFR §§192.02(a) and (d)	Requires design of uranium mill tailings disposal sites to provide for control of residual radioactive materials for up to 1,000 years to the extent reasonably achievable and, in any case, for at least 200 years. The uranium mill tailings disposal site must also be designed and stabilized in a manner that minimizes the need for future maintenance.	**Relevant and Appropriate** These standards are applicable to UMTRCA Title I sites. The Site is not a Title I Site; therefore, these requirements are not applicable. These requirements have been determined to be relevant and appropriate to the design of the engineered cover to be constructed under Alternative 2, which consists of onsite containment of the contaminated soil and uranium waste rock.

Table 7c. Action-Specific ARARs

Media	Requirement	Requirement Synopsis	Prerequisites, Status, and Rationale
Repository	FEDERAL **NRC Regulations** **Domestic Licensing of Source Material** 10 CFR Part 40, Appendix A. Criteria 1, 4, 6(1), 6(3), 6(5) and 6(7)	In selecting and designing uranium mill tailings disposal sites, certain criteria must be considered, including remoteness, hydrologic and topographic features, potential for erosion and vegetation. Disposal sites must be covered by an earthen cap, or approved alterative, that meets certain control requirements, including limiting the release of radon-222 to the atmosphere. When the final radon barrier is placed in phases, verification of the radon-222 release rate must be completed for each portion of the final radon barrier as it is emplaced. Waste or rock with elevated levels of radium must not be placed near the surface of disposal sites. Disposal sites must be closed in a manner that, to the extent necessary, controls, minimizes, or eliminates post closure escape of non-radiological hazardous constituents, leachate, contaminated rainwater, or waste decomposition products to the ground or surface waters or atmosphere.	**Relevant and Appropriate** These standards are applicable to applicants for licenses to possess and use source material in conjunction with uranium and thorium milling or byproduct material at sites formerly associated with such milling. This Site was not used for milling uranium and does not contain mill tailings. These requirements have been determined to be relevant and appropriate to the design of the engineered cover to be constructed in Alternative 2, which consists of onsite containment for the contaminated soil and uranium waste rock.
Repository	FEDERAL **NRC Regulations** **Protection of the General Population from Releases of Radioactivity** 10 CFR § 61.41	"Concentrations of radioactive material which may be released to the general environment in groundwater, surface water, air, soil, plants, or animals must not result in an annual dose exceeding an equivalent of 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public. Reasonable effort should be made to maintain releases of radioactivity in effluents to the general environment as low as is reasonably achievable."	**Relevant and Appropriate** This standard is applicable to NRC sites. The Site is not an NRC site; therefore, this requirement is not applicable. This standard was found to be relevant and appropriate to the design of the engineered cover to be constructed in Alternative 2 for the onsite containment of contaminated soil and uranium waste rock.

Table 7c. Action-Specific ARARs

Media	Requirement	Requirement Synopsis	Prerequisites, Status, and Rationale
Air	STATE OF ARIZONA **Clean Air Act** **Emissions from Existing and New Nonpoint Sources** **Construction of Roadways** AAC R18-2-605(A)	No person shall construct a roadway without taking reasonable precautions to prevent excessive amounts of particulate matter from becoming airborne. Dust and other particulates shall be kept to a minimum by employing temporary dust suppressants, wetting down, detouring, or by other reasonable means.	**Applicable** Haul roads are planned to be constructed for the onsite repository and for the excavation. Dust suppression would be used during construction of the haul roads.
Air	STATE OF ARIZONA **Clean Air Act** **Emissions from Existing and New Nonpoint Sources** **Mineral Tailings** AAC R18-2-608	No person shall operate mineral tailings piles without taking reasonable precautions to prevent excessive amounts of particulate matter from becoming airborne. Reasonable precautions shall mean wetting, chemical stabilization, revegetation, or other such measures.	**Relevant and appropriate** The Site has no mineral tailings piles. However, the alternatives include the excavation and movement of mine waste, which is similar to mineral tailings piles. Dust suppression would be used during the excavation and movement of the mine waste.
Water	STATE OF ARIZONA **State of Arizona 2020 Construction General Permit**	The operator shall design, install, and maintain erosion and sediment control, site stabilization, pollution prevention, and controls for allowable non-stormwater discharges and dewatering activities, and surface outlets.	**TBC** Construction activities in Alternatives 2 and 3 affect more than 1 acre. The substantive provisions of this permit would be used as guidance to comply with the Clean Water Act stormwater control requirements.

Notes:

§	Section
§§	Sections
AAC	*Arizona Administrative Code*
ARAR	Applicable or relevant and appropriate requirement
BMP	Best management practices
CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
mrem/yr	Millirem per year
NAUM	Navajo abandoned uranium mine
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
pCi/m^2-sec	Picocurie per square meter per second
TBC	To be considered
UMTRCA	Uranium Mill Tailings Radiation Control Act
U.S.C.	*United States Code*

APPENDIX A

SCOPING INVESTIGATION SUMMARY MEMORANDUM

TETRA TECH

Technical Memorandum

To:	Estrella Armijo
Cc:	
From:	Kato T. Dee, Geologist/Project Manager, Tetra Tech
Date:	June 30, 2024
Subject:	Response, Assessment, and Evaluation Services 2 Contract, Task Order 020 - Babbitt Ranches Field Scoping Summary: February 6-10, 2024

OVERVIEW

The U.S. Environmental Protection Agency (USEPA) tasked Tetra Tech, Inc. to conduct a field event with repository scoping and disturbance mapping to support the development of the engineering evaluation/cost analysis (EE/CA) and non-time-critical removal action planning and oversight.

This technical memorandum summarizes the data gaps field scoping activities completed by Tetra Tech, Inc. February 6 through 10, 2024, at the mines on Section 9, most of Abandoned Uranium Mine (AUM) 457, AUM 458, and a small portion of AUM 459. Field scoping activities followed the approved Section 9 Lease Mines work plan and field sampling plan. The Section 9 Lease Mines site is adjacent to the Navajo Nation on private land owned by Babbitt Ranches, LLC near Cameron, Coconino County, Arizona.

The objectives of the field event were to map site features, identify locations for potential onsite waste repositories, confirm removal action areas, and select appropriate removal action alternatives for the EE/CA. The data collected during this field event were used to prepare the draft final and final EE/CAs. In addition to disturbance mapping and repository scoping, additional soil samples were collected to support risk assessment, lateral delineation of contamination, and secular equilibrium evaluation of the site.

During the field scoping event, an area of Section 9 was evaluated as a potential waste repository for onsite management EE/CA alternatives. The potential repository location is on a small mesa in the northwestern corner of Section 9 and is evaluated in the EE/CA.

The following sections provide an overview of field activities along with any available associated maps or preliminary results.

DISTURBANCE MAPPING

Disturbance mapping was conducted to support identification of disturbed and undisturbed areas within the Section 9 Lease Mines. The primary purpose of disturbance mapping was to define the geospatial distribution and lateral extent of mining-related physical disturbances across the Section 9 investigation area, identified as the area of potential effect (APE) and North APE in past investigations. The areas within the Section 9 Lease Mines boundaries identified in the removal site evaluation (RSE) (Engineering Analytics, Inc. [EA] 2021) have been investigated by previous contractors. Therefore, disturbance mapping efforts focused on delineation of previously identified mine pits and waste piles at AUM 457 and AUM 458, roads, and exploration areas across the Section 9 Lease Mines. In addition to mapping mining-related disturbance features across the site, locations with elevated gamma radiation measurements documented in the RSE report outside of known mining and exploration areas were investigated to note disturbances, if observed, or identify if elevated gamma radiation measurements were from naturally occurring radioactive material (NORM).

Field observations documented during disturbance mapping are provided on Figure 1, including those recorded as point features and mapped as polygon features. All field observations were collected in an ArcGIS Survey123 form that allows field staff to enter metadata as lines of evidence in identifying if the feature is disturbed or undisturbed. For each field observation, field notes and photographs were also recorded and are available on the USEPA Region 9 AUM GeoPlatform. The classifications of disturbance types and undisturbed areas based on field observations are shown on Figure 2. Disturbance mapping results for AUM 457 and AUM 458 are presented on Figure 3 and Figure 4, respectively.

Figure 5 presents the site drainage pathways and hydrology with the field-verified disturbance map to identify potential waste transport pathways to be used for risk assessment and EE/CA alternative development.

A photographic log of disturbance mapping observations is provided in Attachment 1. The EE/CA will include a comprehensive photographic log to highlight more features associated with the Section 9 Lease Mines.

SURFACE SOIL SAMPLING

Supplemental surface soil sampling was conducted across the Section 9 Lease Mines to further characterize surface soils and provide a sufficient number of soil samples for completing risk assessment exposure point concentration calculations, lateral delineation of contamination for the EE/CA, and secular equilibrium calculations following the Navajo AUM risk assessment methodology (USEPA 2024). Surface and subsurface soil sampling was previously conducted during the site inspection (Weston Solutions, Inc. 2014) and RSE (EA 2021). Additional soil sampling was conducted to meet USEPA requirements for the characterization of AUM sites and to supplement the risk assessment completed during Phase III of the RSE.

Surface soil samples were collected from 0 to 6 inches below ground surface at 20 locations across the Section 9 Lease Mines: 10 samples within the mine boundaries of AUM 457 and AUM 458 and 10 samples in the APE outside the mine boundaries. Sample locations were judgmentally selected based on the results of the walkover gamma radiation survey completed in the RSE investigation. The sample locations were accessible, and no sample locations were relocated by more than 5 feet laterally during sampling except for location APE-SS03, which was relocated by 50 feet from the original location because of proximity to the road. One sample location, 458-SS06, was randomly chosen for duplicate soil sampling before starting the field event.

Soil samples were submitted for analysis of metals and metalloids by USEPA Method 6020; mercury by USEPA Method 7471B; multiple radionuclides, including radium-226, uranium-238, thorium-232, polonium-210, and lead-210 by gamma spectroscopy by U.S. Department of Energy EH-300; and isotopic uranium and isotopic thorium by U.S. Department of Energy HASL-300. Four samples were randomly selected for measurement of hexavalent chromium by USEPA Method 7196A.

The laboratory results of the supplemental surface soil sampling are provided in Table 1 and will be subsequently analyzed while updating the risk assessment and EE/CA. Soil sampling results are shown for AUM 457, AUM 458, and the APE on Figure 6, Figure 7, and Figure 8, respectively.

REPOSITORY SCOPING

Repository scoping was conducted to support development of removal action alternatives for the EE/CA for the Section 9 Lease Mines. Removal action alternatives for AUM sites include onsite management options, such as consolidating and capping mining waste in an onsite waste repository.

Potential locations on Section 9 for an onsite waste repository were identified during the field scoping investigation using the following suitability criteria:

- **Size –** The size of the site determines the volume of material that can be stored on site. Generally, increased site size reduces engineering and operations and maintenance (O&M) costs.
- **Access –** Distance from established roads and other mine sites in the region directly impact hauling costs. Sites located centrally within the region or close to major roadways have reduced construction and O&M costs.
- **Topography –** Flatter sites reduce engineering costs and O&M. Repository locations on steeper sites often have stricter design criteria and phasing with less flexibility for incoming volume fluctuations.
- **Distance from drainage pathways –** Sites located away from major waterways like the Little Colorado River (LCR) and major drainage features provide better protection from erosive conditions, reduce contamination migration, and preserve room for mitigation controls and sampling downgradient from a repository location.

Several locations in the northwest corner of Section 9 about 1 mile from the LCR (Figure 9) meet the screening criteria for an onsite repository. Section 9 is accessed off U.S. Highway 89, and an improved gravel road, Indian Route 6728, provides direct access to potential repository locations. The terrain is flat with limited upgradient stormwater inflows, and no major drainage pathways are near the site. Additionally, local borrow sources offer a range of materials for repository construction, including basalt, sand, gravel, and clay resources. Minor drainage pathways are adjacent to the primary Section 9 location, but none pass through the site itself.

SUMMARY

The field scoping event at the Section 9 Lease Mines conducted in February 2024 comprised disturbance mapping, surface soil sampling, and repository scoping activities. Field observations of disturbance features, such as locations and characteristics of waste rock piles, will be used to improve delineation of areas of technically enhanced naturally occurring radioactive material (TENORM) and estimate waste volumes for use in the EE/CA. Results from the surface soil samples collected during the field scoping are presented here and will be subsequently analyzed alongside past soil sampling results from the site inspection and RSE to update the risk assessment and secular equilibrium calculations. Repository scoping was successful, and multiple locations passed screening criteria for onsite consolidation of waste from AUM 457 and AUM 458 and for consolidation of waste.

Data collected during the field scoping event at the Section 9 Lease Mines will be incorporated into the selection of removal action alternatives, update to the risk assessment including secular equilibrium calculations, determination of the appropriate cleanup level(s) for the contaminant(s) of concern, and identification of the removal action footprint for the final EE/CA.

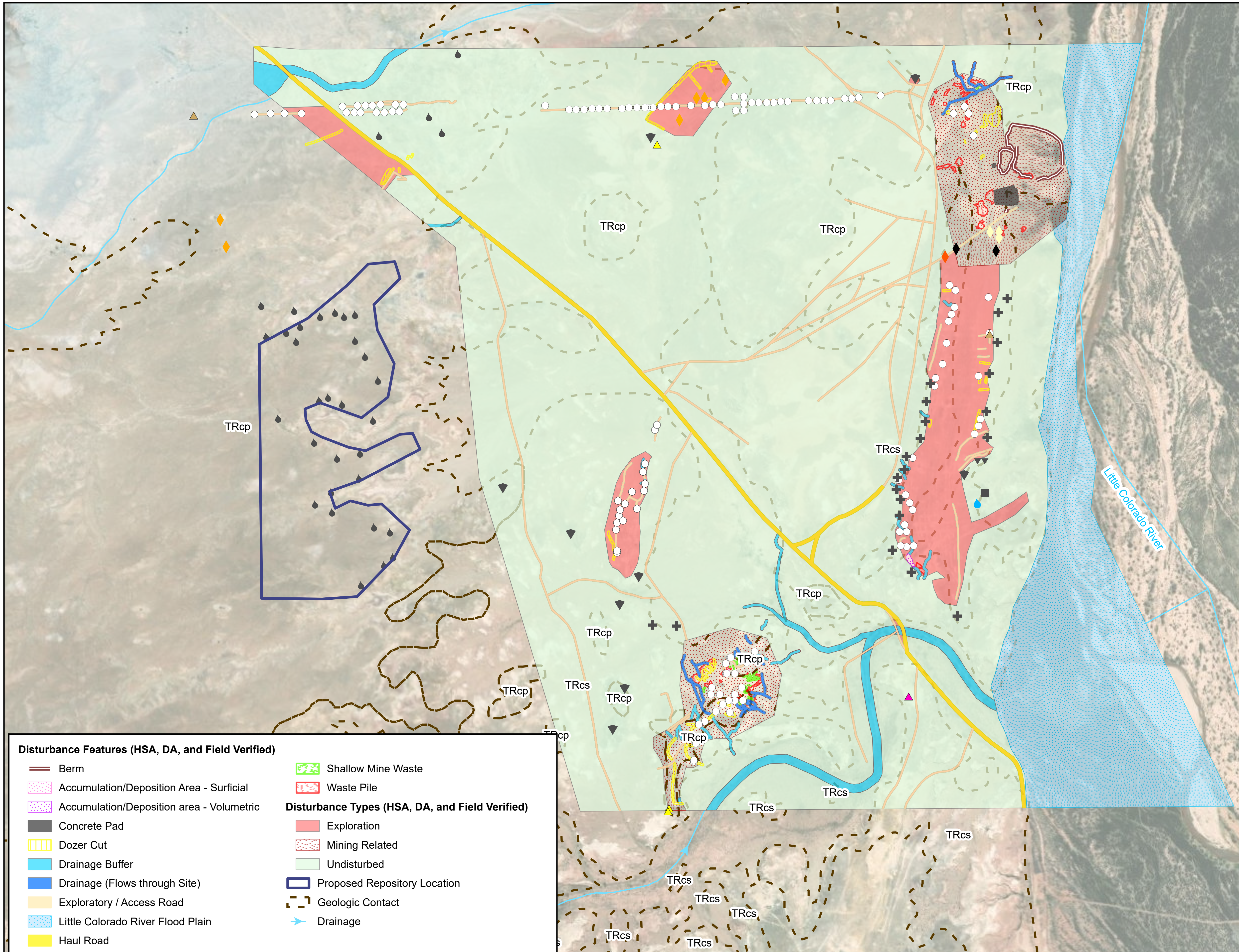
REFERENCES

Engineering Analytics, Inc. (EA). 2021. "Removal Site Evaluation Report, Babbitt Ranches, LLC – Milestone Hawaii Stewardship Project (Section 9 Lease Abandoned Uranium Mine)." Draft. Comprehensive Environmental Response, Compensation, and Liability Act Docket No. 2016-13. March 18.

U.S. Environmental Protection Agency (USEPA). 2024. "Navajo Abandoned Uranium Mines Risk Calculator." Version 1.03. February.

Weston Solutions, Inc. 2014. "Site Inspection Report, Section 9 Lease Abandoned Uranium Mine, Coconino County, Arizona." U.S. Environmental Protection Agency (USEPA) ID No. NNN000909110. Prepared for USEPA Region 9. June.

FIGURES



Disturbance Features - *Field Observations*

Disturbed

Exploration

- Cleared Area
- Dozer Berm
- Drill Trail
- Exploratory Borehole
- Impacted Soil
- Mining Exploration Debris
- Vegetation

Hydrology

- Drainage - Other

Production Mining

- Production Mine Debris
- Concrete Pad
- Haul Road
- Soil

Undisturbed

- Inaccessible - Cliff
- Mass Wasting
- Mineralized Outcrop
- Stream
- Vegetation / Soil / Old-Growth Trees
- Bedrock

Notes:

DA	Desktop analysis
HSA	Historical site evaluation
TRcp	Chinle Formation Petrified Forest Member
TRcs	Chinle Formation Shinarump Member

1 inch = 660 Feet

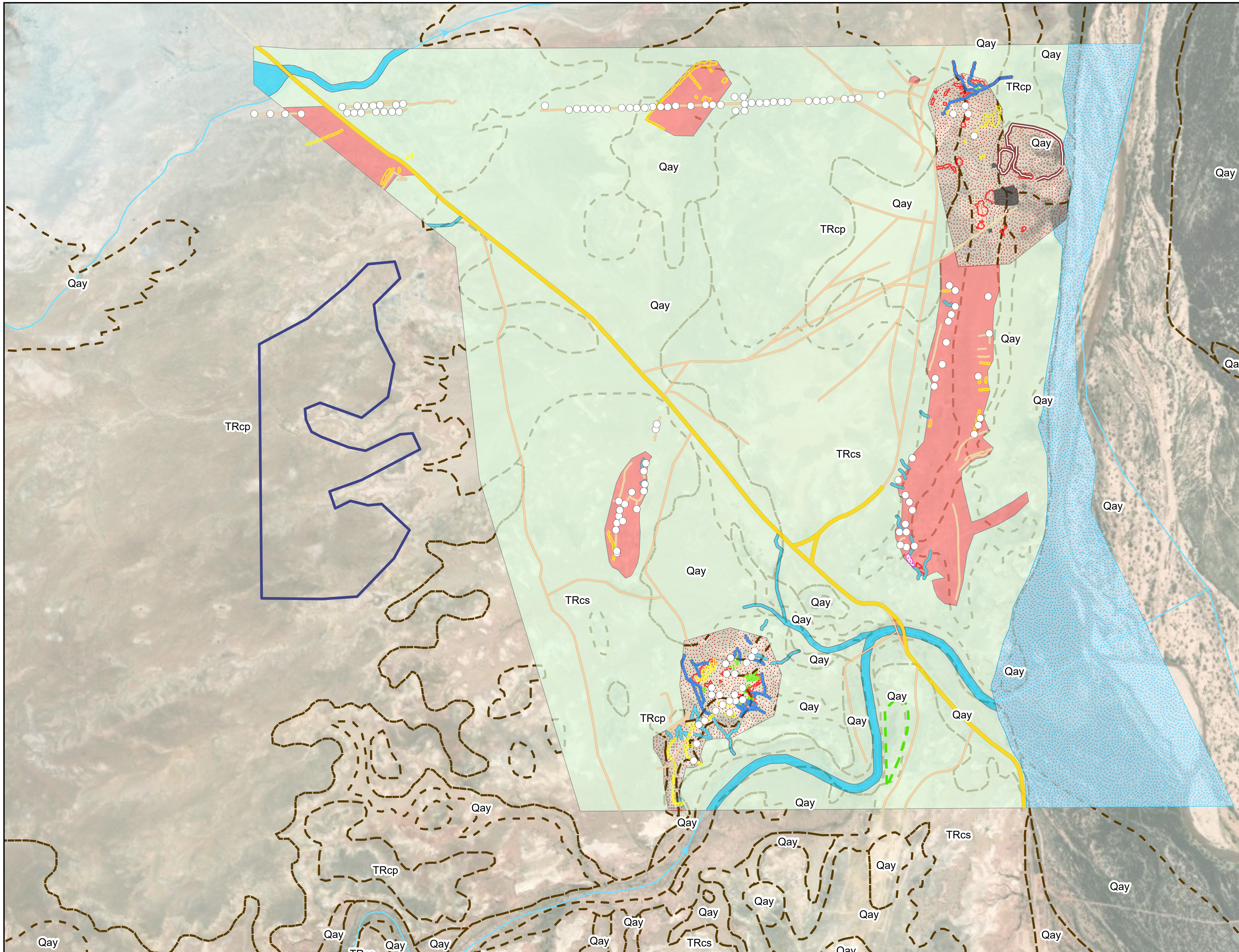
1:7,920

N W E S

660 330 0 660 Feet

SECTION 9 LEASE FIELD VERIFIED DISTURBANCE MAPPING RESULTS WITH FIELD OBSERVATIONS

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 7/2/2024
Coordinate System: NAD 1983 State Plane Arizona Central FIPS 0202 Feet Transverse Mercator	Figure No.: A-1



Disturbance Features (HSA, DA, and Field Verified)

- Exploratory Borehole
- Berm
- Accumulation/Deposition Area - Surficial
- Accumulation/Deposition Area - Volumetric
- Concrete Pad
- Dozer Cut
- Drainage Buffer
- Drainage (Flows through Site)
- Exploratory / Access Road
- Little Colorado River Flood Plain
- Haul Road
- Shallow Mine Waste
- Waste Pile

Disturbance Types (HSA, DA, and Field Verified)

- Exploration
- Mining Related
- Undisturbed
- Proposed Repository Location
- Geologic Contact
- Minearlized Outcrop
- Drainage

Notes:

DA	Desktop analysis
HSA	Historical site evaluation
TRcp	Chinle Formation Petrified Forest Member
TRcs	Chinle Formation Shinarump Member

1 inch = 660 Feet

1:7,920

N W E S

660 330 0 660 Feet

SECTION 9 LEASE FIELD VERIFIED DISTURBANCE MAPPING RESULTS WITHOUT FIELD OBSERVATIONS

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 7/2/2024
Coordinate System: NAD 1983 State Plane Arizona Central FIPS 0202 Feet Transverse Mercator	Figure No.: A-2

Disturbance Features (HSA, DA, and Field Verified)

- Exploratory Borehole
- Berm
- Accumulation/Deposition Area - Surficial
- Accumulation/Deposition Area - Volumetric
- Concrete Pad
- Dozer Cut
- Drainage Buffer
- Drainage (Flows through Site)
- Exploratory / Access Road
- Little Colorado River Flood Plain
- Haul Road
- Shallow Mine Waste
- Waste Pile

Disturbance Types (HSA, DA, and Field Verified)

- Exploration
- Mining Related
- Undisturbed
- Geologic Contact
- Drainage

Notes:

AUM	Abandoned uranium mine
DA	Desktop analysis
HSA	Historical site evaluation
TRcp	Chinle Formation Petrified Forest Member
TRcs	Chinle Formation Shinarump Member

1 inch = 160 Feet

1:1,920

N W E S

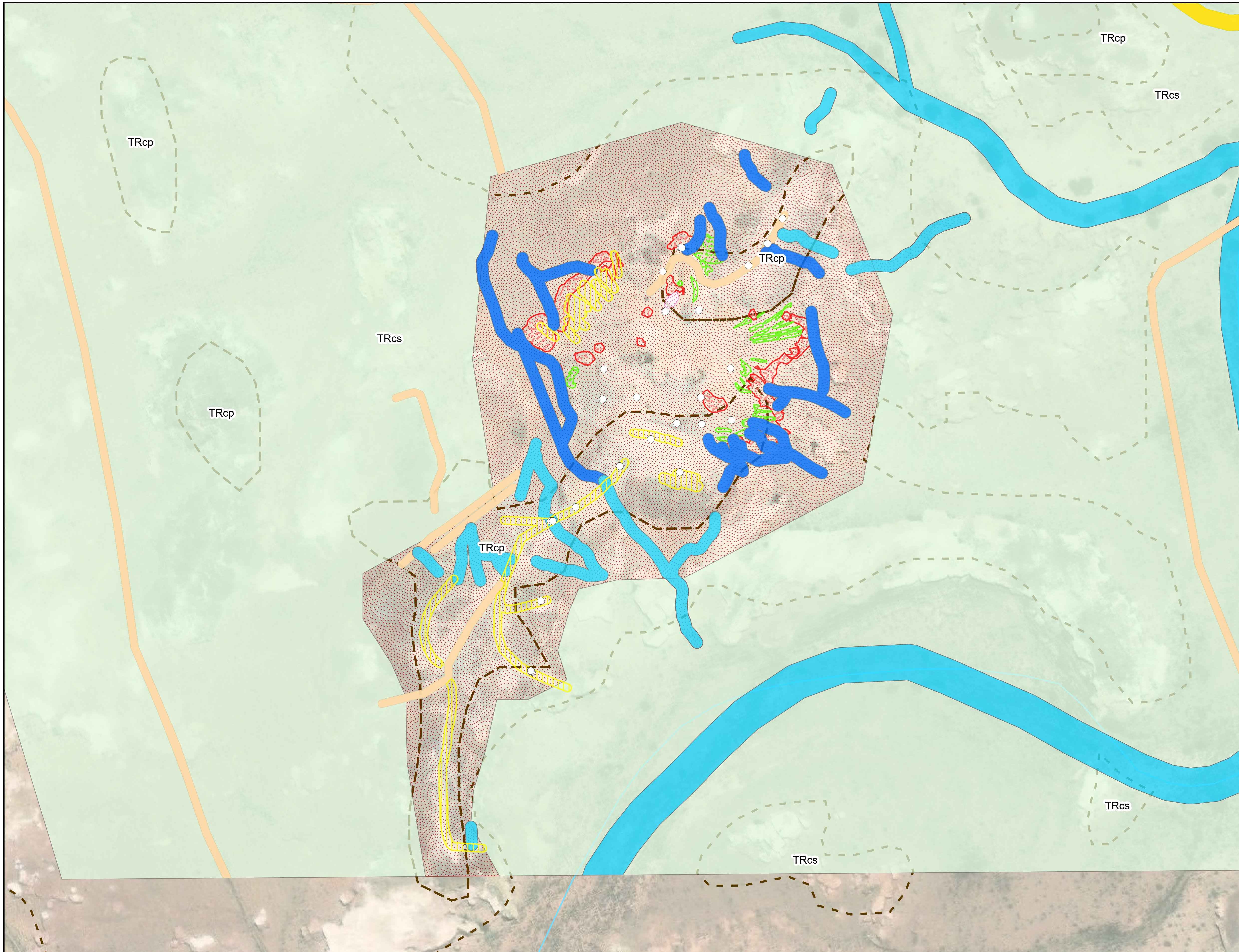
160 80 0 160 Feet

SECTION 9 LEASE FIELD VERIFIED DISTURBANCE MAPPING RESULTS – AUM 457

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612

Task Order No.: 020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 7/2/2024
Coordinate System: NAD 1983 State Plane Arizona Central FIPS 0202 Feet Transverse Mercator	Figure No.: A-3



Disturbance Features (HSA, DA, and Field Verified)

- Exploratory Borehole
- Berm
- Accumulation/Deposition Area - Surficial
- Accumulation/Deposition Area - Volumetric
- Concrete Pad
- Dozer Cut
- Drainage Buffer
- Drainage (Flows through Site)
- Exploratory / Access Road
- Little Colorado River Flood Plain
- Haul Road
- Shallow Mine Waste
- Waste Pile

Disturbance Types (HSA, DA, and Field Verified)

- Exploration
- Mining Related
- Undisturbed
- Geologic Contact
- Drainage

Notes:

AUM	Abandoned uranium mine
DA	Desktop analysis
HSA	Historical site evaluation
TRcp	Chinle Formation Petrified Forest Member
TRcs	Chinle Formation Shinarump Member

1 inch = 160 Feet

1:1,920

160 80 0 160 Feet

N W E S

SECTION 9 LEASE FIELD VERIFIED DISTURBANCE MAPPING RESULTS – AUM 458

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612

Task Order No.: 020

Contract No.: 68HE0923D0002

Location: COCONINO COUNTY, AZ

Date: 7/2/2024

Coordinate System: NAD 1983 State Plane Arizona Central FIPS 0202 Feet Transverse Mercator

Figure No.: A-4

Site Drainage Types

- Waste Transport
- Other
- Undisturbed
- Watershed Catchment Boundary

Disturbance Features (HSA, DA, and Field Verified)

- Berm
- Accumulation/Deposition Area - Surficial
- Accumulation/Deposition Area - Volumetric
- Concrete Pad
- Dozer Cut
- Drainage Buffer
- Drainage (Flows through Site)
- Exploratory / Access Road
- Haul Road
- Shallow Mine Waste
- Waste Pile
- Drainage

Notes:

DA	Desktop analysis
HSA	Historical site evaluation

1 inch = 600 Feet

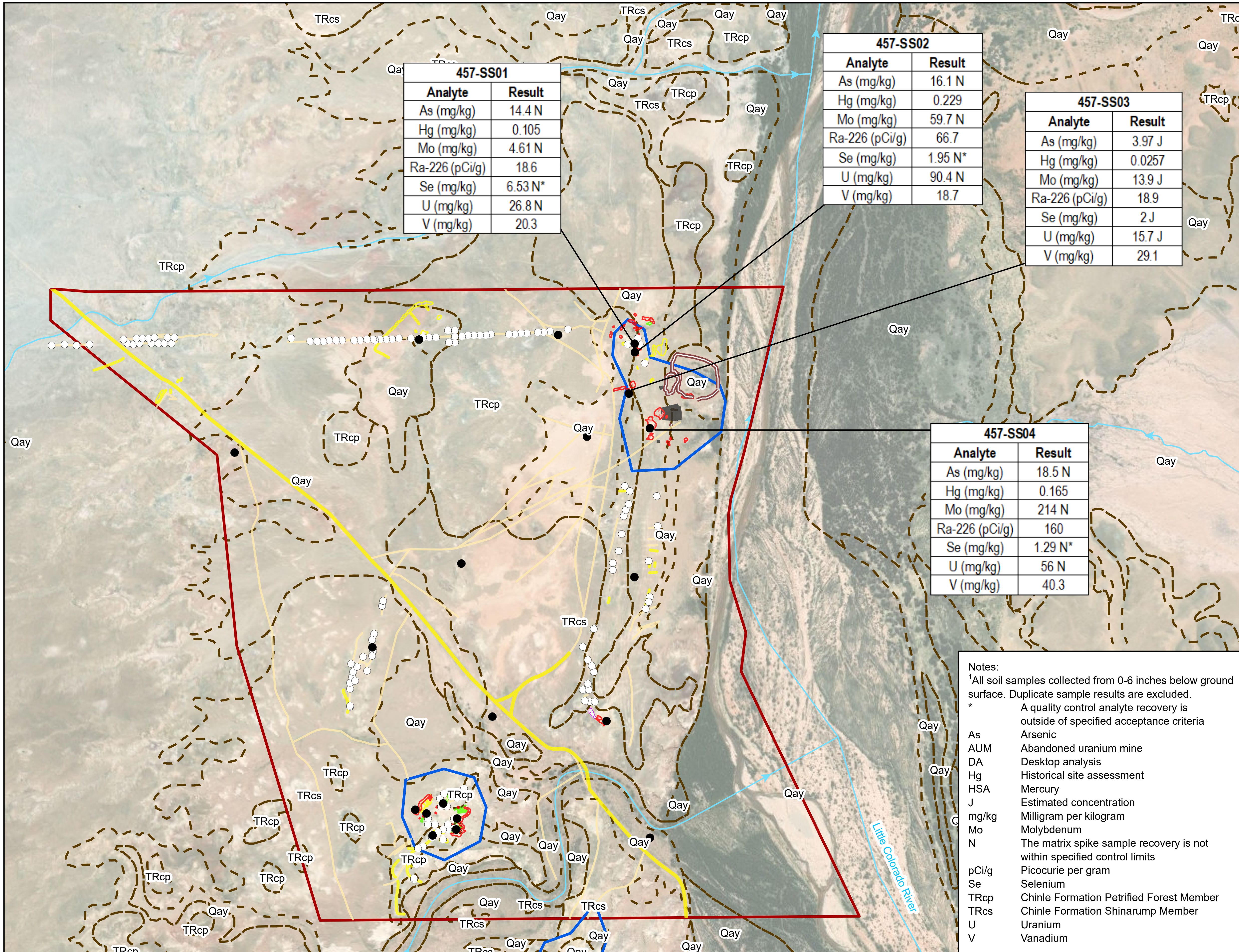
1:7,200

0 300 600 1,200 Feet

N W E S

SECTION 9 LEASE HYDROLOGY

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 7/2/2024
Coordinate System: NAD 1983 State Plane Arizona Central FIPS 0202 Feet Transverse Mercator	Figure No.: A-5



457-SS01

Analyte	Result
As (mg/kg)	14.4 N
Hg (mg/kg)	0.105
Mo (mg/kg)	4.61 N
Ra-226 (pCi/g)	18.6
Se (mg/kg)	6.53 N*
U (mg/kg)	26.8 N
V (mg/kg)	20.3

457-SS02

Analyte	Result
As (mg/kg)	16.1 N
Hg (mg/kg)	0.229
Mo (mg/kg)	59.7 N
Ra-226 (pCi/g)	66.7
Se (mg/kg)	1.95 N*
U (mg/kg)	90.4 N
V (mg/kg)	18.7

457-SS03

Analyte	Result
As (mg/kg)	3.97 J
Hg (mg/kg)	0.0257
Mo (mg/kg)	13.9 J
Ra-226 (pCi/g)	18.9
Se (mg/kg)	2 J
U (mg/kg)	15.7 J
V (mg/kg)	29.1

457-SS04

Analyte	Result
As (mg/kg)	18.5 N
Hg (mg/kg)	0.165
Mo (mg/kg)	214 N
Ra-226 (pCi/g)	160
Se (mg/kg)	1.29 N*
U (mg/kg)	56 N
V (mg/kg)	40.3

Soil Sample Location[1]

Disturbance Features (HSA, DA, and Field Verified)

- Exploratory Borehole
- Berm
- Accumulation/Deposition Area - Surficial
- Accumulation/Deposition Area - Volumetric
- Concrete Pad
- Dozer Cut
- Exploratory / Access Road
- Haul Road
- Shallow Mine Waste
- Waste Pile

AUM Site Boundary

Data Gaps Investigation Area

Geologic Contact

Drainage

1 inch = 800 Feet

1:9,600

800 400 0 800 Feet

N W E S

Notes:

[1]All soil samples collected from 0-6 inches below ground surface. Duplicate sample results are excluded.

*	A quality control analyte recovery is outside of specified acceptance criteria
As	Arsenic
AUM	Abandoned uranium mine
DA	Desktop analysis
Hg	Historical site assessment
HSA	Mercury
J	Estimated concentration
mg/kg	Milligram per kilogram
Mo	Molybdenum
N	The matrix spike sample recovery is not within specified control limits
pCi/g	Picocurie per gram
Se	Selenium
TRcp	Chinle Formation Petrified Forest Member
TRcs	Chinle Formation Shinarump Member
U	Uranium
V	Vanadium

SECTION 9 LEASE MINES

DATA GAPS

SOIL SAMPLING RESULTS – AUM-457

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612

Task Order No.: 020

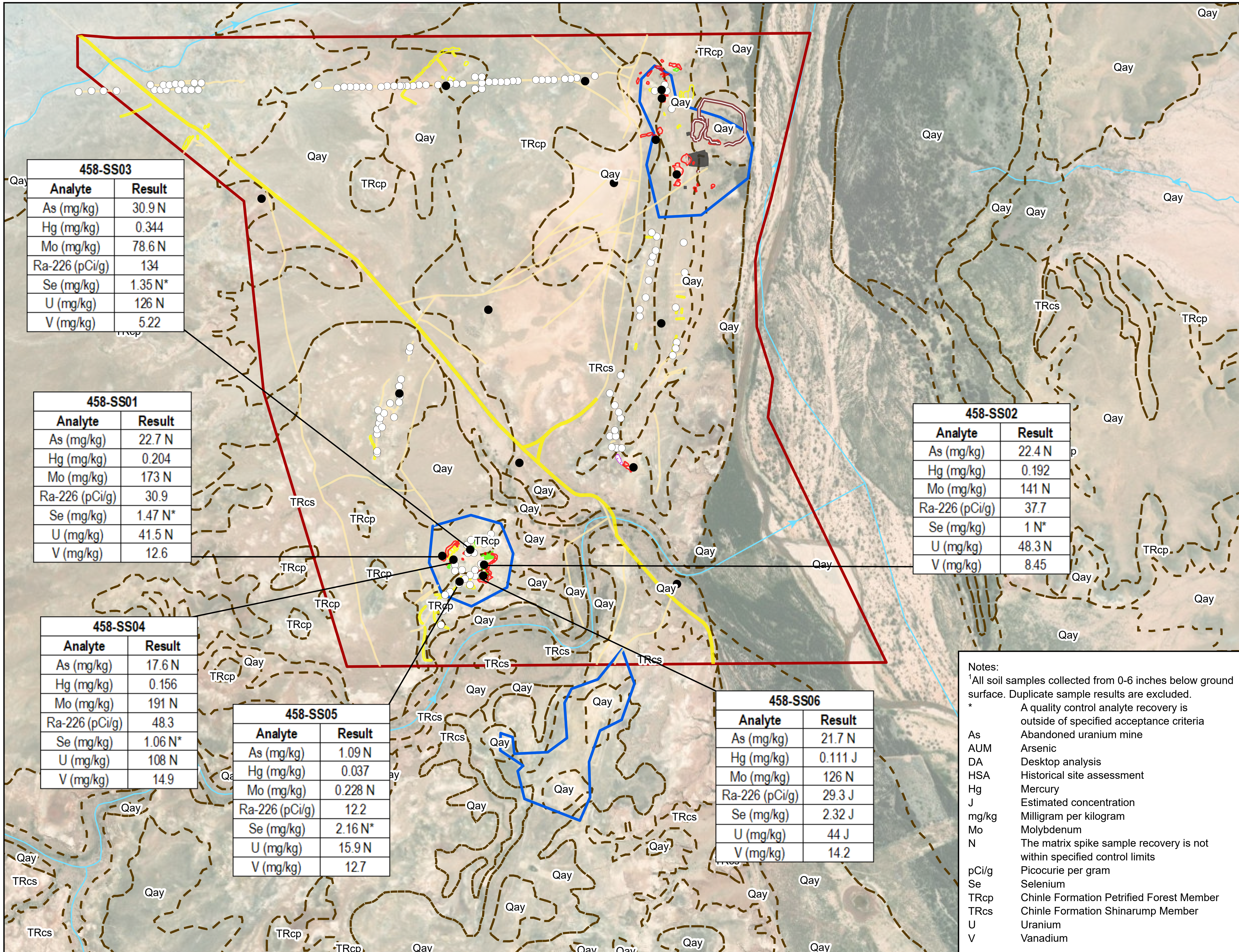
Contract No.: 68HE0923D0002

Location: COVE CHAPTER NAVAJO NATION

Date: 7/2/2024

Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator

Figure No.: A-6



458-SS03	
Analyte	Result
As (mg/kg)	30.9 N
Hg (mg/kg)	0.344
Mo (mg/kg)	78.6 N
Ra-226 (pCi/g)	134
Se (mg/kg)	1.35 N*
U (mg/kg)	126 N
V (mg/kg)	5.22

458-SS01	
Analyte	Result
As (mg/kg)	22.7 N
Hg (mg/kg)	0.204
Mo (mg/kg)	173 N
Ra-226 (pCi/g)	30.9
Se (mg/kg)	1.47 N*
U (mg/kg)	41.5 N
V (mg/kg)	12.6

458-SS04	
Analyte	Result
As (mg/kg)	17.6 N
Hg (mg/kg)	0.156
Mo (mg/kg)	191 N
Ra-226 (pCi/g)	48.3
Se (mg/kg)	1.06 N*
U (mg/kg)	108 N
V (mg/kg)	14.9

458-SS05	
Analyte	Result
As (mg/kg)	1.09 N
Hg (mg/kg)	0.037
Mo (mg/kg)	0.228 N
Ra-226 (pCi/g)	12.2
Se (mg/kg)	2.16 N*
U (mg/kg)	15.9 N
V (mg/kg)	12.7

458-SS06	
Analyte	Result
As (mg/kg)	21.7 N
Hg (mg/kg)	0.111 J
Mo (mg/kg)	126 N
Ra-226 (pCi/g)	29.3 J
Se (mg/kg)	2.32 J
U (mg/kg)	44 J
V (mg/kg)	14.2

458-SS02	
Analyte	Result
As (mg/kg)	22.4 N
Hg (mg/kg)	0.192
Mo (mg/kg)	141 N
Ra-226 (pCi/g)	37.7
Se (mg/kg)	1 N*
U (mg/kg)	48.3 N
V (mg/kg)	8.45

Soil Sample Location[1]

Disturbance Features (HSA, DA, and Field Verified)

- Exploratory Borehole
- Berm
- Accumulation/Deposition Area - Surficial
- Accumulation/Deposition Area - Volumetric
- Concrete Pad
- Dozer Cut
- Exploratory / Access Road
- Haul Road
- Shallow Mine Waste
- Waste Pile

AUM Site Boundary

Data Gaps Investigation Area

Drainage

1 inch = 800 Feet

1:9,600

N W E S

800 400 0 800 Feet

Notes:

[1]All soil samples collected from 0-6 inches below ground surface. Duplicate sample results are excluded.

*	A quality control analyte recovery is outside of specified acceptance criteria
As	Arsenic
AUM	Abandoned uranium mine
DA	Desktop analysis
HSA	Historical site assessment
Hg	Mercury
J	Estimated concentration
mg/kg	Milligram per kilogram
Mo	Molybdenum
N	The matrix spike sample recovery is not within specified control limits
pCi/g	Picocurie per gram
Se	Selenium
TRcp	Chinle Formation Petrified Forest Member
TRcs	Chinle Formation Shinarump Member
U	Uranium
V	Vanadium

SECTION 9 LEASE MINES

DATA GAPS

SOIL SAMPLING RESULTS – AUM 458

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612

Task Order No.: 020

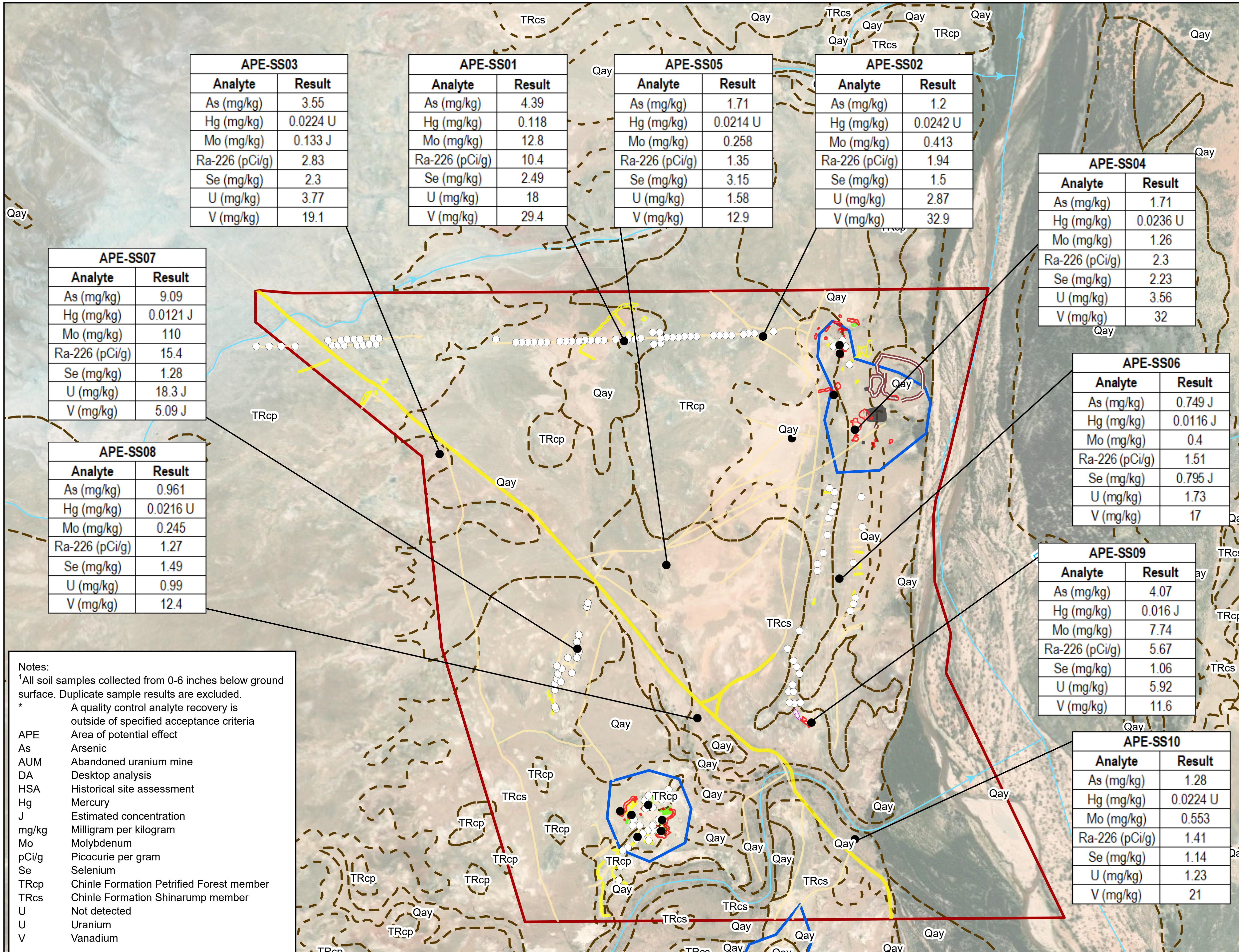
Contract No.: 68HE0923D0002

Location: COVE CHAPTER NAVAJO NATION

Date: 7/2/2024

Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator

Figure No.: A-7



APE-SS03	
Analyte	Result
As (mg/kg)	3.55
Hg (mg/kg)	0.0224 U
Mo (mg/kg)	0.133 J
Ra-226 (pCi/g)	2.83
Se (mg/kg)	2.3
U (mg/kg)	3.77
V (mg/kg)	19.1

APE-SS01	
Analyte	Result
As (mg/kg)	4.39
Hg (mg/kg)	0.118
Mo (mg/kg)	12.8
Ra-226 (pCi/g)	10.4
Se (mg/kg)	2.49
U (mg/kg)	18
V (mg/kg)	29.4

APE-SS05	
Analyte	Result
As (mg/kg)	1.71
Hg (mg/kg)	0.0214 U
Mo (mg/kg)	0.258
Ra-226 (pCi/g)	1.35
Se (mg/kg)	3.15
U (mg/kg)	1.58
V (mg/kg)	12.9

APE-SS02	
Analyte	Result
As (mg/kg)	1.2
Hg (mg/kg)	0.0242 U
Mo (mg/kg)	0.413
Ra-226 (pCi/g)	1.94
Se (mg/kg)	1.5
U (mg/kg)	2.87
V (mg/kg)	32.9

APE-SS04	
Analyte	Result
As (mg/kg)	1.71
Hg (mg/kg)	0.0236 U
Mo (mg/kg)	1.26
Ra-226 (pCi/g)	2.3
Se (mg/kg)	2.23
U (mg/kg)	3.56
V (mg/kg)	32

APE-SS07	
Analyte	Result
As (mg/kg)	9.09
Hg (mg/kg)	0.0121 J
Mo (mg/kg)	110
Ra-226 (pCi/g)	15.4
Se (mg/kg)	1.28
U (mg/kg)	18.3 J
V (mg/kg)	5.09 J

APE-SS06	
Analyte	Result
As (mg/kg)	0.749 J
Hg (mg/kg)	0.0116 J
Mo (mg/kg)	0.4
Ra-226 (pCi/g)	1.51
Se (mg/kg)	0.795 J
U (mg/kg)	1.73
V (mg/kg)	17

APE-SS08	
Analyte	Result
As (mg/kg)	0.961
Hg (mg/kg)	0.0216 U
Mo (mg/kg)	0.245
Ra-226 (pCi/g)	1.27
Se (mg/kg)	1.49
U (mg/kg)	0.99
V (mg/kg)	12.4

APE-SS09	
Analyte	Result
As (mg/kg)	4.07
Hg (mg/kg)	0.016 J
Mo (mg/kg)	7.74
Ra-226 (pCi/g)	5.67
Se (mg/kg)	1.06
U (mg/kg)	5.92
V (mg/kg)	11.6

APE-SS10	
Analyte	Result
As (mg/kg)	1.28
Hg (mg/kg)	0.0224 U
Mo (mg/kg)	0.553
Ra-226 (pCi/g)	1.41
Se (mg/kg)	1.14
U (mg/kg)	1.23
V (mg/kg)	21

Notes:
[1]All soil samples collected from 0-6 inches below ground surface. Duplicate sample results are excluded.

*	A quality control analyte recovery is outside of specified acceptance criteria
APE	Area of potential effect
As	Arsenic
AUM	Abandoned uranium mine
DA	Desktop analysis
HSA	Historical site assessment
Hg	Mercury
J	Estimated concentration
mg/kg	Milligram per kilogram
Mo	Molybdenum
pCi/g	Picocurie per gram
Se	Selenium
TRcp	Chinle Formation Petrified Forest member
TRcs	Chinle Formation Shinarump member
U	Not detected
U	Uranium
V	Vanadium

Soil Sample Location

Disturbance Features (HSA, DA, and Field Verified)

- Exploratory Borehole
- Berm
- Accumulation/Deposition Area - Surficial
- Accumulation/Deposition Area - Volumetric
- Concrete Pad
- Dozer Cut
- Exploratory / Access Road
- Haul Road
- Shallow Mine Waste
- Waste Pile

AUM Site Boundary
Data Gaps Investigation Area
Geologic Contact
Drainage

1 inch = 800 Feet

1:9,600

800 400 0 800 Feet

N E S W

SECTION 9 LEASE MINES
DATA GAPS
SOIL SAMPLING RESULTS – APE

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612

Task Order No.: 020

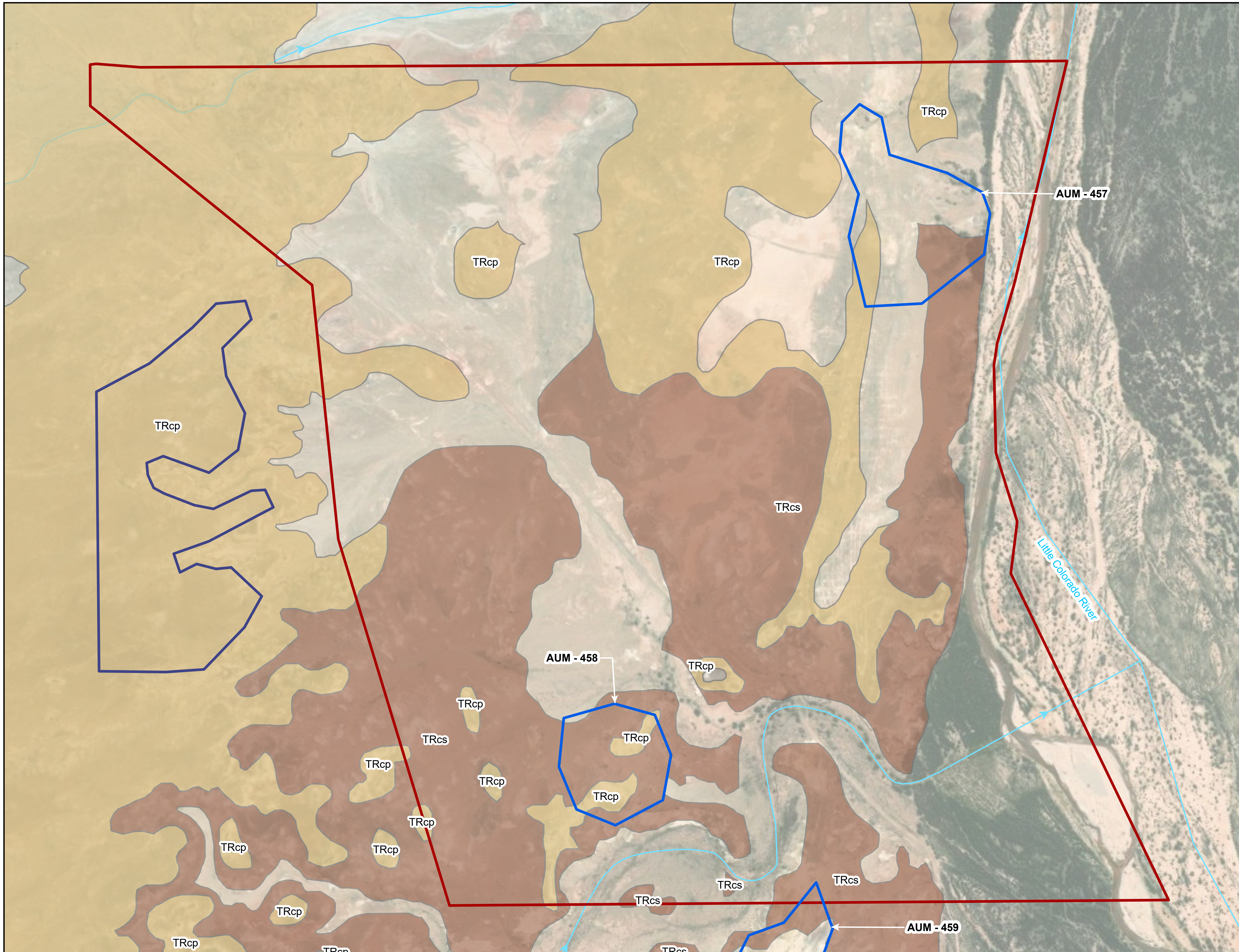
Contract No.: 68HE0923D0002

Location: COVE CHAPTER NAVAJO NATION

Date: 7/2/2024

Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator

Figure No.: A-8



Proposed Repository Location
AUM Site Boundary
Data Gaps Investigation Area
Chinle Formation Ore-Bearing Members
Petrified Forest - TRcp
Shinarump - TRcs
Drainage

Note:
AUM Abandoned uranium mine

1 inch = 600 Feet
1:7,200
N W E S
600 300 0 600 Feet

SECTION 9 LEASE MINES
PROPOSED REPOSITORY LOCATION

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 020	Contract No.: 68HE0923D0002
Location: COVE CHAPTER NAVAJO NATION	Date: 7/2/2024
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: A-9

TABLE

Table 1. Section 9 Lease Mines Data Gaps Surface Soil Sampling Results

	Sample Number:		457-SS01-01-020624		457-SS02-01-020624		457-SS03-01-020624		457-SS04-01-020624		458-SS01-01-020624		458-SS02-01-020624	
	Sampling Location:		457-SS01		457-SS02		457-SS03		457-SS04		458-SS01		458-SS02	
	Matrix:		Soil		Soil		Soil		Soil		Soil		Soil	
	Sample Type:		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample	
	Sample Depth (inches		0 - 6		0 - 6		0 - 6		0 - 6		0 - 6		0 - 6	
	Date Sampled:		2/6/2024		2/6/2024		2/6/2024		2/6/2024		2/6/2024		2/6/2024	
CAS Number	**Analyte**	**Method**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**
METALS (mg/kg)														
7429-90-5	Aluminum	SW6020	6230		4550		6890		3480		4540		3320	
7440-36-0	Antimony	SW6020	1.87	U	1.74	U	1.83	U	1.88	U	1.89	U	1.94	U
7440-38-2	Arsenic	SW6020	14.4	N	16.1	N	3.97	J	18.5	N	22.7	N	22.4	N
7440-39-3	Barium	SW6020	151	*	236	*	189	J	327	*	314	*	256	*
7440-41-7	Beryllium	SW6020	0.467		0.667		0.653		0.424		1.16		0.641	
7440-42-8	Boron	SW6020	1.79	J	2.17	J	2.95	J	1.75	J	2.76	J	1.68	J
7440-43-9	Cadmium	SW6020	0.148	J	0.748		0.109	J	0.794		0.252		0.2	
7440-70-2	Calcium	SW6020	2170		4270		9490		3980		2170		1060	
7440-47-3	Chromium	SW6020	5.82		5		5.3		4.9		6.58		6.44	
7440-48-4	Cobalt	SW6020	23.7	N	28	N	4.19	J	7.45	N	2.93	N	2.01	N
7440-50-8	Copper	SW6020	7.97	N*	22.7	N*	15.9	J	10.3	N*	9.46	N*	7.35	N*
18540-29-9	Hexavalent Chromium	SW7196A					0.138	U	0.0997	U				
7439-89-6	Iron	SW6020	10500		8360		6160		6180		9170		8120	
7439-92-1	Lead	SW6020	9.25	N	16.5	N	9.26	J	74.8	N	17.8	N	12.5	N
7439-93-2	Lithium	SW6020	14	N	5.82	N	7.77	J	3.94	N	3.7	N	2.41	N
7439-95-4	Magnesium	SW6020	899		1130		1490		1520		518		300	
7439-96-5	Manganese	SW6020	56.8	*	144	*	308	J	148	*	30.3	*	19.5	*
7439-97-6	Mercury	SW7471B	0.105		0.229		0.0257		0.165		0.204		0.192	
7439-98-7	Molybdenum	SW6020	4.61	N	59.7	N	13.9	J	214	N	173	N	141	N
7440-02-0	Nickel	SW6020	6.98	N	15.2	N	4.8	J	6.99	N	3.04	N	1.7	N
7782-49-2	Selenium	SW6020	6.53	N*	1.95	N*	2	J	1.29	N*	1.47	N*	1	N*
7440-22-4	Silver	SW6020	0.468	U	0.0955	J-	0.458	U	0.2	J-	0.473	U	0.486	U
7440-23-5	Sodium	SW6020	975	N	407	N	555	J	396	N	91.1	N	64.7	N
7440-28-0	Thallium	SW6020	0.347	J	0.791		0.506		2.82		5.21		5.61	
7440-29-1	Thorium	SW6020	7.65		6.55		8.15		4.24		7.06		5.81	
7440-61-1	Uranium	SW6020	26.8	N	90.4	N	15.7	J	56	N	41.5	N	48.3	N
7440-62-2	Vanadium	SW6020	20.3		18.7		29.1		40.3		12.6		8.45	
7440-66-6	Zinc	SW6020	21.4	N	31.9	N	10.9	J	61.9	N	8.39	N	5.19	N
RADIONUCLIDES (pCi/g)														
14255-04-0	Lead-210	EH300	13.1		34.2		14		96.1		14.4		19.6	U
13981-52-7	Polonium-210	EH300	81.1		12.6		20.8	J	152		86		39.7	
13982-63-3	Radium-226	EH300	18.6		66.7		18.9		160		30.9		37.7	
14274-82-9	Thorium-228	HASL300	1.99		1.6		2.12		0.839		1.43		1.38	
14269-63-7	Thorium-230a	HASL300	28.8		96.3		28.6		225		26.3		43.8	
14269-63-7	Thorium-230g	EH300	18.6		66.7		18.9		160		30.9		37.7	
7440-29-1	Thorium-232	HASL300	1.67		1.56		1.84		2.1		1.23		1.48	
13968-55-3/13966-29-5	Uranium-233/234	HASL300	22.1		37.5		7.55		23.2		13.2		20.8	
13966-29-5	Uranium-234	EH300	18.6		66.7		18.9		160		30.9		37.7	
15117-96-1/13982-70-2	Uranium-235/236	HASL300	1.2		1.99		0.433		1.23		0.596		1.56	
7440-61-1	Uranium-238a	HASL300	22.4		35.4		8.91		31.6		16.7		23	
7440-61-1	Uranium-238g	EH300	15.5		46		8.05		30.5		24.7		29.8	

Table 1. Section 9 Lease Mines Data Gaps Surface Soil Sampling Results

	Sample Number:		458-SS03-01-020624		458-SS04-01-020624		458-SS05-01-020624		458-SS06-01-020624		458-SS06-02-020624		APE-SS01-01-020624	
	Sampling Location:		458-SS03		458-SS04		458-SS05		458-SS06		458-SS06		APE-SS01	
	Matrix:		Soil		Soil		Soil		Soil		Soil		Soil	
	Sample Type:		Field Sample		Field Sample		Field Sample		Field Sample		Field Duplicate		Field Sample	
	Sample Depth (inches		0 - 6		0 - 6		0 - 6		0 - 6		0 - 6		0 - 6	
	Date Sampled:		2/6/2024		2/6/2024		2/6/2024		2/6/2024		2/6/2024		2/6/2024	
CAS Number	**Analyte**	**Method**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**
METALS (mg/kg)														
7429-90-5	Aluminum	SW6020	1810		3730		6930		4530		4420		10500	
7440-36-0	Antimony	SW6020	1.82	U	1.76	U	1.81	U	1.76	U	1.84	U	1.84	U
7440-38-2	Arsenic	SW6020	30.9	N	17.6	N	1.09	N	21.7	N	21.1		4.39	
7440-39-3	Barium	SW6020	335	*	234	*	56.9	*	273	J	173	J	142	
7440-41-7	Beryllium	SW6020	0.289		0.652		1.68		0.818		0.928		1.57	
7440-42-8	Boron	SW6020	0.785	J	1.76	J	3.57		2.38	J	2.66	J	5.77	
7440-43-9	Cadmium	SW6020	0.329		0.316		0.0555	J	0.247		0.251		0.244	
7440-70-2	Calcium	SW6020	2270		2290		2510		714		586		3680	
7440-47-3	Chromium	SW6020	2.11		3.68		4.81		5.93		5.54		7.46	
7440-48-4	Cobalt	SW6020	5.1	N	3.18	N	4.41	N	3.8	N	3.37		9.45	
7440-50-8	Copper	SW6020	3.76	N*	7.74	N*	9.98	N*	10.2	N*	11		17.8	
18540-29-9	Hexavalent Chromium	SW7196A												
7439-89-6	Iron	SW6020	3290		5010		1680		7880		7160		13300	
7439-92-1	Lead	SW6020	47.6	N	21	N	29.1	N	12.9	N	13.7		12.9	
7439-93-2	Lithium	SW6020	2.26	N	3.8	N	15.1	N	3.75	N	3.72		12.6	
7439-95-4	Magnesium	SW6020	199		1000		549		346		271		1570	
7439-96-5	Manganese	SW6020	19	*	91.2	*	35.9	*	19.7	*	15		68.2	
7439-97-6	Mercury	SW7471B	0.344		0.156		0.037		0.111	J	0.167	J	0.118	
7439-98-7	Molybdenum	SW6020	78.6	N	191	N	0.228	N	126	N	121		12.8	
7440-02-0	Nickel	SW6020	2.34	N	3.44	N	2.78	N	2.88	N	2.78		7.04	
7782-49-2	Selenium	SW6020	1.35	N*	1.06	N*	2.16	N*	2.32	J	1.57	J	2.49	
7440-22-4	Silver	SW6020	0.455	U	0.208	J-	0.453	U	0.441	U	0.46	U	0.461	U
7440-23-5	Sodium	SW6020	120	N	182	N	48.5	N	75.7	N	63		1910	
7440-28-0	Thallium	SW6020	1.17		3.88		0.349	U	2.68		2.65		0.768	
7440-29-1	Thorium	SW6020	8.95		7.06		18		7.83		7.34		8.55	
7440-61-1	Uranium	SW6020	126	N	108	N	15.9	N	44	J	90.6	J	18	
7440-62-2	Vanadium	SW6020	5.22		14.9		12.7		14.2		11.9		29.4	
7440-66-6	Zinc	SW6020	7.97	N	9.97	N	11.7	N	9.15	N	8.54		21.5	
RADIONUCLIDES (pCi/g)														
14255-04-0	Lead-210	EH300	76.4		50	U	29.2	U	20.6		37.1		21.7	
13981-52-7	Polonium-210	EH300	21.7		34.8		23.2		5.11	J	21.9	J	5.49	
13982-63-3	Radium-226	EH300	134		48.3		12.2		29.3	J	34.5	J	10.4	
14274-82-9	Thorium-228	HASL300	1.42		1.28		3.32		1.52		1.08		1.29	
14269-63-7	Thorium-230a	HASL300	63.4		66.1		9.22		28.5	J	23.2	J	7.76	
14269-63-7	Thorium-230g	EH300	134		48.3		12.2		29.3		34.5		10.4	
7440-29-1	Thorium-232	HASL300	1.55		1.66		2.78		1.71		1.41		1.52	
13968-55-3/13966-29-5	Uranium-233/234	HASL300	27.6		24		6.42		16.7		14.8		6.52	
13966-29-5	Uranium-234	EH300	134		48.3		12.2		29.3	J	34.5	J	10.4	
15117-96-1/13982-70-2	Uranium-235/236	HASL300	2.08		1.84		0.568		1.16		1.24		0.296	
7440-61-1	Uranium-238a	HASL300	39.8		35.5		6.39		20.9		18.9		7.4	
7440-61-1	Uranium-238g	EH300	56.4		27.3		9.36		25.3		17.9		8.75	

Table 1. Section 9 Lease Mines Data Gaps Surface Soil Sampling Results

	Sample Number:		APE-SS02-01-020624		APE-SS03-01-020624		APE-SS04-01-020624		APE-SS05-01-020624		APE-SS06-01-020624		APE-SS07-01-020624	
	Sampling Location:		APE-SS02		APE-SS03		APE-SS04		APE-SS05		APE-SS06		APE-SS07	
	Matrix:		Soil		Soil		Soil		Soil		Soil		Soil	
	Sample Type:		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample	
	Sample Depth (inches		0 - 6		0 - 6		0 - 6		0 - 6		0 - 6		0 - 6	
	Date Sampled:		2/6/2024		2/6/2024		2/6/2024		2/6/2024		2/6/2024		2/6/2024	
CAS Number	**Analyte**	**Method**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**
METALS (mg/kg)														
7429-90-5	Aluminum	SW6020	6560		12100		18400		6070		6710		2210	
7440-36-0	Antimony	SW6020	1.79	U	1.85	U	2.04	U	2.01	U	1.81	U	1.8	U
7440-38-2	Arsenic	SW6020	1.2		3.55		1.71		1.71		0.749	J	9.09	
7440-39-3	Barium	SW6020	424		24.8		347		198		223		52.2	
7440-41-7	Beryllium	SW6020	0.571		1.19		1.18		0.538		0.726		0.373	
7440-42-8	Boron	SW6020	2.78	J	4.43		6.78		2.51	J	2.32	J	1.04	J
7440-43-9	Cadmium	SW6020	0.0715	J	0.196	U	0.0378	J	0.0241	J	0.122	J	0.125	J
7440-70-2	Calcium	SW6020	12900		3180		10200		4400		5610		1750	
7440-47-3	Chromium	SW6020	8.28		5.01		7.78		2.82		5		3.05	J
7440-48-4	Cobalt	SW6020	5.03		4.95		4.72		1.87		3.5		0.641	
7440-50-8	Copper	SW6020	9.36		8.2		12.8		6.64		6.99		5.48	
18540-29-9	Hexavalent Chromium	SW7196A											0.247	J
7439-89-6	Iron	SW6020	15200		17400		15900		5130		8130		1660	
7439-92-1	Lead	SW6020	7.34		6.65		9.86		4.48		5.4		4.03	J
7439-93-2	Lithium	SW6020	5.04		9.24		16.5		4.66		6.97		0.861	J
7439-95-4	Magnesium	SW6020	3960		2550		2750		1180		1970		155	J
7439-96-5	Manganese	SW6020	385		50.1		155		119		110		4.96	
7439-97-6	Mercury	SW7471B	0.0242	U	0.0224	U	0.0236	U	0.0214	U	0.0116	J	0.0121	J
7439-98-7	Molybdenum	SW6020	0.413		0.133	J	1.26		0.258		0.4		110	
7440-02-0	Nickel	SW6020	12.5		5.26		4.75		2.24		4.57		0.437	
7782-49-2	Selenium	SW6020	1.5		2.3		2.23		3.15		0.795	J	1.28	
7440-22-4	Silver	SW6020	0.447	U	0.462	U	0.51	U	0.501	U	0.454	U	0.45	U
7440-23-5	Sodium	SW6020	879		5090		6640		328		223		36.6	J
7440-28-0	Thallium	SW6020	0.393	U	0.283	J	0.143	J	0.369	U	0.371	U	0.413	
7440-29-1	Thorium	SW6020	6.01		6.26		9.18		7.12		4.93		3.86	
7440-61-1	Uranium	SW6020	2.87		3.77		3.56		1.58		1.73		18.3	J
7440-62-2	Vanadium	SW6020	32.9		19.1		32		12.9		17		5.09	J
7440-66-6	Zinc	SW6020	11.4		23		19.9		10.8		9.15		2.69	J
RADIONUCLIDES (pCi/g)														
14255-04-0	Lead-210	EH300	13.3	U	2.01		19.9	U	12.9	U	6.28	U	32.7	UJ
13981-52-7	Polonium-210	EH300	1.94		1.18		1.84		1.05		1.45		12.2	
13982-63-3	Radium-226	EH300	1.94		2.83		2.3		1.35		1.51		15.4	
14274-82-9	Thorium-228	HASL300	1.18		1.08		2.04		0.936		1		0.971	
14269-63-7	Thorium-230a	HASL300	2.22		2.03		2.33		1.03		1.28		10.1	
14269-63-7	Thorium-230g	EH300	1.94		2.83		2.3		1.35		1.51		15.4	
7440-29-1	Thorium-232	HASL300	1.41		1.76		2.53		0.816		1.11		0.666	
13968-55-3/13966-29-5	Uranium-233/234	HASL300	1.62		2.43		2.07		0.991		1.31		8.96	
13966-29-5	Uranium-234	EH300	1.94		2.83		2.3		1.35		1.51		15.4	
15117-96-1/13982-70-2	Uranium-235/236	HASL300	0.292	U	0.462	U	0.308	U	0.42	U	0.224	U	1.14	
7440-61-1	Uranium-238a	HASL300	1.32		2.53		2.19		0.749		1.05		11.3	
7440-61-1	Uranium-238g	EH300	2.99	U	2.04		4.79	U	3.81	U	2.22	U	9.32	U

Table 1. Section 9 Lease Mines Data Gaps Surface Soil Sampling Results

	Sample Number:		APE-SS08-01-020624		APE-SS09-01-020624		APE-SS10-01-020624	
	Sampling Location:		APE-SS08		APE-SS09		APE-SS10	
	Matrix:		Soil		Soil		Soil	
	Sample Type:		Field Sample		Field Sample		Field Sample	
	Sample Depth (inches		0 - 6		0 - 6		0 - 6	
	Date Sampled:		2/6/2024		2/6/2024		2/6/2024	
CAS Number	**Analyte**	**Method**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**
METALS (mg/kg)								
7429-90-5	Aluminum	SW6020	3650		3670		7620	
7440-36-0	Antimony	SW6020	1.89	U	1.81	U	1.73	U
7440-38-2	Arsenic	SW6020	0.961		4.07		1.28	
7440-39-3	Barium	SW6020	238		212		273	
7440-41-7	Beryllium	SW6020	0.333		0.408		0.468	
7440-42-8	Boron	SW6020	1.94	J	2.45	J	5.8	
7440-43-9	Cadmium	SW6020	0.186	U	0.187	U	0.172	U
7440-70-2	Calcium	SW6020	4500		4650		14000	
7440-47-3	Chromium	SW6020	3.57		3.19		8.51	
7440-48-4	Cobalt	SW6020	2.03		5.32		4.98	
7440-50-8	Copper	SW6020	4.87		6.15		8.69	
18540-29-9	Hexavalent Chromium	SW7196A					0.145	U
7439-89-6	Iron	SW6020	6150		6110		10800	
7439-92-1	Lead	SW6020	4.27		6.33		5.29	
7439-93-2	Lithium	SW6020	3.2		4.43		5.15	
7439-95-4	Magnesium	SW6020	1660		1390		5890	
7439-96-5	Manganese	SW6020	176		104		262	
7439-97-6	Mercury	SW7471B	0.0216	U	0.016	J	0.0224	U
7439-98-7	Molybdenum	SW6020	0.245		7.74		0.553	
7440-02-0	Nickel	SW6020	4.36		3.69		13.2	
7782-49-2	Selenium	SW6020	1.49		1.06		1.14	
7440-22-4	Silver	SW6020	0.0999	J-	0.453	U	0.433	U
7440-23-5	Sodium	SW6020	302		424		786	
7440-28-0	Thallium	SW6020	0.373	U	0.389		0.345	U
7440-29-1	Thorium	SW6020	7.14		4.85		5.01	
7440-61-1	Uranium	SW6020	0.99		5.92		1.23	
7440-62-2	Vanadium	SW6020	12.4		11.6		21	
7440-66-6	Zinc	SW6020	8.46		13.2		16.4	
RADIONUCLIDES (pCi/g)								
14255-04-0	Lead-210	EH300	5.16	U	22.6	U	1.14	
13981-52-7	Polonium-210	EH300	1.38		4.87		1.33	
13982-63-3	Radium-226	EH300	1.27		5.67		1.41	
14274-82-9	Thorium-228	HASL300	0.823		1.44		1.27	
14269-63-7	Thorium-230a	HASL300	1.39		4.22		0.924	
14269-63-7	Thorium-230g	EH300	1.27		5.67		1.41	
7440-29-1	Thorium-232	HASL300	1.25		0.929		1.29	
13968-55-3/13966-29-5	Uranium-233/234	HASL300	0.99		2.8		0.841	
13966-29-5	Uranium-234	EH300	1.27		5.67		1.41	
15117-96-1/13982-70-2	Uranium-235/236	HASL300	0.381	U	0.372	U	0.162	U
7440-61-1	Uranium-238a	HASL300	1.41		2.93		1.31	
7440-61-1	Uranium-238g	EH300	1.75		5.36	U	0.965	

Notes:

*	A quality control analyte recovery is outside of specified acceptance criteria
bgs	Below ground surface
CAS	Chemical Abstracts Service
J	The analyte was detected at the reported concentration; the quantitation is an estimate
J-	The analyte was detected at the reported concentration; the quantitation is an estimate and may be biased low
mg/kg	Milligram per kilogram
N	The matrix spike sample recovery is not within specified control limits
pCi/g	Picocurie per gram
U	Not considered detected. The associated number is the reported concentration

ATTACHMENT 1

DISTURBANCE MAPPING PHOTOGRAPHIC LOG

The following photographs were taken during the Response, Assessment, and Evaluation Services 2 Task Order 020 field scoping event at the Section 9 Lease Mines from February 6 to 10, 2024. A more comprehensive photographic log will be developed for the engineering evaluation/cost analysis. All disturbance mapping observations with photographs and notes are available on the U.S. Environmental Protection Agency Region 9 Abandoned Uranium Mine (AUM) GeoPlatform.

Field Observations – Undisturbed Areas

	**PHOTOGRAPH 1** **Date:** 02/06/2024 **Location:** 35.729999; -111.326361 **Feature:** Mineralized outcrop **Description:** Outcrop of mineralized Shinarump Member exposed from natural erosion located next to Indian Road 6728.

	**PHOTOGRAPH 2** **Date:** 02/06/2024 **Location:** 35.733213; -111.334057 **Feature:** Mineralized outcrop **Description:** Lower Petrified Forest Member; likely naturally occurring radioactive material; gamma survey for the removal site evaluation recorded 40 to 90,000 counts per minute (cpm) during mapping.

	**PHOTOGRAPH 3** **Date:** 02/07/2024 **Location:** 35.735000; -111.324383 **Feature:** Vegetation, soil, and old-growth trees; exploratory dozer cut **Description:** Large exploratory dozer cut in exploratory area south of AUM 457.

PHOTOGRAPH 5

Date: 02/08/2024

Location:
35.736952;
-111.324326

Feature:
Drill trail

Description:
Exploratory drill trail in exploratory area south of AUM 457.

PHOTOGRAPH 6

Date: 02/07/2024

Location:
35.737197;
-111.325271

Feature:
Exploratory borehole

Description:
Exploratory borehole (wood plug in forefront) in exploration area south of AUM 457.

Field Observations – Mine-Related Disturbed Areas (Production Mine Features)

<table>
<tr><td></td><td>PHOTOGRAPH 7

Date: 02/07/2024

Location:
35.739281;
-111.324434

Feature:
Mine waste pile

Description:
Unreclaimed mine waste pile at AUM 457 approximately 12 feet high; gamma readings up to 390,000 cpm.</td></tr>
</table>

<table>
<tr><td></td><td>PHOTOGRAPH 8

Date: 02/06/20124

Location:
35.730493;
-111.331163

Feature:
Mine waste pile

Description:
Waste pile near western side of Atlas AUM boundary in AUM 458; 6 to 10 feet high, flattens out into slope from dozer push-off; larger waste rock present.</td></tr>
</table>

	**PHOTOGRAPH 9** **Date:** 02/08/2024 **Location:** 35.739538; -111.323738 **Feature:** Concrete structure related to mill facility **Description:** Approximately 36-foot-high structure at AUM 457, gamma readings from 90 to 300,000 cpm.
	**PHOTOGRAPH 10** **Date:** 02/07/2024 **Location:** 35.738422; -111.325347 **Feature:** Haul road **Description:** Haul road to AUM 457.

	**PHOTOGRAPH 11** **Date:** 02/07/2024 **Location:** 35.738881; -111.324294 **Feature:** Concrete pad **Description:** Approximately 20-square-foot concrete pad at AUM 457, gamma readings up to 70,000 cpm.

Field Observations – Mine-Related Disturbed Areas (Reclamation Features)

No photographs are available for reclamation features because the site has not undergone any mine reclamation.

Field Observations – Hydrology in Disturbed Areas

PHOTOGRAPH 12

Date: 02/06/2024

Location:
35.729520;
-111.331035

Feature:
Drainage, waste transport

Description:
Drainage from AUM 458.

PHOTOGRAPH 13

Date: 02/06/2024

Location:
35.733745;
-111.325043

Feature:
Drainage-Other

Description:
Drainage in exploration area south of AUM 457.

PHOTOGRAPH 14

Date: 02/07/2024

Location:
35.740821;
-111.336997

Feature:
Undisturbed drainage

Description: Natural drainage; no evidence of mining-related disturbance.

APPENDIX B

RISK ASSESSMENT

Navajo Abandoned Uranium Mines
Western Abandoned Uranium Mine Region
Coconino County, Arizona

Draft Final
Appendix B
Risk Assessment

Section 9 Lease Mines
Engineering Evaluation/Cost Analysis

Response, Assessment, and Evaluation Services 2

Contract No. 68HE0923D0002

Task Order 020

July 2024

Submitted to

U.S. Environmental Protection Agency

Submitted by

Tetra Tech, Inc.

1999 Harrison Street, Suite 500

Oakland, CA 94612

TABLE OF CONTENTS

EXHIBITS

FIGURES

TABLES

ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

AUM	Abandoned uranium mine
bgs	Below ground surface
BLM	Bureau of Land Management
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Contaminant of concern
COEC	Contaminant of ecological concern
COI	Constituent of interest
COPC	Contaminant of potential concern
COPEC	Contaminant of potential ecological concern
CSM	Conceptual site model
Eco-SSL	Ecological soil screening level
EE/CA	Engineering evaluation/cost analysis
EPC	Exposure point concentration
ERA	Ecological risk assessment
ERICA	Environmental Risks from Ionising Contaminants: Assessment and Management
ESL	Ecological screening level
EU	Exposure unit
HHRA	Human health risk assessment
HQ	Hazard quotient
LANL	Los Alamos National Laboratory
LCR	Little Colorado River
N3B	Newport News Nuclear BWXT-Los Alamos, LLC
NAUM	Navajo abandoned uranium mine
NOEC	No observed effect concentration
NORM	Naturally occurring radioactive material
ORNL	Oak Ridge National Laboratory
OSWER	Office of Solid Waste and Emergency Response
RfC	Reference concentration
RfD	Reference dose
RME	Reasonable maximum exposure
RSL	Regional screening level

ACRONYMS AND ABBREVIATIONS (CONTINUED)

SE	Secular equilibrium
SF	Slope factor
SLERA	Screening-level ecological risk assessment
SWCA	SWCA Environmental Consultants
TENORM	Technologically enhanced naturally occurring radioactive material
Tetra Tech	Tetra Tech, Inc.
UCL95	95 percent upper confidence limit
USEPA	U.S. Environmental Protection Agency
Weston	Weston Solutions, Inc.

1.0 BACKGROUND AND ENVIRONMENTAL SETTING

The Section 9 Lease Mines are on private and federal property adjacent to the Navajo Nation and the investigation and remediation of the site is being addressed under the Navajo Abandoned Uranium Mines (NAUM) program. The purpose of this NAUM program site-specific risk assessment is to estimate current and future human health risk under appropriate reasonable maximum exposure (RME) scenarios and ecological risk focused on the known ecosystems for the region. The results of the risk assessment are used to assist in removal action decisions at the Section 9 Lease Mines.

The human health risk assessment (HHRA) identifies candidate human health contaminants of concern (COC) for each exposure unit (EU) while the ecological risk assessment (ERA) identifies candidate contaminants of ecological concern (COEC) for the site. The results of the risk assessment serve as lines of evidence in determining the extent of soil removal necessary at the Section 9 Lease Mines to meet the removal action goals. See the "Navajo Abandoned Uranium Mines Risk Assessment Methodology" (U.S. Environmental Protection Agency [USEPA] 2024c) for additional information for conducting risk assessments at NAUM sites.

The Navajo Nation and surrounding areas contain areas of naturally elevated levels of uranium. Starting in the 1940s, large amounts of uranium were mined in the southwest United States. Mining has brought more uranium to the surface of the earth, making exposure to people, plants, and animals more likely. Uranium is a naturally occurring radioactive material (NORM), and the effects of mining can lead to technologically enhanced naturally occurring radioactive material (TENORM).

Examples of TENORM at the Section 9 Lease Mines include waste rock piles, burial cells, contaminated access roads, areas contaminated by eroding waste and windblown dust, and adjacent drainages receiving potentially contaminated runoff.

1.1 MINE HISTORY AND LOCATION

The Section 9 Lease Mines include Abandoned Uranium Mines (AUM) 457 and 458 and a small northern portion of AUM 459 (see Figure B-1). The following subsections describe the site location, type of mines and operational status, regulatory history, features and landscape, geology and hydrology, land use and populations, sensitive ecosystems and habitat, and meteorology and climate. Former open pit mining operation facilities are located on AUMs 457 and 458. Figure 3 of the main engineering evaluation/cost analysis (EE/CA) report provides the locations of major site features for AUMs 457 and 458, including pit areas, observed unreclaimed waste piles and mining debris, and remnants of former structures.

The Section 9 Lease Mines site is 10.8 air miles and 14.5 road miles from Cameron, Arizona. The elevation is 4,206 feet above mean sea level. The Section 9 Lease Mines area is currently not used by the property owners although evidence of trespassing is apparent at the site.

The site is in the Little Colorado River (LCR) valley in Coconino County, Arizona, on the west side of the LCR at 35.734 degrees latitude and -111.328 degrees longitude (see Figure B-1). The Navajo Nation surrounds the site to the north and east. The site is largely on land owned by

Babbitt Ranches, LLC and CO Bar, Inc. in Section 9 with a small portion on federal land managed by the Bureau of Land Management (BLM) in Section 10. Land ownership for the site and locations of mine boundaries that were established from historical records and observations are shown on Figure 2 of the main EE/CA report.

AUM 457 is 16.5 acres and contained within Section 9 except for the easternmost boundary on the banks of the LCR, which is in Section 10 on BLM land. AUM 457 includes a former borrow pit and pond. Concrete foundations and two 30-foot-tall walls from the Benson Upgrader (the ore processing plant demolished in 1961) are near the center of the AUM boundary (Weston Solutions, Inc. [Weston] 2011). The main foundation covers a footprint of approximately 100 feet by 50 feet, and a smaller foundation south of the larger concrete pad measures 20 feet by 20 feet.

AUM 458 is 9.3 acres and contained entirely within Section 9. AUM 458 is 0.25 mile west of the LCR and includes uranium waste rock, mining debris, and a recessed pit near the center of the AUM (Weston 2011). A regional drainage, Mays Wash, is east and immediately to the south of the AUM boundary.

For additional details on the Section 9 Lease Mines mine history and site features, see Section 2.0 of the main EE/CA report. Appendix A of the EE/CA report contains site images that show the condition of the site at the time of the site visit in February 2024.

1.2 GEOLOGY, HYDROGEOLOGY, AND HYDROLOGY

The following subsections describe the geology, hydrogeology, and hydrology of the Section 9 Lease Mines. For more information, see Section 2.1.5 of the main EE/CA report.

1.2.1 Geology

The geology of the Cameron area is characterized by layered sedimentary units typical of the Colorado Plateau. The complex geologic history and long-term stability of the Colorado Plateau allowed for the mineralization of uranium, and the Cameron area contains abundant uranium ore deposits that are found primarily in the upper Triassic Chinle Formation. Quaternary-age materials, comprising sedimentary alluvium, sand, and gravel deposits, overlay the Triassic Chinle Formation. Fluvial sandstones in the lower part of the Petrified Forest Member of the Chinle Formation contain most of the uranium deposits around Cameron with a lesser amount found in the Shinarump Member of the Chinle Formation. The Moenkopi Formation underlies the Chinle Formation and is exposed in areas near the LCR and other washes where overlying deposits have been eroded (Chenoweth 1993). Ore bodies occur at the surface to a depth of 130 feet and vary in size from a single mineralized fossil log to hundreds of feet in length (Chenoweth and Malan 1973). General descriptions of the three relevant geological units are presented below in descending stratigraphic order (Bollin and Kerr 1958; Dubiel and others 1991):

- **Petrified Forest Member of the Chinle Formation (Late Triassic, 237 to 201 million years ago):** Red and brown fluvial sandstones and floodplain mudstone deposits with volcanic ash and carbonaceous material.

- **Shinarump Member of the Chinle Formation (Late Triassic, 237 to 201 million years ago):** White to yellow and gray sandstone and conglomerate with minor gray mudstone. Fluvial channel and valley fill deposits were incised into the underlying Moenkopi Formation. Sediments were deposited as lenticular beds that contain carbonaceous material.
- **Quaternary Alluvium (Holocene, less than 11,700 years ago):** Quaternary-age materials, comprising sedimentary alluvium, sand, and gravel deposits, overlay the Triassic Chinle Formation.

A map showing the geologic units for the site and vicinity are presented on Figure 4 of the main EE/CA report.

1.2.2 Hydrogeology

No wells were identified near the Section 9 Lease Mines that would confirm the occurrence and depth of groundwater. No known drinking water wells or sources are within 1 mile of the site (Weston 2012). The Section 9 Lease Mines are located above the Chinle Aquifer.

1.2.3 Hydrology

Most precipitation at the Section 9 Lease Mines occurs from July to October as monsoon thunderstorms. The annual evaporation rate is nearly five times the precipitation rate; consequently, most streams in the area are ephemeral or have flowing water only during storms or rapid snowmelt. The dry conditions and high-intensity rains cause quick saturation of the surface soils, preventing precipitation from penetrating deeper. As a result, intense rainfall drives surface flow into canyon washes, generating short-term and fast-moving streams. These streams produce arroyos that cut through the sedimentary bedrock in the canyons and erode sediments that are transported downstream to be deposited as alluvium.

Water that discharges from the seeps travels through a fracture flow system, which makes identifying water flow paths difficult. The concentrations of potential contaminants found in the water may be attributable to mineralized rock in the mine workings or flow through naturally occurring mineralized rock. A summary of the occurrence, drainage pattern, and chemical characteristics of surface water is presented in Appendix J of the "Western Agency Tronox Mines Removal Site Evaluation Report" (Tetra Tech, Inc. [Tetra Tech] 2019).

1.3 LAND USE

A land easement prohibiting residential use of land owned by Babbitt Ranches, LLC within Section 9 was established in 2019 (Engineering Analytics, Inc. 2021). Accessing the site is prohibited for purposes other than for maintenance of the main access road and inspection of the property. The site is not currently used for livestock, agricultural, or other purposes. No structures are in use at the site, and no structures will be built on the site in the future.

The people most likely to access the portion of the site within Section 9 are periodic workers, including employees of Babbitt Ranches, LLC and CO Bar, Inc., and possible trespassers, which are likely to be recreators camping on BLM land that are trespassing onto deed-restricted

Section 9 property. Recreators on BLM land, as well as BLM staff, can access the portion of the site on Section 10. No long-term practicable physical barrier solutions limit movement between Sections 9 and 10; thus, a person legally accessing BLM-managed land on Section 10 may also likely trespass on Section 9. Thus, a trespasser scenario based on BLM recreator inputs was selected as the most appropriate RME scenario for the Section 9 Lease Mines.

Activities that occur near or on the site that may expose people to soil contaminants include camping, gathering firewood, walking, hiking, and using all-terrain vehicles. Persons traversing the site may be exposed to contaminated dust by inhalation of particulate matter. Whole body (external) radiation may be experienced by people on or near the site.

1.4 ECOLOGICAL SETTING

The Section 9 Lease Mines are in a remote area with a revegetated, previously disturbed mine area. Wildlife inhabiting the area may directly ingest radionuclides and chemicals, which may then be transported to the organs or other sites within the wildlife receptor.

In 2016, the U.S. Fish and Wildlife Service determined that no federally listed or proposed endangered or threatened species are present at or near the site and that no critical habitats for such species exist at the site (SWCA Environmental Consultants [SWCA] 2016). The biological resources survey assessed other special status plant and animal species that were identified by the State of Arizona and Navajo Nation as potentially relevant to the site and found a low likelihood of occurrence of these species at the site (SWCA 2016). Sparse vegetation at the site is not ideal for many ecological receptors; therefore, the potential for occurrence of Navajo endangered species and State of Arizona species of greatest conservation need is very low at the site.

At the time of the biological survey in 2016, no aquatic vegetation was observed in the dry channel of the LCR, and no aquatic life was observed in standing pools from recent rain events in the channel bed. Further, wetland features previously identified by USEPA (Weston 2014) were not observed and are not present at the site (SWCA 2016).

Tetra Tech recognizes that these findings are outdated, and a new biological assessment will be conducted at least 2 years before removal activities. However, because the area is largely unchanged since the 2016 biological assessment, no major changes to this original assessment are expected.

1.4.1 Climate

The site lies in a semi-arid climate with a high annual net pan evaporation rate of 81 inches per year with an average annual rainfall of 5.6 inches. The average annual low temperature is 43 °F with an average annual high temperature of 75 °F. Wind is predominately from the west with an average wind speed of 5 miles per hour. Extreme heat in the summer (100 °F) and cold in the winter (-34 °F) can occur. Climate data that occurs within Ecoregion 22p is summarized in the NAUM risk assessment methodology (USEPA 2024c).

1.4.2 Vegetation

Ecoregion 22 represents a large transitional region between the drier shrublands and wooded higher-relief tablelands of the Colorado Plateaus (Ecoregion 20) in the north and the lower, hotter, less vegetated ecoregions to the west and east. Ecoregion 22p is the Little Colorado Valley/Painted Desert, which is characterized by irregular plains, valleys, and basins with meandering river floodplain, alluvial terraces, and adjacent mesas, buttes, hills, and badlands. Streams are mostly ephemeral and intermittent. Higher, forest-covered mountainous ecoregions border the region on the northeast and south (Ecoregion 23). Common plant species include mound saltbush (*Atriplex obovata*), four-wing saltbush (*Atriplex canescens*), shadscale (*Atriplex confertifolia*), alkali sacaton (*Sporobolus airoides*), galleta grass (*Pleuraphis jamesii*), gyp dropseed (*Sporobolus nealleyi*), black grama (*Bouteloua eriopoda*), Indian ricegrass (*Stipa hymenoides*), yucca (*Yucca baccata*, *Yucca glauca*), Mormon tea (*Ephedra nevadensis*), and black greasewood (*Sarcobatus vermiculatus*). On floodplains, vegetation is mostly exotic tamarisk (*Tamarix ramosissima*) with some scattered cottonwood (*Populus* spp.) and willow (*Salicaceae* spp.).

1.4.3 Wildlife

Gunnison prairie dogs (*Cynomys gunnisoni*) are a keystone species in many of the sagebrush ecosystems, and their burrows provide habitat for other wildlife, including burrowing owls (*Athene cunicularia*), weasels (*Mustela* spp.), badgers (*Taxidea taxus*), and a variety of snakes.

1.4.4 Special Status Species

The U.S. Fish and Wildlife Service determined that no federally listed or proposed endangered or threatened species are present at or near the site and that no critical habitats for such species exist at the site (SWCA 2016).

2.0 DATA USED IN THE RISK ASSESSMENT

Data compilation and management tasks conducted for the Section 9 Lease Mines risk assessment included the selection of useable data and evaluation of sample depth intervals and selection of depth intervals to be evaluated. At this time, gamma data are not considered definitive data and, therefore, were not used in the risk assessment. However, gamma data were used to help delineate TENORM boundaries and to establish the footprint for the risk assessment and will be used for future removal decisions.

The compiled investigation data for the constituents of interest (COI) were reviewed to confirm that the appropriate data were used in the risk assessment. Essential nutrients such as calcium, magnesium, potassium, and sodium are not retained as COIs. The data were separated by the depth intervals to be evaluated prior to calculating the exposure point concentrations (EPC) and other statistical values. Figure B-2 presents an overview of the locations of the available soil samples used in the risk assessment for the Section 9 Lease Mines.

2.1 AVAILABLE DATA

Evaluation of potential human and ecological exposure at the Section 9 Lease Mines is limited to radionuclides and metals in soil. All available data for samples collected within the EU (see Section 2.3) were used in the risk assessments. Table B-1 provides the summary statistics for all soil sample results available for the risk assessment. Attachment B-1 presents the results of all soil samples used in the risk assessment.

A data useability assessment was conducted to confirm that the useability of the laboratory data is consistent with USEPA (1992a) guidance. Data validation of all results used in the risk assessment was performed per the guidelines for data review (USEPA 2004, 2020). The following key data validation flags were considered in the data reduction process:

- Estimated values (flagged with “J” qualifiers) should be treated as detected concentrations.
- Rejected data (flagged with “R” qualifiers) should not be included in the risk assessment datasets because of deficiencies in meeting quality control criteria. No data in the datasets were rejected.
- Results with final validation qualifiers containing a “U” or “UJ” are nondetect values included in the risk assessment datasets. The method reporting limit was used as the value for nondetect results.

Four samples from the Section 9 Lease Mines were analyzed for hexavalent chromium because the field sampling plan (Tetra Tech 2024) was prepared prior to completion of the NAUM risk assessment methodology (USEPA 2024c). At the time of sampling in February 2024, analysis for hexavalent chromium was being discussed as a potential additional requirement in the risk assessment methodology, thus the analyses were requested rather than having a potential data gap.

The four hexavalent chromium results were not used in the quantitative risk assessment. Three of the four samples were nondetect for hexavalent chromium, and one sample (APE-SS07-01-020624) had a detection (0.247 mg/kg) below the method reporting limit. Review of the laboratory report for the detected result raised concern that the detected concentration may not be an actual detection and may instead be caused by spectral interference from other metals present in the sample, notably molybdenum and vanadium. Evidence of this includes that the matrix spike sample, which was performed on the sample with the detection, had a result lower than that of the unspiked sample even though the spike concentration was much higher than the native concentration and the recovery was still within quality criteria. Despite this, the assumption made for the risk assessment was that the total chromium results were 100 percent hexavalent chromium to provide a more protective assessment. Use of total chromium results relies on data from inductively coupled plasma mass spectroscopy that is commonly used for evaluation of metals for use in risk assessments.

2.2 DATA REDUCTION METHODS

The metals and radiological data were queried to select the best result for each unique combination of sample media, location ID, sample date, and sample depth for which duplicate data exist. These procedures conservatively select one result for original and field duplicate pairs. For duplicate samples, the maximum detected concentration of the original and field duplicate result was selected as the result for use in the risk assessment. If both the original and field duplicate results are nondetect, the result associated with the higher reporting limit was used.

2.3 EXPOSURE UNITS

An EU is a geographic area with a particular land use within which an exposed receptor (a person, animal, or plant) may reasonably be assumed to move at random and where contact across the EU is equally likely over the course of an exposure duration. The Section 9 Lease Mines EU was developed by identifying areas of contiguous TENORM contamination and anticipated future land use. Areas of NORM, such as natural mineralized outcrops and nonimpacted areas in the northeastern portion of the site, although not included in the TENORM boundary, were also included within the risk assessment boundary because a receptor would also be exposed to the NORM areas when at the site. The risk assessment boundary (the entirety of all areas evaluated within the EU) was established via soil sampling and augmented through examination of gamma survey data. See Section 2.3 of the main EE/CA report for descriptions of previous investigations and Section 2.4 of the main EE/CA report for the extent of contamination.

Based on the site evaluation and summarized in Table B-2, the Section 9 Lease Mines are being evaluated as a single EU for the HHRA and ERA. The existing or anticipated future land use for an area is key in selecting the potential receptors evaluated in the HHRA conducted for a site. The RME receptor for the HHRA was selected based on site knowledge. This HHRA only evaluates the RME receptor at the EU. Figure B-3 through Figure B-5 provide the locations of samples used in the risk assessment.

2.4 EXPOSURE POINT CONCENTRATIONS

To determine concentrations in environmental media (for example, surface soil) to which people and ecological receptors might be exposed, representative statistics are calculated from the datasets. Soil samples were grouped by sample depth to correspond to the surface and subsurface soil intervals evaluated in the risk assessment. Surface soil samples are those collected from 0 to 6 inches below ground surface (bgs) while subsurface soil samples are those collected from 0 up to 72 inches bgs. As described in the NAUM risk assessment methodology (USEPA 2024c), these soil depths were selected to incorporate more data from the NAUM sites. A depth of 72 inches was selected for potential human health exposures because deeper soil could become exposed in the future by erosion. In addition, plants in desert settings commonly have roots to 72 inches bgs. Thus, uptake to plants from contamination at depth is a complete exposure pathway for the ERA. Furthermore, burrowing animals are evaluated in the ERA; 72 inches bgs is an appropriate exposure depth for evaluating these ecological receptors.

The process provided in Appendix D of the NAUM risk assessment methodology (USEPA 2024c) was used to calculate the EPC for each contaminant of potential concern (COPC). The approach and calculations for EPCs follow USEPA (1989, 1992b, 2000a, 2002, 2022) guidance. The 95 percent upper confidence limit (UCL95) of the mean values were calculated for each COPC using ProUCL 5.2 (USEPA 2022). A minimum of 10 samples and 4 detected results are required for a given contaminant to calculate the UCL95 that can be used as the EPC. If the dataset was smaller than 10 samples or the number of detections was less than 4, the maximum detected concentration should be used as the EPC. In cases where the UCL95 exceeds the maximum detected concentration, the maximum detected concentration was used as the soil EPC. If a nonradioactive COPC was not detected in a sample when entering data into ProUCL, the sample reporting limit was used as the numerical value for that sample for EPC calculations.

2.5 EVALUATION OF SECULAR EQUILIBRIUM

A site-specific secular equilibrium (SE) preliminary determination was conducted on the Section 9 Lease Mines radiological dataset. A range of equilibrium conditions were observed; however, the site-wide disequilibrium factor was 0.7 and the overall conclusion is that uranium-238 is in SE with its decay products. When uranium-238 is in SE, site data for radium-226 in conjunction with uranium-238 in SE toxicity values can be used to calculate the risk for the entire uranium-238 decay chain (USEPA 2024c). Attachment B-2 presents a summary of the SE preliminary determination and calculation of the disequilibrium factor.

3.0 HUMAN HEALTH RISK ASSESSMENT

The HHRA evaluates whether site-related contaminants detected in soil pose unacceptable risks to potential current and future people at a site under conditions at the time of the EE/CA (unremediated conditions) (USEPA 1989). The HHRA results will serve, along with other factors (such as the ERA and the three National Oil and Hazardous Substances Pollution Contingency Plan and EE/CA criteria of feasibility, implementability, and cost), as a basis for risk management decisions. The HHRA is intended to provide input for risk management decision-making for a site while maintaining a conservative approach protective of the people at a site. The methodology for the HHRA is based on the NAUM risk assessment methodology (USEPA 2024c) with the exception that the screening levels used in the COPC screening. Default resident screening values from the RSL (USEPA 2024e) were used in the COPC screening because the site is not located on the Navajo Nation. Table B-1 through Table B-7 present data and analysis associated with the HHRA.

3.1 DATA EVALUATION AND IDENTIFICATION OF CONTAMINANTS OF POTENTIAL CONCERN

There are only samples available between 0 and 60 inches bgs. Samples analyzed by a certified laboratory were used to screen for COPCs for the HHRA. Samples at the Section 9 Lease Mines were analyzed for metals and radium-226. The NAUM Risk Calculator (USEPA 2024d) was used to calculate the COPC screening levels. The maximum detected concentrations of contaminants were screened using the default resident soil screening levels, based on a target cancer risk of one in one million (1×10^{-6}) and a noncancer target hazard quotient of 0.1 except for lead. The lead screening value is based on the regional screening level (RSL) for residential soil (USEPA 2024e). These conservative screening levels were used to identify and include all contaminants that could contribute to cumulative risk in the cancer risk calculations, and to ensure that the contaminants affecting the same target organ are accounted for in the noncancer hazard calculations. For contaminants with both cancer and noncancer health effects, the lower of the two screening levels was used for screening.

Any contaminant with a maximum detected concentration exceeding its COPC screening level is retained as a COPC for the HHRA risk calculations. Table B-1 provides the COPC screening for the available Section 9 Lease Mines soil data. Based on the screening, the following contaminants were identified as COPCs and are included in the risk estimates in the HHRA: uranium-238 in SE, aluminum, arsenic, cadmium, chromium, cobalt, iron, manganese, mercury, molybdenum, thallium, uranium, and vanadium.

3.2 EXPOSURE ASSESSMENT

The exposure assessment is the process of measuring or estimating intensity, frequency, and duration of human exposure to a contaminant in the environment. The exposure assessment considers land use assumptions, discusses the mechanisms by which people might contact COPCs in environmental media, and characterizes exposure factors (for example, time on site). The intake assumptions are combined with the estimated concentration for each COPC, called the EPC, to quantitatively estimate the contaminant exposure for the receptors at the EU. In accordance with USEPA (1989) guidance, an exposure assessment consists of three steps:

1. Characterization of the exposure setting (physical environment and potential receptors)
2. Identification of exposure pathways (constituent sources, exposure points, and exposure routes)
3. Quantification of pathway-specific exposures (receptor intake calculations using the EPC and exposure assumptions)

3.2.1 Conceptual Site Model

The risk assessment conceptual site model (CSM) describes the exposure setting and identifies potentially complete exposure pathways by which receptors (people, plants, and animals) could contact site-related contamination. The CSM is used throughout the site investigation and removal processes to (1) provide a framework for addressing potential risks, (2) evaluate the need for additional data acquisition activities, and (3) evaluate health risks and the need for corrective measures. As defined in Volume 1, Part A, of the "Risk Assessment Guidance for Superfund" (USEPA 1989), the following four elements are necessary to form a complete exposure pathway:

- A source or release from a source
- A mechanism of release and transport
- A point of contact for potential receptors
- An exposure route

If any one of the four elements are missing, the exposure pathway is incomplete. In general, only potentially complete exposure pathways are evaluated in the HHRA. The removal actions at NAUM sites are focused on removing soil as the source of contamination. Removal of contaminated soil should remove the source of contamination to surface water and groundwater. There is no current or expected future exposure to groundwater at the site. See Section 1.4 of the main EE/CA report for further discussion on the sources and extent of contamination. The site-specific CSM for the Section 9 Lease Mines is presented on Figure B-6.

3.2.2 Human Health Receptors, Exposure Pathways, and Exposure Parameters

The areas of concern for soil contamination at the Section 9 Lease Mines are AUMs 457 and 458, and the northern portion of AUM 459 located on Section 9. AUM 457 includes a former borrow pit, a pond, concrete foundations, and two 30-foot-tall walls from the ore processing plant while AUM 458 includes uranium waste rock, mining debris, and a recessed pit near the center of the AUM (Weston 2011). In addition, waste piles, debris, haul roads, and specific step-out areas indicated by elevated radium-226 soil sampling results or scan and static survey results within Section 9 are included in the risk assessment boundary. The drainages adjacent to and downstream of the mines are also areas of potential contamination.

Consistent with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) methodology, the risks and hazards related to removal activities at the site are anticipated to be managed within acceptable levels using engineering controls and personal protective equipment. Therefore, potential exposures to contaminants by removal action workers are not evaluated in the risk assessment, but worker protections should be included for removal actions at the site.

The CSM (Figure B-6) describes the exposure setting and identifies potentially complete exposure pathways by which people could contact site-related contamination.

Consistent with the NAUM risk assessment methodology (USEPA 2024c), the HHRA only evaluates the RME individual at the EU. Trespassers are assumed to have greater exposure than workers who rarely visit the site; therefore, the BLM recreator on Section 10 who trespasses onto Section 9 was selected as the RME individual for the site. Exhibit B-1 presents the RME receptor selected and a description of the exposure scenario.

Exhibit B-1. Receptor Evaluated

Receptor Name	Receptor Description
Trespasser	A person (adult and child) who is on the site for 2 weeks per year for 26 years to camp and recreate. Includes external exposure to radiation, incidental ingestion of soil, dermal exposure to soil (metals only), and inhalation of soil or dust.

The specific exposure inputs for the receptor evaluated in the HHRA are provided in Table B-3.

3.2.3 Exposure Parameters

Exposure inputs for the trespasser receptor are based on a BLM recreator due to the unrestricted access of BLM property within Section 10 and the lack of a physical barrier that limits movement between Sections 9 and 10; thus, a person legally accessing BLM-managed land on Section 10 could trespass onto Section 9. Camping is generally permitted on BLM land for 14 days of every 28 days. For this HHRA, a trespasser was assumed to return to the Section 9 Lease Mines site yearly for 26 years and to be on site for 24 hours a day during a 2-week visit.

3.3 TOXICITY ASSESSMENT

The toxicity assessment describes the relationship between a dose of a contaminant and the potential likelihood of an adverse health effect. The purpose of the toxicity assessment is to quantitatively estimate the inherent toxicity of COPCs for use in risk characterization. Potential effects of contaminants are separated into two categories: cancer and noncancer effects. Some contaminants can cause cancer while others can cause noncancer health effects such as neurological problems, kidney disease, and thyroid disease. Some contaminants, such as arsenic, have both cancer and noncancer health effects. Potential health risks for radionuclide COPCs are evaluated only for cancer risks while metals COPCs are evaluated for both cancer risks and noncancer hazards as appropriate.

3.3.1 Carcinogenic Effects

For carcinogens, such as radionuclides, USEPA assumes that no dose is low enough to not cause an adverse health effect and that the risk increases as the dose increases.

Potential carcinogenic effects resulting from human exposure to contaminants are estimated quantitatively using cancer slope factors (SF), which represent the theoretical increased risk per milligram of constituent intake per kilogram body weight per day (inverse of milligram per kilogram per day). Oral SFs are toxicity values for evaluating the probability of an individual developing cancer from oral exposure to contaminant levels over a lifetime. The oral SF is also used in the dermal exposure pathway with an absorption factor applied for the nonradioactive contaminants.

The inhalation unit risk factor is defined as the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to a contaminant at a concentration of 1 microgram per cubic meter in air. SFs or inhalation unit risk factors are used to estimate a theoretical upper-bound lifetime probability of an individual developing cancer from exposure to a potential carcinogen.

3.3.2 Noncarcinogenic Effects

Potential noncarcinogenic effects resulting from human exposure to contaminants are generally estimated quantitatively using chronic reference doses (RfD) and chronic reference concentrations (RfC). The RfD, expressed in units of daily dose (in milligrams per kilogram per day), is an estimate of the daily maximum level of exposure to human populations (including sensitive sub-populations) that is likely to be without an appreciable risk of deleterious effects (USEPA 1989). The oral RfD is also used in the dermal exposure pathway with an absorption factor applied. USEPA has derived RfCs for inhalation exposures for some contaminants. An inhalation RfC is similar to an RfD. If the concentration of a contaminant in air to which a human is exposed is lower than the RfC, no appreciable risk for noncancer health effects results from that exposure.

3.3.3 Sources of Toxicity Values and Other Contaminant-Specific Parameters

USEPA (2003) established a hierarchy of human health toxicity values for CERCLA; this hierarchy should be followed for selecting the toxicity values used in the HHRA. This HHRA used the toxicity values used in the NAUM Risk Calculator (USEPA 2024d), which are provided in Table 4 and Table 5 of the NAUM risk assessment methodology (USEPA 2024c) for radionuclides and metals, respectively.

3.4 RISK CHARACTERIZATION

In general, risk characterization proceeds by combining the results of the exposure and toxicity assessments. In standard CERCLA HHRAs, exposures are calculated by use of medium-specific EPCs (Table B-4) and a series of pathway-specific exposure parameters. These exposures are then multiplied or divided by analyte-specific toxicity factors (for example, SFs, unit risk factors, RfDs, and RfCs) to generate receptor- and exposure pathway-specific risks and hazards.

3.4.1 Estimates of Cancer Risk and Noncancer Hazard

Human health exposure factors were calculated for each applicable receptor and COPCs for all the potentially complete soil-related exposure pathways. For metal COPCs with both carcinogenic and noncarcinogenic toxicity, intake factors were calculated for both cancer and noncancer for each relevant exposure pathway. The methods, assumptions, and inputs for the calculation of the intake factors is provided in the NAUM risk assessment methodology (USEPA 2024c). Table B-5 presents the calculated cumulative cancer risk and noncancer hazard for each COPC by soil depth interval. That is, the risk was summed for all the exposure pathways relevant to the receptor.

Table B-6 provides a summary of the cumulative risk by exposure pathway. This HHRA only evaluates the RME receptor at the single EU, and these results are used for risk management decisions for the site.

The intake factors used in the HHRA were calculated using the NAUM Risk Calculator (USEPA 2024d). The USEPA's RSL Calculator considers only direct soil exposures (for example, soil ingestion, dermal contact, and inhalation of fugitive dust). The NAUM Risk Calculator generates exposure pathway-specific cancer risks and noncancer hazards, as well as external exposure to radiation and direct exposure to radiation in soil through incidental ingestion and inhalation. The complete set of equations and inputs for calculating exposure inputs for receptors is provided in the NAUM risk assessment methodology (USEPA 2024c).

The cumulative cancer risk for the age-adjusted adult and child receptors and noncancer hazards for the adult and child receptors and soil depth interval are provided in Table B-7 and summarized in Exhibit B-2.

Exhibit B-2. Cancer Risks and Noncancer Hazards

Exposure Unit	Soil Interval	Cancer Risk	Adult Noncancer Hazard	Child Noncancer Hazard
Section 9 Lease Mines – Trespasser	Surface Soil	**8×10^{-4}**	0.04	0.5
	Subsurface Soil	**5×10^{-4}**	0.03	0.3

Notes:
Bolded values exceed the target cancer risk or target hazard quotient.

Candidate COCs were identified based on the estimated cancer risk exceeding the target cancer risk of 1×10^{-4} or the estimated noncancer hazard exceeding the target hazard quotient of 1 for the RME receptor at the EU. COPCs with a cancer risk within the USEPA risk range of 1×10^{-6} to 1×10^{-4} are italicized on Table B-7. Target organ analyses were not performed for any scenario-media combination because no instances arose where the target organ hazard index exceeded 1 and no individual COPC had a hazard exceeding 1. Exhibit B-3 presents the candidate COCs as identified in Table B-7.

Exhibit B-3. Candidate Contaminants of Concern

Exposure Unit	Soil Interval	Cancer Risk	Noncancer Hazard
Section 9 Lease Mines – Trespasser	Surface Soil	Uranium-238 in SE	--
	Subsurface Soil	Uranium-238 in SE	--

Notes:
-- Not applicable
SE Secular equilibrium

3.4.2 Uncertainty Associated with the Human Health Risk Assessment

Uncertainties are inherent in the process of quantitative risk assessments based on the use of environmental sampling results, assumptions regarding exposure, and the quantitative representation of contaminant toxicity. Analysis of the critical areas of uncertainty in a risk assessment provides a better understanding of the quantitative results through the identification of the uncertainties that most significantly affect the results.

USEPA (1989) guidance stresses the importance of providing an in-depth analysis of uncertainties so that risk managers are better informed when evaluating risk assessment conclusions. Potentially significant sources of uncertainty for this risk assessment are discussed in the following subsections. The NAUM risk assessment methodology (USEPA 2024c) provides general HHRA uncertainty discussions for topics applicable to all NAUM sites.

3.4.2.1 Conceptual Site Model and Reasonable Maximum Exposed Receptor Selection

The most significant site-specific uncertainty associated with the Section 9 Lease Mines HHRA is the selection of the RME receptor. EUs used in NAUM risk assessments and future removal actions within the TENORM area are developed by identifying areas of TENORM with the same expected human health receptors. The RME receptor was selected based on site knowledge. If the selected receptor is less conservative than the actual future land use (for example, trespasser is selected, but the actual use is residential), the HHRA would not be protective. Likewise, if the future land use is less intensive than the receptor selected (for example, residential is selected, but the actual use is trespasser), the HHRA would be overly protective. This uncertainty is moderate. The direction of the uncertainty is more likely to be overprotective because of the conservative selection methodology used to identify the RME receptor for the EU.

3.4.2.2 Sample Design and Exposure Point Concentrations

The sampling collection for the site was not based on a random sampling design. Instead, sampling was biased toward known areas of contamination based on the results of gamma surveys. Thus, while some areas do not have the same level of sampling coverage as others, those areas are not likely to have elevated levels of contamination based on the site survey techniques employed before collection of discrete samples for laboratory analysis. The uncertainty associated with the sample collection is moderate, but the samples used in the risk assessment are likely to overestimate the actual site risk because of the biased nature of the samples collected at the site.

Four hexavalent chromium samples were collected from the Section 9 Lease Mines but were not used in the risk assessment. In lieu of the hexavalent chromium results and to be health protective, analytical results for total chromium were evaluated in this HHRA assuming the chromium concentration is in the form of the more toxic hexavalent chromium. Three of the four hexavalent chromium samples were nondetect, and one hexavalent chromium sample had a detection (0.25 mg/kg) that would result in an EPC of 0.25 mg/kg, which is less than the EPC derived using the total chromium results (5.0 mg/kg). Use of the EPC associated with the more robust total chromium dataset is more conservative than using the EPC for hexavalent chromium associated with the single detected result.

4.0 ECOLOGICAL RISK ASSESSMENT

An ERA is the process for evaluating how likely the environment will be impacted as a result of exposure to one or more environmental stressors, such as radionuclides or metals. The objective of the ERA is to evaluate whether ecological receptors may be adversely affected by exposure to contaminants. The ERA is intended to provide input for risk management decision-making at each site while maintaining a conservative approach protective of ecological populations and communities. This ERA follows the guidelines in the NAUM risk assessment methodology (USEPA 2024c).

As described in USEPA (1993) EE/CA guidance, a risk assessment is used to help justify a removal action, identify what current or potential exposures should be prevented, and focus on the specific problem that the removal action is intended to address. NAUM ERAs include a screening-level ecological risk assessment (SLERA) and SLERA refinement. The SLERA includes Steps 1 and 2 of USEPA's eight-step ERA process (USEPA 1997) and is intended to provide a conservative estimate using maximum site concentrations of potential ecological risks and compensate for uncertainty in a precautionary manner by incorporating conservative assumptions. The SLERA refinement includes a refinement of Steps 1 and 2 and is intended to provide additional information for risk managers. Candidate COECs are identified based on the results of the SLERA refinement for soil. Table B-1, Table B-2, and Table B-8 through Table B-12 present data and analysis associated with the ERA.

Consistent with standard risk assessment practice and USEPA (1992a, 1998, 2023) guidance, the ERA is presented in three major phases:

- Problem formulation
- Analysis of exposure and effects
- Risk characterization

4.1 PROBLEM FORMULATION

The problem formulation phase is a planning and scoping process that establishes the goals, breadth, and focus of the risk assessment. The product of the problem formation is a CSM that identifies the environmental values to be protected (assessment endpoints), data needed, and analyses to be used. The components of the problem formulation include:

- Ecological habitat and biological resources
- Stressors and COI selection
- Potentially complete exposure pathways
- Assessment endpoints
- Measurement endpoints
- Ecological CSM

The SLERA includes the screening-level problem formulation (Step 1), exposure estimation, effects evaluation, and screening-level risk calculation (Step 2) of the USEPA risk assessment process. The maximum detected concentration across the site is used as the EPC in the SLERA, which is compared with the minimum no observed effect concentration (NOEC) for all ecological receptors. The product of the SLERA is a list of contaminants of potential ecological concern (COPEC) in affected media that are recommended for further ecological assessment.

The SLERA refinement provides additional information for risk managers. For plants and invertebrates, the SLERA refinement includes a point-by-point comparison of individual sample results to plant and invertebrate NOECs. For free-ranging birds and mammals, the SLERA refinement uses an estimate of the average concentration as the EPC to represent exposure to free-ranging birds and mammals and includes a comparison of the EPC with the minimum NOEC for birds and mammals.

At the conclusion of the SLERA refinement, the candidate COECs are identified. For plants and invertebrates, analytes with any individual sample results exceeding the plant and invertebrate NOEC will be identified as candidate COECs, and for birds and mammals, analytes with a refined hazard quotient (HQ) equal to or greater than 1.0 will be identified as candidate COECs. These analytes are called candidate COECs (rather than COECs) because the analytes have not yet undergone a background evaluation, which will be completed in the EE/CA. The background evaluation should not be performed as part of the risk assessment.

4.1.1 Ecological Habitat and Biological Resources

The ecological habitat and biological resources at the Section 9 Lease Mines are described in Section 1.4.

4.1.2 Stressors and Constituents of Interest Selection

All detected metals and radionuclides in soil were considered COIs in this ERA. Essential nutrients that are not priority pollutants, such as calcium, magnesium, potassium, and sodium, were not retained as COIs. See Section 2.4 of the main EE/CA report for further discussion on the sources and extent of contamination. Samples collected within soil (0 to 60 inches bgs) at the site were used in this risk assessment.

4.1.3 Potentially Complete Exposure Pathways

A contaminant must be able to travel from the source to the representative receptor and must be taken up by the receptor through one or more exposure routes for an exposure pathway to be considered complete. Potential exposure pathways that may result in receptor contact with contaminants in the environment include soils, sediment, surface water, groundwater, air, and food-chain transfer. Soil and sediment are the primary exposure media of concern. Surface water from seeps and ephemeral streams is also a primary exposure medium of concern for aquatic invertebrates and a secondary exposure medium of concern for terrestrial receptors; however, no surface water samples are available for the Section 9 Lease Mines. Potential exposure pathways are shown in the CSM (Figure B-6). Discussion of the exposure pathways for ecological receptors is provided in the NAUM risk assessment methodology (USEPA 2024c).

Soil exposures are evaluated in the ERA for the Section 9 Lease Mines. The removal actions at NAUM sites are focused on removing soil because the removal of contaminated soil should remove the source of contamination to surface water and groundwater. Exposure to surface water or groundwater is assumed to be minimal because the presence of surface water at the Section 9 Lease Mines is intermittent and groundwater is too deep for ecological receptors to access.

4.1.4 Assessment Endpoints

USEPA (1997) defines assessment endpoints as explicit expressions of the actual environmental values (for example, ecological resources) that are to be protected. Assessment endpoints are environmental characteristics that, if impaired, would indicate a need for action by risk managers.

The assessment endpoints identified for evaluation in the ERA were based on the ecological habitat, stressors and COPECs, and potentially complete exposure pathways identified in Section 4.1 and depicted on the CSM (Figure B-6). Each assessment endpoint is intended to protect the local populations of the identified resources. The assessment endpoints used to evaluate the potential ecological risk to receptors typical of the area at the Section 9 Lease Mines were:

- Protection of terrestrial plants
- Protection of terrestrial invertebrates
- Protection of herbivorous birds
- Protection of insectivorous birds
- Protection of carnivorous birds
- Protection of herbivorous mammals
- Protection of insectivorous mammals
- Protection of carnivorous mammals

4.1.5 Measurement Endpoints

Measurement endpoints related to the assessment endpoints were identified because assessment endpoints are usually not amenable to direct measurement. USEPA (1997) defines a measurement endpoint as a measurable ecological characteristic that is related to the valued characteristic chosen as the assessment endpoint and is a measure of biological effects (such as mortality, reproduction, or growth). Measurement endpoints for soil and sediment for both radionuclides and metals are described below.

For radionuclides in soil, ecological screening levels (ESL) for the NAUM program were developed by Tetra Tech (Appendix F of the NAUM risk assessment methodology [USEPA 2024c]). An ecological radiation dose assessment was performed for radionuclides in the uranium-238 decay chain using the dose assessment model Environmental Risks from Ionising Contaminants: Assessment and Management (ERICA). The ERICA model is scientifically robust, follows approaches recommended by the International Commission on Radiation

Protection for radiation protection of the environment, and provides dose assessment for uranium-238 and all its decay progeny. Using the ERICA Tool (Brown and others 2008; Larsson 2008), ESLs were calculated for the following radionuclides or groups of radionuclides in soil for terrestrial organisms:

- Uranium-238 in SE (adjusted radium-226) adjusted to account for the entire uranium-238 decay chain
- Radium-226 in SE (adjusted radium-226) adjusted to account for radium-226 and decay products
- Individual radionuclides uranium-238, uranium-234, and thorium-230

ESLs are based on dose rates where no effects have been observed and, therefore, are NOECs. For all radionuclides, the limiting ESLs are for lichen-bryophytes and small burrowing animals at 4 and 6 picocuries per gram, respectively. The ESLs are designed for use for comparison with radium-226 site concentrations. Use of site data for radium-226 reduces the number of analytical methods needed to evaluate risks from radionuclides. Furthermore, radium-226 concentrations can be correlated to gamma survey results, which provides an efficient and reliable way to evaluate the extent of radiation contamination.

For metals for soil, USEPA (2024d) ecological soil screening levels (Eco-SSL) are used as the primary source for NOEC levels. Eco-SSLs are available for the protection of terrestrial plants, invertebrates, birds, and mammals from the three primary feeding groups (herbivores, insectivores, and carnivores). The Eco-SSLs for soil-dwelling invertebrates and plants are based on direct contact with soil by plants and soil-dwelling organisms living in impacted soil. The Eco-SSLs for upper-trophic-level wildlife are based on incidental ingestion of soil and ingestion of food sources that have bioaccumulated contaminants. The no effect Eco-SSL is based on a no observed adverse effect level-based toxicity reference value that is protective of wildlife populations and sensitive individuals because it represents an exposure that is not associated with an adverse effect. The Eco-SSLs are intended to be conservative screening values that can be used to eliminate contaminants not associated with unacceptable risks (USEPA 2005).

Where an Eco-SSL is not available for a COPEC and receptor combination (for example, total mercury, thallium, and uranium), a no observed adverse effect level-based toxicity value from the Los Alamos National Laboratory (LANL) EcoRisk database (Newport News Nuclear BWXT-Los Alamos, LLC [N3B] 2022) is selected as the screening level. The LANL EcoRisk database includes ESLs for plant, invertebrate, avian, and mammalian receptors. Soil invertebrate and plant screening levels were also taken from the Oak Ridge National Laboratory (ORNL) (Efroymson, Will, and Suter II 1997; Efroymson, Will, Suter II, and Wooten 1997) if a screening level was not available as an Eco-SSL or from the LANL EcoRisk database. No Eco-SSL or LANL values for mammals were available for molybdenum; therefore, screening values were taken from ORNL's "Preliminary Remediation Goals for Ecological Endpoints" (Efroymson, Suter II, Sample, and Jones 1997).

The screening levels selected from USEPA Eco-SSLs, LANL ESLs, and ORNL for metals and developed from ERICA (for radionuclides) for use in the SLERA screening are the lowest NOECs for all receptor groups (that is, the lowest of the plant, invertebrate, bird [herbivorous, insectivorous, and carnivorous], and mammal [herbivorous, insectivorous, and carnivorous] NOECs) for each COPEC. The screening levels are provided in Table B-8.

4.1.6 Conceptual Site Model

The CSM illustrates exposure pathways to be evaluated in the ERA and provides other key information such as contaminant sources, release and transport mechanisms, and the relative importance of exposure pathways to specific receptor groups. The CSM incorporates all components of the problem formulation as discussed above and illustrated on Figure B-6.

4.2 ANALYSIS OF EXPOSURE AND EFFECTS

In the analysis phase, exposure to stressors (metals and radionuclides) and their relationship to ecological effects are evaluated. A determination is made of (1) the degree to which ecological receptors are exposed and (2) whether that level of exposure is likely to cause harmful ecological effects.

4.2.1 Exposure Estimates

For the SLERA, a single site-wide exposure area that included all data collected within the Section 9 Lease Mines EU was used for the evaluation of potential risk to ecological receptors. Exposure estimates for the SLERA for soil are the maximum detected concentrations for COIs in soil compared to the minimum screening levels for all receptors (plants, invertebrates, birds [herbivorous, insectivorous, and carnivorous], and mammals [herbivorous, insectivorous, and carnivorous]). For each detected analyte, the maximum detected concentrations used in the SLERA for each COPEC are presented in Table B-8 for soil.

Following the comparison of the maximum detection to the NOEC, a SLERA refinement of exposure was completed by assessing site data within surface and subsurface soils and using the EPC instead of the maximum detected concentration to evaluate risk to free-ranging receptors (birds and mammals) for the assessment of wildlife. Surface and subsurface soils include depth intervals of 0 to 6 inches bgs for surface soil and 0 to 60 inches bgs for subsurface soil (see Section 2.4). The EPCs used in the SLERA refinement for birds and mammals for each COPEC are presented in Table B-9. For the SLERA refinement for plants and invertebrates, individual sample concentrations are used in a point-by-point comparison.

4.2.2 Ecological Effects

Ecological effects of potential concern are those that can impact populations by causing adverse effects on development, reproduction, and survival (USEPA 1997). Literature-based NOECs as described in Section 4.1.5 were used in the ERA to characterize potential effects from direct contact and uptake through the food web to terrestrial ecological receptors, including vegetation, soil invertebrates, birds, and mammals.

For the SLERA, an HQ was calculated as the ratio of the maximum contaminant concentration to the screening level (NOEC) by COPEC and receptor. HQs greater than or equal to 1.0 indicate potential unacceptable risk to plants, invertebrates, birds, and mammals based on a conservative comparison of the maximum detected concentration to the minimum NOEC-based screening level for all receptors. HQs less than 1.0 indicate little to no potential ecological risk for a given COPEC, and the COPEC is excluded from further consideration (that is, the COPEC was not evaluated in the SLERA refinement). The SLERA HQ was calculated as follows:

$$\text{SLERA HQ} = \frac{\text{Maximum Detected Concentration}}{\text{Screening Level (NOEC or ESL)}}$$

To better understand potential risk to free-ranging receptors, the site-wide EPC (based on the lesser of the UCL95 and maximum detected concentration) will be used as a refinement in the SLERA refinement using NOECs based on birds and mammals. The refined SLERA HQ is calculated as follows:

$$\text{Refined SLERA HQ} = \frac{\text{EPC}}{\text{Screening Level (NOEC or ESL)}}$$

Because plant and soil invertebrates are not mobile, concentration data from each sample location should be compared to the plant and invertebrate NOEC-based screening levels in a separate table.

4.3 RISK CHARACTERIZATION

In the risk characterization phase, potential risk is estimated through integration of exposure and effects, potential risks are considered in the context of uncertainties associated with the SLERA, and risk descriptions are provided.

4.3.1 Screening-Level Ecological Risk Assessment for Contaminants of Potential Ecological Concern

HQs, which represent the ratio of the maximum detected concentration in the environmental medium to the screening levels, are presented in Table B-8 for soil. Contaminants in soil for which the HQ was greater than or equal to 1.0 were uranium-238 in SE (adjusted radium-226), arsenic, barium, cadmium, chromium, cobalt, lead, manganese, mercury, molybdenum, nickel, selenium, thallium, uranium, vanadium, and zinc.

4.3.2 Screening-Level Ecological Risk Assessment Refinement

The SLERA refinement incorporates components of Step 3 of USEPA's eight-step ERA process to refine the soil risk estimates from the SLERA (USEPA 2000b, 2001). The SLERA refinement involves assessing plants and invertebrates on a point-by-point basis and wildlife (birds and mammals) based on a refined EPC.

4.3.2.1 Plants and Soil Invertebrates

Plants and soil invertebrates are not mobile; therefore, comparison of the EPC to the NOEC (for metals) or ESL (for radionuclides) may not appropriately assess whether potential unacceptable risk to plants and invertebrates exists. Therefore, a comparison on a point-by-point basis using the plant and invertebrate NOECs is required. COPECs are identified as candidate COECs if at least one sample result exceeds the plant or soil invertebrate NOEC or ESL for surface soil, or the plant NOEC or ESL for subsurface soil. Table B-10 presents a comparison of individual surface soil sample results to NOECs or ESLs for the plant and invertebrate communities, and of individual subsurface soil sample results to NOECs or ESL for the plant communities (invertebrates are not exposed to soil at depths greater than 6 inches). For plants and invertebrates, analytes with any individual sample results exceeding the plant and invertebrate NOEC or ESL are identified as candidate COECs.

Candidate COECs for plants were uranium-238 in SE, arsenic, barium, chromium, cobalt, lead (surface soil only), manganese, mercury, molybdenum, selenium, thallium (surface soil only), uranium, and vanadium (surface soil only). Candidate COECs for invertebrates were uranium-238 in SE, arsenic, barium, chromium, manganese, mercury, and selenium.

4.3.2.2 Birds and Mammals

For free-ranging wildlife, the EPCs were calculated on a site-wide basis for contaminants with analyte-specific HQs that are equal to or greater than 1.0 in the SLERA. SLERA refinement risk estimates were calculated by dividing EPCs by the minimum NOEC or ESL for birds and mammals for each COPEC in surface soil and by dividing EPCs by the NOEC or ESL for insectivorous mammals in subsurface soil (birds and non-burrowing mammals are not exposed to soil at depths greater than 6 inches).

Table B-11 and Table B-12 present HQs for birds and mammals, respectively. Candidate COECs for birds and mammals were identified for analytes with HQs greater than 1.0 based on the comparison of the EPC (UCL95) to the minimum screening level (minimum NOEC or ESL for wildlife).

Candidate COECs for birds were uranium-238 in SE, lead, mercury, molybdenum, selenium, thallium, and vanadium. Candidate COECs for mammals were uranium-238 in SE, barium, selenium, and thallium.

4.3.3 Candidate Contaminants of Ecological Concern

Candidate COECs were identified based on available laboratory and toxicological data for the Section 9 Lease Mines. The SLERA results indicate that risk is above a level of concern for the contaminants listed in Exhibit B-4.

Exhibit B-4. Site-Wide Candidate Contaminants of Ecological Concern

Receptor	Soil Interval	Candidate Contaminant of Ecological Concern												
		Uranium-238 in SE	Arsenic	Barium	Chromium	Cobalt	Lead	Manganese	Mercury	Molybdenum	Selenium	Thallium	Uranium	Vanadium
Plants	Surface Soil	X	X	X	X	X	X	X	X	X	X	X	X	X
	Subsurface Soil	X	X	X	X	X	--	X	X	X	X	--	X	--
Invertebrates	Surface Soil	X	X	X	X	--	--	X	X	--	X	--	--	--
Birds	Surface Soil	X	--	--	--	--	X	--	X	X	X	X	--	X
Mammals	Surface Soil	X	--	X	--	--	--	--	--	--	X	X	--	--
	Subsurface Soil	X	--	X	--	--	--	--	--	--	X	X	--	--

Notes:
-- Not a candidate COEC
X Candidate COEC
COEC Contaminant of ecological concern
SE Secular equilibrium

4.4 UNCERTAINTY ANALYSIS ASSOCIATED WITH THE ECOLOGICAL RISK ASSESSMENT

Uncertainty plays an important role in risk-based decision-making and is, therefore, incorporated explicitly into the risk characterization process. Identifying known sources of uncertainty is a critical component of an ERA because conservative default assumptions incorporated into the ERA protocol are associated with substantial uncertainty. The ERA process is based on assumptions and extrapolations to evaluate potential risk to ecological receptors. These assumptions are intentionally conservative and may result in overestimates of site-specific risk to ensure that no COPECs that pose actual risk are eliminated from the ERA. The primary components of uncertainties include those associated with site data and exposure, the development and use of toxicity values, and interpretation of HQs to estimate potential risk to representative receptors. The NAUM risk assessment methodology (USEPA 2024c) provides more general ERA uncertainty discussions for topics applicable to all NAUM sites.

4.4.1 Exposure Estimates

Because Tetra Tech evaluated the Section 9 Lease Mines using limited collected data, all concentrations measured are, therefore, only estimates of concentrations that may occur throughout the site (with associated error). As with any site investigation, uncertainty will be associated with the representativeness of the samples both spatially and temporally. Soil samples were collected during three events:

- Site investigation in 2013

- Removal site evaluation in 2018
- Data gaps investigation in 2024

The sampling events were conducted by different entities; therefore, the data collection methods were likely not consistent. Figure B-3 through Figure B-5 show the sample locations. Spatial variability is limited because soil samples used in the risk assessment were primarily collected within the disturbed area of the site. Temporal variability is limited because soil sampling methods because of the known environmental fate of the COPECs (lack of degradation).

Four hexavalent chromium samples were collected from the Section 9 Lease Mines but were not used in the risk assessment. In lieu of the hexavalent chromium results and to be health protective, analytical results for total chromium were evaluated in this ERA assuming the chromium concentration is in the form of the more toxic hexavalent chromium. Three of the hexavalent chromium four samples were nondetect, and one hexavalent chromium sample had a detection (0.25 mg/kg) that would result in an EPC of 0.25 mg/kg, which is less than the EPC derived using the total chromium results (5.0 mg/kg). Use of the EPC associated with the more robust total chromium dataset is more conservative than using the EPC for hexavalent chromium associated with the single detected result. is less than the minimum NOEC (0.34 mg/kg) for all ecological receptors.

4.4.2 Nondetected Contaminants of Potential Ecological Concern

Little uncertainty is involved with the analytical analysis for soil at the Section 9 Lease Mines except for antimony. Antimony was not detected in any sample, but some samples have reporting limits greater than ESLs. This possibility was described in the NAUM risk assessment methodology (USEPA 2024c) with the lowest no-effect ESL for antimony of 0.27 mg/kg as compared to the typical method detection limits for metals methods ranging from 0.5 mg/kg to 3 mg/kg. For this site, there were no detections of antimony, but the detection limits in soil ranged from 33 mg/kg to 1.73 mg/kg. The lowest no-effect level screening value for antimony is protective of the mammalian ground insectivore and is an order of magnitude lower than the next lowest Eco-SSL of 4.9 mg/kg protective of mammalian carnivores. The other soil screening levels include the following: 11 mg/kg protective of plants, 78 mg/kg protective of soil invertebrates, and 10 mg/kg protective of mammalian herbivores. There is uncertainty associated with the assessment of antimony and protection of ecological receptors; however, most of the detection limits are below the screening level protective of mammalian herbivores and plants, and all the detection limits are below the screening level protective of soil invertebrates. This analysis identifies the uncertainty that concentrations of antimony could be present at the site below the detection limits but greater than calculated screening level protective of certain classes (e.g., ground insectivores) of ecological receptors.

4.4.3 Combined Exposures Across Media

The design of the ecological screening process and use of media-based screening levels assumes isolation of exposure (for example, risk from exposure to soil is not added to the risk from exposure to surface water). The risk analysis does not account for exposure to COPECs in drinking water, but the magnitude of this uncertainty is unknown.

4.4.4 Risk to Plant and Invertebrate Communities

To address the potential risk to plant and invertebrate communities, concentration data from each sample are compared to the conservative screening values protective of individual plants and invertebrates (NOECs and ESLs). Table B-10 presents this analysis so that risk managers can evaluate the potential risk to these communities by sample location.

Aluminum and iron do not have screening values for either community. The magnitude of the impacts of aluminum and iron on nonmobile communities is unknown. Six additional COIs at the Section 9 Lease Mines (cobalt, molybdenum, silver, thallium, uranium, and vanadium) do not have soil invertebrate screening values. The magnitude of the impacts of these metals on the soil invertebrate community is unknown.

5.0 RISK ASSESSMENT RESULTS SUMMARY

The HHRA and SLERA results indicate human health and ecological risk exceed the acceptable risk levels. Candidate COCs were identified based on available laboratory and toxicological data at the Section 9 Lease Mines, and candidate COECs were identified on a site-wide basis. The HHRA and ERA results indicate that risk is above a level of concern for the contaminants listed in Exhibit B-5.

Exhibit B-5. Candidate Contaminants of Concern or Contaminants of Ecological Concern for Soil

Exposure Unit	Receptor	Media	Contaminant												
			Uranium-238 in SE	Arsenic	Barium	Chromium	Cobalt	Lead	Manganese	Mercury	Molybdenum	Selenium	Thallium	Uranium	Vanadium
Site-Wide	Trespasser	Surface and Subsurface Soil	X	--	--	--	--	--	--	--	--	--	--	--	--
Site-Wide	Plants	Surface Soil	X	X	X	X	X	X	X	X	X	X	X	X	X
		Subsurface Soil	X	X	X	X	X	--	X	X	X	X	--	X	--
Site-Wide	Invertebrates	Surface Soil	X	X	X	X	--	--	X	X	--	X	--	--	--
Site-Wide	Birds	Surface Soil	X	--	--	--	--	X	--	X	X	X	X	--	X
Site-Wide	Mammals	Surface and Subsurface Soil	X	--	X	--	--	--	--	--	--	X	X	--	--

Notes:
-- Not a candidate COC or COEC. Not recommended for further evaluation in the EE/CA.
X Candidate COC and/or COEC. Recommended for further evaluation in the EE/CA.
COC Contaminant of concern
COEC Contaminant of ecological concern
EE/CA Engineering evaluation/cost analysis
SE Secular equilibrium

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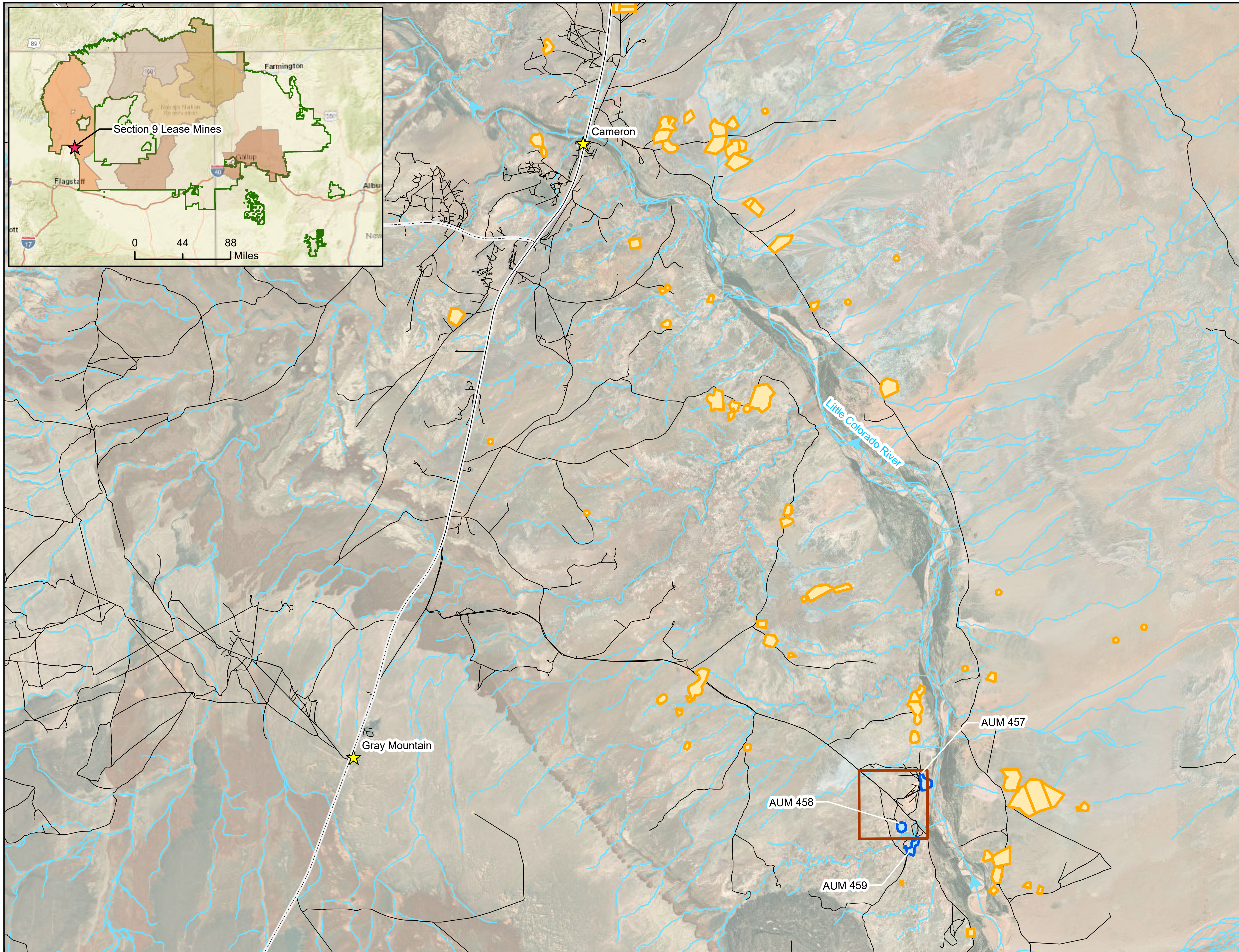
FIGURES



Populated Place

AUM Site Locations

- Section 9 Lease Mine
- Other AUM Site
- PLSS Section Boundary *Section 9*

Navajo Nation AUM Regions

- Central Region
- Eastern Region
- North Central Region
- Northern Region
- Southern Region
- Western Region
- Navajo Nation Boundary
- Paved Road
- Unpaved Road
- Drainage

Notes:

AUM	Abandoned uranium mine
PLSS	Public Land Survey System

1 inch = 7,400 Feet

1:88,800

7,400 3,700 0 7,400 Feet

N W E S

SECTION 9 LEASE MINES LOCATION AND ACCESS

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 0020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 6/27/2024
Coordinate System: NAD 1983 State Plane Arizona Central FIPS 0202 Feet Transverse Mercator	Figure No.: B-1

- Soil Sample Location
- Risk Assessment Boundary
- TENORM Boundary
- Section 9 Lease Mines AUM Site
- Geologic Contact
- PLSS Section Boundary
- Babbit Ranches Property Boundary
- BLM Land Boundary
- Navajo Nation Boundary
- Access Road
- Drainage

Notes:

AUM	Abandoned uranium mine
BLM	Bureau of Land Management
Qay	Quaternary Alluvium
TENORM	Technologically enhanced naturally occurring radioactive material
TRcp	Chinle Formation Petrified Forest Member
TRcs	Chinle Formation Shinarump Member

1 inch = 620 Feet

1:7,440

620 310 0 620 Feet

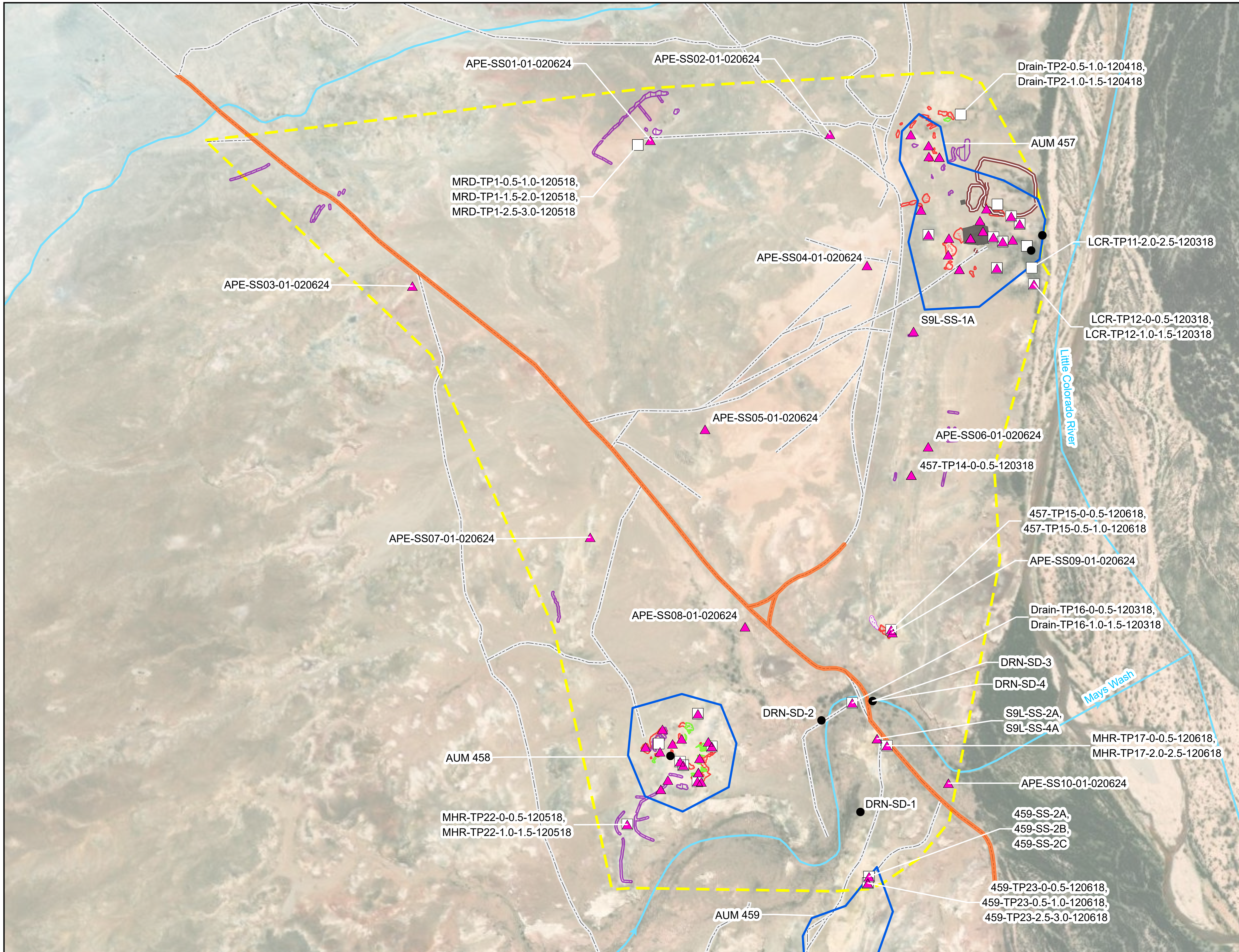
N E S W

SECTION 9 LEASE MINES EXPOSURE UNIT WITH RISK ASSESSMENT SAMPLE LOCATIONS

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612

Task Order No.: 0020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 6/27/2024
Coordinate System: NAD 1983 State Plane Arizona Central FIPS 0202 Feet Transverse Mercator	Figure No.: B-2



Soil Sample Locations[1]

- Sediment Sample (0-6 inches bgs)
- Surface Soil Sample (0-6 inches bgs) *(includes all laboratory samples with bottom depth ≤ 6 inches)*
- Subsurface Soil Sample (below 6 inches bgs) *(includes all laboratory samples with top depth > 6 inches and ≤ 60 inches)*
- Risk Assessment Boundary
- Section 9 Lease Mines AUM Site

Site Features

- Berm
- Accumulation/Deposition Area - Surficial
- Accumulation/Deposition Area - Volumetric
- Concrete Pad
- Dozer Cut
- Haul Road
- Shallow Mine Waste
- Waste Pile
- Access Road
- Drainage

Notes:
[1]Sample IDs for AUM 457 and AUM 458 are shown on the following figures.
AUM Abandoned uranium mine
bgs Below ground surface

1 inch = 620 Feet

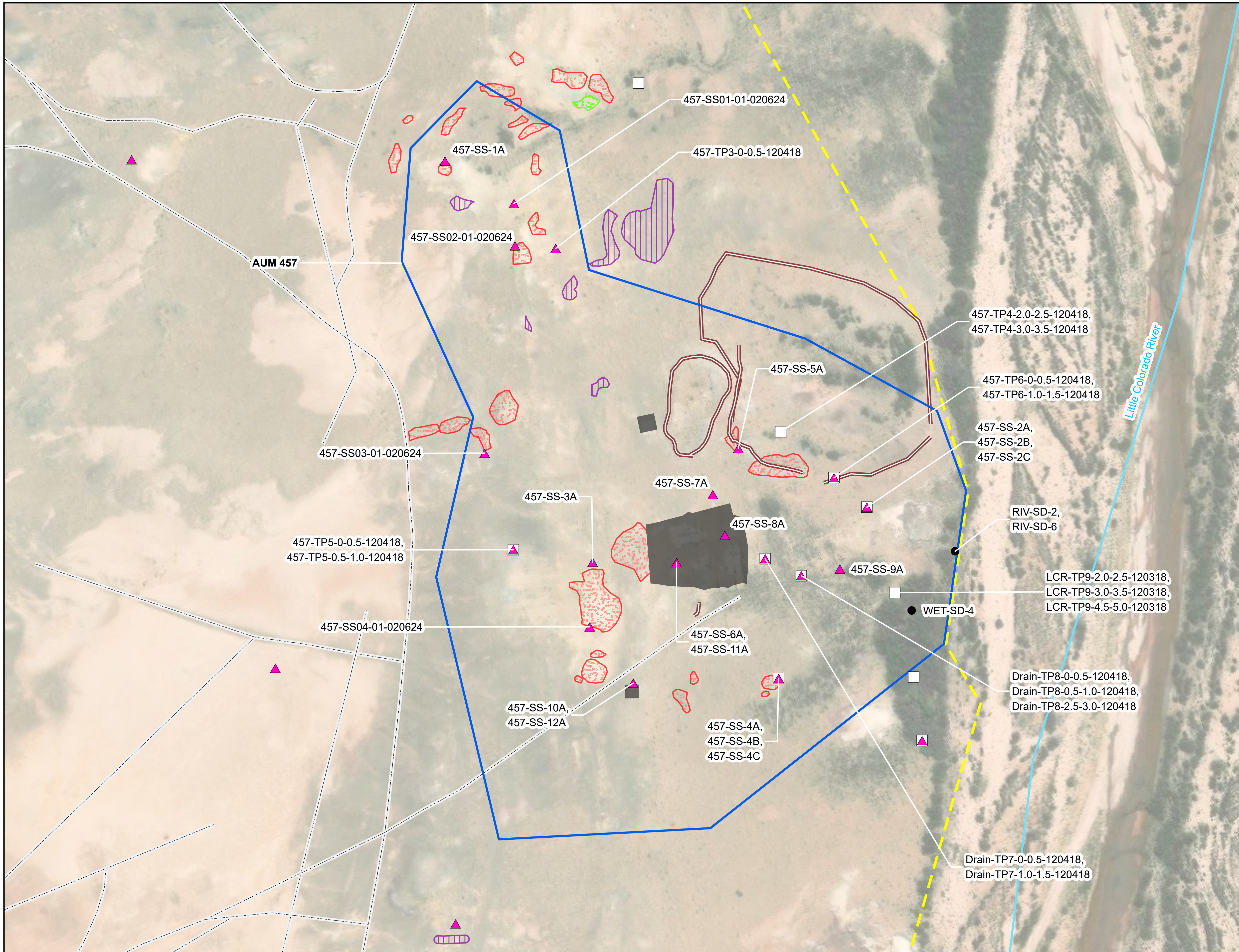
1:7,440

620 310 0 620 Feet

N W E S

SECTION 9 LEASE MINES EXPOSURE UNIT SAMPLE LOCATIONS OVERVIEW

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 0020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 6/27/2024
Coordinate System: NAD 1983 State Plane Arizona Central FIPS 0202 Feet Transverse Mercator	Figure No.: B-3



Soil Sample Locations[1]

- Sediment Sample (0-6 inches bgs)
- Surface Soil Sample (0-6 inches bgs) *(includes all laboratory samples with bottom depth ≤ 6 inches)*
- Subsurface Soil Sample (below 6 inches bgs) *(includes all laboratory samples with top depth > 6 inches and ≤ 60 inches)*
- Risk Assessment Boundary
- Section 9 Lease Mines AUM Site

Site Features

- Berm
- Concrete Pad
- Dozer Cut
- Shallow Mine Waste
- Waste Pile
- Access Road
- Drainage

Notes:
[1]Sample IDs for outside of the AUM 457 boundary are shown on Figure B-3.
AUM Abandoned uranium mine
bgs Below ground surface

1 inch = 160 Feet

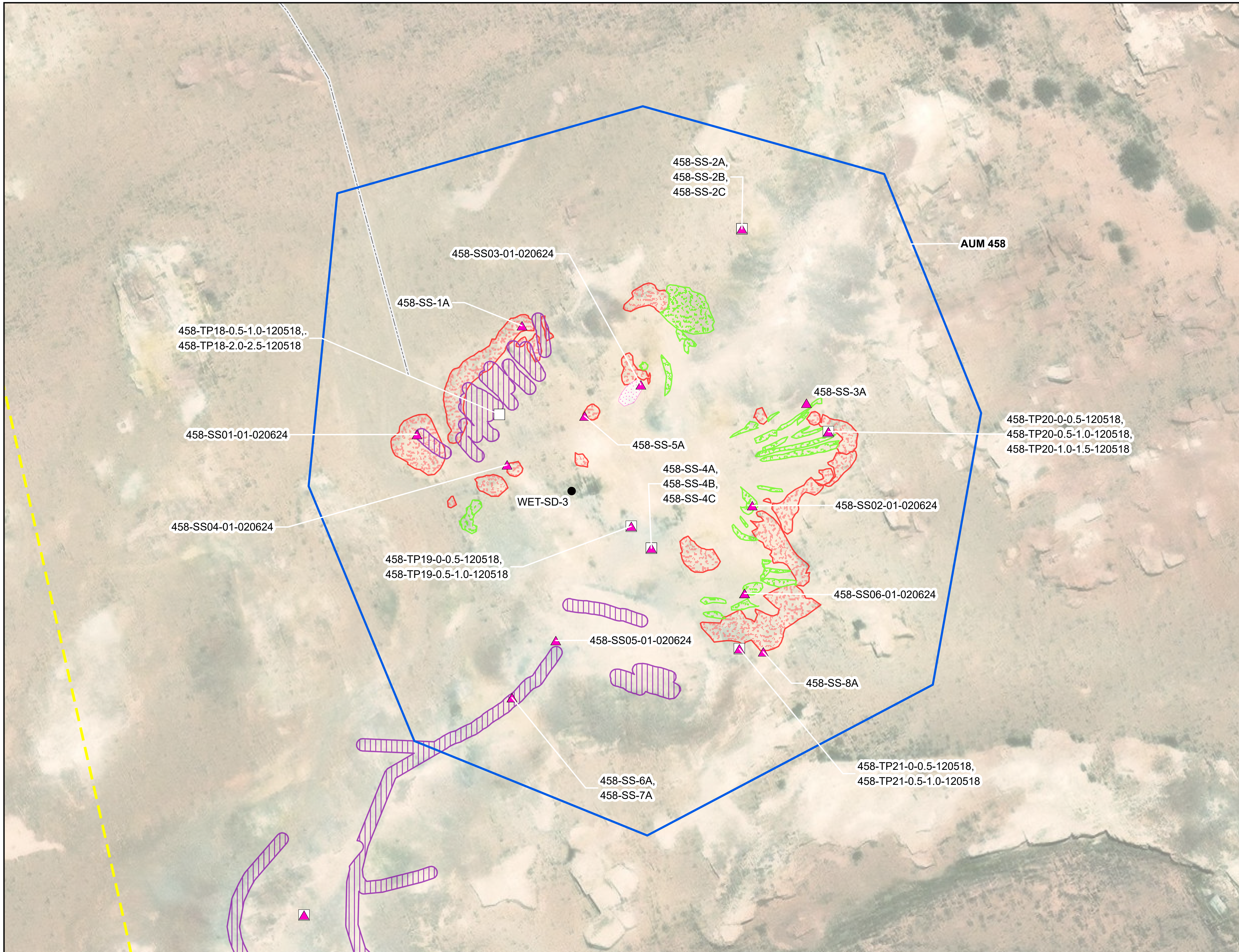
1:1,920

160 80 0 160 Feet

N W E S

SECTION 9 LEASE MINES EXPOSURE UNIT SAMPLE LOCATIONS - AUM 457

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 0020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 6/27/2024
Coordinate System: NAD 1983 State Plane Arizona Central FIPS 0202 Feet Transverse Mercator	Figure No.: B-4



Soil Sample Locations[1]

- Sediment Sample (0-6 inches bgs)
- Surface Soil Sample (0-6 inches bgs) *(includes all laboratory samples with bottom depth ≤ 6 inches)*
- Subsurface Soil Sample (below 6 inches bgs) *(includes all laboratory samples with top depth > 6 inches and ≤ 60 inches)*
- Risk Assessment Boundary
- Section 9 Lease Mines AUM Site

Site Features

- Accumulation/Deposition Area - Surficial
- Dozer Cut
- Shallow Mine Waste
- Waste Pile
- Access Road

Notes:
[1]Sample IDs for outside of the AUM 458 boundary are shown on Figure B-3.
AUM Abandoned uranium mine
bgs Below ground surface

1 inch = 100 Feet

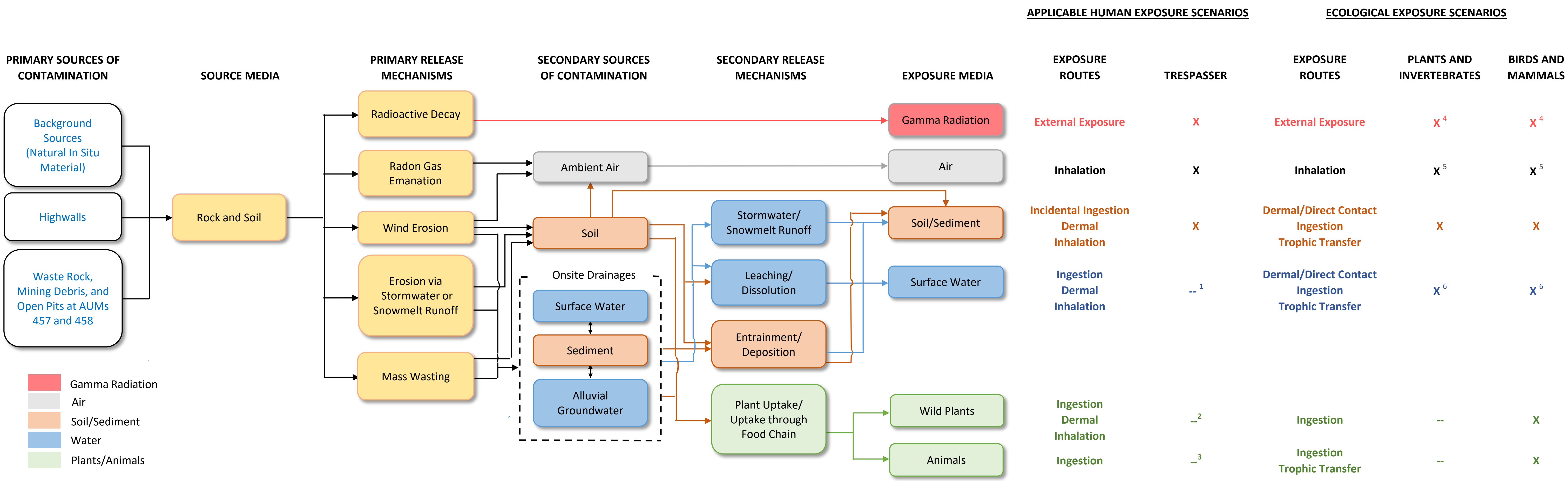
1:1,200

N W E S

100 50 0 100 Feet

SECTION 9 LEASE MINES EXPOSURE UNIT SAMPLE LOCATIONS - AUM 458

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 0020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 6/27/2024
Coordinate System: NAD 1983 State Plane Arizona Central FIPS 0202 Feet Transverse Mercator	Figure No.: B-5



Notes:

X Indicates the exposure pathway is potentially complete and is evaluated in the risk assessment except as noted.

-- Indicates the exposure pathway is not complete or *de minimis* and is not evaluated in the risk assessment.

[1] The human health risk evaluation does not include ingestion of surface water or groundwater by humans.

[2] The human health risk evaluation does not include ingestion, dermal (metals only), and inhalation of wild plants by this receptor.

[3] The human health risk evaluation does not include ingestion of home-raised animals (meat, milk, and eggs) and hunted animals (meat only) for this receptor.

[4] The ecological risk evaluation does not include evaluation of external exposure to gamma radiation.

[5] Potential exposures include inhalation of ambient air and air in burrows. The ecological risk evaluation does not include evaluation of the inhalation pathway.

[6] The ecological risk evaluation does not include evaluation of direct contact with or ingestion of surface water.

AUM Abandoned uranium mine

Figure B-6. Section 9 Lease Mines Conceptual Site Model

TABLES

Table B-1. Soil Results Data Summary and Contaminant of Potential Concern Screening

Constituent of Interest[a]	Detection Frequency[b]	Units	Minimum Detected Concentration (qualifier)[b]	Maximum Detected Concentration (qualifier)[b]	Location of Maximum Detected Concentration[b]	Depth of Maximum Concentration (inches bgs)[b]	COPC Screening Level[c]	Include Constituent as a COPC?[d]
Radionuclides								
Uranium-238 in SE[e]	110 / 110	pCi/g	0.977	945	457-SS-7A	0-6	0.012	**Yes**
Metals								
Aluminum	63 / 63	mg/kg	1,100 D	18,400	APE-SS04-01-020624	0-6	7,670	**Yes**
Antimony	0 / 63	mg/kg	--	--	--	--	3.1	No
Arsenic	96 / 110	mg/kg	0.749 J	230 D	457-SS-7A	0-6	0.68	**Yes**
Barium	63 / 63	mg/kg	24.8	1,100 D	457-SS-7A	0-6	1,500	No
Beryllium	21 / 35	mg/kg	0.289	1.68	458-SS05-01-020624	0-6	15	No
Cadmium	18 / 56	mg/kg	0.0241 J	1 JD	457-SS-7A	0-6	0.71	**Yes**
Chromium	42 / 63	mg/kg	2.11	8.51	APE-SS10-01-020624	0-6	1.32	**Yes**
Cobalt	41 / 63	mg/kg	0.641	47 JD	459-SS-2C	12-18	2.3	**Yes**
Copper	49 / 63	mg/kg	3.76 N*	37 D	457-SS-7A	0-6	313	No
Iron	63 / 63	mg/kg	1,660	97,000 D	458-SS-6A	0-6	5,480	**Yes**
Lead	63 / 63	mg/kg	4 JD	150 D	457-SS-7A	0-6	200	No
Manganese	61 / 63	mg/kg	4.96	540 D	DRN-SD-4	0-6	179	**Yes**
Mercury	84 / 110	mg/kg	0.0012 J	8.7	457-SS-8A	0-6	2.4	**Yes**
Molybdenum	97 / 110	mg/kg	0.133 J	2,000 D	457-SS-7A	0-6	39	**Yes**
Nickel	59 / 63	mg/kg	0.437	17 JD	DRN-SD-1	0-6	137	No
Selenium	45 / 110	mg/kg	0.056 J	37 JD	458-SS-6A	0-6	39	No
Silver	4 / 63	mg/kg	0.0955 J-	0.208 J-	458-SS04-01-020624	0-6	39	No
Thallium	16 / 63	mg/kg	0.143 J	26 JD	457-SS-7A	0-6	0.078	**Yes**
Uranium	69 / 110	mg/kg	0.99	970 D	457-SS-7A	0-6	1.6	**Yes**
Vanadium	97 / 110	mg/kg	3.6	390 D	457-SS-7A	0-6	39	**Yes**
Zinc	33 / 63	mg/kg	2.69 J	66 JD	457-SS-7A	0-6	2,350	No

Notes:

[a] **Bolded contaminants** are selected as human health COPCs because the maximum detected concentration exceeds the COPC screening level.

[b] Includes all soil samples, including duplicate samples, with analytical results from the Section 9 Lease Mines collected during the site evaluation (Weston 2014), removal site evaluation (EA 2021), and 2024 data gaps investigation sampling (Tetra Tech 2024).

[c] The COPC screening levels were calculated using the NAUM Risk Calculator (USEPA 2024d) and exposure assumptions for a default resident based on a target hazard quotient of 0.1 and a target cancer risk of one in one million (1E-06), except for lead. The lead screening value is based on the USEPA Regional Screening Level (RSL) for lead (USEPA 2024e).

[d] A contaminant is included as a COPC for the human health risk assessment if the maximum detected concentration exceeds the COPC screening level.

[e] When uranium-238 is in SE, site data for radium-226 in conjunction with uranium-238 in SE toxicity values can be used to calculate the risk for the entire uranium-238 decay chain.

Table B-1. Soil Results Data Summary and Contaminant of Potential Concern Screening

Notes (continued):

bgs	Below ground surface
COPC	Contaminant of potential concern
D	Dilution
EA	Engineering Analytics, Inc.
J	Estimated concentration
J-	Estimated concentration, biased low
mg/kg	Milligram per kilogram
N*	Matrix spike sample recovery is not within specified control limits
NAUM	Navajo abandoned uranium mine
pCi/g	Picocurie per gram
SE	Secular equilibrium
Tetra Tech	Tetra Tech, Inc.
USEPA	U.S. Environmental Protection Agency
Weston	Weston Solutions, Inc.

References:

Engineering Analytics, Inc. (EA). 2021. “Removal Site Evaluation Report, Babbitt Ranches, LLC – Milestone Hawaii Stewardship Project (Section 9 Lease Abandoned Uranium Mine).” Draft. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Docket No. 2016-13. March 18.

Tetra Tech, Inc. (Tetra Tech). 2024. "Section 9 Lease Mines Data Gap Investigation Report." Response, Assessment, and Evaluation Services 2. Contract No. 68HE0923D0002. May.

U.S. Environmental Protection Agency (USEPA). 2024c. “Navajo Abandoned Uranium Mines Risk Assessment Methodology.” Draft Final. March.

USEPA. 2024e. “Regional Screening Levels (RSLs)." May 14. https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search.

Weston Solutions, Inc. (Weston). 2014. “Site Inspection Report, Section 9 Lease Abandoned Uranium Mine, Coconino County, Arizona.” Report Prepared for U.S. Environmental Protection Agency Region 9. June.

Table B-2. Exposure Unit Summary of Land Use, Geologic Formation, Type, Area, and Available Samples

Exposure Unit	Land Use / Receptor	Geologic Formation	Type	Area (acre)	Number of Surface Soil (or Sediment) Samples (0-6 inches bgs)[a]	Number of Subsurface Soil Samples (0-60 inches bgs)[a]
Section 9 Lease Mines	Trespasser and Ecological Receptors	Qay TRcp TRcs	TENORM	406	72 - Radiological 72 - Arsenic, Mercury, Molybdenum, Selenium, Uranium, Vanadium 53 - Aluminum, Antimony, Barium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Nickel, Silver, Thallium, Zinc 48 - Cadmium 32 - Beryllium	110 - Radiological 110 - Arsenic, Mercury, Molybdenum, Selenium, Uranium, Vanadium 63 - Aluminum, Antimony, Barium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Nickel, Silver, Thallium, Zinc 56 - Cadmium 35 - Beryllium

Notes:

[a] Includes all soil samples, including duplicate samples, with analytical results from the Section 9 Lease Mines collected during the site evaluation (Weston 2014), removal site evaluation (EA 2021), and 2024 data gaps investigation (Tetra Tech 2024).

bgs	Below ground surface
EA	Engineering Analytics, Inc.
Qay	Quaternary Alluvium
TENORM	Technologically enhanced naturally occurring radioactive material
Tetra Tech	Tetra Tech, Inc.
TRcp	Petrified Forest Member of the Chinle Formation
TRcs	Shinarump Member of the Chinle Formation
Weston	Weston Solutions, Inc.

References:

Engineering Analytics, Inc. (EA). 2021. “Removal Site Evaluation Report, Babbitt Ranches, LLC – Milestone Hawaii Stewardship Project (Section 9 Lease Abandoned Uranium Mine).” Draft. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Docket No. 2016-13. March 18.

Tetra Tech, Inc. (Tetra Tech). 2024. "Section 9 Lease Mines Data Gap Investigation Report." Response, Assessment, and Evaluation Services 2. Contract No. 68HE0923D0002. May.

Weston Solutions, Inc. (Weston). 2014. “Site Inspection Report, Section 9 Lease Abandoned Uranium Mine, Coconino County, Arizona.” Report Prepared for U.S. Environmental Protection Agency Region 9. June.

Table B-3. Human Health Exposure Parameters

Input Parameter	Symbol	Units	Receptor
			Trespasser [a]
Common Parameters			
Exposure Duration - Adult	ED	years	24
Exposure Duration - Child	EDc	years	2
Exposure Duration - Lifetime Total	EDa	years	26
Exposure Time - Lifetime Total	t	years	26
Averaging Time - Cancer	ATc	days	25,550
Averaging Time - Noncancer - Adult	ATnc	days	8,760
Averaging Time - Noncancer - Child	ATnc	days	730
Exposure Frequency - Adult	EFa	days/year	14
Exposure Frequency - Child	EFc	days/year	14
Body Weight - Adult	BWa	kg	80
Body Weight - Child	BWc	kg	15
Conversion Factor 1	CF1	g/mg	1/1,000
Conversion Factor 2	CF2	kg/mg	1/1,000,000
Conversion Factor 3	CF3	day/hours	1/24
Conversion Factor 4	CF4	g/kg	1,000
Conversion Factor 5	CF5	year/days	1/365
Conversion Factor 6	CF6	kg/g	1/1,000
Conversion Factor 7	CF7	pCi/Bq	27.027
Decay Constant	λ	1/year	Radionuclide-specific from the PRG Calculator (USEPA 2024b)
Soil Ingestion Parameters			
Onsite Soil Ingestion Rate - Adult	IRSa	mg/day	100
Onsite Soil Ingestion Rate - Child	IRSc	mg/day	200
Dust Inhalation Parameters			
Inhalation Rate when Exposed - Adult	IRAres-a	m^3/day	25
Inhalation Rate when Exposed - Child	IRAres-c	m^3/day	10
Exposure Time - Adult	ETa	hours/day	24
Exposure Time - Child	ETc	hours/day	24
City/Climatic Zone	-	-	Cameron, AZ (Climatic Zone 3)
Mean Annual Wind Speed	Um	m/s	5.0
Areal extent of site surface soil	As	acres	406
Fraction of Vegetative Cover	V	-	0.1
Particulate Emission Factor	PEF	m^3/kg	1.36E+08
Radiation External Exposure Parameters			
Gamma Shielding Factor - Outdoor	GSF_o	-	1
Exposure Time on Site Outdoors - Adult	$ET_{a\text{-}o}$	hours/day	24
Exposure Time on Site Outdoors - Child	$ET_{c\text{-}o}$	hours/day	24
Metals Dermal Exposure Parameters			
Surface Area - Adult	SAa	cm^2/day	6,032
Surface Area - Child	SAc	cm^2/day	2,373
Adherence Factor - Adult	AFa	mg/cm^2	0.12
Adherence Factor - Child	AFc	mg/cm^2	0.2

Table B-3. Human Health Exposure Parameters

Notes:

[a] Potential trespassers at Section 9 Lease Mines are assumed to have the same exposure assumptions as a BLM recreator due to the open access of BLM property within Section 10 and the lack of a physical barrier that limits movement between Sections 9 and 10. A person legally accessing BLM-managed land on Section 10 could trespass on Section 9.

-	Not applicable
AZ	Arizona
BLM	Bureau of Land Management
cm^2/day	Square centimeter per day
g/kg	Gram per kilogram
g/mg	Gram per milligram
kg	Kilogram
kg/g	Kilogram per gram
kg/mg	Kilogram per milligram
m/s	Meter per second
m^3/day	Cubic meter per day
m^3/kg	Cubic meter per kilogram
mg/cm^2	Milligram per square centimeter
mg/day	Milligram per day
pCi/Bq	Picocurie per becquerel
PRG	Preliminary remediation goal
USEPA	U.S. Environmental Protection Agency

References:

U.S. Environmental Protection Agency (USEPA). 2024b. "Preliminary Remediation Goals for Radionuclides (PRG)." February. https://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search.

Table B-4. Exposure Point Concentrations for Human Health Risk Assessment

Section 9 Lease Mines											
COPC[a]	Units	Detection Frequency	Number of High Nondetect Results[b]	Maximum Concentration (qualifier)	Location of Maximum Concentration	Arithmetic Mean[c]	UCL95 / Distribution[d]		Exposure Point Concentration		
									Value[e]	Statistic[e]	Method[f]
Surface Soil (0-6 inches bgs)											
Radium-226	pCi/g	62 / 62	0	945	457-SS-7A	58.77	96.8	LN	97	UCL95	(14)
Aluminum	mg/kg	46 / 46	0	18,400	APE-SS04-01-020624	4,526	5,319	LN	5,320	UCL95	(14)
Arsenic	mg/kg	55 / 62	0	230 D	457-SS-7A	20.16	29.07	LN	29	UCL95	(15)
Cadmium	mg/kg	17 / 42	0	1 JD	457-SS-7A	0.228	0.309	G	0.31	UCL95	(5)
Chromium	mg/kg	34 / 45	2	8.51	APE-SS10-01-020624	4.526	5.009	N	5.00	UCL95	(2)
Cobalt	mg/kg	34 / 45	2	28	457-SS02-01-020624	8.349	10.47	G	10	UCL95	(5)
Iron	mg/kg	46 / 46	0	97,000 D	458-SS-6A	11,555	15,254	NP	15,300	UCL95	(14)
Manganese	mg/kg	45 / 46	0	540 D	DRN-SD-4	145.1	182.2	G	182	UCL95	(5)
Mercury	mg/kg	47 / 62	0	8.7	457-SS-8A	0.251	0.531	LN	0.53	UCL95	(15)
Molybdenum	mg/kg	56 / 62	0	2,000 D	457-SS-7A	142.6	241.7	G	242	UCL95	(7)
Thallium	mg/kg	15 / 45	2	26 JD	457-SS-7A	1.872	3.104	LN	3.1	UCL95	(13)
Uranium	mg/kg	37 / 62	0	970 D	457-SS-7A	38.54	69.05	LN	69	UCL95	(15)
Vanadium	mg/kg	55 / 62	0	390 D	457-SS-7A	29.07	41.89	NP	42	UCL95	(15)

Table B-4. Exposure Point Concentrations for Human Health Risk Assessment

COPC[a]	Units	Detection Frequency			Number of High Nondetect Results[b]	Maximum Concentration (qualifier)		Location of Maximum Concentration	Arithmetic Mean[c]	UCL95 / Distribution[d]		Exposure Point Concentration		
Section 9 Lease Mines														
												Value[e]	Statistic[e]	Method[f]
Subsurface Soil (0-60 inches bgs)														
Radium-226	pCi/g	100	/	100	0	945		457-SS-7A	42.40	65.41	NP	65	UCL95	(14)
Aluminum	mg/kg	56	/	56	0	18,400		APE-SS04-01-020624	4,145	4,823	LN	4,820	UCL95	(14)
Arsenic	mg/kg	88	/	100	0	230	D	457-SS-7A	15.67	21.18	NP	21	UCL95	(15)
Cadmium	mg/kg	17	/	56	0	1.00	JD	457-SS-7A	0.224	0.293	G	0.29	UCL95	(7)
Chromium	mg/kg	37	/	55	2	8.51		APE-SS10-01-020624	4.243	4.681	N	4.70	UCL95	(3)
Cobalt	mg/kg	38	/	56	2	47	JD	459-SS-2C	8.925	11.18	G	11	UCL95	(7)
Iron	mg/kg	56	/	56	0	97,000	D	458-SS-6A	11034	13,985	NP	14,000	UCL95	(14)
Manganese	mg/kg	55	/	56	0	540	D	DRN-SD-4	138	167.7	G	168	UCL95	(7)
Mercury	mg/kg	76	/	100	0	8.7		457-SS-8A	0.179	0.36	LN	0.36	UCL95	(15)
Molybdenum	mg/kg	89	/	100	0	2,000	D	457-SS-7A	105.80	167.9	G	168	UCL95	(7)
Thallium	mg/kg	15	/	55	2	26	JD	457-SS-7A	1.772	2.838	LN	2.8	UCL95	(13)
Uranium	mg/kg	65	/	100	0	970	D	457-SS-7A	31.15	50.28	NP	50	UCL95	(15)
Vanadium	mg/kg	88	/	100	0	390	D	457-SS-7A	25.75	33.44	NP	33	UCL95	(15)

Table B-4. Exposure Point Concentrations for Human Health Risk Assessment

Notes:

[a] EPCs calculated if "Yes" for "Include Constituent as a COPC?" on Table B-1.

[b] Number of nondetect results that exceeded the maximum detected concentration. These results were not included in the statistical calculations.

[c] The arithmetic mean for datasets with nondetected results is calculated using the KM method.

[d] Following USEPA (2002, 2022b) guidance, this value may be estimated by a 95, 97.5, or 99 percent UCL depending on the sample size, skewness, and degree of censorship.

[e] Tested using the Shapiro-Wilk W or Lilliefors test for normal and lognormal distributions and the Anderson-Darling and Kolmogorov-Smirnov tests for gamma distributions. A 5 percent level of significance was used in all tests. Distribution tests were conducted only for samples with at least four detected results.

[f] The EPC is the lesser of the UCL95 (or UCL99) and the maximum detected concentration. The maximum detected concentration is the default when there are fewer than 10 samples or fewer than 4 detected results. See Appendix D of the "Navajo Abandoned Uranium Mines Risk Assessment Methodology" report (USEPA 2024c).

[g] The statistical methods for selecting the exposure point concentration are as follows (not all are used):

(1) Maximum detected concentration	(7) 95% Gamma Approximate KM-UCL	(13) 95% KM BCA UCL
(2) 95% Student's t UCL	(8) 95% H-UCL	(14) 95% Percentile Bootstrap UCL
(3) 95% KM (t) UCL	(9) 95% H-UCL (KM log)	(15) 95% KM Percentile Bootstrap UCL
(4) 95% Adjusted Gamma UCL	(10) 95% Bootstrap-t UCL	(16) 99% Bootstrap-t UCL
(5) 95% Gamma Adjusted KM-UCL	(11) 95% KM Bootstrap-t UCL	(17) 99% KM Percentile Bootstrap UCL
(6) 95% Approximate Gamma UCL	(12) 95% BCA UCL	

BCA	Bias-corrected accelerated bootstrap method	LN	Lognormal distribution
bgs	Below ground surface	mg/kg	Milligram per kilogram
COPC	Contaminant of potential concern	N	Normal distribution
D	Dilution	NP	Nonparametric distribution
EPC	Exposure point concentration	pCi/g	Picocurie per gram
G	Gamma distribution	UCL	Upper confidence limit
H-UCL	UCL based upon Land’s H-statistic	UCL95	95 percent upper confidence limit
J	Estimated concentration	UCL99	99 percent upper confidence limit
KM	Kaplan-Meier	USEPA	U.S. Environmental Protection Agency

References:

U.S. Environmental Protection Agency (USEPA). 2002. “Calculating Exposure Point Concentrations at Hazardous Waste Sites.” Office of Solid Waste and Emergency Response. Directive 9285.6-10. December.

USEPA. 2022b. “ProUCL Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations.” Version 5.2.0. June 14.

USEPA. 2024c. “Navajo Abandoned Uranium Mines Risk Assessment Methodology.” Draft Final. March.

Table B-5. Human Health Risk and Hazard Calculations

Section 9 Lease Mines - Trespasser																	
COPC[a]	EPC[b]	Units	Cancer Intake[c]	Units	Slope Factor/ Unit Risk[d]	Units	Cancer Risk[e]	Adult Noncancer Intake[c]	Units	RfD/ RfC[d]	Units	Noncancer Hazard[f] Adult	Child Noncancer Intake[c]	Units	RfD/ RfC[d]	Units	Noncancer Hazard[f] Child
Exposure Medium: Surface Soil (0-6 inches bgs)																	
Exposure Route: Incidental Soil Ingestion																	
Uranium-238 in SE	9.7E+01	pCi/g	3.8E+03	pCi/g	6.2E-09	Risk/pCi/g	2.4E-05	--	--	--	--	--	--	--	--	--	--
						Radionuclide Cancer Total	2E-05				**Radionuclide Noncancer Total**	--				**Radionuclide Noncancer Total**	--
Aluminum	5.3E+03	mg/kg	--	--	--	--	--	2.5E-04	mg/kg-day	1.0E+00	mg/kg-day	0.00025	2.7E-03	mg/kg-day	1.0E+00	mg/kg-day	0.0027
Arsenic	2.9E+01	mg/kg	7.5E-07	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	1.1E-06	8.4E-07	mg/kg-day	3.0E-04	mg/kg-day	0.0028	8.9E-06	mg/kg-day	3.0E-04	mg/kg-day	0.030
Cadmium	3.1E-01	mg/kg	--	--	--	--	--	1.5E-08	mg/kg-day	1.0E-04	mg/kg-day	0.00015	1.6E-07	mg/kg-day	1.0E-04	mg/kg-day	0.0016
Chromium	5.0E+00	mg/kg	3.7E-07	mg/kg-day	5.0E-01	$(mg/kg\text{-}day)^{-1}$	1.9E-07	2.4E-07	mg/kg-day	3.0E-03	mg/kg-day	0.000080	2.6E-06	mg/kg-day	3.0E-03	mg/kg-day	0.00085
Cobalt	1.0E+01	mg/kg	--	--	--	--	--	4.8E-07	mg/kg-day	3.0E-04	mg/kg-day	0.0016	5.1E-06	mg/kg-day	3.0E-04	mg/kg-day	0.017
Iron	1.5E+04	mg/kg	--	--	--	--	--	7.3E-04	mg/kg-day	7.0E-01	mg/kg-day	0.0010	7.8E-03	mg/kg-day	7.0E-01	mg/kg-day	0.011
Manganese	1.8E+02	mg/kg	--	--	--	--	--	8.7E-06	mg/kg-day	2.4E-02	mg/kg-day	0.00036	9.3E-05	mg/kg-day	2.4E-02	mg/kg-day	0.0039
Mercury	5.3E-01	mg/kg	--	--	--	--	--	2.5E-08	mg/kg-day	3.0E-04	mg/kg-day	0.000085	2.7E-07	mg/kg-day	3.0E-04	mg/kg-day	0.00090
Molybdenum	2.4E+02	mg/kg	--	--	--	--	--	1.2E-05	mg/kg-day	5.0E-03	mg/kg-day	0.0023	1.2E-04	mg/kg-day	5.0E-03	mg/kg-day	0.025
Thallium	3.1E+00	mg/kg	--	--	--	--	--	1.5E-07	mg/kg-day	1.0E-05	mg/kg-day	0.015	1.6E-06	mg/kg-day	1.0E-05	mg/kg-day	0.16
Uranium	6.9E+01	mg/kg	--	--	--	--	--	3.3E-06	mg/kg-day	2.0E-04	mg/kg-day	0.017	3.5E-05	mg/kg-day	2.0E-04	mg/kg-day	0.18
Vanadium	4.2E+01	mg/kg	--	--	--	--	--	2.0E-06	mg/kg-day	5.0E-03	mg/kg-day	0.00040	2.1E-05	mg/kg-day	5.0E-03	mg/kg-day	0.0043
						Metals Cancer Total	1E-06				**Metals Noncancer Total**	0.04				**Metals Noncancer Total**	0.4
						Exposure Route Cancer Total	2E-05				**Exposure Route Noncancer Total**	0.04				**Exposure Route Noncancer Total**	0.4
Exposure Medium: Surface Soil (0-6 inches bgs)																	
Exposure Route: External Exposure																	
Uranium-238 in SE	9.7E+01	pCi/g	8.7E+01	pCi/g	8.5E-06	risk/year pCi/g	7.4E-04	--	--	--	--	--	--	--	--	--	--
						Radionuclide Cancer Total	7E-04				**Radionuclide Noncancer Total**	--				**Radionuclide Noncancer Total**	--
						Exposure Route Cancer Total	7E-04				**Exposure Route Noncancer Total**	--				**Exposure Route Noncancer Total**	--
Exposure Route: Dermal Exposure																	
Aluminum	5.3E+03	mg/kg	--	--	--	--	--	--	--	1.0E+00	mg/kg-day	--	--	--	1.0E+00	mg/kg-day	--
Arsenic	2.9E+01	mg/kg	9.0E-08	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	1.4E-07	1.8E-07	mg/kg-day	3.0E-04	mg/kg-day	0.00059	1.1E-06	mg/kg-day	3.0E-04	mg/kg-day	0.0035
Cadmium	3.1E-01	mg/kg	--	--	--	--	--	2.5E-09	mg/kg-day	1.0E-04	mg/kg-day	0.000025	1.5E-08	mg/kg-day	1.0E-04	mg/kg-day	0.00015
Chromium	5.0E+00	mg/kg	--	--	5.0E-01	$(mg/kg\text{-}day)^{-1}$	--	--	--	3.0E-03	mg/kg-day	--	--	--	3.0E-03	mg/kg-day	--
Cobalt	1.0E+01	mg/kg	--	--	--	--	--	--	--	3.0E-04	mg/kg-day	--	--	--	3.0E-04	mg/kg-day	--
Iron	1.5E+04	mg/kg	--	--	--	--	--	--	--	7.0E-01	mg/kg-day	--	--	--	7.0E-01	mg/kg-day	--
Manganese	1.8E+02	mg/kg	--	--	--	--	--	--	--	2.4E-02	mg/kg-day	--	--	--	2.4E-02	mg/kg-day	--
Mercury	5.3E-01	mg/kg	--	--	--	--	--	--	--	3.0E-04	mg/kg-day	--	--	--	3.0E-04	mg/kg-day	--
Molybdenum	2.4E+02	mg/kg	--	--	--	--	--	--	--	5.0E-03	mg/kg-day	--	--	--	5.0E-03	mg/kg-day	--
Thallium	3.1E+00	mg/kg	--	--	--	--	--	--	--	1.0E-05	mg/kg-day	--	--	--	1.0E-05	mg/kg-day	--
Uranium	6.9E+01	mg/kg	--	--	--	--	--	--	--	2.0E-04	mg/kg-day	--	--	--	2.0E-04	mg/kg-day	--
Vanadium	4.2E+01	mg/kg	--	--	--	--	--	--	--	5.0E-03	mg/kg-day	--	--	--	5.0E-03	mg/kg-day	--
						Metals Cancer Total	1E-07				**Metals Noncancer Total**	0.0006				**Metals Noncancer Total**	0.004
						Exposure Route Cancer Total	1E-07				**Exposure Route Noncancer Total**	0.0006				**Exposure Route Noncancer Total**	0.004

Table B-5. Human Health Risk and Hazard Calculations

COPC[a]	EPC[b]	Units	Cancer Intake[c]	Units	Slope Factor/ Unit Risk[d]	Units	Cancer Risk[e]	Adult Noncancer Intake[c]	Units	RfD/ RfC[d]	Units	Noncancer Hazard[f] Adult	Child Noncancer Intake[c]	Units	RfD/ RfC[d]	Units	Noncancer Hazard[f] Child
Section 9 Lease Mines - Trespasser																	
Exposure Medium: Surface Soil (0-6 inches bgs)																	
Exposure Route: Inhalation of Particulates																	
Uranium-238 in SE	9.7E+01	pCi/g	3.8E+01	pCi	1.5E-07	Risk/pCi	5.5E-06	--	--	--	--	--	--	--	--	--	--
						Radionuclide Cancer Total	5E-06				**Radionuclide Noncancer Total**	--				**Radionuclide Noncancer Total**	--
Aluminum	5.3E+03	mg/kg	--	--	--	--	--	1.5E-06	mg/m^3	5.0E-03	mg/m^3	0.00030	1.5E-06	mg/m^3	5.0E-03	mg/m^3	0.00030
Arsenic	2.9E+01	mg/kg	3.0E-06	$\mu g/m^3$	4.3E-03	$(\mu g/m^3)^{-1}$	1.3E-08	8.2E-09	mg/m^3	1.5E-05	mg/m^3	0.00055	8.2E-09	mg/m^3	1.5E-05	mg/m^3	0.00055
Cadmium	3.1E-01	mg/kg	3.2E-08	$\mu g/m^3$	1.8E-03	$(\mu g/m^3)^{-1}$	5.8E-11	8.8E-11	mg/m^3	1.0E-05	mg/m^3	0.0000088	8.8E-11	mg/m^3	1.0E-05	mg/m^3	0.0000088
Chromium	5.0E+00	mg/kg	1.1E-06	$\mu g/m^3$	8.4E-02	$(\mu g/m^3)^{-1}$	9.0E-08	1.4E-09	mg/m^3	1.0E-04	mg/m^3	0.000014	1.4E-09	mg/m^3	1.0E-04	mg/m^3	0.000014
Cobalt	1.0E+01	mg/kg	1.0E-06	$\mu g/m^3$	9.0E-03	$(\mu g/m^3)^{-1}$	9.4E-09	2.8E-09	mg/m^3	6.0E-06	mg/m^3	0.00047	2.8E-09	mg/m^3	6.0E-06	mg/m^3	0.00047
Iron	1.5E+04	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese	1.8E+02	mg/kg	--	--	--	--	--	5.1E-08	mg/m^3	5.0E-05	mg/m^3	0.0010	5.1E-08	mg/m^3	5.0E-05	mg/m^3	0.0010
Mercury	5.3E-01	mg/kg	--	--	--	--	--	1.5E-10	mg/m^3	3.0E-04	mg/m^3	0.00000050	1.5E-10	mg/m^3	3.0E-04	mg/m^3	0.00000050
Molybdenum	2.4E+02	mg/kg	--	--	--	--	--	6.8E-08	mg/m^3	2.0E-03	mg/m^3	0.000034	6.8E-08	mg/m^3	2.0E-03	mg/m^3	0.000034
Thallium	3.1E+00	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Uranium	6.9E+01	mg/kg	--	--	--	--	--	1.9E-08	mg/m^3	4.0E-05	mg/m^3	0.00049	1.9E-08	mg/m^3	4.0E-05	mg/m^3	0.00049
Vanadium	4.2E+01	mg/kg	--	--	--	--	--	1.2E-08	mg/m^3	1.0E-04	mg/m^3	0.00012	1.2E-08	mg/m^3	1.0E-04	mg/m^3	0.00012
						Metals Cancer Total	1E-07				**Metals Noncancer Total**	0.003				**Metals Noncancer Total**	0.003
						Exposure Route Cancer Total	6E-06				**Exposure Route Noncancer Total**	0.003				**Exposure Route Noncancer Total**	0.003
						Surface Soil (0-6 inches bgs) Receptor Cancer Risk Total	**8E-04**				**Receptor/Media Noncancer Hazard Total**	**0.04**				**Receptor/Media Noncancer Hazard Total**	**0.4**

Table B-5. Human Health Risk and Hazard Calculations

Section 9 Lease Mines - Trespasser																	
COPC[a]	EPC[b]	Units	Cancer Intake[c]	Units	Slope Factor/ Unit Risk[d]	Units	Cancer Risk[e]	Adult Noncancer Intake[c]	Units	RfD/ RfC[d]	Units	Noncancer Hazard[f] Adult	Child Noncancer Intake[c]	Units	RfD/ RfC[d]	Units	Noncancer Hazard[f] Child
Exposure Medium: Subsurface Soil (0-60 inches bgs)																	
Exposure Route: Incidental Soil Ingestion																	
Uranium-238 in SE	6.5E+01	pCi/g	2.6E+03	pCi/g	6.2E-09	Risk/pCi/g	1.6E-05	--	--	--	--	--	--	--	--	--	--
						Radionuclide Cancer Total	2E-05				**Radionuclide Noncancer Total**	--				**Radionuclide Noncancer Total**	--
Aluminum	4.8E+03	mg/kg	--	--	--	--	--	2.3E-04	mg/kg-day	1.0E+00	mg/kg-day	0.00023	2.5E-03	mg/kg-day	1.0E+00	mg/kg-day	0.0025
Arsenic	2.1E+01	mg/kg	5.4E-07	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	8.1E-07	6.1E-07	mg/kg-day	3.0E-04	mg/kg-day	0.0020	6.4E-06	mg/kg-day	3.0E-04	mg/kg-day	0.021
Cadmium	2.9E-01	mg/kg	--	--	--	--	--	1.4E-08	mg/kg-day	1.0E-04	mg/kg-day	0.00014	1.5E-07	mg/kg-day	1.0E-04	mg/kg-day	0.0015
Chromium	4.7E+00	mg/kg	3.5E-07	mg/kg-day	5.0E-01	(mg/kg-day)$^{-1}$	1.7E-07	2.3E-07	mg/kg-day	3.0E-03	mg/kg-day	0.000075	2.4E-06	mg/kg-day	3.0E-03	mg/kg-day	0.00080
Cobalt	1.1E+01	mg/kg	--	--	--	--	--	5.3E-07	mg/kg-day	3.0E-04	mg/kg-day	0.0018	5.6E-06	mg/kg-day	3.0E-04	mg/kg-day	0.019
Iron	1.4E+04	mg/kg	--	--	--	--	--	6.7E-04	mg/kg-day	7.0E-01	mg/kg-day	0.00096	7.2E-03	mg/kg-day	7.0E-01	mg/kg-day	0.010
Manganese	1.7E+02	mg/kg	--	--	--	--	--	8.0E-06	mg/kg-day	2.4E-02	mg/kg-day	0.00034	8.6E-05	mg/kg-day	2.4E-02	mg/kg-day	0.0036
Mercury	3.6E-01	mg/kg	--	--	--	--	--	1.7E-08	mg/kg-day	3.0E-04	mg/kg-day	0.000058	1.8E-07	mg/kg-day	3.0E-04	mg/kg-day	0.00061
Molybdenum	1.7E+02	mg/kg	--	--	--	--	--	8.1E-06	mg/kg-day	5.0E-03	mg/kg-day	0.0016	8.6E-05	mg/kg-day	5.0E-03	mg/kg-day	0.017
Thallium	2.8E+00	mg/kg	--	--	--	--	--	1.3E-07	mg/kg-day	1.0E-05	mg/kg-day	0.013	1.4E-06	mg/kg-day	1.0E-05	mg/kg-day	0.14
Uranium	5.0E+01	mg/kg	--	--	--	--	--	2.4E-06	mg/kg-day	2.0E-04	mg/kg-day	0.012	2.6E-05	mg/kg-day	2.0E-04	mg/kg-day	0.13
Vanadium	3.3E+01	mg/kg	--	--	--	--	--	1.6E-06	mg/kg-day	5.0E-03	mg/kg-day	0.00032	1.7E-05	mg/kg-day	5.0E-03	mg/kg-day	0.0034
						Metals Cancer Total	1E-06				**Metals Noncancer Total**	0.03				**Metals Noncancer Total**	0.4
						Exposure Route Cancer Total	2E-05				**Exposure Route Noncancer Total**	0.03				**Exposure Route Noncancer Total**	0.4
Exposure Medium: Subsurface Soil (0-60 inches bgs)																	
Exposure Route: External Exposure																	
Uranium-238 in SE	6.5E+01	pCi/g	5.8E+01	pCi/g	8.5E-06	risk/year pCi/g	5.0E-04	--	--	--	--	--	--	--	--	--	--
						Radionuclide Cancer Total	5E-04				**Radionuclide Noncancer Total**	--				**Radionuclide Noncancer Total**	--
						Exposure Route Cancer Total	5E-04				**Exposure Route Noncancer Total**	--				**Exposure Route Noncancer Total**	--
Exposure Route: Dermal Exposure																	
Aluminum	4.8E+03	mg/kg	--	--	--	--	--	--	--	1.0E+00	mg/kg-day	--	--	--	1.0E+00	mg/kg-day	--
Arsenic	2.1E+01	mg/kg	6.5E-08	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	9.8E-08	1.3E-07	mg/kg-day	3.0E-04	mg/kg-day	0.00043	7.6E-07	mg/kg-day	3.0E-04	mg/kg-day	0.0025
Cadmium	2.9E-01	mg/kg	--	--	--	--	--	2.4E-09	mg/kg-day	1.0E-04	mg/kg-day	0.000024	1.4E-08	mg/kg-day	1.0E-04	mg/kg-day	0.00014
Chromium	4.7E+00	mg/kg	--	--	5.0E-01	(mg/kg-day)$^{-1}$	--	--	--	3.0E-03	mg/kg-day	--	--	--	3.0E-03	mg/kg-day	--
Cobalt	1.1E+01	mg/kg	--	--	--	--	--	--	--	3.0E-04	mg/kg-day	--	--	--	3.0E-04	mg/kg-day	--
Iron	1.4E+04	mg/kg	--	--	--	--	--	--	--	7.0E-01	mg/kg-day	--	--	--	7.0E-01	mg/kg-day	--
Manganese	1.7E+02	mg/kg	--	--	--	--	--	--	--	2.4E-02	mg/kg-day	--	--	--	2.4E-02	mg/kg-day	--
Mercury	3.6E-01	mg/kg	--	--	--	--	--	--	--	3.0E-04	mg/kg-day	--	--	--	3.0E-04	mg/kg-day	--
Molybdenum	1.7E+02	mg/kg	--	--	--	--	--	--	--	5.0E-03	mg/kg-day	--	--	--	5.0E-03	mg/kg-day	--
Thallium	2.8E+00	mg/kg	--	--	--	--	--	--	--	1.0E-05	mg/kg-day	--	--	--	1.0E-05	mg/kg-day	--
Uranium	5.0E+01	mg/kg	--	--	--	--	--	--	--	2.0E-04	mg/kg-day	--	--	--	2.0E-04	mg/kg-day	--
Vanadium	3.3E+01	mg/kg	--	--	--	--	--	--	--	5.0E-03	mg/kg-day	--	--	--	5.0E-03	mg/kg-day	--
						Metals Cancer Total	1E-07				**Metals Noncancer Total**	0.0004				**Metals Noncancer Total**	0.003
						Exposure Route Cancer Total	1E-07				**Exposure Route Noncancer Total**	0.0004				**Exposure Route Noncancer Total**	0.003

Table B-5. Human Health Risk and Hazard Calculations

Section 9 Lease Mines - Trespasser																	
COPC[a]	EPC[b]	Units	Cancer Intake[c]	Units	Slope Factor/ Unit Risk[d]	Units	Cancer Risk[e]	Adult Noncancer Intake[c]	Units	RfD/ RfC[d]	Units	Noncancer Hazard[f] Adult	Child Noncancer Intake[c]	Units	RfD/ RfC[d]	Units	Noncancer Hazard[f] Child
Exposure Medium: Subsurface Soil (0-60 inches bgs)																	
Exposure Route: Inhalation of Particulates																	
Uranium-238 in SE	6.5E+01	pCi/g	2.5E+01	pCi	1.5E-07	Risk/pCi	3.7E-06	--	--	--	--	--	--	--	--	--	--
						Radionuclide Cancer Total	4E-06				**Radionuclide Noncancer Total**	--				**Radionuclide Noncancer Total**	--
Aluminum	4.8E+03	mg/kg	--	--	--	--	--	1.4E-06	mg/m^3	5.0E-03	mg/m^3	0.00027	1.4E-06	mg/m^3	5.0E-03	mg/m^3	0.00027
Arsenic	2.1E+01	mg/kg	2.2E-06	$\mu g/m^3$	4.3E-03	$(\mu g/m^3)^{-1}$	9.5E-09	5.9E-09	mg/m^3	1.5E-05	mg/m^3	0.00040	5.9E-09	mg/m^3	1.5E-05	mg/m^3	0.00040
Cadmium	2.9E-01	mg/kg	3.0E-08	$\mu g/m^3$	1.8E-03	$(\mu g/m^3)^{-1}$	5.5E-11	8.2E-11	mg/m^3	1.0E-05	mg/m^3	0.0000082	8.2E-11	mg/m^3	1.0E-05	mg/m^3	0.0000082
Chromium	4.7E+00	mg/kg	9.5E-07	$\mu g/m^3$	8.4E-02	$(\mu g/m^3)^{-1}$	8.0E-08	1.3E-09	mg/m^3	1.0E-04	mg/m^3	0.000013	1.3E-09	mg/m^3	1.0E-04	mg/m^3	0.000013
Cobalt	1.1E+01	mg/kg	1.2E-06	$\mu g/m^3$	9.0E-03	$(\mu g/m^3)^{-1}$	1.0E-08	3.1E-09	mg/m^3	6.0E-06	mg/m^3	0.00052	3.1E-09	mg/m^3	6.0E-06	mg/m^3	0.00052
Iron	1.4E+04	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese	1.7E+02	mg/kg	--	--	--	--	--	4.7E-08	mg/m^3	5.0E-05	mg/m^3	0.00095	4.7E-08	mg/m^3	5.0E-05	mg/m^3	0.00095
Mercury	3.6E-01	mg/kg	--	--	--	--	--	1.0E-10	mg/m^3	3.0E-04	mg/m^3	0.00000034	1.0E-10	mg/m^3	3.0E-04	mg/m^3	0.00000034
Molybdenum	1.7E+02	mg/kg	--	--	--	--	--	4.7E-08	mg/m^3	2.0E-03	mg/m^3	0.000024	4.7E-08	mg/m^3	2.0E-03	mg/m^3	0.000024
Thallium	2.8E+00	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Uranium	5.0E+01	mg/kg	--	--	--	--	--	1.4E-08	mg/m^3	4.0E-05	mg/m^3	0.00035	1.4E-08	mg/m^3	4.0E-05	mg/m^3	0.00035
Vanadium	3.3E+01	mg/kg	--	--	--	--	--	9.3E-09	mg/m^3	1.0E-04	mg/m^3	0.000093	9.3E-09	mg/m^3	1.0E-04	mg/m^3	0.000093
						Metals Cancer Total	1E-07				**Metals Noncancer Total**	0.003				**Metals Noncancer Total**	0.003
						Exposure Route Cancer Total	4E-06				**Exposure Route Noncancer Total**	0.003				**Exposure Route Noncancer Total**	0.003
						Subsurface Soil (0-60 inches bgs) Receptor Cancer Risk Total	**5E-04**				**Receptor/Media Noncancer Hazard Total**	**0.04**				**Receptor/Media Noncancer Hazard Total**	**0.4**

Notes:

[a] COPCs are the constituents of interest with a maximum detected concentration exceeding the COPC screening level (see Table B-1).

[b] EPCs are provided on Table B-4.

[c] The intakes are the EPC multiplied by the exposure parameters and any applicable contaminant-specific inputs (see Table B-3 for exposure inputs, Table 4 of the NAUM risk assessment methodology [USEPA 2024c] for contaminant-specific inputs).

[d] The toxicity values are provided in Table 4 of the NAUM risk assessment methodology (USEPA 2024c).

[e] The cancer risk for each contaminant for each exposure pathway is calculated by multiplying the cancer intake value with the toxicity value as follows:

For contaminant i : $Risk_i$ = Cancer $Intake_i$ x Toxicity $Factor_i$

[f] The noncancer hazard for each contaminant for each exposure pathway is calculated by dividing the noncancer intake value by the toxicity value as follows:

For contaminant i : $Hazard_i$ = Noncancer $Intake_i$ / Toxicity $Factor_i$

--	Not applicable	NAUM	Navajo abandoned uranium mine
$\mu g/m^3$	Microgram per cubic meter	pCi	Picocurie
bgs	Below ground surface	pCi/g	Picocurie per gram
COPC	Contaminant of potential concern	RfC	Reference concentration
EPC	Exposure point concentration	RfD	Reference dose
mg/kg	Milligram per kilogram	SE	Secular equilibrium
mg/kg-day	Milligram per kilogram per day	USEPA	U.S. Environmental Protection Agency
mg/m^3	Milligram per cubic meter		

Reference:

U.S. Environmental Protection Agency (USEPA). 2024c. “Navajo Abandoned Uranium Mines Risk Assessment Methodology.” Draft Final. March.

Table B-6. Human Health Risk and Hazard Summary by Exposure Pathway

Section 9 Lease Mines - Trespasser														
COPC	EPC	Units	Incidental Soil Ingestion			External Exposure / Dermal Contact			Inhalation of Particulates			Total Risk or Hazard		
			Cancer Risk	Adult Hazard	Child Hazard	Cancer Risk	Adult Hazard	Child Hazard	Cancer Risk	Adult Hazard	Child Hazard	Cancer Risk	Adult Hazard	Child Hazard
Surface Soil (0-6 inches bgs)														
Uranium-238 in SE	9.7E+01	pCi/g	2.4E-05	--	--	7.4E-04	--	--	5.5E-06	--	--	8.0E-04	--	--
Aluminum	5.3E+03	mg/kg	--	0.00025	0.0027	--	--	--	--	0.00030	0.00030	--	0.00060	0.0030
Arsenic	2.9E+01	mg/kg	1.1E-06	0.0028	0.030	1.4E-07	0.00059	0.0035	1.3E-08	0.00055	0.00055	1.0E-06	0.0040	0.030
Cadmium	3.1E-01	mg/kg	--	0.00015	0.0016	--	0.000025	0.00015	5.8E-11	0.0000088	0.0000088	6.0E-11	0.00020	0.0020
Chromium	5.0E+00	mg/kg	1.9E-07	0.000080	0.00085	--	--	--	9.0E-08	0.000014	0.000014	3.0E-07	0.000090	0.00090
Cobalt	1.0E+01	mg/kg	--	0.0016	0.017	--	--	--	9.4E-09	0.00047	0.00047	9.0E-09	0.0020	0.020
Iron	1.5E+04	mg/kg	--	0.0010	0.011	--	--	--	--	--	--	--	0.0010	0.010
Manganese	1.8E+02	mg/kg	--	0.00036	0.0039	--	--	--	--	0.0010	0.0010	--	0.0010	0.0050
Mercury	5.3E-01	mg/kg	--	0.000085	0.00090	--	--	--	--	0.00000050	0.00000050	--	0.000090	0.00090
Molybdenum	2.4E+02	mg/kg	--	0.0023	0.025	--	--	--	--	0.000034	0.000034	--	0.0020	0.0200
Thallium	3.1E+00	mg/kg	--	0.015	0.16	--	--	--	--	--	--	--	0.010	0.20
Uranium	6.9E+01	mg/kg	--	0.017	0.18	--	--	--	--	0.00049	0.00049	--	0.020	0.20
Vanadium	4.2E+01	mg/kg	--	0.00040	0.0043	--	--	--	--	0.00012	0.00012	--	0.00050	0.0040
Exposure Pathway Risk/Hazard Total			**2E-05**	**0.04**	**0.4**	**7E-04**	**0.0006**	**0.004**	**6E-06**	**0.003**	**0.003**	**8E-04**	**0.04**	**0.4**

Table B-6. Human Health Risk and Hazard Summary by Exposure Pathway

Section 9 Lease Mines - Trespasser														
COPC	EPC	Units	Incidental Soil Ingestion			External Exposure / Dermal Contact			Inhalation of Particulates			Total Risk or Hazard		
			Cancer Risk	Adult Hazard	Child Hazard	Cancer Risk	Adult Hazard	Child Hazard	Cancer Risk	Adult Hazard	Child Hazard	Cancer Risk	Adult Hazard	Child Hazard
Subsurface Soil (0-60 inches bgs)														
Uranium-238 in SE	6.5E+01	pCi/g	1.6E-05	--	--	5.0E-04	--	--	3.7E-06	--	--	5.0E-04	--	--
Aluminum	4.8E+03	mg/kg	--	0.00023	0.0025	--	--	--	--	0.00027	0.00027	--	0.00050	0.0030
Arsenic	2.1E+01	mg/kg	8.1E-07	0.0020	0.021	9.8E-08	0.00043	0.0025	9.5E-09	0.00040	0.00040	9.0E-07	0.0030	0.020
Cadmium	2.9E-01	mg/kg	--	0.00014	0.0015	--	0.000024	0.00014	5.5E-11	0.0000082	0.0000082	5.0E-11	0.00020	0.0020
Chromium	4.7E+00	mg/kg	1.7E-07	0.000075	0.00080	--	--	--	8.0E-08	0.000013	0.000013	3.0E-07	0.000090	0.00080
Cobalt	1.1E+01	mg/kg	--	0.0018	0.019	--	--	--	1.0E-08	0.00052	0.00052	1.0E-08	0.0020	0.020
Iron	1.4E+04	mg/kg	--	0.00096	0.010	--	--	--	--	--	--	--	0.0010	0.010
Manganese	1.7E+02	mg/kg	--	0.00034	0.0036	--	--	--	--	0.00095	0.00095	--	0.0010	0.0050
Mercury	3.6E-01	mg/kg	--	0.000058	0.00061	--	--	--	--	0.00000034	0.00000034	--	0.000060	0.00060
Molybdenum	1.7E+02	mg/kg	--	0.0016	0.017	--	--	--	--	0.000024	0.000024	--	0.0020	0.0200
Thallium	2.8E+00	mg/kg	--	0.013	0.14	--	--	--	--	--	--	--	0.010	0.10
Uranium	5.0E+01	mg/kg	--	0.012	0.13	--	--	--	--	0.00035	0.00035	--	0.010	0.10
Vanadium	3.3E+01	mg/kg	--	0.00032	0.0034	--	--	--	--	0.000093	0.000093	--	0.00040	0.0030
Exposure Pathway Risk/Hazard Total			**2E-05**	**0.03**	**0.4**	**5E-04**	**0.0004**	**0.003**	**4E-06**	**0.003**	**0.003**	**5E-04**	**0.04**	**0.4**

Notes:
Results are from Table B-5.

--	Not applicable
bgs	Below ground surface
COPC	Contaminant of potential concern
EPC	Exposure point concentration
mg/kg	Milligram per kilogram
pCi/g	Picocurie per gram
SE	Secular equilibrium

Table B-7. Human Health Risk and Hazard Summary and Identification of Candidate Contaminants of Concern

Section 9 Lease Mines - Trespasser					
COPC[a]	Units	Exposure Point Concentration	Cancer Risk[b,c,d]	Noncancer Hazard[b,d,e]	
				Adult	Child
Surface Soil (0-6 inches bgs)					
Radionuclides [f]					
Uranium-238 in SE	pCi/g	9.7E+01	**8.0E-04**	--	--
		Radionuclide Total	**8E-04**	--	--
Metals [h]					
Aluminum	mg/kg	5.3E+03	--	0.00060	0.0030
Arsenic	mg/kg	2.9E+01	*2.0E-06*	0.0040	0.030
Cadmium	mg/kg	3.1E-01	6.0E-11	0.00020	0.0020
Chromium	mg/kg	5.0E+00	3.0E-07	0.000090	0.00090
Cobalt	mg/kg	1.0E+01	9.0E-09	0.0020	0.020
Iron	mg/kg	1.5E+04	--	0.0010	0.010
Manganese	mg/kg	1.8E+02	--	0.0010	0.0050
Mercury	mg/kg	5.3E-01	--	0.0001	0.00090
Molybdenum	mg/kg	2.4E+02	--	0.0020	0.0200
Thallium	mg/kg	3.1E+00	--	0.010	0.20
Uranium	mg/kg	6.9E+01	--	0.020	0.20
Vanadium	mg/kg	4.2E+01	--	0.00050	0.0040
		Metal Total	*2E-06*	0.04	0.5
		Cumulative Risk/Hazard Total	**8E-04**	0.04	0.5
Subsurface Soil (0-60 inches bgs)					
Radionuclides [f]					
Uranium-238 in SE	pCi/g	6.5E+01	**5.0E-04**	--	--
		Radionuclide Total	**5E-04**	--	--
Metals [h]					
Aluminum	mg/kg	4.8E+03	--	0.00050	0.0030
Arsenic	mg/kg	2.1E+01	*1.0E-06*	0.0030	0.020
Cadmium	mg/kg	2.9E-01	5.0E-11	0.00020	0.0020
Chromium	mg/kg	4.7E+00	2.0E-07	0.000090	0.00080
Cobalt	mg/kg	1.1E+01	1.0E-08	0.0020	0.020
Iron	mg/kg	1.4E+04	--	0.0010	0.010
Manganese	mg/kg	1.7E+02	--	0.0010	0.0050
Mercury	mg/kg	3.6E-01	--	0.000060	0.00060
Molybdenum	mg/kg	1.7E+02	--	0.0020	0.020
Thallium	mg/kg	2.8E+00	--	0.010	0.10
Uranium	mg/kg	5.0E+01	--	0.010	0.10
Vanadium	mg/kg	3.3E+01	--	0.00040	0.0030
		Metal Total	*1E-06*	0.03	0.3
		Cumulative Risk/Hazard Total	**5E-04**	0.03	0.3

Table B-7. Human Health Risk and Hazard Summary and Identification of Candidate Contaminants of Concern

Notes:

[a] **Bolded COPCs** are selected as candidate COCs because cancer risk is greater than one in ten thousand (1E-04) or noncancer hazard is greater than 1. *Italicized COPCs* are contaminants within the USEPA's cancer risk range (cancer risk greater than 1 in 1 million [1E-06] and less than or equal to 1E-04).

[b] **Bolded values** are values greater than the target cancer risk of one in ten thousand (1E-04) or noncancer target hazard of 1. *Italicized values* are within the USEPA's acceptable cancer risk range (cancer risk greater than 1E-06 and less than or equal to 1E-04). Total risks and total hazards are reported to one significant digit; thus, values are commonly rounded. In practice, values can be slightly higher than the stated cutoff but still be considered equal to the cutoff because of rounding.

[c] Cancer risks are provided on Table B-5.

[d] The methodology for calculating the risks and hazards and the inputs for cancer and noncancer equations are provided in the "Navajo Abandoned Uranium Mines Risk Assessment Methodology" report (USEPA 2024c).

[e] Noncancer hazards are presented on Table B-5.

[f] For radionuclides, uranium-238 is assumed to be in SE with its decay chain; that is, all decay chain nuclides are present in equal activity concentrations. In this case, the risk from radium-226 and its decay products (that is, radium-226 in SE) will account for most of the risk from the uranium-238 decay chain.

[h] Chromium is evaluated using the assumption that it is 100 percent hexavalent chromium (USEPA 2024c).

--	Not applicable
bgs	Below ground surface
COC	Contaminant of concern
COPC	Contaminant of potential concern
mg/kg	Milligram per kilogram
pCi/g	Picocurie per gram
SE	Secular equilibrium
USEPA	U.S. Environmental Protection Agency

Reference:

U.S. Environmental Protection Agency (USEPA). 2024c. “Navajo Abandoned Uranium Mines Risk Assessment Methodology.” Draft Final. March.

Table B-8. Screening-Level Ecological Risk Assessment Screening for Soil

Constituent of Interest[a]	Detection Frequency[b]	Maximum Detected Concentration (qualifier)[b]	Plant NOEC	Soil Invertebrates NOEC	Avian Herbivore NOEC	Avian Ground Insectivore NOEC	Avian Carnivore NOEC	Mammalian Herbivore NOEC	Mammalian Ground Insectivore NOEC	Mammalian Carnivore NOEC	Minimum NOEC	HQ based on Minimum NOEC[c]	Include Contaminant as COPEC in SLERA Refinement?[d]
Radionuclides (pCi/g) [e]													
Uranium-238 in SE (Adjusted Radium-226)	110 / 110	945	4.0	230	15	15	15	6.0	6.0	6.0	4.0	**240**	**Yes**
Metals (mg/kg) [f,g]													
Aluminum	63 / 63	18,400	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	No
Antimony	0 / 63	--	11	78	NSL	NSL	NSL	10	0.27	4.9	0.27	**--**	No (Not Detected)
Arsenic	96 / 110	230 D	18	6.8	67	43	1,100	170	46	170	6.8	**34**	**Yes**
Barium	63 / 63	1,100 D	110	330	720	820	7,500	3,200	200	9,100	110	**10**	**Yes**
Beryllium	21 / 35	1.68	2.5	40	NSL	NSL	NSL	21	34	90	2.5	0.67	No
Cadmium	18 / 56	1.0 JD	32	140	28	0.77	630	73	0.36	84	0.36	**2.8**	**Yes**
Chromium[h]	42 / 63	8.51	0.35	0.34	78	26	780	380	34	180	0.34	**25**	**Yes**
Cobalt	41 / 63	47 JD	13	NSL	270	120	1,300	2,100	230	470	13	**3.6**	**Yes**
Copper	49 / 63	37 D	70	80	76	80	1,600	1,100	49	560	49	0.76	No
Iron	63 / 63	97,000 D	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	No
Lead	63 / 63	150 D	120	1,700	46	11	510	1,200	56	460	11	**14**	**Yes**
Manganese	61 / 63	540 D	220	450	4,300	4,300	650,000	5,300	4,000	6,200	220	**2.5**	**Yes**
Mercury	84 / 110	8.7	0.3	0.05	0.067	0.013	0.058	23	1.7	76	0.013	**670**	**Yes**
Molybdenum[i,j]	97 / 110	2,000 D	**2**	NSL	18	15	90	*635*	*4.8*	*64*	2	**1,000**	**Yes**
Nickel	59 / 63	17 JD	38	280	210	20	2,800	340	10	130	10	**1.7**	**Yes**
Selenium	45 / 110	37 JD	0.52	4.1	2.2	1.2	83	2.7	0.63	2.8	0.52	**71**	**Yes**
Silver	4 / 63	0.208 J-	560	NSL	69	4.2	930	1,500	14	990	4.2	0.050	No
Thallium	16 / 63	26 JD	0.050	NSL	6.9	4.5	48	1.2	0.42	5.0	0.050	**520**	**Yes**
Uranium	69 / 110	970 D	25	NSL	1,500	1,100	14,000	1,000	480	4,800	25	**39**	**Yes**
Vanadium	97 / 110	390 D	60	NSL	13	7.8	140	1,300	280	580	7.8	**50**	**Yes**
Zinc	33 / 63	66 JD	160	120	950	46	30,000	6,800	79	10,000	46	**1.4**	**Yes**

Notes:

Grey highlighted cells indicate the maximum concentration exceeds the NOEC for the receptor group.

[a] **Bolded contaminants** are selected as COPECs for the SLERA refinement because the HQ is greater than or equal to 1.0.

[b] Includes soil samples collected site-wide from all depths. Includes all duplicate soil samples. See Table B-1 for the summary statistics for each contaminant.

[c] HQ is calculated by dividing the maximum concentration by the minimum NOEC. **Bolded HQ values** indicate HQs greater than 1.0.

[d] A contaminant is included as a COPEC for the SLERA refinement if the calculated HQ is greater than 1.0.

[e] Radionuclide ESLs are based on dose assessments using the ERICA Tool (Brown and others 2008) for terrestrial animals and plants (see Appendix F of the "Navajo Abandoned Uranium Mines Risk Assessment Methodology" Report [USEPA 2024c]). ESLs for uranium-238 in SE are based on individual radium-226 ESLs that are adjusted to include doses from all progeny of uranium-238 in SE. Site data for radium-226 are used to evaluate uranium-238 in SE.

[f] NOECs for metals are based on the Eco-SSL (USEPA 2023a) unless underlined, **bolded**, or *italicized.*

[g] Underlined values are based on LANL no effect level ESLs (N3B 2022) for contaminants for which Eco-SSLs are not available.

[h] Chromium is evaluated using the assumption that it is 100 percent hexavalent chromium (USEPA 2024b). LANL chromium screening values are based on Cr(VI) (hexavalent chromium) for plants and invertebrates (N3B 2022) and Cr(III) (trivalent chromium) for birds and mammals (USEPA 2023). Eco-SSLs for hexavalent chromium are not available for birds, and the hexavalent chromium Eco-SSLs for mammals are higher than the trivalent chromium values (USEPA 2023).

[i] **Bold value** for molybdenum is based on Oak Ridge National Laboratory no effect level for plants for which neither an Eco-SSL nor LANL ESL is available (Efroymson, Will, Suter II, and Wooten 1997).

[j] *Italicized values* for molybdenum are based on the Oak Ridge National Laboratory preliminary remediation goals for ecological receptors (Efroymson, Suter II, Sample, and Jones 1997) for mammals for which Eco-SSLs and LANL NOECs are not available.

Table B-8. Screening-Level Ecological Risk Assessment Screening for Soil

Notes (Continued):

--	Not applicable
COPEC	Contaminant of potential ecological concern
D	Dilution
Eco-SSL	Ecological soil screening level
ERICA	Environmental Risk from Ionising Contaminants: Assessment and Management
ESL	Ecological screening level
HQ	Hazard quotient
J	Estimated concentration
J-	Estimated concentration, biased low
LANL	Los Alamos National Laboratory
mg/kg	Milligram per kilogram
N3B	Newport News Nuclear BWXT-Los Alamos, LLC
NOEC	No observed effect concentration
NSL	No screening level
pCi/g	Picocurie per gram
SE	Secular equilibrium
SLERA	Screening-level ecological risk assessment
USEPA	U.S. Environmental Protection Agency

References:

Brown, J.E., B. Alfonso, R. Avila, N.A. Beresford, D. Copplestone, G. Pröhl, and A. Ulanovsky. 2008. “The ERICA Tool.” *Journal of Environmental Radioactivity* . Volume 99, Issue 9. Pages 1371 through 1383.

Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997. "Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process." ES/ER/TM-126/R2. Oak Ridge National Laboratories, Oak Ridge, TN.

Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997. "Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants." ES/ER/TM-85/R3. Oak Ridge National Laboratories, Oak Ridge, TN.

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U.S. Environmental Protection Agency (USEPA). 2023. "Interim Ecological Soil Screening Level Documents." Accessed July 20. https://www.epa.gov/chemical-research/interim-ecological-soil-screening-level-documents.

USEPA. 2024c. “Navajo Abandoned Uranium Mines Risk Assessment Methodology.” Draft Final. March.

Table B-9. Exposure Point Concentrations for Ecological Risk Assessment

Site-Wide											
Contaminant	Units	Detection Frequency	Number of High Nondetect Results[a]	Maximum Concentration (qualifier)	Location of Maximum Concentration	Arithmetic Mean[b]	UCL95 / Distribution[c]		Exposure Point Concentration		
									Value[d]	Statistic[d]	Method[e]
Surface Soil (0-6 inches bgs)											
Radium-226	pCi/g	62 / 62	0	945	457-SS-7A	58.77	96.77	LN	97	UCL95	(14)
Arsenic	mg/kg	55 / 62	0	230 D	457-SS-7A	20.16	29.07	LN	29	UCL95	(15)
Barium	mg/kg	46 / 46	0	1,100 D	457-SS-7A	269.10	316.50	G	317	UCL95	(4)
Cadmium	mg/kg	17 / 42	0	1 JD	457-SS-7A	0.23	0.31	G	0.31	UCL95	(5)
Chromium	mg/kg	34 / 45	2	8.51	APE-SS10-01-020624	4.53	5.01	N	5.0	UCL95	(2)
Cobalt	mg/kg	34 / 45	2	28	457-SS02-01-020624	8.35	10.47	G	10	UCL95	(5)
Lead	mg/kg	46 / 46	0	150 D	457-SS-7A	24.86	32.44	LN	32	UCL95	(14)
Manganese	mg/kg	45 / 46	0	540 D	DRN-SD-4	145.10	182.20	G	182	UCL95	(5)
Mercury	mg/kg	47 / 62	0	8.7	457-SS-8A	0.25	0.53	LN	0.53	UCL95	(15)
Molybdenum	mg/kg	56 / 62	0	2,000 D	457-SS-7A	142.60	241.70	G	242	UCL95	(7)
Nickel	mg/kg	44 / 46	0	17 JD	DRN-SD-1	6.46	7.63	G	7.6	UCL95	(5)
Selenium	mg/kg	30 / 62	0	37 JD	458-SS-6A	1.67	2.84	LN	2.8	UCL95	(15)
Thallium	mg/kg	15 / 45	2	26 JD	457-SS-7A	1.87	3.10	LN	3.1	UCL95	(13)
Uranium	mg/kg	37 / 62	0	970 D	457-SS-7A	38.54	69.05	LN	69	UCL95	(15)
Vanadium	mg/kg	55 / 62	0	390 D	457-SS-7A	29.07	41.89	NP	42	UCL95	(15)
Zinc	mg/kg	29 / 45	2	66 JD	457-SS-7A	18.10	22.73	G	23	UCL95	(5)

Table B-9. Exposure Point Concentrations for Ecological Risk Assessment

Site-Wide											
Contaminant	Units	Detection Frequency	Number of High Nondetect Results[a]	Maximum Concentration (qualifier)	Location of Maximum Concentration	Arithmetic Mean[b]	UCL95 / Distribution[c]		Exposure Point Concentration		
									Value[d]	Statistic[d]	Method[e]
Subsurface Soil (0-60 inches bgs)											
Radium-226	pCi/g	100 / 100	0	945	457-SS-7A	42.40	65.41	NP	65	UCL95	(14)
Arsenic	mg/kg	88 / 100	0	230 D	457-SS-7A	15.67	21.18	NP	21	UCL95	(15)
Barium	mg/kg	56 / 56	0	1,100 D	457-SS-7A	261.20	298.10	G	298	UCL95	(6)
Cadmium	mg/kg	17 / 56	0	1 JD	457-SS-7A	0.22	0.29	G	0.29	UCL95	(7)
Chromium	mg/kg	37 / 55	2	8.51	APE-SS10-01-020624	4.24	4.68	N	4.7	UCL95	(3)
Cobalt	mg/kg	38 / 56	2	47 JD	459-SS-2C	8.93	11.18	G	11	UCL95	(7)
Lead	mg/kg	56 / 56	0	150 D	457-SS-7A	21.97	28.23	NP	28	UCL95	(14)
Manganese	mg/kg	55 / 56	0	540 D	DRN-SD-4	137.90	167.70	G	168	UCL95	(7)
Mercury	mg/kg	76 / 100	0	8.7	457-SS-8A	0.18	0.36	LN	0.36	UCL95	(15)
Molybdenum	mg/kg	89 / 100	0	2,000 D	457-SS-7A	105.80	167.90	G	168	UCL95	(7)
Nickel	mg/kg	53 / 56	0	17 JD	DRN-SD-1	6.22	7.19	G	7.2	UCL95	(7)
Selenium	mg/kg	43 / 100	0	37 JD	458-SS-6A	1.05	1.74	LN	1.7	UCL95	(15)
Thallium	mg/kg	15 / 55	2	26 JD	457-SS-7A	1.77	2.84	LN	2.8	UCL95	(13)
Uranium	mg/kg	65 / 100	0	970 D	457-SS-7A	31.15	50.28	NP	50	UCL95	(15)
Vanadium	mg/kg	88 / 100	0	390 D	457-SS-7A	25.75	33.44	NP	33	UCL95	(15)
Zinc	mg/kg	29 / 55	2	66 JD	457-SS-7A	16.64	20.33	G	20	UCL95	(7)

Notes:

[a] Number of nondetect results that exceeded the maximum detected concentration. These results were not included in the statistical calculations.

[b] The arithmetic mean for datasets with nondetected results is calculated using the Kaplan-Meier method.

[c] Tested using the Shapiro-Wilk W or Lilliefors test for normal and lognormal distributions and the Anderson-Darling and Kolmogorov-Smirnov tests for gamma distributions. A 5 percent level of significance was used in all tests. Distribution tests were conducted only for samples with at least four detected results. Distributions not confirmed as N, LN, or G were treated as NP in all statistical calculations.

[d] The EPC is the lesser of the UCL95 (or UCL99) and the maximum detected concentration. The maximum detected concentration is the default when there are fewer than 10 samples or fewer than four detected results. See Appendix D of the "Navajo Abandoned Uranium Mines Risk Assessment Methodology" report

(USEPA 2024c).

Table B-9. Exposure Point Concentrations for Ecological Risk Assessment

Notes (Continued):

[e] The statistical methods for selecting the exposure point concentration are as follows (not all are used):

(1)	Maximum detected concentration	(7)	95% Gamma Approximate KM-UCL	(13)	95% KM BCA UCL
(2)	95% Student's t UCL	(8)	95% H-UCL	(14)	95% Percentile Bootstrap UCL
(3)	95% KM (t) UCL	(9)	95% H-UCL (KM log)	(15)	95% KM Percentile Bootstrap UCL
(4)	95% Adjusted Gamma UCL	(10)	95% Bootstrap-t UCL	(16)	99% Bootstrap-t UCL
(5)	95% Gamma Adjusted KM-UCL	(11)	95% KM Bootstrap-t UCL	(17)	99% KM Percentile Bootstrap UCL
(6)	95% Approximate Gamma UCL	(12)	95% BCA UCL		

BCA	Bias-corrected accelerated bootstrap method
bgs	Below ground surface
D	Dilution
EPC	Exposure point concentration
G	Gamma distribution
H-UCL	UCL based upon Land’s H-statistic
J	Estimated concentration
KM	Kaplan-Meier
LN	Lognormal distribution
mg/kg	Milligram per kilogram
N	Normal distribution
NP	Nonparametric distribution
pCi/g	Picocurie per gram
UCL	Upper confidence limit
UCL95	95 percent upper confidence limit
UCL99	99 percent upper confidence limit
USEPA	U.S. Environmental Protection Agency

Reference:

U.S. Environmental Protection Agency (USEPA). 2024c. “Navajo Abandoned Uranium Mines Risk Assessment Methodology.” Draft Final. March.

Table B-10. Comparison of Individual Sample Results to Plant and Invertebrate No Observed Effect Concentrations

Sample Identification	Sample Bottom Depth (inches bgs)[d]	COPEC:[a]	Uranium-238 in SE (Adjusted Radium-226) [b]	Antimony	Arsenic	Barium	Cadmium	Chromium[c]	Cobalt	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Thallium	Uranium	Vanadium	Zinc
		Plant NOEC:[d]	4.0	11	18	110	32	0.35	13	120	220	0.3	2	38	0.52	0.050	25	60	160
		Soil Invertebrate NOEC:[d]	230	78	6.8	330	140	0.34	NSL	1,700	450	0.05	NSL	280	4.1	NSL	NSL	NSL	120
		Units:	pCi/g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Surface Soil (0-6 inches bgs)[e]																			
457-SS01-01-020624	6		18.6	1.87 U	14.4	151	0.148	5.82	23.7	9.25	56.8	0.105	4.61	6.98	6.53	0.347	26.8	20.3	21.4
457-SS02-01-020624	6		66.7	1.74 U	16.1	236	0.748	5	28	16.5	144	0.229	59.7	15.2	1.95	0.791	90.4	18.7	31.9
457-SS03-01-020624	6		18.9	1.83 U	3.97	189	0.109	5.3	4.19	9.26	308	0.0257	13.9	4.8	2	0.506	15.7	29.1	10.9
457-SS04-01-020624	6		160	1.88 U	18.5	327	0.794	4.9	7.45	74.8	148	0.165	214	6.99	1.29	2.82	56	40.3	61.9
457-SS-10A	6		2.87	6.5 U	3.2 U	320	1 U	3.8	9.5 U	18	250	0.028	10 U	6.6	2.9 U	15 U	98 U	35	28
457-SS-11A	6		411	6 U	72	510	0.94 U	7.1	10	66	180	0.88	910	9.1	2.7 U	14 U	430 U	70	55
457-SS-12A	6		3.19	6.2 U	3 U	310	0.96 U	4.6	9 U	18	240	0.032	9.6 U	6.9	2.8 U	15 U	110 U	34	30
457-SS-1A	6		156	6.4 U	83	310	1 U	3.1 U	13	40	15	0.31	420	8	2.9 U	15 U	390 U	13 U	20
457-SS-2A	6		30.1	5.8 U	7.3	280	0.9 U	2.8	8.7	10	280	0.024	61	6	2.6 U	14 U	120 U	24	18 U
457-SS-3A	6		57.1	6.1 U	37	260	0.95 U	3	8.9 U	32	190	0.1	180	6.3	2.7 U	14 U	130 U	32	25
457-SS-4A	6		3.32	6.4 U	3.2 U	300	1 U	4.5	9.4 U	44	250	0.016	10 U	6.6	2.9 U	15 U	120 U	37	31
457-SS-5A	6		8.37	6.4 U	3.1 U	250	0.99 U	4.1	11	12	170	0.021	9.9 U	5.6	2.9 U	15 U	130 U	35	20 U
457-SS-6A	6		382	5.8 U	54	390	0.91 U	3.5	9.4	52	180	0.8	650	7.7	2.6 U	14 U	350 U	57	58
457-SS-7A	6		945	6.4 U	230	1100	1	8	23	150	110	1.3	2000	11	3.4	26	970	390	66
457-SS-8A	6		747	6.1 U	98	590	0.95 U	7.1	15	77	170	8.7	960	9.7	2.7 U	14 U	470 U	210	46
457-SS-9A	6		27.2	6.3 U	19	340	0.98 U	3 U	9.2 U	26	230	0.037	140	5.5	2.8 U	15 U	110 U	26	19 U
457-TP14-0-0.5-120318	6		2.94	--	--	--	--	--	--	--	--	0.00006 U	0.58	--	0.32	--	--	4	--
457-TP14-0-0.5-120318 DUP	6		--	--	0.97	--	--	--	--	--	--	--	--	--	--	--	1.4	--	--
457-TP15-0-0.5-120618	6		8.2	--	9.9	--	--	--	--	--	--	0.02	30	--	0.054 U	--	6.7	15	--
457-TP3-0-0.5-120418	6		--	--	--	--	--	--	--	--	--	--	35	--	0.092	--	--	27	--
457-TP3-0-0.5-120418 DUP	6		12.5	--	17	--	--	--	--	--	--	0.018	--	--	--	--	19	--	--
457-TP5-0-0.5-120418	6		3.00	--	2.6	--	--	--	--	--	--	0.000064 U	3.6	--	0.055 U	--	4.5	39	--
457-TP6-0-0.5-120418	6		1.76	--	2	--	--	--	--	--	--	0.000058 U	3	--	0.26	--	2.7	27	--
458-SS01-01-020624	6		30.9	1.89 U	22.7	314	0.252	6.58	2.93	17.8	30.3	0.204	173	3.04	1.47	5.21	41.5	12.6	8.39
458-SS02-01-020624	6		37.7	1.94 U	22.4	256	0.2	6.44	2.01	12.5	19.5	0.192	141	1.7	1	5.61	48.3	8.45	5.19
458-SS03-01-020624	6		134	1.82 U	30.9	335	0.329	2.11	5.1	47.6	19	0.344	78.6	2.34	1.35	1.17	126	5.22	7.97
458-SS04-01-020624	6		48.3	1.76 U	17.6	234	0.316	3.68	3.18	21	91.2	0.156	191	3.44	1.06	3.88	108	14.9	9.97
458-SS05-01-020624	6		12.2	1.81 U	1.09	56.9	0.0555	4.81	4.41	29.1	35.9	0.037	0.228	2.78	2.16	0.349 U	15.9	12.7	11.7
458-SS06-01-020624	6		--	--	21.7	273	--	5.93	3.8	--	19.7	--	126	2.88	2.32	2.68	--	14.2	9.15
458-SS06-02-020624	6		34.50	1.84 U	--	--	0.251	--	--	13.7	--	0.167	--	--	--	--	90.6	--	--
458-SS-1A	6		51.80	6.4 U	31	390	1 U	3.4	17	16	81	0.093	180	3.8	2.9 U	15 U	55 U	15	20 U
458-SS-2A	6		9.84	6.5 U	3.2 U	160	1 U	3.1 U	13	13	110	0.015	18	5.1	2.9 U	15 U	53 U	14	20 U
458-SS-3A	6		39.10	6.3 U	31	200	0.98 U	3 U	9.2 U	18	29	0.36	440	2.2	2.8 U	15 U	150 U	12	19 U
458-SS-4A	6		11.10	8.3 U	12	500	1.3 U	4 U	12	17	32	0.028	48	4.9	3.7 U	20 U	88 U	16 U	26 U
458-SS-5A	6		28.70	6.6 U	7.9	67	1 U	3.1 U	9.6 U	9.1	24	0.043	130	10	3 U	15 U	170 U	13 U	20 U
458-SS-6A	6		83.50	33 U	160	99	5.1 U	16 U	48 U	110	7.9 U	0.33	840	12 U	37	78 U	370 U	65 U	100 U
458-SS-7A	6		93.40	33 U	140	70	5.6 U	17 U	52 U	68	8.6 U	0.35	490	13 U	35	84 U	290 U	70 U	110 U
458-SS-8A	6		16.70	6.3 U	9.4	150	0.98 U	3 U	9.9	13	39	0.086	87	3.2	2.8 U	15 U	52 U	12	19 U
458-TP19-0-0.5-120518	6		73.90	--	30	--	--	--	--	--	--	0.21	350	--	0.53	--	110	17	--
458-TP20-0.5-1.0-120518	6		24.10	--	30	--	--	--	--	--	--	0.16	160	--	0.21	--	44	8.1	--
458-TP20-0-0.5-120518	6		6.18	--	18	--	--	--	--	--	--	0.1	22	--	0.14	--	12	17	--
458-TP21-0-0.5-120518	6		6.88	--	8.5	--	--	--	--	--	--	0.04	14	--	0.049 U	--	9.3	12	--
459-SS-2A	6		9.23	5.7 U	9.7	260	0.88 U	2.7 U	8.3 U	4.7	78	0.022	46	3.8	2.6 U	13 U	46 U	11 U	18 U
459-TP23-0-0.5-120618	6		15.9	--	--	--	--	--	--	--	--	0.019	52	--	--	--	--	6.7	--

Table B-10. Comparison of Individual Sample Results to Plant and Invertebrate No Observed Effect Concentrations

Sample Identification	Sample Bottom Depth (inches bgs)[d]	COPEC:[a]	Uranium-238 in SE (Adjusted Radium-226)[b]	Antimony	Arsenic	Barium	Cadmium	Chromium[c]	Cobalt	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Thallium	Uranium	Vanadium	Zinc
		Plant NOEC:[d]	4.0	11	18	110	32	0.35	13	120	220	0.3	2	38	0.52	0.050	25	60	160
		Soil Invertebrate NOEC:[d]	230	78	6.8	330	140	0.34	NSL	1,700	450	0.05	NSL	280	4.1	NSL	NSL	NSL	120
		Units:	pCi/g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
459-TP23-0-0.5-120618 DUP	6		--	--	7.4	--	--	--	--	--	--	--	--	--	0.053 U	--	9.7	--	--
APE-SS01-01-020624	6		10.4	1.84 U	4.39	142	0.244	7.46	9.45	12.9	68.2	0.118	12.8	7.04	2.49	0.768	18	29.4	21.5
APE-SS02-01-020624	6		1.94	1.79 U	1.2	424	0.0715	8.28	5.03	7.34	385	0.0242 U	0.413	12.5	1.5	0.393 U	2.87	32.9	11.4
APE-SS03-01-020624	6		2.83	1.85 U	3.55	24.8	0.196 U	5.01	4.95	6.65	50.1	0.0224 U	0.133	5.26	2.3	0.283	3.77	19.1	23
APE-SS04-01-020624	6		2.3	2.04 U	1.71	347	0.0378	7.78	4.72	9.86	155	0.0236 U	1.26	4.75	2.23	0.143	3.56	32	19.9
APE-SS05-01-020624	6		1.35	2.01 U	1.71	198	0.0241	2.82	1.87	4.48	119	0.0214 U	0.258	2.24	3.15	0.369 U	1.58	12.9	10.8
APE-SS06-01-020624	6		1.51	1.81 U	0.749	223	0.122	5	3.5	5.4	110	0.0116	0.4	4.57	0.795	0.371 U	1.73	17	9.15
APE-SS07-01-020624	6		15.4	1.8 U	9.09	52.2	0.125	3.05	0.641	4.03	4.96	0.0121	110	0.437	1.28	0.413	18.3	5.09	2.69
APE-SS08-01-020624	6		1.27	1.89 U	0.961	238	0.186 U	3.57	2.03	4.27	176	0.0216 U	0.245	4.36	1.49	0.373 U	0.99	12.4	8.46
APE-SS09-01-020624	6		5.67	1.81 U	4.07	212	0.187 U	3.19	5.32	6.33	104	0.016	7.74	3.69	1.06	0.389	5.92	11.6	13.2
APE-SS10-01-020624	6		1.41	1.73 U	1.28	273	0.172 U	8.51	4.98	5.29	262	0.0224 U	0.553	13.2	1.14	0.345 U	1.23	21	16.4
Drain-TP16-0-0.5-120318	6		1.23	--	1.7	--	--	--	--	--	--	0.000058 U	0.27	--	0.051 U	--	1.3	24	--
Drain-TP7-0-0.5-120418	6		5.71	--	2.7	--	--	--	--	--	--	0.000062 U	18	--	0.12	--	6	19	--
Drain-TP8-0-0.5-120418	6		37.5	--	6.3	--	--	--	--	--	--	0.019	37	--	0.32	--	14	25	--
DRN-SD-1	6		1.3	6.5 U	3.2 U	180	1 U	6.4	14	6.2	270	0.011 U	10 U	17	2.9 U	15 U	110 U	26	20 U
DRN-SD-2	6		0.977	6.3 U	3.1 U	210	0.99 U	4.9	10	5.8	260	0.011 U	9.9 U	14	2.9 U	15 U	72 U	24	20 U
DRN-SD-4 (DUP)	6		3.74	6.4 U	3.2 U	180	1 U	5.3	9.4 U	5.9	540	0.011 U	10 U	14	2.9 U	15 U	86 U	24	20 U
LCR-TP12-0-0.5-120318	6		1.48	--	2.4	--	--	--	--	--	--	0.000071 U	0.71	--	0.06 U	--	1.8	25	--
MHR-TP17-0-0.5-120618	6		8.7	--	8.2	--	--	--	--	--	--	0.0027	27	--	0.054 U	--	11	20	--
MHR-TP22-0-0.5-120518	6		2.69	--	2.1	--	--	--	--	--	--	0.065	0.2	--	0.054 U	--	2.7	13	--
RIV-SD-2	6		21.2	--	11	360	--	--	--	12	--	--	34	--	--	--	--	26	--
RIV-SD-6	6		--	6.7 U	--	--	1 U	3.2 U	9.8 U	--	370	0.29	--	3.2	3 U	16 U	180 U	--	21 U
S9L-SS-1A	6		13	6.1 U	13	75	0.96 U	2.9 U	9 U	38	25	0.2	160	2.2 U	2.8 U	14 U	150 U	12 U	19 U
S9L-SS-2A	6		65.2	6.4 U	--	--	0.99 U	--	20	--	--	0.073	--	--	2.9 U	15 U	170 U	--	20 U
S9L-SS-4A	6		--	--	15	330	--	4.7	--	34	170	--	32	9.5	--	--	--	25	--
WET-SD-3	6		64.4	7.5 U	29	130	1.2 U	4.7	25	26	130	0.039	220	9.8	3.4 U	18 U	180 U	15 U	32
WET-SD-4	6		7.29	8.4 U	15	320	1.3 U	4 U	12 U	22	360	0.031	37	7.4	3.8 U	20 U	160 U	25	30
Frequency of Plant NOEC Exceedance:			**46/65**	0/49	**19/65**	**42/49**	0/49	**36/49**	**8/49**	**1/49**	**13/49**	**9/65**	**46/65**	0/49	**24/65**	**15/49**	**11/65**	**3/65**	0/49
Frequency of Soil Invertebrate NOEC Exceedance:			**4/65**	0/49	**38/65**	**11/49**	0/49	**36/49**	NA	0/49	**1/49**	**27/65**	NA	0/49	**3/65**	NA	NA	NA	0/49
Frequency of Plant and Soil Invertebrate Exceedance:			**4/65**	0/49	**19/65**	**11/49**	0/49	**36/49**	**8/49**	0/49	**1/49**	**9/65**	**46/65**	0/49	**3/65**	**15/49**	**11/65**	**3/65**	0/49
Analyte Identified as Surface Soil Candidate COEC?[f]			**Yes (P/I)**	No	**Yes (P/I)**	**Yes (P/I)**	No	**Yes (P/I)**	**Yes (P)**	**Yes (P)**	**Yes (P/I)**	**Yes (P/I)**	**Yes (P)**	No	**Yes (P/I)**	**Yes (P)**	**Yes (P)**	**Yes (P)**	No

Table B-10. Comparison of Individual Sample Results to Plant and Invertebrate No Observed Effect Concentrations

Sample Identification	Sample Bottom Depth (inches bgs)[d]	COPEC:[a]	Uranium-238 in SE (Adjusted Radium-226) [b]	Antimony	Arsenic	Barium	Cadmium	Chromium[c]	Cobalt	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Thallium	Uranium	Vanadium	Zinc
		Plant NOEC:[d]	4.0	11	18	110	32	0.35	13	120	220	0.3	2	38	0.52	0.050	25	60	160
		Soil Invertebrate NOEC:[d]	230	78	6.8	330	140	0.34	NSL	1,700	450	0.05	NSL	280	4.1	NSL	NSL	NSL	120
		Units:	pCi/g	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Subsurface Soil (6-60 inches bgs) [e]																			
457-SS-2B	12		3.06	5.8 U	2.9 U	290	0.9 U	2.8 U	8.5 U	7.7	110	0.012	9 U	2.3	2.6 U	14 U	110 U	20	18 U
457-SS-4B	12		1.93	6.1 U	3 U	360	0.95 U	5	8.9 U	7.5	190	0.012	9.5 U	9.3	2.8 U	14 U	100 U	28	19 U
457-TP15-0.5-1.0-120618	12		7.54	--	6.6	--	--	--	--	--	--	0.026	6.7	--	0.055 U	--	5.7	9.2	--
457-TP5-0.5-1.0-120418	12		1.93	--	2.4	--	--	--	--	--	--	0.000064 U	1.4	--	0.18	--	2	39	--
458-SS-2B	12		6.01	6.5 U	3.2 U	170	1 U	3.1 U	13	6.9	100	0.011 U	10 U	5.4	2.9 U	15 U	53 U	13	20 U
458-SS-4B	12		18.7	5.8 U	12	160	0.9 U	2.8 U	18	13	38	0.074	87	4.3	2.6 U	14 U	120 U	11 U	18 U
458-TP18-0.5-1.0-120518	12		14	--	19	--	--	--	--	--	--	0.071	72	--	0.74	--	15	12	--
458-TP19-0.5-1.0-120518	12		126	--	55	--	--	--	--	--	--	0.54	820	--	0.46	--	140	13	--
458-TP21-0.5-1.0-120518	12		5.64	--	23	--	--	--	--	--	--	0.074	23	--	0.3	--	8.3	19	--
459-SS-2B	12		10.1	6.8 U	7.3	260	--	3.3 U	10 U	5.6	77	0.029	32	3.9	3.1 U	16 U	56 U	13 U	21 U
459-TP23-0.5-1.0-120618	12		19.7	--	8.2	--	--	--	--	--	--	0.032	55	--	0.17	--	15	9.8	--
Drain-TP2-0.5-1.0-120418	12		2.82	--	3.7	--	--	--	--	--	--	0.0065	3.5	--	0.051 U	--	3.4	41	--
Drain-TP8-0.5-1.0-120418	12		31.3	--	12	--	--	--	--	--	--	0.028	53	--	0.23	--	21	23	--
MRD-TP1-0.5-1.0-120518	12		31.6	--	1.3	--	--	--	--	--	--	0.081	8	--	0.054 U	--	45	16	--
457-SS-2C	18		2.47	6.6 U	3.2 U	250	1 U	3.1 U	9.6 U	7.5	110	0.012	10 U	2.3 U	3 U	15 U	140 U	21	20 U
457-SS-4C	18		1.07	6.7 U	3.3 U	230	1 U	5.9	9.7 U	6.3	250	0.011 U	10 U	11	3 U	16 U	120 U	30	21 U
457-TP6-1.0-1.5-120418	18		1.61	--	1.8	--	--	--	--	--	--	0.000061 U	0.71	--	0.048 U	--	1.6	32	--
458-SS-2C	18		22.8	6.7 U	4.5	180	1 U	3.2 U	9.8 U	12	78	0.081	69	3.7	3 U	16 U	55 U	13 U	21 U
458-SS-4C	18		21.5	6.3 U	42	230	0.99 U	3.1	12	14	20	0.14	110	4.4	2.9 U	15 U	190 U	12 U	20 U
458-TP20-1.0-1.5-120518	18		19.8	--	39	--	--	--	--	--	--	0.26	130	--	0.7	--	42	7.9	--
459-SS-2C	18		9.76	7.7 U	8	120	--	3.7 U	47	6	72	0.033	36	5.4	3.5 U	18 U	64 U	15 U	24 U
Drain-TP16-1.0-1.5-120318	18		1.2	--	2	--	--	--	--	--	--	0.000062 U	0.2	--	0.052 U	--	1.3	29	--
Drain-TP2-1.0-1.5-120418	18		2.69	--	3.4	--	--	--	--	--	--	0.0012	2.1	--	0.058 U	--	3.9	42	--
Drain-TP7-1.0-1.5-120418	18		1.69	--	1.7	--	--	--	--	--	--	0.000058 U	7.9	--	0.15	--	3.6	17	--
LCR-TP12-1.0-1.5-120318	18		1.86	--	2.6	--	--	--	--	--	--	0.0089	0.71	--	0.056 U	--	2	26	--
MHR-TP22-1.0-1.5-120518	18		4.14	--	2.4	--	--	--	--	--	--	0.082	0.37	--	0.17	--	3.9	8.4	--
MRD-TP1-1.5-2.0-120518	24		71.8	--	1.7	--	--	--	--	--	--	0.33	0.84	--	0.35	--	180	21	--
457-TP4-2.0-2.5-120418	30		5.92	--	2.4	--	--	--	--	--	--	0.0095	4.3	--	0.053 U	--	5.6	29	--
458-TP18-2.0-2.5-120518	30		4.08	--	5.3	--	--	--	--	--	--	0.017	12	--	0.052 U	--	6.8	13	--
LCR-TP11-2.0-2.5-120318	30		1.81	--	2.4	--	--	--	--	--	--	0.0099	0.77	--	0.061 U	--	1.5	23	--
LCR-TP9-2.0-2.5-120318	30		58.2	--	10	--	--	--	--	--	--	0.17	78	--	0.047 U	--	28	16	--
MHR-TP17-2.0-2.5-120618	30		1.64	--	2	--	--	--	--	--	--	0.000062 U	13	--	0.047 U	--	3.9	21	--
459-TP23-2.5-3.0-120618	36		10.1	--	8.3	--	--	--	--	--	--	0.02	28	--	0.056	--	8.9	13	--
Drain-TP8-2.5-3.0-120418	36		1.76	--	2.2	--	--	--	--	--	--	0.000059 U	6.5	--	0.057	--	2.8	21	--
MRD-TP1-2.5-3.0-120518	36		3.94	--	0.92	--	--	--	--	--	--	0.002	1.5	--	0.052 U	--	21	49	--
457-TP4-3.0-3.5-120418	42		2.46	--	2	--	--	--	--	--	--	0.00006 U	2.8	--	0.054 U	--	3.4	22	--
LCR-TP9-3.0-3.5-120318	42		55.7	--	7.9	--	--	--	--	--	--	0.16	34	--	0.074	--	37	21	--
LCR-TP9-4.5-5.0-120318	60		7.37	--	3.6	--	--	--	--	--	--	0.028	18	--	0.063 U	--	16	22	--
Frequency of Plant NOEC Exceedance:			**22/38**	0/10	**5/38**	**10/10**	0/8	**3/10**	**2/10**	0/10	**1/10**	**2/38**	**25/38**	0/10	**2/38**	0/10	**6/38**	0/38	0/10
Analyte Identified as Subsurface Soil Candidate COEC? [f]			**Yes (P)**	No	**Yes (P)**	**Yes (P)**	No	**Yes (P)**	**Yes (P)**	No	**Yes (P)**	**Yes (P)**	**Yes (P)**	No	**Yes (P)**	No	**Yes (P)**	No	No

Table B-10. Comparison of Individual Sample Results to Plant and Invertebrate No Observed Effect Concentrations

Notes:

(green)	Exceeds the plant NOEC
(yellow)	Exceeds soil invertebrate NOEC
(orange)	Exceeds both soil invertebrate and plant NOECs

[a] A constituent is included as a COPEC if the calculated SLERA HQ is greater than or equal to 1.0 (see Table B-8).

[b] The NOECs for uranium-238 in SE are based on individual radium-226 ESLs that are adjusted to include doses from all progeny of uranium-238 in SE. Site data for radium-226 are used to evaluate uranium-238 in SE.

[c] Chromium is evaluated using the assumption that it is 100 percent hexavalent chromium (USEPA 2024c). LANL chromium screening values are based on Cr(VI) (hexavalent chromium) for plants and invertebrates (Newport News Nuclear BWXT-Los Alamos, LLC. 2022).

[d] Screening levels for plants and invertebrates are NOECs (see Table B-8).

[e] Plants are exposed to surface and subsurface soil from 0 to 72 inches bgs; however, the deepest samples collected at hte site are 60 inches bgs. Soil invertebrates are exposed to surface soil (0 to 6 inches bgs) only; subsurface soil samples results are not compared to soil invertebrates NOECs.

[f] COPECs are identified as candidate COECs if at least one sample result exceeds the plant or soil invertebrate NOEC for surface soil or the plant NOEC for subsurface soil. "P" refers to plant and "I" refers to invertebrate.

--	Not analyzed
bgs	Below ground surface
COEC	Contaminant of ecological concern
COPEC	Contaminant of potential ecological concern
ESL	Ecological screening level
HQ	Hazard quotient
LANL	Los Alamos National Laboratory
mg/kg	Milligram per kilogram
NOEC	No observed effect concentration
NSL	No screening level
pCi/g	Picocurie per gram
Ra-226	Radium-226
SE	Secular equilibrium
SLERA	Screening-level ecological risk assessment
U	Not detected
USEPA	U.S. Environmental Protection Agency

References:

Newport News Nuclear BWXT-Los Alamos, LLC. 2022. “ECORISK Database." Release 4.3. 701067. Document EM2020-0575. September.
U.S. Environmental Protection Agency (USEPA). 2024c. “Navajo Abandoned Uranium Mines Risk Assessment Methodology.” Draft Final. March.

Table B-11. Screening-Level Ecological Risk Assessment Refinement for Soil - Birds

Site-Wide							
COPEC[a]	**EPC[b]**	**Avian Herbivore NOEC[c]**	**Avian Ground Insectivore NOEC[c]**	**Avian Carnivore NOEC[c]**	**Minimum Avian NOEC**	**Refined HQ based on Minimum Avian NOEC[d]**	**Include Contaminant as Candidate COEC for Birds?[e]**
Surface Soil (0-6 inches bgs)							
Radionuclides (pCi/g) [f]							
Uranium-238 in SE (Adjusted Radium-226)	97	15	15	15	15	**6.5**	**Yes**
Metals (mg/kg)							
Arsenic	29	67	43	1,100	43	0.67	No
Barium	317	720	820	7,500	720	0.44	No
Cadmium	0.31	28	0.77	630	0.77	0.40	No
Chromium[g]	5.0	78	26	780	26	0.19	No
Cobalt	10	270	120	1,300	120	0.083	No
Lead	32	11	510	1,200	11	**2.9**	**Yes**
Manganese	182	4,300	650,000	5,300	4,300	0.042	No
Mercury	0.53	0.013	0.058	23.000	0.013	**41**	**Yes**
Molybdenum	242	15	90	NSL	15	**16**	**Yes**
Nickel	7.6	20	2,800	340	20	0.38	No
Selenium	2.8	1.2	83.0	3	1.2	**2.3**	**Yes**
Thallium	3.1	4.5	48	1.2	1.2	**2.6**	**Yes**
Uranium	69	1,100	14,000	1,000	1,000	0.069	No
Vanadium	42	7.8	140	1,300	7.8	**5.4**	**Yes**
Zinc	23	46	30,000	6,800	46	0.50	No

Notes:

Grey highlighted cells indicate the EPC exceeds the NOEC for the receptor group.

[a] **Bolded COPECs** have a HQ greater than 1.0.

[b] EPCs are provided in Table B-9.

[c] See Table B-8 for sources of NOECs.

[d] HQ is calculated by dividing the EPC by the minimum NOEC. **Bolded HQ values** indicate HQs greater than or equal to 1.0.

[e] A contaminant is identified as a candidate COEC if the HQ (HQ based on minimum NOEC) is greater than or equal to 1.0.

[f] ESLs for uranium-238 in SE are based on individual radium-226 ESLs that are adjusted to include doses from all progeny of uranium-238 in SE. Site data for radium-226 are used to evaluate uranium-238 in SE.

Table B-11. Screening-Level Ecological Risk Assessment Refinement for Soil - Birds

Notes (Continued):

[g] Chromium is evaluated using the assumption that it is 100 percent hexavalent chromium (USEPA 2024c). Eco-SSLs for hexavalent chromium are not available for birds; therefore, Cr(III) (trivalent chromium) Eco-SSLs were used (USEPA 2023).

bgs	Below ground surface
COEC	Contaminant of ecological concern
COPEC	Contaminant of potential ecological concern
Eco-SSL	Ecological soil screening level
EPC	Exposure point concentration
ESL	Ecological screening level
HQ	Hazard quotient
mg/kg	Milligram per kilogram
NOEC	No observed effect concentration
NSL	No screening level
pCi/g	Picocurie per gram
SE	Secular equilibrium
USEPA	U.S. Environmental Protection Agency

References:

U.S. Environmental Protection Agency (USEPA). 2023. "Interim Ecological Soil Screening Level Documents." Accessed July 20. https://www.epa.gov/chemical-research/interim-ecological-soil-screening-level-documents.

USEPA. 2024c. “Navajo Abandoned Uranium Mines Risk Assessment Methodology.” Draft Final. March.

Table B-12. Screening-Level Ecological Risk Assessment Refinement for Soil - Mammals

Site-Wide							
COPEC[a]	**EPC[b]**	**Mammalian Herbivore NOEC[c]**	**Mammalian Ground Insectivore NOEC[c]**	**Mammalian Carnivore NOEC[c]**	**Minimum NOEC**	**Refined HQ based on Minimum Mammalian NOEC[d]**	**Include Contaminant as Candidate COEC for Mammals?[e]**
Surface Soil (0-6 inches bgs)							
Radionuclides (pCi/g) [f]							
Uranium-238 in SE (Adjusted Radium-226)	97	6.0	6.0	6.0	6.0	**16**	**Yes**
Metals (mg/kg)							
Arsenic	29	170	46	170	46	0.63	No
Barium	317	3,200	200	9,100	200	**1.6**	**Yes**
Cadmium	0.31	73	0.36	84	0.36	0.86	No
Chromium[g]	5.0	380	34	180	34	0.15	No
Cobalt	10	2,100	230	470	230	0.043	No
Lead	32	1,200	56	460	56	0.57	No
Manganese	182	5,300	4,000	6,200	4,000	0.046	No
Mercury	0.53	23	1.7	76	1.7	0.31	No
Molybdenum	242	NSL	NSL	NSL	NSL	**--**	--
Nickel	7.6	340	10	130	10	0.76	No
Selenium	2.8	2.7	0.63	2.8	0.63	**4.4**	**Yes**
Thallium	3.1	1.2	0.42	5.0	0.42	**7.4**	**Yes**
Uranium	69	1,000	480	4,800	480	0.14	No
Vanadium	42	1,300	280	580	280	0.15	No
Zinc	23	6,800	79	10,000	79	0.29	No

Table B-12. Screening-Level Ecological Risk Assessment Refinement for Soil - Mammals

Site-Wide							
COPEC[a]	**EPC[b]**	**Mammalian Herbivore NOEC[c]**	**Mammalian Ground Insectivore NOEC[c]**	**Mammalian Carnivore NOEC[c]**	**Minimum NOEC**	**Refined HQ based on Minimum Mammalian NOEC[d]**	**Include Contaminant as Candidate COEC for Mammals?[e]**
Subsurface Soil (0-60 inches bgs)							
Radionuclides (pCi/g) [f]							
Uranium-238 in SE (Adjusted Radium-226)	65	6.0	6.0	6.0	6.0	**11**	**Yes**
Metals (mg/kg)							
Arsenic	21	170	46	170	46	0.46	No
Barium	298	3,200	200	9,100	200	**1.5**	**Yes**
Cadmium	0.29	73	0.36	84	0.36	0.81	No
Chromium[g]	4.7	380	34	180	34	0.14	No
Cobalt	11	2,100	230	470	230	0.048	No
Lead	28	1,200	56	460	56	0.50	No
Manganese	168	5,300	4,000	6,200	4,000	0.042	No
Mercury	0.36	23	1.7	76	2	0.21	No
Molybdenum	168	NSL	NSL	NSL	NSL	--	--
Nickel	7.2	340	10	130	10	0.72	No
Selenium	1.7	2.7	0.63	2.8	0.63	**2.7**	**Yes**
Thallium	2.8	1.2	0.42	5.0	0.42	**6.7**	**Yes**
Uranium	50	1,000	480	4,800	480	0.10	No
Vanadium	33	1,300	280	580	280	0.12	No
Zinc	20	6,800	79	10,000	79	0.25	No

Notes:

Grey highlighted cells indicate the EPC exceeds the NOEC for the receptor group.

[a] **Bolded COPECs** have a HQ greater than 1.0.

[b] EPCs are provided in Table B-9.

[c] See Table B-8 for sources of NOECs.

[d] HQ is calculated by dividing the EPC by the minimum NOEC. **Bolded HQ values** indicate HQs equal to or greater than 1.0.

[e] A contaminant is identified as a candidate COEC if the HQ (HQ based on minimum NOEC) is equal to or greater than 1.0.

Table B-12. Screening-Level Ecological Risk Assessment Refinement for Soil - Mammals

Notes (Continued):

[f] ESLs for uranium-238 in SE are based on individual radium-226 ESLs that are adjusted to include doses from all progeny of uranium-238 in SE. Site data for radium-226 are used to evaluate uranium-238 in SE.

[g] Chromium is evaluated using the assumption that it is 100 percent hexavalent chromium (USEPA 2024c). No speciated chromium data are available. Cr(III) (trivalent chromium) Eco-SSLs were used for mammals because the hexavalent chromium Eco-SSLs for mammals are higher than the trivalent chromium values (USEPA 2023).

--	Not applicable
bgs	Below ground surface
COEC	Contaminant of ecological concern
COPEC	Contaminant of potential ecological concern
Eco-SSL	Ecological soil screening level
EPC	Exposure point concentration
ESL	Ecological screening level
HQ	Hazard quotient
mg/kg	Milligram per kilogram
NOEC	No observed effect concentration
pCi/g	Picocurie per gram
SE	Secular equlibrium
USEPA	U.S. Environmental Protection Agency

References:

U.S. Environmental Protection Agency (USEPA). 2023. "Interim Ecological Soil Screening Level Documents." Accessed July 20. https://www.epa.gov/chemical-research/interim-ecological-soil-screening-level-documents.

USEPA. 2024c. “Navajo Abandoned Uranium Mines Risk Assessment Methodology.” Draft Final. March.

ATTACHMENT B-1

DATA USED IN THE RISK ASSESSMENT

Attachment B-1. Data Used in the Risk Assessment

Sample ID	Sample Date	Geologic Unit	Latitude	Longitude	Sample Top Depth (inches bgs)	Sample Bottom Depth (inches bgs)	Analytical Method	Analyte	Units	Result and Qualifier		Reporting Limit
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	SW6020B	Aluminum	mg/kg	6,230		8790
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	SW6010D	Antimony	mg/kg	1.87	U	1870
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	SW6020B	Arsenic	mg/kg	14.4	N	879
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	SW6020B	Barium	mg/kg	151	*	703
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	SW6020B	Beryllium	mg/kg	0.467		87.9
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	SW6020B	Cadmium	mg/kg	0.148	J	176
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	SW6020B	Chromium	mg/kg	5.82		528
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	SW6020B	Cobalt	mg/kg	23.7	N	176
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	SW6020B	Copper	mg/kg	7.97	N*	352
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	SW6020B	Iron	mg/kg	10,500		176000
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	SW6020B	Lead	mg/kg	9.25	N	352
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	SW6020B	Manganese	mg/kg	56.8	*	879
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	SW7471B	Mercury	mg/kg	0.105		21.7
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	SW6020B	Molybdenum	mg/kg	4.61	N	176
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	SW6020B	Nickel	mg/kg	6.98	N	352
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	EH300	Radium-226	pCi/g	18.6		0.227
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	SW6020B	Selenium	mg/kg	6.53	N*	879
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	SW6010D	Silver	mg/kg	0.468	U	468
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	SW6020B	Thallium	mg/kg	0.347	J	352
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	SW6020B	Uranium	mg/kg	26.8	N	35.2
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	SW6020B	Vanadium	mg/kg	20.3		3520
457-SS01-01-020624	2/6/2024	Qay	35.74115498	-111.3249375	0	6	SW6020B	Zinc	mg/kg	21.4	N	3520
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	SW6020B	Aluminum	mg/kg	4,550		10000
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	SW6010D	Antimony	mg/kg	1.74	U	1740
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	SW6020B	Arsenic	mg/kg	16.1	N	1000
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	SW6020B	Barium	mg/kg	236	*	8030
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	SW6020B	Beryllium	mg/kg	0.667		100
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	SW6020B	Cadmium	mg/kg	0.748		201
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	SW6020B	Chromium	mg/kg	5		602
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	SW6020B	Cobalt	mg/kg	28	N	201
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	SW6020B	Copper	mg/kg	22.7	N*	401
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	SW6020B	Iron	mg/kg	8,360		20100
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	SW6020B	Lead	mg/kg	16.5	N	401
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	SW6020B	Manganese	mg/kg	144	*	1000
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	SW7471B	Mercury	mg/kg	0.229		22.9
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	SW6020B	Molybdenum	mg/kg	59.7	N	201
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	SW6020B	Nickel	mg/kg	15.2	N	401
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	EH300	Radium-226	pCi/g	66.7		0.372
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	SW6020B	Selenium	mg/kg	1.95	N*	1000
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	SW6010D	Silver	mg/kg	0.0955	J-	436
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	SW6020B	Thallium	mg/kg	0.791		401
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	SW6020B	Uranium	mg/kg	90.4	N	40.1
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	SW6020B	Vanadium	mg/kg	18.7		4010
457-SS02-01-020624	2/6/2024	Qay	35.74096079	-111.324933	0	6	SW6020B	Zinc	mg/kg	31.9	N	4010
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW6020B	Aluminum	mg/kg	6,890		10000
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW6010D	Antimony	mg/kg	1.83	U	1830
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW6020B	Arsenic	mg/kg	3.97	J	1000
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW6020B	Barium	mg/kg	189	J	803
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW6020B	Beryllium	mg/kg	0.653		100
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW6020B	Cadmium	mg/kg	0.109	J	201
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW6020B	Chromium	mg/kg	5.3		602
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW6020B	Cobalt	mg/kg	4.19	J	201
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW6020B	Copper	mg/kg	15.9	J	401
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW7196A	xavalent Chromi	mg/kg	0.138	U	0.345
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW6020B	Iron	mg/kg	6,160		20100
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW6020B	Lead	mg/kg	9.26	J	401
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW6020B	Manganese	mg/kg	308	J	10000
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW7471B	Mercury	mg/kg	0.0257		23.1
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW6020B	Molybdenum	mg/kg	13.9	J	201
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW6020B	Nickel	mg/kg	4.8	J	401
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	EH300	Radium-226	pCi/g	18.9		0.217
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW6020B	Selenium	mg/kg	2	J	1000
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW6010D	Silver	mg/kg	0.458	U	458
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW6020B	Thallium	mg/kg	0.506		401
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW6020B	Uranium	mg/kg	15.7	J	40.1
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW6020B	Vanadium	mg/kg	29.1		4010
457-SS03-01-020624	2/6/2024	Qay	35.74001051	-111.325111	0	6	SW6020B	Zinc	mg/kg	10.9	J	4010
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW6020B	Aluminum	mg/kg	3,480		8860
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW6010D	Antimony	mg/kg	1.88	U	1880
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW6020B	Arsenic	mg/kg	18.5	N	886
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW6020B	Barium	mg/kg	327	*	7090
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW6020B	Beryllium	mg/kg	0.424		88.6
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW6020B	Cadmium	mg/kg	0.794		177
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW6020B	Chromium	mg/kg	4.9		531
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW6020B	Cobalt	mg/kg	7.45	N	177
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW6020B	Copper	mg/kg	10.3	N*	354
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW7196A	xavalent Chromi	mg/kg	0.0997	U	0.249
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW6020B	Iron	mg/kg	6,180		17700
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW6020B	Lead	mg/kg	74.8	N	354
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW6020B	Manganese	mg/kg	148	*	886
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW7471B	Mercury	mg/kg	0.165		24.1
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW6020B	Molybdenum	mg/kg	214	N	1770
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW6020B	Nickel	mg/kg	6.99	N	354
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	EH300	Radium-226	pCi/g	160		0.502
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW6020B	Selenium	mg/kg	1.29	N*	886
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW6010D	Silver	mg/kg	0.2	J-	469
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW6020B	Thallium	mg/kg	2.82		354
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW6020B	Uranium	mg/kg	56	N	35.4

Attachment B-1. Data Used in the Risk Assessment

Sample ID	Sample Date	Geologic Unit	Latitude	Longitude	Sample Top Depth (inches bgs)	Sample Bottom Depth (inches bgs)	Analytical Method	Analyte	Units	Result and Qualifier		Reporting Limit
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW6020B	Vanadium	mg/kg	40.3		3540
457-SS04-01-020624	2/6/2024	Qay	35.73921099	-111.3245257	0	6	SW6020B	Zinc	mg/kg	61.9	N	3540
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Aluminum	mg/kg	3,400	D	NR
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Antimony	mg/kg	6.5	U	NR
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Arsenic	mg/kg	3.2	U	NR
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Barium	mg/kg	320	D	NR
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Beryllium	mg/kg	1.7	U	NR
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Cadmium	mg/kg	1	U	NR
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Chromium	mg/kg	3.8	JD	NR
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Cobalt	mg/kg	9.5	U	NR
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Copper	mg/kg	8.6	JD	NR
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Iron	mg/kg	15,000	D	NR
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Lead	mg/kg	18	D	NR
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Manganese	mg/kg	250	D	NR
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Mercury	mg/kg	0.028	J	NR
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Molybdenum	mg/kg	10	U	NR
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Nickel	mg/kg	6.6	JD	NR
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	GA-01-R	Radium-226	pCi/g	2.87		NR
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Selenium	mg/kg	2.9	U	NR
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Silver	mg/kg	2.4	U	NR
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Thallium	mg/kg	15	U	NR
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Uranium	mg/kg	98	U	NR
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Vanadium	mg/kg	35	JD	NR
457-SS-10A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Zinc	mg/kg	28	JD	NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Aluminum	mg/kg	3,300	D	NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Antimony	mg/kg	6	U	NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Arsenic	mg/kg	72	D	NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Barium	mg/kg	510	D	NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Beryllium	mg/kg	1.6	U	NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Cadmium	mg/kg	0.94	U	NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Chromium	mg/kg	7.1	JD	NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Cobalt	mg/kg	10	JD	NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Copper	mg/kg	20	JD	NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Iron	mg/kg	15,000	D	NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Lead	mg/kg	66	D	NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Manganese	mg/kg	180	D	NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Mercury	mg/kg	0.88		NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Molybdenum	mg/kg	910	D	NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Nickel	mg/kg	9.1	JD	NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	GA-01-R	Radium-226	pCi/g	411		NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Selenium	mg/kg	2.7	U	NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Silver	mg/kg	2.2	U	NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Thallium	mg/kg	14	U	NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Uranium	mg/kg	430	U	NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Vanadium	mg/kg	70	D	NR
457-SS-11A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Zinc	mg/kg	55	JD	NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Aluminum	mg/kg	3,900	D	NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Antimony	mg/kg	6.2	U	NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Arsenic	mg/kg	3	U	NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Barium	mg/kg	310	D	NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Beryllium	mg/kg	1.6	U	NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Cadmium	mg/kg	0.96	U	NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Chromium	mg/kg	4.6	JD	NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Cobalt	mg/kg	9	U	NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Copper	mg/kg	9	JD	NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Iron	mg/kg	15,000	D	NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Lead	mg/kg	18	D	NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Manganese	mg/kg	240	D	NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Mercury	mg/kg	0.032	J	NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Molybdenum	mg/kg	9.6	U	NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Nickel	mg/kg	6.9	JD	NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	GA-01-R	Radium-226	pCi/g	3.19		NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Selenium	mg/kg	2.8	U	NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Silver	mg/kg	2.2	U	NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Thallium	mg/kg	15	U	NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Uranium	mg/kg	110	U	NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Vanadium	mg/kg	34	JD	NR
457-SS-12A	8/6/2013	Qay	35.73895147	-111.3242831	0	6	6010C DOD	Zinc	mg/kg	30	JD	NR
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	6010C DOD	Aluminum	mg/kg	1,400	D	NR
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	6010C DOD	Antimony	mg/kg	6.4	U	NR
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	6010C DOD	Arsenic	mg/kg	83	D	NR
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	6010C DOD	Barium	mg/kg	310	D	NR
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	6010C DOD	Beryllium	mg/kg	1.7	U	NR
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	6010C DOD	Cadmium	mg/kg	1	U	NR
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	6010C DOD	Chromium	mg/kg	3.1	U	NR
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	6010C DOD	Cobalt	mg/kg	13	JD	NR
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	6010C DOD	Copper	mg/kg	27	D	NR
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	6010C DOD	Iron	mg/kg	7,200	D	NR
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	6010C DOD	Lead	mg/kg	40	D	NR
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	6010C DOD	Manganese	mg/kg	15	D	NR
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	6010C DOD	Mercury	mg/kg	0.31		NR
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	6010C DOD	Molybdenum	mg/kg	420	D	NR
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	6010C DOD	Nickel	mg/kg	8	JD	NR
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	GA-01-R	Radium-226	pCi/g	156		NR
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	6010C DOD	Selenium	mg/kg	2.9	U	NR
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	6010C DOD	Silver	mg/kg	2.3	U	NR
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	6010C DOD	Thallium	mg/kg	15	U	NR
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	6010C DOD	Uranium	mg/kg	390	U	NR

Attachment B-1. Data Used in the Risk Assessment

Sample ID	Sample Date	Geologic Unit	Latitude	Longitude	Sample Top Depth (inches bgs)	Sample Bottom Depth (inches bgs)	Analytical Method	Analyte	Units	Result and Qualifier		Reporting Limit
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	6010C DOD	Vanadium	mg/kg	13	U	NR
457-SS-1A	8/6/2013	Qay	35.74135147	-111.3253241	0	6	6010C DOD	Zinc	mg/kg	20	JD	NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	6010C DOD	Aluminum	mg/kg	3,600	D	NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	6010C DOD	Antimony	mg/kg	5.8	U	NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	6010C DOD	Arsenic	mg/kg	7.3	JD	NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	6010C DOD	Barium	mg/kg	280	D	NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	6010C DOD	Beryllium	mg/kg	1.5	U	NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	6010C DOD	Cadmium	mg/kg	0.9	U	NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	6010C DOD	Chromium	mg/kg	2.8	JD	NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	6010C DOD	Cobalt	mg/kg	8.7	JD	NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	6010C DOD	Copper	mg/kg	8.6	JD	NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	6010C DOD	Iron	mg/kg	10,000	D	NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	6010C DOD	Lead	mg/kg	10	D	NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	6010C DOD	Manganese	mg/kg	280	D	NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	6010C DOD	Mercury	mg/kg	0.024	J	NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	6010C DOD	Molybdenum	mg/kg	61	D	NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	6010C DOD	Nickel	mg/kg	6	JD	NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	GA-01-R	Radium-226	pCi/g	30.1		NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	6010C DOD	Selenium	mg/kg	2.6	U	NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	6010C DOD	Silver	mg/kg	2.1	U	NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	6010C DOD	Thallium	mg/kg	14	U	NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	6010C DOD	Uranium	mg/kg	120	U	NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	6010C DOD	Vanadium	mg/kg	24	JD	NR
457-SS-2A	8/6/2013	Qay	35.73975247	-111.3229631	0	6	6010C DOD	Zinc	mg/kg	18	U	NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	6010C DOD	Aluminum	mg/kg	3,300	D	NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	6010C DOD	Antimony	mg/kg	5.8	U	NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	6010C DOD	Arsenic	mg/kg	2.9	U	NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	6010C DOD	Barium	mg/kg	290	D	NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	6010C DOD	Beryllium	mg/kg	1.5	U	NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	6010C DOD	Cadmium	mg/kg	0.9	U	NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	6010C DOD	Chromium	mg/kg	2.8	U	NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	6010C DOD	Cobalt	mg/kg	8.5	U	NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	6010C DOD	Copper	mg/kg	6.9	JD	NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	6010C DOD	Iron	mg/kg	11,000	D	NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	6010C DOD	Lead	mg/kg	7.7	JD	NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	6010C DOD	Manganese	mg/kg	110	D	NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	6010C DOD	Mercury	mg/kg	0.012	J	NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	6010C DOD	Molybdenum	mg/kg	9	U	NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	6010C DOD	Nickel	mg/kg	2.3	JD	NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	GA-01-R	Radium-226	pCi/g	3.06		NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	6010C DOD	Selenium	mg/kg	2.6	U	NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	6010C DOD	Silver	mg/kg	2.1	U	NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	6010C DOD	Thallium	mg/kg	14	U	NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	6010C DOD	Uranium	mg/kg	110	U	NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	6010C DOD	Vanadium	mg/kg	20	JD	NR
457-SS-2B	8/6/2013	Qay	35.73975247	-111.3229631	6	12	6010C DOD	Zinc	mg/kg	18	U	NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	6010C DOD	Aluminum	mg/kg	3,000	D	NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	6010C DOD	Antimony	mg/kg	6.6	U	NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	6010C DOD	Arsenic	mg/kg	3.2	U	NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	6010C DOD	Barium	mg/kg	250	D	NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	6010C DOD	Beryllium	mg/kg	1.7	U	NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	6010C DOD	Cadmium	mg/kg	1	U	NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	6010C DOD	Chromium	mg/kg	3.1	U	NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	6010C DOD	Cobalt	mg/kg	9.6	U	NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	6010C DOD	Copper	mg/kg	7.4	U	NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	6010C DOD	Iron	mg/kg	10,000	D	NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	6010C DOD	Lead	mg/kg	7.5	JD	NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	6010C DOD	Manganese	mg/kg	110	D	NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	6010C DOD	Mercury	mg/kg	0.012	J	NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	6010C DOD	Molybdenum	mg/kg	10	U	NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	6010C DOD	Nickel	mg/kg	2.3	U	NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	GA-01-R	Radium-226	pCi/g	2.47		NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	6010C DOD	Selenium	mg/kg	3	U	NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	6010C DOD	Silver	mg/kg	2.4	U	NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	6010C DOD	Thallium	mg/kg	15	U	NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	6010C DOD	Uranium	mg/kg	140	U	NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	6010C DOD	Vanadium	mg/kg	21	JD	NR
457-SS-2C	8/6/2013	Qay	35.73975247	-111.3229631	12	18	6010C DOD	Zinc	mg/kg	20	U	NR
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	6010C DOD	Aluminum	mg/kg	2,200	D	NR
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	6010C DOD	Antimony	mg/kg	6.1	U	NR
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	6010C DOD	Arsenic	mg/kg	37	D	NR
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	6010C DOD	Barium	mg/kg	260	D	NR
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	6010C DOD	Beryllium	mg/kg	1.6	U	NR
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	6010C DOD	Cadmium	mg/kg	0.95	U	NR
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	6010C DOD	Chromium	mg/kg	3	JD	NR
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	6010C DOD	Cobalt	mg/kg	8.9	U	NR
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	6010C DOD	Copper	mg/kg	15	JD	NR
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	6010C DOD	Iron	mg/kg	14,000	D	NR
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	6010C DOD	Lead	mg/kg	32	D	NR
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	6010C DOD	Manganese	mg/kg	190	D	NR
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	6010C DOD	Mercury	mg/kg	0.1		NR
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	6010C DOD	Molybdenum	mg/kg	180	D	NR
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	6010C DOD	Nickel	mg/kg	6.3	JD	NR
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	GA-01-R	Radium-226	pCi/g	57.1		NR
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	6010C DOD	Selenium	mg/kg	2.7	U	NR
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	6010C DOD	Silver	mg/kg	2.2	U	NR
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	6010C DOD	Thallium	mg/kg	14	U	NR
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	6010C DOD	Uranium	mg/kg	130	U	NR

Attachment B-1. Data Used in the Risk Assessment

Sample ID	Sample Date	Geologic Unit	Latitude	Longitude	Sample Top Depth (inches bgs)	Sample Bottom Depth (inches bgs)	Analytical Method	Analyte	Units	Result and Qualifier		Reporting Limit
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	6010C DOD	Vanadium	mg/kg	32	JD	NR
457-SS-3A	8/6/2013	Qay	35.73950747	-111.3245071	0	6	6010C DOD	Zinc	mg/kg	25	JD	NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	6010C DOD	Aluminum	mg/kg	3,000	D	NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	6010C DOD	Antimony	mg/kg	6.4	U	NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	6010C DOD	Arsenic	mg/kg	3.2	U	NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	6010C DOD	Barium	mg/kg	300	D	NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	6010C DOD	Beryllium	mg/kg	1.7	U	NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	6010C DOD	Cadmium	mg/kg	1	U	NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	6010C DOD	Chromium	mg/kg	4.5	JD	NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	6010C DOD	Cobalt	mg/kg	9.4	U	NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	6010C DOD	Copper	mg/kg	7.3	U	NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	6010C DOD	Iron	mg/kg	16,000	D	NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	6010C DOD	Lead	mg/kg	44	D	NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	6010C DOD	Manganese	mg/kg	250	D	NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	6010C DOD	Mercury	mg/kg	0.016	J	NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	6010C DOD	Molybdenum	mg/kg	10	U	NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	6010C DOD	Nickel	mg/kg	6.6	JD	NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	GA-01-R	Radium-226	pCi/g	3.32		NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	6010C DOD	Selenium	mg/kg	2.9	U	NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	6010C DOD	Silver	mg/kg	2.3	U	NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	6010C DOD	Thallium	mg/kg	15	U	NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	6010C DOD	Uranium	mg/kg	120	U	NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	6010C DOD	Vanadium	mg/kg	37	JD	NR
457-SS-4A	8/6/2013	TRcs	35.73896947	-111.3234651	0	6	6010C DOD	Zinc	mg/kg	31	JD	NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	6010C DOD	Aluminum	mg/kg	3,000	D	NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	6010C DOD	Antimony	mg/kg	6.1	U	NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	6010C DOD	Arsenic	mg/kg	3	U	NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	6010C DOD	Barium	mg/kg	360	D	NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	6010C DOD	Beryllium	mg/kg	1.6	U	NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	6010C DOD	Cadmium	mg/kg	0.95	U	NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	6010C DOD	Chromium	mg/kg	5	JD	NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	6010C DOD	Cobalt	mg/kg	8.9	U	NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	6010C DOD	Copper	mg/kg	7.5	JD	NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	6010C DOD	Iron	mg/kg	13,000	D	NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	6010C DOD	Lead	mg/kg	7.5	JD	NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	6010C DOD	Manganese	mg/kg	190	D	NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	6010C DOD	Mercury	mg/kg	0.012	J	NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	6010C DOD	Molybdenum	mg/kg	9.5	U	NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	6010C DOD	Nickel	mg/kg	9.3	JD	NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	GA-01-R	Radium-226	pCi/g	1.93		NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	6010C DOD	Selenium	mg/kg	2.8	U	NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	6010C DOD	Silver	mg/kg	2.2	U	NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	6010C DOD	Thallium	mg/kg	14	U	NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	6010C DOD	Uranium	mg/kg	100	U	NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	6010C DOD	Vanadium	mg/kg	28	JD	NR
457-SS-4B	8/6/2013	TRcs	35.73896947	-111.3234651	6	12	6010C DOD	Zinc	mg/kg	19	U	NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	6010C DOD	Aluminum	mg/kg	3,800	D	NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	6010C DOD	Antimony	mg/kg	6.7	U	NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	6010C DOD	Arsenic	mg/kg	3.3	U	NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	6010C DOD	Barium	mg/kg	230	D	NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	6010C DOD	Beryllium	mg/kg	1.8	U	NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	6010C DOD	Cadmium	mg/kg	1	U	NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	6010C DOD	Chromium	mg/kg	5.9	JD	NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	6010C DOD	Cobalt	mg/kg	9.7	U	NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	6010C DOD	Copper	mg/kg	8.7	JD	NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	6010C DOD	Iron	mg/kg	15,000	D	NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	6010C DOD	Lead	mg/kg	6.3	JD	NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	6010C DOD	Manganese	mg/kg	250	D	NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	6010C DOD	Mercury	mg/kg	0.011	U	NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	6010C DOD	Molybdenum	mg/kg	10	U	NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	6010C DOD	Nickel	mg/kg	11	JD	NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	GA-01-R	Radium-226	pCi/g	1.07		NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	6010C DOD	Selenium	mg/kg	3	U	NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	6010C DOD	Silver	mg/kg	2.4	U	NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	6010C DOD	Thallium	mg/kg	16	U	NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	6010C DOD	Uranium	mg/kg	120	U	NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	6010C DOD	Vanadium	mg/kg	30	JD	NR
457-SS-4C	8/6/2013	TRcs	35.73896947	-111.3234651	12	18	6010C DOD	Zinc	mg/kg	21	U	NR
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	6010C DOD	Aluminum	mg/kg	3,200	D	NR
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	6010C DOD	Antimony	mg/kg	6.4	U	NR
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	6010C DOD	Arsenic	mg/kg	3.1	U	NR
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	6010C DOD	Barium	mg/kg	250	D	NR
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	6010C DOD	Beryllium	mg/kg	1.7	U	NR
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	6010C DOD	Cadmium	mg/kg	0.99	U	NR
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	6010C DOD	Chromium	mg/kg	4.1	JD	NR
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	6010C DOD	Cobalt	mg/kg	11	JD	NR
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	6010C DOD	Copper	mg/kg	8.6	JD	NR
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	6010C DOD	Iron	mg/kg	15,000	D	NR
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	6010C DOD	Lead	mg/kg	12	D	NR
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	6010C DOD	Manganese	mg/kg	170	D	NR
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	6010C DOD	Mercury	mg/kg	0.021	J	NR
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	6010C DOD	Molybdenum	mg/kg	9.9	U	NR
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	6010C DOD	Nickel	mg/kg	5.6	JD	NR
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	GA-01-R	Radium-226	pCi/g	8.37		NR
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	6010C DOD	Selenium	mg/kg	2.9	U	NR
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	6010C DOD	Silver	mg/kg	2.3	U	NR
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	6010C DOD	Thallium	mg/kg	15	U	NR
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	6010C DOD	Uranium	mg/kg	130	U	NR

Attachment B-1. Data Used in the Risk Assessment

Sample ID	Sample Date	Geologic Unit	Latitude	Longitude	Sample Top Depth (inches bgs)	Sample Bottom Depth (inches bgs)	Analytical Method	Analyte	Units	Result and Qualifier		Reporting Limit
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	6010C DOD	Vanadium	mg/kg	35	JD	NR
457-SS-5A	8/6/2013	Qay	35.74002547	-111.3236841	0	6	6010C DOD	Zinc	mg/kg	20	U	NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Aluminum	mg/kg	3,000	D	NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Antimony	mg/kg	5.8	U	NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Arsenic	mg/kg	54	D	NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Barium	mg/kg	390	D	NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Beryllium	mg/kg	1.5	U	NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Cadmium	mg/kg	0.91	U	NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Chromium	mg/kg	3.5	JD	NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Cobalt	mg/kg	9.4	JD	NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Copper	mg/kg	16	JD	NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Iron	mg/kg	13,000	D	NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Lead	mg/kg	52	D	NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Manganese	mg/kg	180	D	NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Mercury	mg/kg	0.8		NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Molybdenum	mg/kg	650	D	NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Nickel	mg/kg	7.7	JD	NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	GA-01-R	Radium-226	pCi/g	382		NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Selenium	mg/kg	2.6	U	NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Silver	mg/kg	2.1	U	NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Thallium	mg/kg	14	U	NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Uranium	mg/kg	350	U	NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Vanadium	mg/kg	57	D	NR
457-SS-6A	8/6/2013	Qay	35.73950347	-111.3240351	0	6	6010C DOD	Zinc	mg/kg	58	JD	NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	6010C DOD	Aluminum	mg/kg	5,900	D	NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	6010C DOD	Antimony	mg/kg	6.4	U	NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	6010C DOD	Arsenic	mg/kg	230	D	NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	6010C DOD	Barium	mg/kg	1,100	D	NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	6010C DOD	Beryllium	mg/kg	1.7	U	NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	6010C DOD	Cadmium	mg/kg	1	JD	NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	6010C DOD	Chromium	mg/kg	8	JD	NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	6010C DOD	Cobalt	mg/kg	23	JD	NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	6010C DOD	Copper	mg/kg	37	D	NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	6010C DOD	Iron	mg/kg	18,000	D	NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	6010C DOD	Lead	mg/kg	150	D	NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	6010C DOD	Manganese	mg/kg	110	D	NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	6010C DOD	Mercury	mg/kg	1.3		NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	6010C DOD	Molybdenum	mg/kg	2,000	D	NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	6010C DOD	Nickel	mg/kg	11	JD	NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	GA-01-R	Radium-226	pCi/g	945		NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	6010C DOD	Selenium	mg/kg	3.4	JD	NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	6010C DOD	Silver	mg/kg	2.3	U	NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	6010C DOD	Thallium	mg/kg	26	JD	NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	6010C DOD	Uranium	mg/kg	970	D	NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	6010C DOD	Vanadium	mg/kg	390	D	NR
457-SS-7A	8/6/2013	Qay	35.73981447	-111.3238291	0	6	6010C DOD	Zinc	mg/kg	66	JD	NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	6010C DOD	Aluminum	mg/kg	6,600	D	NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	6010C DOD	Antimony	mg/kg	6.1	U	NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	6010C DOD	Arsenic	mg/kg	98	D	NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	6010C DOD	Barium	mg/kg	590	D	NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	6010C DOD	Beryllium	mg/kg	1.6	U	NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	6010C DOD	Cadmium	mg/kg	0.95	U	NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	6010C DOD	Chromium	mg/kg	7.1	JD	NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	6010C DOD	Cobalt	mg/kg	15	JD	NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	6010C DOD	Copper	mg/kg	21	JD	NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	6010C DOD	Iron	mg/kg	15,000	D	NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	6010C DOD	Lead	mg/kg	77	D	NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	6010C DOD	Manganese	mg/kg	170	D	NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	6010C DOD	Mercury	mg/kg	8.7		NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	6010C DOD	Molybdenum	mg/kg	960	D	NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	6010C DOD	Nickel	mg/kg	9.7	JD	NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	GA-01-R	Radium-226	pCi/g	747		NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	6010C DOD	Selenium	mg/kg	2.7	U	NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	6010C DOD	Silver	mg/kg	2.2	U	NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	6010C DOD	Thallium	mg/kg	14	U	NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	6010C DOD	Uranium	mg/kg	470	U	NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	6010C DOD	Vanadium	mg/kg	210	D	NR
457-SS-8A	8/6/2013	Qay	35.73962753	-111.3237631	0	6	6010C DOD	Zinc	mg/kg	46	JD	NR
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	6010C DOD	Aluminum	mg/kg	2,400	D	NR
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	6010C DOD	Antimony	mg/kg	6.3	U	NR
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	6010C DOD	Arsenic	mg/kg	19	D	NR
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	6010C DOD	Barium	mg/kg	340	D	NR
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	6010C DOD	Beryllium	mg/kg	1.7	U	NR
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	6010C DOD	Cadmium	mg/kg	0.98	U	NR
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	6010C DOD	Chromium	mg/kg	3	U	NR
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	6010C DOD	Cobalt	mg/kg	9.2	U	NR
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	6010C DOD	Copper	mg/kg	7.1	JD	NR
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	6010C DOD	Iron	mg/kg	12,000	D	NR
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	6010C DOD	Lead	mg/kg	26	D	NR
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	6010C DOD	Manganese	mg/kg	230	D	NR
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	6010C DOD	Mercury	mg/kg	0.037		NR
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	6010C DOD	Molybdenum	mg/kg	140	D	NR
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	6010C DOD	Nickel	mg/kg	5.5	JD	NR
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	GA-01-R	Radium-226	pCi/g	27.2		NR
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	6010C DOD	Selenium	mg/kg	2.8	U	NR
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	6010C DOD	Silver	mg/kg	2.3	U	NR
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	6010C DOD	Thallium	mg/kg	15	U	NR
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	6010C DOD	Uranium	mg/kg	110	U	NR

Sample ID	Sample Date	Geologic Unit	Latitude	Longitude	Sample Top Depth (inches bgs)	Sample Bottom Depth (inches bgs)	Analytical Method	Analyte	Units	Result and Qualifier	Reporting Limit
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	6010C DOD	Vanadium	mg/kg	26 JD	NR
457-SS-9A	8/6/2013	TRcs	35.73946947	-111.3231171	0	6	6010C DOD	Zinc	mg/kg	19 U	NR
457-TP14-0-0.5-120318	12/3/2018	TRcp	35.73529905	-111.3253575	0	6	SW6020	Arsenic	mg/kg	0.94	NR
457-TP14-0-0.5-120318	12/3/2018	TRcp	35.73529905	-111.3253575	0	6	SW7471	Mercury	mg/kg	0.00006 U	NR
457-TP14-0-0.5-120318	12/3/2018	TRcp	35.73529905	-111.3253575	0	6	SW6010	Molybdenum	mg/kg	0.58 J	NR
457-TP14-0-0.5-120318	12/3/2018	TRcp	35.73529905	-111.3253575	0	6	713R14	Radium-226	pCi/g	2.94 M3	NR
457-TP14-0-0.5-120318	12/3/2018	TRcp	35.73529905	-111.3253575	0	6	SW6010	Selenium	mg/kg	0.32 J	NR
457-TP14-0-0.5-120318	12/3/2018	TRcp	35.73529905	-111.3253575	0	6	SW6020	Uranium	mg/kg	1.4	NR
457-TP14-0-0.5-120318	12/3/2018	TRcp	35.73529905	-111.3253575	0	6	SW6010	Vanadium	mg/kg	4	NR
457-TP14-0-0.5-120318 DUP	12/3/2018	TRcp	35.73529905	-111.3253575	0	6	SW6020	Arsenic	mg/kg	0.97	NR
457-TP14-0-0.5-120318 DUP	12/3/2018	TRcp	35.73529905	-111.3253575	0	6	SW7471	Mercury	mg/kg	5.7E-05 U	NR
457-TP14-0-0.5-120318 DUP	12/3/2018	TRcp	35.73529905	-111.3253575	0	6	SW6010	Molybdenum	mg/kg	0.55 J	NR
457-TP14-0-0.5-120318 DUP	12/3/2018	TRcp	35.73529905	-111.3253575	0	6	713R14	Radium-226	pCi/g	2.93 M3	NR
457-TP14-0-0.5-120318 DUP	12/3/2018	TRcp	35.73529905	-111.3253575	0	6	SW6010	Selenium	mg/kg	0.051 U	NR
457-TP14-0-0.5-120318 DUP	12/3/2018	TRcp	35.73529905	-111.3253575	0	6	SW6020	Uranium	mg/kg	1.4	NR
457-TP14-0-0.5-120318 DUP	12/3/2018	TRcp	35.73529905	-111.3253575	0	6	SW6010	Vanadium	mg/kg	3.6	NR
457-TP15-0.5-1.0-120618	12/6/2018	TRcs	35.73255134	-111.3258167	6	12	SW6020	Arsenic	mg/kg	6.6	NR
457-TP15-0.5-1.0-120618	12/6/2018	TRcs	35.73255134	-111.3258167	6	12	SW7471	Mercury	mg/kg	0.026 J	NR
457-TP15-0.5-1.0-120618	12/6/2018	TRcs	35.73255134	-111.3258167	6	12	SW6010	Molybdenum	mg/kg	6.7	NR
457-TP15-0.5-1.0-120618	12/6/2018	TRcs	35.73255134	-111.3258167	6	12	713R14	Radium-226	pCi/g	7.54 M3	NR
457-TP15-0.5-1.0-120618	12/6/2018	TRcs	35.73255134	-111.3258167	6	12	SW6010	Selenium	mg/kg	0.055 U	NR
457-TP15-0.5-1.0-120618	12/6/2018	TRcs	35.73255134	-111.3258167	6	12	SW6020	Uranium	mg/kg	5.7	NR
457-TP15-0.5-1.0-120618	12/6/2018	TRcs	35.73255134	-111.3258167	6	12	SW6010	Vanadium	mg/kg	9.2	NR
457-TP15-0-0.5-120618	12/6/2018	TRcs	35.73255134	-111.3258167	0	6	SW6020	Arsenic	mg/kg	9.9	NR
457-TP15-0-0.5-120618	12/6/2018	TRcs	35.73255134	-111.3258167	0	6	SW7471	Mercury	mg/kg	0.02 J	NR
457-TP15-0-0.5-120618	12/6/2018	TRcs	35.73255134	-111.3258167	0	6	SW6010	Molybdenum	mg/kg	30	NR
457-TP15-0-0.5-120618	12/6/2018	TRcs	35.73255134	-111.3258167	0	6	713R14	Radium-226	pCi/g	8.2 M3	NR
457-TP15-0-0.5-120618	12/6/2018	TRcs	35.73255134	-111.3258167	0	6	SW6010	Selenium	mg/kg	0.054 U	NR
457-TP15-0-0.5-120618	12/6/2018	TRcs	35.73255134	-111.3258167	0	6	SW6020	Uranium	mg/kg	6.7	NR
457-TP15-0-0.5-120618	12/6/2018	TRcs	35.73255134	-111.3258167	0	6	SW6010	Vanadium	mg/kg	15	NR
457-TP3-0-0.5-120418	12/4/2018	Qay	35.7409476	-111.3247049	0	6	SW6020	Arsenic	mg/kg	14	NR
457-TP3-0-0.5-120418	12/4/2018	Qay	35.7409476	-111.3247049	0	6	SW7471	Mercury	mg/kg	0.015 J	NR
457-TP3-0-0.5-120418	12/4/2018	Qay	35.7409476	-111.3247049	0	6	SW6010	Molybdenum	mg/kg	35	NR
457-TP3-0-0.5-120418	12/4/2018	Qay	35.7409476	-111.3247049	0	6	713R14	Radium-226	pCi/g	12.1 M3	NR
457-TP3-0-0.5-120418	12/4/2018	Qay	35.7409476	-111.3247049	0	6	SW6010	Selenium	mg/kg	0.092 J	NR
457-TP3-0-0.5-120418	12/4/2018	Qay	35.7409476	-111.3247049	0	6	SW6020	Uranium	mg/kg	8	NR
457-TP3-0-0.5-120418	12/4/2018	Qay	35.7409476	-111.3247049	0	6	SW6010	Vanadium	mg/kg	27	NR
457-TP3-0-0.5-120418 DUP	12/4/2018	Qay	35.7409476	-111.3247049	0	6	SW6020	Arsenic	mg/kg	17	NR
457-TP3-0-0.5-120418 DUP	12/4/2018	Qay	35.7409476	-111.3247049	0	6	SW7471	Mercury	mg/kg	0.018 J	NR
457-TP3-0-0.5-120418 DUP	12/4/2018	Qay	35.7409476	-111.3247049	0	6	SW6010	Molybdenum	mg/kg	25	NR
457-TP3-0-0.5-120418 DUP	12/4/2018	Qay	35.7409476	-111.3247049	0	6	713R14	Radium-226	pCi/g	12.5 M3	NR
457-TP3-0-0.5-120418 DUP	12/4/2018	Qay	35.7409476	-111.3247049	0	6	SW6010	Selenium	mg/kg	0.054 U	NR
457-TP3-0-0.5-120418 DUP	12/4/2018	Qay	35.7409476	-111.3247049	0	6	SW6020	Uranium	mg/kg	19	NR
457-TP3-0-0.5-120418 DUP	12/4/2018	Qay	35.7409476	-111.3247049	0	6	SW6010	Vanadium	mg/kg	24	NR
457-TP4-2.0-2.5-120418	12/4/2018	Qay	35.74010083	-111.3234451	24	30	SW6020	Arsenic	mg/kg	2.4	NR
457-TP4-2.0-2.5-120418	12/4/2018	Qay	35.74010083	-111.3234451	24	30	SW7471	Mercury	mg/kg	0.0095 J	NR
457-TP4-2.0-2.5-120418	12/4/2018	Qay	35.74010083	-111.3234451	24	30	SW6010	Molybdenum	mg/kg	4.3	NR
457-TP4-2.0-2.5-120418	12/4/2018	Qay	35.74010083	-111.3234451	24	30	713R14	Radium-226	pCi/g	5.92 M3	NR
457-TP4-2.0-2.5-120418	12/4/2018	Qay	35.74010083	-111.3234451	24	30	SW6010	Selenium	mg/kg	0.053 U	NR
457-TP4-2.0-2.5-120418	12/4/2018	Qay	35.74010083	-111.3234451	24	30	SW6020	Uranium	mg/kg	5.6	NR
457-TP4-2.0-2.5-120418	12/4/2018	Qay	35.74010083	-111.3234451	24	30	SW6010	Vanadium	mg/kg	29	NR
457-TP4-3.0-3.5-120418	12/4/2018	Qay	35.74010083	-111.3234451	36	42	SW6020	Arsenic	mg/kg	2	NR
457-TP4-3.0-3.5-120418	12/4/2018	Qay	35.74010083	-111.3234451	36	42	SW7471	Mercury	mg/kg	0.00006 U	NR
457-TP4-3.0-3.5-120418	12/4/2018	Qay	35.74010083	-111.3234451	36	42	SW6010	Molybdenum	mg/kg	2.8	NR
457-TP4-3.0-3.5-120418	12/4/2018	Qay	35.74010083	-111.3234451	36	42	713R14	Radium-226	pCi/g	2.46 M3	NR
457-TP4-3.0-3.5-120418	12/4/2018	Qay	35.74010083	-111.3234451	36	42	SW6010	Selenium	mg/kg	0.054 U	NR
457-TP4-3.0-3.5-120418	12/4/2018	Qay	35.74010083	-111.3234451	36	42	SW6020	Uranium	mg/kg	3.4	NR
457-TP4-3.0-3.5-120418	12/4/2018	Qay	35.74010083	-111.3234451	36	42	SW6010	Vanadium	mg/kg	22	NR
457-TP5-0.5-1.0-120418	12/4/2018	TRcp	35.73956684	-111.3249528	6	12	SW6020	Arsenic	mg/kg	2.4	NR
457-TP5-0.5-1.0-120418	12/4/2018	TRcp	35.73956684	-111.3249528	6	12	SW7471	Mercury	mg/kg	6.4E-05 U	NR
457-TP5-0.5-1.0-120418	12/4/2018	TRcp	35.73956684	-111.3249528	6	12	SW6010	Molybdenum	mg/kg	1.4	NR
457-TP5-0.5-1.0-120418	12/4/2018	TRcp	35.73956684	-111.3249528	6	12	713R14	Radium-226	pCi/g	1.93 M3	NR
457-TP5-0.5-1.0-120418	12/4/2018	TRcp	35.73956684	-111.3249528	6	12	SW6010	Selenium	mg/kg	0.18 J	NR
457-TP5-0.5-1.0-120418	12/4/2018	TRcp	35.73956684	-111.3249528	6	12	SW6020	Uranium	mg/kg	2	NR
457-TP5-0.5-1.0-120418	12/4/2018	TRcp	35.73956684	-111.3249528	6	12	SW6010	Vanadium	mg/kg	39	NR
457-TP5-0-0.5-120418	12/4/2018	TRcp	35.73956684	-111.3249528	0	6	SW6020	Arsenic	mg/kg	2.6	NR
457-TP5-0-0.5-120418	12/4/2018	TRcp	35.73956684	-111.3249528	0	6	SW7471	Mercury	mg/kg	6.4E-05 U	NR
457-TP5-0-0.5-120418	12/4/2018	TRcp	35.73956684	-111.3249528	0	6	SW6010	Molybdenum	mg/kg	3.6	NR
457-TP5-0-0.5-120418	12/4/2018	TRcp	35.73956684	-111.3249528	0	6	713R14	Radium-226	pCi/g	3 M3	NR
457-TP5-0-0.5-120418	12/4/2018	TRcp	35.73956684	-111.3249528	0	6	SW6010	Selenium	mg/kg	0.055 U	NR
457-TP5-0-0.5-120418	12/4/2018	TRcp	35.73956684	-111.3249528	0	6	SW6020	Uranium	mg/kg	4.5	NR
457-TP5-0-0.5-120418	12/4/2018	TRcp	35.73956684	-111.3249528	0	6	SW6010	Vanadium	mg/kg	39	NR
457-TP6-0-0.5-120418	12/4/2018	Qay	35.73988842	-111.3231471	0	6	SW6020	Arsenic	mg/kg	2	NR
457-TP6-0-0.5-120418	12/4/2018	Qay	35.73988842	-111.3231471	0	6	SW7471	Mercury	mg/kg	5.8E-05 U	NR
457-TP6-0-0.5-120418	12/4/2018	Qay	35.73988842	-111.3231471	0	6	SW6010	Molybdenum	mg/kg	3	NR
457-TP6-0-0.5-120418	12/4/2018	Qay	35.73988842	-111.3231471	0	6	713R14	Radium-226	pCi/g	1.76 M3	NR
457-TP6-0-0.5-120418	12/4/2018	Qay	35.73988842	-111.3231471	0	6	SW6010	Selenium	mg/kg	0.26 J	NR
457-TP6-0-0.5-120418	12/4/2018	Qay	35.73988842	-111.3231471	0	6	SW6020	Uranium	mg/kg	2.7	NR
457-TP6-0-0.5-120418	12/4/2018	Qay	35.73988842	-111.3231471	0	6	SW6010	Vanadium	mg/kg	27	NR
457-TP6-1.0-1.5-120418	12/4/2018	Qay	35.73988842	-111.3231471	12	18	SW6020	Arsenic	mg/kg	1.8	NR
457-TP6-1.0-1.5-120418	12/4/2018	Qay	35.73988842	-111.3231471	12	18	SW7471	Mercury	mg/kg	6.1E-05 U	NR
457-TP6-1.0-1.5-120418	12/4/2018	Qay	35.73988842	-111.3231471	12	18	SW6010	Molybdenum	mg/kg	0.71 J	NR
457-TP6-1.0-1.5-120418	12/4/2018	Qay	35.73988842	-111.3231471	12	18	713R14	Radium-226	pCi/g	1.61 M3	NR
457-TP6-1.0-1.5-120418	12/4/2018	Qay	35.73988842	-111.3231471	12	18	SW6010	Selenium	mg/kg	0.048 U	NR
457-TP6-1.0-1.5-120418	12/4/2018	Qay	35.73988842	-111.3231471	12	18	SW6020	Uranium	mg/kg	1.6	NR
457-TP6-1.0-1.5-120418	12/4/2018	Qay	35.73988842	-111.3231471	12	18	SW6010	Vanadium	mg/kg	32	NR
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	SW6020B	Aluminum	mg/kg	4,540	9240
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	SW6010D	Antimony	mg/kg	1.89 U	1890

Attachment B-1. Data Used in the Risk Assessment

Sample ID	Sample Date	Geologic Unit	Latitude	Longitude	Sample Top Depth (inches bgs)	Sample Bottom Depth (inches bgs)	Analytical Method	Analyte	Units	Result and Qualifier		Reporting Limit
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	SW6020B	Arsenic	mg/kg	22.7	N	924
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	SW6020B	Barium	mg/kg	314	*	7390
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	SW6020B	Beryllium	mg/kg	1.16		92.4
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	SW6020B	Cadmium	mg/kg	0.252		185
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	SW6020B	Chromium	mg/kg	6.58		555
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	SW6020B	Cobalt	mg/kg	2.93	N	185
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	SW6020B	Copper	mg/kg	9.46	N*	370
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	SW6020B	Iron	mg/kg	9,170		18500
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	SW6020B	Lead	mg/kg	17.8	N	370
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	SW6020B	Manganese	mg/kg	30.3	*	924
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	SW7471B	Mercury	mg/kg	0.204		21.2
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	SW6020B	Molybdenum	mg/kg	173	N	185
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	SW6020B	Nickel	mg/kg	3.04	N	370
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	EH300	Radium-226	pCi/g	30.9		0.292
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	SW6020B	Selenium	mg/kg	1.47	N*	924
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	SW6010D	Silver	mg/kg	0.473	U	473
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	SW6020B	Thallium	mg/kg	5.21		370
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	SW6020B	Uranium	mg/kg	41.5	N	37
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	SW6020B	Vanadium	mg/kg	12.6		3700
458-SS01-01-020624	2/6/2024	TRcs	35.73049648	-111.3311852	0	6	SW6020B	Zinc	mg/kg	8.39	N	3700
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	SW6020B	Aluminum	mg/kg	3,320		9400
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	SW6010D	Antimony	mg/kg	1.94	U	1940
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	SW6020B	Arsenic	mg/kg	22.4	N	940
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	SW6020B	Barium	mg/kg	256	*	7520
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	SW6020B	Beryllium	mg/kg	0.641		94
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	SW6020B	Cadmium	mg/kg	0.2		188
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	SW6020B	Chromium	mg/kg	6.44		564
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	SW6020B	Cobalt	mg/kg	2.01	N	188
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	SW6020B	Copper	mg/kg	7.35	N*	376
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	SW6020B	Iron	mg/kg	8,120		18800
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	SW6020B	Lead	mg/kg	12.5	N	376
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	SW6020B	Manganese	mg/kg	19.5	*	940
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	SW7471B	Mercury	mg/kg	0.192		21
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	SW6020B	Molybdenum	mg/kg	141	N	188
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	SW6020B	Nickel	mg/kg	1.7	N	376
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	EH300	Radium-226	pCi/g	37.7		0.312
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	SW6020B	Selenium	mg/kg	1	N*	940
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	SW6010D	Silver	mg/kg	0.486	U	486
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	SW6020B	Thallium	mg/kg	5.61		376
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	SW6020B	Uranium	mg/kg	48.3	N	37.6
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	SW6020B	Vanadium	mg/kg	8.45		3760
458-SS02-01-020624	2/6/2024	TRcs	35.7302868	-111.3300088	0	6	SW6020B	Zinc	mg/kg	5.19	N	3760
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	SW6020B	Aluminum	mg/kg	1,810		9020
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	SW6010D	Antimony	mg/kg	1.82	U	1820
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	SW6020B	Arsenic	mg/kg	30.9	N	902
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	SW6020B	Barium	mg/kg	335	*	7220
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	SW6020B	Beryllium	mg/kg	0.289		90.2
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	SW6020B	Cadmium	mg/kg	0.329		180
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	SW6020B	Chromium	mg/kg	2.11		541
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	SW6020B	Cobalt	mg/kg	5.1	N	180
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	SW6020B	Copper	mg/kg	3.76	N*	361
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	SW6020B	Iron	mg/kg	3,290		18000
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	SW6020B	Lead	mg/kg	47.6	N	361
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	SW6020B	Manganese	mg/kg	19	*	902
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	SW7471B	Mercury	mg/kg	0.344		22.6
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	SW6020B	Molybdenum	mg/kg	78.6	N	180
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	SW6020B	Nickel	mg/kg	2.34	N	361
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	EH300	Radium-226	pCi/g	134		0.543
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	SW6020B	Selenium	mg/kg	1.35	N*	902
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	SW6010D	Silver	mg/kg	0.455	U	455
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	SW6020B	Thallium	mg/kg	1.17		361
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	SW6020B	Uranium	mg/kg	126	N	36.1
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	SW6020B	Vanadium	mg/kg	5.22		3610
458-SS03-01-020624	2/6/2024	TRcp	35.73063509	-111.3303975	0	6	SW6020B	Zinc	mg/kg	7.97	N	3610
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	SW6020B	Aluminum	mg/kg	3,730		9870
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	SW6010D	Antimony	mg/kg	1.76	U	1760
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	SW6020B	Arsenic	mg/kg	17.6	N	987
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	SW6020B	Barium	mg/kg	234	*	7900
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	SW6020B	Beryllium	mg/kg	0.652		98.7
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	SW6020B	Cadmium	mg/kg	0.316		197
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	SW6020B	Chromium	mg/kg	3.68		592
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	SW6020B	Cobalt	mg/kg	3.18	N	197
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	SW6020B	Copper	mg/kg	7.74	N*	395
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	SW6020B	Iron	mg/kg	5,010		19700
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	SW6020B	Lead	mg/kg	21	N	395
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	SW6020B	Manganese	mg/kg	91.2	*	987
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	SW7471B	Mercury	mg/kg	0.156		22.9
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	SW6020B	Molybdenum	mg/kg	191	N	1970
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	SW6020B	Nickel	mg/kg	3.44	N	395
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	EH300	Radium-226	pCi/g	48.3		0.375
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	SW6020B	Selenium	mg/kg	1.06	N*	987
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	SW6010D	Silver	mg/kg	0.208	J-	439
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	SW6020B	Thallium	mg/kg	3.88		395
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	SW6020B	Uranium	mg/kg	108	N	39.5
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	SW6020B	Vanadium	mg/kg	14.9		3950
458-SS04-01-020624	2/6/2024	TRcs	35.73040801	-111.3308695	0	6	SW6020B	Zinc	mg/kg	9.97	N	3950
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	SW6020B	Aluminum	mg/kg	6,930		8730
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	SW6010D	Antimony	mg/kg	1.81	U	1810

Attachment B-1. Data Used in the Risk Assessment

Sample ID	Sample Date	Geologic Unit	Latitude	Longitude	Sample Top Depth (inches bgs)	Sample Bottom Depth (inches bgs)	Analytical Method	Analyte	Units	Result and Qualifier		Reporting Limit
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	SW6020B	Arsenic	mg/kg	1.09	N	873
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	SW6020B	Barium	mg/kg	56.9	*	698
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	SW6020B	Beryllium	mg/kg	1.68		87.3
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	SW6020B	Cadmium	mg/kg	0.0555	J	175
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	SW6020B	Chromium	mg/kg	4.81		524
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	SW6020B	Cobalt	mg/kg	4.41	N	175
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	SW6020B	Copper	mg/kg	9.98	N*	349
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	SW6020B	Iron	mg/kg	1,680		17500
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	SW6020B	Lead	mg/kg	29.1	N	349
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	SW6020B	Manganese	mg/kg	35.9	*	873
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	SW7471B	Mercury	mg/kg	0.037		23.1
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	SW6020B	Molybdenum	mg/kg	0.228	N	175
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	SW6020B	Nickel	mg/kg	2.78	N	349
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	EH300	Radium-226	pCi/g	12.2		0.264
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	SW6020B	Selenium	mg/kg	2.16	N*	873
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	SW6010D	Silver	mg/kg	0.453	U	453
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	SW6020B	Thallium	mg/kg	0.349	U	349
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	SW6020B	Uranium	mg/kg	15.9	N	34.9
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	SW6020B	Vanadium	mg/kg	12.7		3490
458-SS05-01-020624	2/6/2024	TRcp	35.72990332	-111.3307021	0	6	SW6020B	Zinc	mg/kg	11.7	N	3490
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Aluminum	mg/kg	4,530		9250
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6010D	Antimony	mg/kg	1.76	U	1760
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Arsenic	mg/kg	21.7	N	925
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Barium	mg/kg	273	J	7400
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Beryllium	mg/kg	0.818		92.5
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Cadmium	mg/kg	0.247		185
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Chromium	mg/kg	5.93		555
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Cobalt	mg/kg	3.8	N	185
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Copper	mg/kg	10.2	N*	370
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Iron	mg/kg	7,880		18500
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Lead	mg/kg	12.9	N	370
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Manganese	mg/kg	19.7	*	925
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW7471B	Mercury	mg/kg	0.111	J	23.8
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Molybdenum	mg/kg	126	N	185
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Nickel	mg/kg	2.88	N	370
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	EH300	Radium-226	pCi/g	29.3	J	0.304
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Selenium	mg/kg	2.32	J	925
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6010D	Silver	mg/kg	0.441	U	441
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Thallium	mg/kg	2.68		370
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Uranium	mg/kg	44	J	37
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Vanadium	mg/kg	14.2		3700
458-SS06-01-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Zinc	mg/kg	9.15	N	3700
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Aluminum	mg/kg	4,420		9970
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6010D	Antimony	mg/kg	1.84	U	1840
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Arsenic	mg/kg	21.1		997
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Barium	mg/kg	173	J	797
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Beryllium	mg/kg	0.928		99.7
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Cadmium	mg/kg	0.251		199
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Chromium	mg/kg	5.54		598
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Cobalt	mg/kg	3.37		199
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Copper	mg/kg	11		399
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Iron	mg/kg	7,160		19900
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Lead	mg/kg	13.7		399
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Manganese	mg/kg	15		997
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW7471B	Mercury	mg/kg	0.167	J	22.2
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Molybdenum	mg/kg	121		199
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Nickel	mg/kg	2.78		399
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	EH300	Radium-226	pCi/g	34.5	J	0.387
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Selenium	mg/kg	1.57	J	997
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6010D	Silver	mg/kg	0.46	U	460
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Thallium	mg/kg	2.65		399
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Uranium	mg/kg	90.6	J	39.9
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Vanadium	mg/kg	11.9		3990
458-SS06-02-020624	2/6/2024	TRcp	35.73003514	-111.3300376	0	6	SW6020B	Zinc	mg/kg	8.54		3990
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	6010C DOD	Aluminum	mg/kg	2,200	D	NR
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	6010C DOD	Antimony	mg/kg	6.4	U	NR
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	6010C DOD	Arsenic	mg/kg	31	D	NR
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	6010C DOD	Barium	mg/kg	390	D	NR
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	6010C DOD	Beryllium	mg/kg	1.7	U	NR
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	6010C DOD	Cadmium	mg/kg	1	U	NR
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	6010C DOD	Chromium	mg/kg	3.4	JD	NR
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	6010C DOD	Cobalt	mg/kg	17	JD	NR
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	6010C DOD	Copper	mg/kg	8.6	JD	NR
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	6010C DOD	Iron	mg/kg	11,000	D	NR
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	6010C DOD	Lead	mg/kg	16	D	NR
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	6010C DOD	Manganese	mg/kg	81	D	NR
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	6010C DOD	Mercury	mg/kg	0.093		NR
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	6010C DOD	Molybdenum	mg/kg	180	D	NR
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	6010C DOD	Nickel	mg/kg	3.8	JD	NR
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	GA-01-R	Radium-226	pCi/g	51.8		NR
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	6010C DOD	Selenium	mg/kg	2.9	U	NR
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	6010C DOD	Silver	mg/kg	2.3	U	NR
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	6010C DOD	Thallium	mg/kg	15	U	NR
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	6010C DOD	Uranium	mg/kg	55	U	NR
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	6010C DOD	Vanadium	mg/kg	15	JD	NR
458-SS-1A	8/7/2013	TRcs	35.73080647	-111.3308141	0	6	6010C DOD	Zinc	mg/kg	20	U	NR
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	6010C DOD	Aluminum	mg/kg	2,100	D	NR
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	6010C DOD	Antimony	mg/kg	6.5	U	NR

Attachment B-1. Data Used in the Risk Assessment

Sample ID	Sample Date	Geologic Unit	Latitude	Longitude	Sample Top Depth (inches bgs)	Sample Bottom Depth (inches bgs)	Analytical Method	Analyte	Units	Result and Qualifier		Reporting Limit
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	6010C DOD	Arsenic	mg/kg	3.2	U	NR
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	6010C DOD	Barium	mg/kg	160	D	NR
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	6010C DOD	Beryllium	mg/kg	1.7	U	NR
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	6010C DOD	Cadmium	mg/kg	1	U	NR
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	6010C DOD	Chromium	mg/kg	3.1	U	NR
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	6010C DOD	Cobalt	mg/kg	13	JD	NR
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	6010C DOD	Copper	mg/kg	7.4	U	NR
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	6010C DOD	Iron	mg/kg	6,700	D	NR
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	6010C DOD	Lead	mg/kg	13	D	NR
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	6010C DOD	Manganese	mg/kg	110	D	NR
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	6010C DOD	Mercury	mg/kg	0.015	J	NR
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	6010C DOD	Molybdenum	mg/kg	18	JD	NR
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	6010C DOD	Nickel	mg/kg	5.1	JD	NR
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	GA-01-R	Radium-226	pCi/g	9.84		NR
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	6010C DOD	Selenium	mg/kg	2.9	U	NR
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	6010C DOD	Silver	mg/kg	2.4	U	NR
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	6010C DOD	Thallium	mg/kg	15	U	NR
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	6010C DOD	Uranium	mg/kg	53	U	NR
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	6010C DOD	Vanadium	mg/kg	14	JD	NR
458-SS-2A	8/7/2013	TRcs	35.73108047	-111.3300391	0	6	6010C DOD	Zinc	mg/kg	20	U	NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	6010C DOD	Aluminum	mg/kg	2,100	D	NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	6010C DOD	Antimony	mg/kg	6.5	U	NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	6010C DOD	Arsenic	mg/kg	3.2	U	NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	6010C DOD	Barium	mg/kg	170	D	NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	6010C DOD	Beryllium	mg/kg	1.7	U	NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	6010C DOD	Cadmium	mg/kg	1	U	NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	6010C DOD	Chromium	mg/kg	3.1	U	NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	6010C DOD	Cobalt	mg/kg	13	JD	NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	6010C DOD	Copper	mg/kg	7.4	U	NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	6010C DOD	Iron	mg/kg	6,900	D	NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	6010C DOD	Lead	mg/kg	6.9	JD	NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	6010C DOD	Manganese	mg/kg	100	D	NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	6010C DOD	Mercury	mg/kg	0.011	U	NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	6010C DOD	Molybdenum	mg/kg	10	U	NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	6010C DOD	Nickel	mg/kg	5.4	JD	NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	GA-01-R	Radium-226	pCi/g	6.01		NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	6010C DOD	Selenium	mg/kg	2.9	U	NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	6010C DOD	Silver	mg/kg	2.4	U	NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	6010C DOD	Thallium	mg/kg	15	U	NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	6010C DOD	Uranium	mg/kg	53	U	NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	6010C DOD	Vanadium	mg/kg	13	JD	NR
458-SS-2B	8/7/2013	TRcs	35.73108047	-111.3300391	6	12	6010C DOD	Zinc	mg/kg	20	U	NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	6010C DOD	Aluminum	mg/kg	1,600	D	NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	6010C DOD	Antimony	mg/kg	6.7	U	NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	6010C DOD	Arsenic	mg/kg	4.5	JD	NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	6010C DOD	Barium	mg/kg	180	D	NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	6010C DOD	Beryllium	mg/kg	1.8	U	NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	6010C DOD	Cadmium	mg/kg	1	U	NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	6010C DOD	Chromium	mg/kg	3.2	U	NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	6010C DOD	Cobalt	mg/kg	9.8	U	NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	6010C DOD	Copper	mg/kg	7.6	U	NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	6010C DOD	Iron	mg/kg	5,300	D	NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	6010C DOD	Lead	mg/kg	12	D	NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	6010C DOD	Manganese	mg/kg	78	D	NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	6010C DOD	Mercury	mg/kg	0.081		NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	6010C DOD	Molybdenum	mg/kg	69	D	NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	6010C DOD	Nickel	mg/kg	3.7	JD	NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	GA-01-R	Radium-226	pCi/g	22.8		NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	6010C DOD	Selenium	mg/kg	3	U	NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	6010C DOD	Silver	mg/kg	2.4	U	NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	6010C DOD	Thallium	mg/kg	16	U	NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	6010C DOD	Uranium	mg/kg	55	U	NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	6010C DOD	Vanadium	mg/kg	13	U	NR
458-SS-2C	8/7/2013	TRcs	35.73108047	-111.3300391	12	18	6010C DOD	Zinc	mg/kg	21	U	NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	6010C DOD	Aluminum	mg/kg	1,700	JD	NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	6010C DOD	Antimony	mg/kg	6.3	UJ	NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	6010C DOD	Arsenic	mg/kg	31	D	NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	6010C DOD	Barium	mg/kg	200	JD	NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	6010C DOD	Beryllium	mg/kg	1.7	U	NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	6010C DOD	Cadmium	mg/kg	0.98	U	NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	6010C DOD	Chromium	mg/kg	3	U	NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	6010C DOD	Cobalt	mg/kg	9.2	U	NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	6010C DOD	Copper	mg/kg	15	JD	NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	6010C DOD	Iron	mg/kg	8,300	JD	NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	6010C DOD	Lead	mg/kg	18	D	NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	6010C DOD	Manganese	mg/kg	29	D	NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	6010C DOD	Mercury	mg/kg	0.36	J	NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	6010C DOD	Molybdenum	mg/kg	440	JD	NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	6010C DOD	Nickel	mg/kg	2.2	JD	NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	GA-01-R	Radium-226	pCi/g	39.1		NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	6010C DOD	Selenium	mg/kg	2.8	U	NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	6010C DOD	Silver	mg/kg	2.3	UJ	NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	6010C DOD	Thallium	mg/kg	15	UJ	NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	6010C DOD	Uranium	mg/kg	150	U	NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	6010C DOD	Vanadium	mg/kg	12	JD	NR
458-SS-3A	8/7/2013	TRcs	35.73057947	-111.3298161	0	6	6010C DOD	Zinc	mg/kg	19	U	NR
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	6010C DOD	Aluminum	mg/kg	2,800	D	NR
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	6010C DOD	Antimony	mg/kg	8.3	U	NR

Attachment B-1. Data Used in the Risk Assessment

Sample ID	Sample Date	Geologic Unit	Latitude	Longitude	Sample Top Depth (inches bgs)	Sample Bottom Depth (inches bgs)	Analytical Method	Analyte	Units	Result and Qualifier		Reporting Limit
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	6010C DOD	Arsenic	mg/kg	12	JD	NR
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	6010C DOD	Barium	mg/kg	500	D	NR
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	6010C DOD	Beryllium	mg/kg	2.2	U	NR
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	6010C DOD	Cadmium	mg/kg	1.3	U	NR
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	6010C DOD	Chromium	mg/kg	4	U	NR
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	6010C DOD	Cobalt	mg/kg	12	JD	NR
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	6010C DOD	Copper	mg/kg	9.4	U	NR
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	6010C DOD	Iron	mg/kg	6,300	D	NR
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	6010C DOD	Lead	mg/kg	17	D	NR
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	6010C DOD	Manganese	mg/kg	32	D	NR
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	6010C DOD	Mercury	mg/kg	0.028	J	NR
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	6010C DOD	Molybdenum	mg/kg	48	JD	NR
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	6010C DOD	Nickel	mg/kg	4.9	JD	NR
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	GA-01-R	Radium-226	pCi/g	11.1		NR
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	6010C DOD	Selenium	mg/kg	3.7	U	NR
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	6010C DOD	Silver	mg/kg	3	U	NR
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	6010C DOD	Thallium	mg/kg	20	U	NR
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	6010C DOD	Uranium	mg/kg	88	U	NR
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	6010C DOD	Vanadium	mg/kg	16	U	NR
458-SS-4A	8/7/2013	TRcs	35.73016647	-111.3303641	0	6	6010C DOD	Zinc	mg/kg	26	U	NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	6010C DOD	Aluminum	mg/kg	2,100	D	NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	6010C DOD	Antimony	mg/kg	5.8	U	NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	6010C DOD	Arsenic	mg/kg	12	D	NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	6010C DOD	Barium	mg/kg	160	D	NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	6010C DOD	Beryllium	mg/kg	1.5	U	NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	6010C DOD	Cadmium	mg/kg	0.9	U	NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	6010C DOD	Chromium	mg/kg	2.8	U	NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	6010C DOD	Cobalt	mg/kg	18	JD	NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	6010C DOD	Copper	mg/kg	7.2	JD	NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	6010C DOD	Iron	mg/kg	6,700	D	NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	6010C DOD	Lead	mg/kg	13	D	NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	6010C DOD	Manganese	mg/kg	38	D	NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	6010C DOD	Mercury	mg/kg	0.074		NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	6010C DOD	Molybdenum	mg/kg	87	D	NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	6010C DOD	Nickel	mg/kg	4.3	JD	NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	GA-01-R	Radium-226	pCi/g	18.7		NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	6010C DOD	Selenium	mg/kg	2.6	U	NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	6010C DOD	Silver	mg/kg	2.1	U	NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	6010C DOD	Thallium	mg/kg	14	U	NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	6010C DOD	Uranium	mg/kg	120	U	NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	6010C DOD	Vanadium	mg/kg	11	U	NR
458-SS-4B	8/7/2013	TRcs	35.73016647	-111.3303641	6	12	6010C DOD	Zinc	mg/kg	18	U	NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	6010C DOD	Aluminum	mg/kg	2,300	D	NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	6010C DOD	Antimony	mg/kg	6.3	U	NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	6010C DOD	Arsenic	mg/kg	42	D	NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	6010C DOD	Barium	mg/kg	230	D	NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	6010C DOD	Beryllium	mg/kg	1.7	U	NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	6010C DOD	Cadmium	mg/kg	0.99	U	NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	6010C DOD	Chromium	mg/kg	3.1	JD	NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	6010C DOD	Cobalt	mg/kg	12	JD	NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	6010C DOD	Copper	mg/kg	8	JD	NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	6010C DOD	Iron	mg/kg	9,600	D	NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	6010C DOD	Lead	mg/kg	14	D	NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	6010C DOD	Manganese	mg/kg	20	D	NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	6010C DOD	Mercury	mg/kg	0.14		NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	6010C DOD	Molybdenum	mg/kg	110	D	NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	6010C DOD	Nickel	mg/kg	4.4	JD	NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	GA-01-R	Radium-226	pCi/g	21.5		NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	6010C DOD	Selenium	mg/kg	2.9	U	NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	6010C DOD	Silver	mg/kg	2.3	U	NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	6010C DOD	Thallium	mg/kg	15	U	NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	6010C DOD	Uranium	mg/kg	190	U	NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	6010C DOD	Vanadium	mg/kg	12	U	NR
458-SS-4C	8/7/2013	TRcs	35.73016647	-111.3303641	12	18	6010C DOD	Zinc	mg/kg	20	U	NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	6010C DOD	Aluminum	mg/kg	2,300	D	NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	6010C DOD	Antimony	mg/kg	6.6	U	NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	6010C DOD	Arsenic	mg/kg	7.9	JD	NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	6010C DOD	Barium	mg/kg	67	D	NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	6010C DOD	Beryllium	mg/kg	1.7	U	NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	6010C DOD	Cadmium	mg/kg	1	U	NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	6010C DOD	Chromium	mg/kg	3.1	U	NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	6010C DOD	Cobalt	mg/kg	9.6	U	NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	6010C DOD	Copper	mg/kg	21	JD	NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	6010C DOD	Iron	mg/kg	4,600	D	NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	6010C DOD	Lead	mg/kg	9.1	JD	NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	6010C DOD	Manganese	mg/kg	24	D	NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	6010C DOD	Mercury	mg/kg	0.043		NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	6010C DOD	Molybdenum	mg/kg	130	D	NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	6010C DOD	Nickel	mg/kg	10	JD	NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	GA-01-R	Radium-226	pCi/g	28.7		NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	6010C DOD	Selenium	mg/kg	3	U	NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	6010C DOD	Silver	mg/kg	2.4	U	NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	6010C DOD	Thallium	mg/kg	15	U	NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	6010C DOD	Uranium	mg/kg	170	U	NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	6010C DOD	Vanadium	mg/kg	13	U	NR
458-SS-5A	8/7/2013	TRcs	35.73054647	-111.3305961	0	6	6010C DOD	Zinc	mg/kg	20	U	NR
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Aluminum	mg/kg	2,300	D	NR
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Antimony	mg/kg	33	U	NR

Attachment B-1. Data Used in the Risk Assessment

Sample ID	Sample Date	Geologic Unit	Latitude	Longitude	Sample Top Depth (inches bgs)	Sample Bottom Depth (inches bgs)	Analytical Method	Analyte	Units	Result and Qualifier		Reporting Limit
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Arsenic	mg/kg	160	D	NR
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Barium	mg/kg	99	JD	NR
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Beryllium	mg/kg	8.7	U	NR
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Cadmium	mg/kg	5.1	U	NR
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Chromium	mg/kg	16	U	NR
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Cobalt	mg/kg	48	U	NR
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Copper	mg/kg	37	U	NR
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Iron	mg/kg	97,000	D	NR
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Lead	mg/kg	110	D	NR
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Manganese	mg/kg	7.9	U	NR
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Mercury	mg/kg	0.33		NR
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Molybdenum	mg/kg	840	D	NR
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Nickel	mg/kg	12	U	NR
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	GA-01-R	Radium-226	pCi/g	83.5		NR
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Selenium	mg/kg	37	JD	NR
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Silver	mg/kg	12	U	NR
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Thallium	mg/kg	78	U	NR
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Uranium	mg/kg	370	U	NR
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Vanadium	mg/kg	65	U	NR
458-SS-6A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Zinc	mg/kg	100	U	NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Aluminum	mg/kg	2,400	D	NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Antimony	mg/kg	33	U	NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Arsenic	mg/kg	140	D	NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Barium	mg/kg	70	JD	NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Beryllium	mg/kg	9.4	U	NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Cadmium	mg/kg	5.6	U	NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Chromium	mg/kg	17	U	NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Cobalt	mg/kg	52	U	NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Copper	mg/kg	41	U	NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Iron	mg/kg	73,000	D	NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Lead	mg/kg	68	D	NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Manganese	mg/kg	8.6	U	NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Mercury	mg/kg	0.35		NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Molybdenum	mg/kg	490	D	NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Nickel	mg/kg	13	U	NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	GA-01-R	Radium-226	pCi/g	93.4		NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Selenium	mg/kg	35	JD	NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Silver	mg/kg	13	U	NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Thallium	mg/kg	84	U	NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Uranium	mg/kg	290	U	NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Vanadium	mg/kg	70	U	NR
458-SS-7A	8/7/2013	TRcp	35.72974047	-111.3308571	0	6	6010C DOD	Zinc	mg/kg	110	U	NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	6010C DOD	Aluminum	mg/kg	1,700	D	NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	6010C DOD	Antimony	mg/kg	6.3	U	NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	6010C DOD	Arsenic	mg/kg	9.4	JD	NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	6010C DOD	Barium	mg/kg	150	D	NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	6010C DOD	Beryllium	mg/kg	1.7	U	NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	6010C DOD	Cadmium	mg/kg	0.98	U	NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	6010C DOD	Chromium	mg/kg	3	U	NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	6010C DOD	Cobalt	mg/kg	9.9	JD	NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	6010C DOD	Copper	mg/kg	7.2	U	NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	6010C DOD	Iron	mg/kg	5,800	D	NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	6010C DOD	Lead	mg/kg	13	D	NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	6010C DOD	Manganese	mg/kg	39	D	NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	6010C DOD	Mercury	mg/kg	0.086		NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	6010C DOD	Molybdenum	mg/kg	87	D	NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	6010C DOD	Nickel	mg/kg	3.2	JD	NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	GA-01-R	Radium-226	pCi/g	16.7		NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	6010C DOD	Selenium	mg/kg	2.8	U	NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	6010C DOD	Silver	mg/kg	2.3	U	NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	6010C DOD	Thallium	mg/kg	15	U	NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	6010C DOD	Uranium	mg/kg	52	U	NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	6010C DOD	Vanadium	mg/kg	12	JD	NR
458-SS-8A	8/7/2013	TRcs	35.72986747	-111.3299731	0	6	6010C DOD	Zinc	mg/kg	19	U	NR
458-TP18-0.5-1.0-120518	12/5/2018	TRcs	35.73055255	-111.3308955	6	12	SW6020	Arsenic	mg/kg	19		NR
458-TP18-0.5-1.0-120518	12/5/2018	TRcs	35.73055255	-111.3308955	6	12	SW7471	Mercury	mg/kg	0.071		NR
458-TP18-0.5-1.0-120518	12/5/2018	TRcs	35.73055255	-111.3308955	6	12	SW6010	Molybdenum	mg/kg	72		NR
458-TP18-0.5-1.0-120518	12/5/2018	TRcs	35.73055255	-111.3308955	6	12	713R14	Radium-226	pCi/g	14	M3	NR
458-TP18-0.5-1.0-120518	12/5/2018	TRcs	35.73055255	-111.3308955	6	12	SW6010	Selenium	mg/kg	0.74		NR
458-TP18-0.5-1.0-120518	12/5/2018	TRcs	35.73055255	-111.3308955	6	12	SW6020	Uranium	mg/kg	15		NR
458-TP18-0.5-1.0-120518	12/5/2018	TRcs	35.73055255	-111.3308955	6	12	SW6010	Vanadium	mg/kg	12		NR
458-TP18-2.0-2.5-120518	12/5/2018	TRcs	35.73055255	-111.3308955	24	30	SW6020	Arsenic	mg/kg	5.3		NR
458-TP18-2.0-2.5-120518	12/5/2018	TRcs	35.73055255	-111.3308955	24	30	SW7471	Mercury	mg/kg	0.017	J	NR
458-TP18-2.0-2.5-120518	12/5/2018	TRcs	35.73055255	-111.3308955	24	30	SW6010	Molybdenum	mg/kg	12		NR
458-TP18-2.0-2.5-120518	12/5/2018	TRcs	35.73055255	-111.3308955	24	30	713R14	Radium-226	pCi/g	4.08	M3	NR
458-TP18-2.0-2.5-120518	12/5/2018	TRcs	35.73055255	-111.3308955	24	30	SW6010	Selenium	mg/kg	0.052	U	NR
458-TP18-2.0-2.5-120518	12/5/2018	TRcs	35.73055255	-111.3308955	24	30	SW6020	Uranium	mg/kg	6.8		NR
458-TP18-2.0-2.5-120518	12/5/2018	TRcs	35.73055255	-111.3308955	24	30	SW6010	Vanadium	mg/kg	13		NR
458-TP19-0.5-1.0-120518	12/5/2018	TRcs	35.73022964	-111.3304343	6	12	SW6020	Arsenic	mg/kg	55		NR
458-TP19-0.5-1.0-120518	12/5/2018	TRcs	35.73022964	-111.3304343	6	12	SW7471	Mercury	mg/kg	0.54		NR
458-TP19-0.5-1.0-120518	12/5/2018	TRcs	35.73022964	-111.3304343	6	12	SW6010	Molybdenum	mg/kg	820		NR
458-TP19-0.5-1.0-120518	12/5/2018	TRcs	35.73022964	-111.3304343	6	12	713R14	Radium-226	pCi/g	126	M3,G	NR
458-TP19-0.5-1.0-120518	12/5/2018	TRcs	35.73022964	-111.3304343	6	12	SW6010	Selenium	mg/kg	0.46	J	NR
458-TP19-0.5-1.0-120518	12/5/2018	TRcs	35.73022964	-111.3304343	6	12	SW6020	Uranium	mg/kg	140		NR
458-TP19-0.5-1.0-120518	12/5/2018	TRcs	35.73022964	-111.3304343	6	12	SW6010	Vanadium	mg/kg	13		NR
458-TP19-0-0.5-120518	12/5/2018	TRcs	35.73022964	-111.3304343	0	6	SW6020	Arsenic	mg/kg	30		NR
458-TP19-0-0.5-120518	12/5/2018	TRcs	35.73022964	-111.3304343	0	6	SW7471	Mercury	mg/kg	0.21		NR
458-TP19-0-0.5-120518	12/5/2018	TRcs	35.73022964	-111.3304343	0	6	SW6010	Molybdenum	mg/kg	350		NR

Attachment B-1. Data Used in the Risk Assessment

Sample ID	Sample Date	Geologic Unit	Latitude	Longitude	Sample Top Depth (inches bgs)	Sample Bottom Depth (inches bgs)	Analytical Method	Analyte	Units	Result and Qualifier		Reporting Limit
458-TP19-0-0.5-120518	12/5/2018	TRcs	35.73022964	-111.3304343	0	6	713R14	Radium-226	pCi/g	73.9	M3,G	NR
458-TP19-0-0.5-120518	12/5/2018	TRcs	35.73022964	-111.3304343	0	6	SW6010	Selenium	mg/kg	0.53		NR
458-TP19-0-0.5-120518	12/5/2018	TRcs	35.73022964	-111.3304343	0	6	SW6020	Uranium	mg/kg	110		NR
458-TP19-0-0.5-120518	12/5/2018	TRcs	35.73022964	-111.3304343	0	6	SW6010	Vanadium	mg/kg	17		NR
458-TP20-0.5-1.0-120518	12/5/2018	TRcs	35.73049751	-111.3297397	0	6	SW6020	Arsenic	mg/kg	30		NR
458-TP20-0.5-1.0-120518	12/5/2018	TRcs	35.73049751	-111.3297397	0	6	SW7471	Mercury	mg/kg	0.16		NR
458-TP20-0.5-1.0-120518	12/5/2018	TRcs	35.73049751	-111.3297397	0	6	SW6010	Molybdenum	mg/kg	160		NR
458-TP20-0.5-1.0-120518	12/5/2018	TRcs	35.73049751	-111.3297397	0	6	713R14	Radium-226	pCi/g	24.1	M3	NR
458-TP20-0.5-1.0-120518	12/5/2018	TRcs	35.73049751	-111.3297397	0	6	SW6010	Selenium	mg/kg	0.21	J	NR
458-TP20-0.5-1.0-120518	12/5/2018	TRcs	35.73049751	-111.3297397	0	6	SW6020	Uranium	mg/kg	44		NR
458-TP20-0.5-1.0-120518	12/5/2018	TRcs	35.73049751	-111.3297397	0	6	SW6010	Vanadium	mg/kg	8.1		NR
458-TP20-0-0.5-120518	12/5/2018	TRcs	35.73049751	-111.3297397	0	6	SW6020	Arsenic	mg/kg	18		NR
458-TP20-0-0.5-120518	12/5/2018	TRcs	35.73049751	-111.3297397	0	6	SW7471	Mercury	mg/kg	0.1		NR
458-TP20-0-0.5-120518	12/5/2018	TRcs	35.73049751	-111.3297397	0	6	SW6010	Molybdenum	mg/kg	22		NR
458-TP20-0-0.5-120518	12/5/2018	TRcs	35.73049751	-111.3297397	0	6	713R14	Radium-226	pCi/g	6.18	M3	NR
458-TP20-0-0.5-120518	12/5/2018	TRcs	35.73049751	-111.3297397	0	6	SW6010	Selenium	mg/kg	0.14	J	NR
458-TP20-0-0.5-120518	12/5/2018	TRcs	35.73049751	-111.3297397	0	6	SW6020	Uranium	mg/kg	12		NR
458-TP20-0-0.5-120518	12/5/2018	TRcs	35.73049751	-111.3297397	0	6	SW6010	Vanadium	mg/kg	17		NR
458-TP20-1.0-1.5-120518	12/5/2018	TRcs	35.73049751	-111.3297397	12	18	SW6020	Arsenic	mg/kg	39		NR
458-TP20-1.0-1.5-120518	12/5/2018	TRcs	35.73049751	-111.3297397	12	18	SW7471	Mercury	mg/kg	0.26		NR
458-TP20-1.0-1.5-120518	12/5/2018	TRcs	35.73049751	-111.3297397	12	18	SW6010	Molybdenum	mg/kg	130		NR
458-TP20-1.0-1.5-120518	12/5/2018	TRcs	35.73049751	-111.3297397	12	18	713R14	Radium-226	pCi/g	19.8	M3	NR
458-TP20-1.0-1.5-120518	12/5/2018	TRcs	35.73049751	-111.3297397	12	18	SW6010	Selenium	mg/kg	0.7		NR
458-TP20-1.0-1.5-120518	12/5/2018	TRcs	35.73049751	-111.3297397	12	18	SW6020	Uranium	mg/kg	42		NR
458-TP20-1.0-1.5-120518	12/5/2018	TRcs	35.73049751	-111.3297397	12	18	SW6010	Vanadium	mg/kg	7.9		NR
458-TP21-0.5-1.0-120518	12/5/2018	TRcp	35.7298768	-111.3300571	6	12	SW6020	Arsenic	mg/kg	23		NR
458-TP21-0.5-1.0-120518	12/5/2018	TRcp	35.7298768	-111.3300571	6	12	SW7471	Mercury	mg/kg	0.074		NR
458-TP21-0.5-1.0-120518	12/5/2018	TRcp	35.7298768	-111.3300571	6	12	SW6010	Molybdenum	mg/kg	23		NR
458-TP21-0.5-1.0-120518	12/5/2018	TRcp	35.7298768	-111.3300571	6	12	713R14	Radium-226	pCi/g	5.64	M3	NR
458-TP21-0.5-1.0-120518	12/5/2018	TRcp	35.7298768	-111.3300571	6	12	SW6010	Selenium	mg/kg	0.3	J	NR
458-TP21-0.5-1.0-120518	12/5/2018	TRcp	35.7298768	-111.3300571	6	12	SW6020	Uranium	mg/kg	8.3		NR
458-TP21-0.5-1.0-120518	12/5/2018	TRcp	35.7298768	-111.3300571	6	12	SW6010	Vanadium	mg/kg	19		NR
458-TP21-0-0.5-120518	12/5/2018	TRcp	35.7298768	-111.3300571	0	6	SW6020	Arsenic	mg/kg	8.5		NR
458-TP21-0-0.5-120518	12/5/2018	TRcp	35.7298768	-111.3300571	0	6	SW7471	Mercury	mg/kg	0.04		NR
458-TP21-0-0.5-120518	12/5/2018	TRcp	35.7298768	-111.3300571	0	6	SW6010	Molybdenum	mg/kg	14		NR
458-TP21-0-0.5-120518	12/5/2018	TRcp	35.7298768	-111.3300571	0	6	713R14	Radium-226	pCi/g	6.88	M3	NR
458-TP21-0-0.5-120518	12/5/2018	TRcp	35.7298768	-111.3300571	0	6	SW6010	Selenium	mg/kg	0.049	U	NR
458-TP21-0-0.5-120518	12/5/2018	TRcp	35.7298768	-111.3300571	0	6	SW6020	Uranium	mg/kg	9.3		NR
458-TP21-0-0.5-120518	12/5/2018	TRcp	35.7298768	-111.3300571	0	6	SW6010	Vanadium	mg/kg	12		NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	6010C DOD	Aluminum	mg/kg	1,100	D	NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	6010C DOD	Antimony	mg/kg	5.7	U	NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	6010C DOD	Arsenic	mg/kg	9.7	D	NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	6010C DOD	Barium	mg/kg	260	D	NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	6010C DOD	Beryllium	mg/kg	1.5	U	NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	6010C DOD	Cadmium	mg/kg	0.88	U	NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	6010C DOD	Chromium	mg/kg	2.7	U	NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	6010C DOD	Cobalt	mg/kg	8.3	U	NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	6010C DOD	Copper	mg/kg	6.4	U	NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	6010C DOD	Iron	mg/kg	4,200	D	NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	6010C DOD	Lead	mg/kg	4.7	JD	NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	6010C DOD	Manganese	mg/kg	78	D	NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	6010C DOD	Mercury	mg/kg	0.022	J	NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	6010C DOD	Molybdenum	mg/kg	46	D	NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	6010C DOD	Nickel	mg/kg	3.8	JD	NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	GA-01-R	Radium-226	pCi/g	9.23		NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	6010C DOD	Selenium	mg/kg	2.6	U	NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	6010C DOD	Silver	mg/kg	2.1	U	NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	6010C DOD	Thallium	mg/kg	13	U	NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	6010C DOD	Uranium	mg/kg	46	U	NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	6010C DOD	Vanadium	mg/kg	11	U	NR
459-SS-2A	8/7/2013	TRcs	35.72816647	-111.3263311	0	6	6010C DOD	Zinc	mg/kg	18	U	NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	6010C DOD	Aluminum	mg/kg	1,200	D	NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	6010C DOD	Antimony	mg/kg	6.8	U	NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	6010C DOD	Arsenic	mg/kg	7.3	JD	NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	6010C DOD	Barium	mg/kg	260	D	NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	6010C DOD	Beryllium	mg/kg	1.8	U	NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	6010C DOD	Cadmium	mg/kg	1.1	U	NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	6010C DOD	Chromium	mg/kg	3.3	U	NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	6010C DOD	Cobalt	mg/kg	10	U	NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	6010C DOD	Copper	mg/kg	7.7	U	NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	6010C DOD	Iron	mg/kg	4,200	D	NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	6010C DOD	Lead	mg/kg	5.6	JD	NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	6010C DOD	Manganese	mg/kg	77	D	NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	6010C DOD	Mercury	mg/kg	0.029	J	NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	6010C DOD	Molybdenum	mg/kg	32	JD	NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	6010C DOD	Nickel	mg/kg	3.9	JD	NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	GA-01-R	Radium-226	pCi/g	10.1		NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	6010C DOD	Selenium	mg/kg	3.1	U	NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	6010C DOD	Silver	mg/kg	2.5	U	NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	6010C DOD	Thallium	mg/kg	16	U	NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	6010C DOD	Uranium	mg/kg	56	U	NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	6010C DOD	Vanadium	mg/kg	13	U	NR
459-SS-2B	8/7/2013	TRcs	35.72816647	-111.3263311	6	12	6010C DOD	Zinc	mg/kg	21	U	NR
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	6010C DOD	Aluminum	mg/kg	1,500	D	NR
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	6010C DOD	Antimony	mg/kg	7.7	U	NR
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	6010C DOD	Arsenic	mg/kg	8	JD	NR
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	6010C DOD	Barium	mg/kg	120	D	NR
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	6010C DOD	Beryllium	mg/kg	2	U	NR

Attachment B-1. Data Used in the Risk Assessment

Sample ID	Sample Date	Geologic Unit	Latitude	Longitude	Sample Top Depth (inches bgs)	Sample Bottom Depth (inches bgs)	Analytical Method	Analyte	Units	Result and Qualifier	Reporting Limit
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	6010C DOD	Cadmium	mg/kg	1.2 U	NR
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	6010C DOD	Chromium	mg/kg	3.7 U	NR
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	6010C DOD	Cobalt	mg/kg	47 JD	NR
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	6010C DOD	Copper	mg/kg	8.7 U	NR
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	6010C DOD	Iron	mg/kg	4,700 D	NR
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	6010C DOD	Lead	mg/kg	6 JD	NR
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	6010C DOD	Manganese	mg/kg	72 D	NR
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	6010C DOD	Mercury	mg/kg	0.033 J	NR
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	6010C DOD	Molybdenum	mg/kg	36 JD	NR
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	6010C DOD	Nickel	mg/kg	5.4 JD	NR
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	GA-01-R	Radium-226	pCi/g	9.76	NR
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	6010C DOD	Selenium	mg/kg	3.5 U	NR
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	6010C DOD	Silver	mg/kg	2.8 U	NR
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	6010C DOD	Thallium	mg/kg	18 U	NR
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	6010C DOD	Uranium	mg/kg	64 U	NR
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	6010C DOD	Vanadium	mg/kg	15 U	NR
459-SS-2C	8/7/2013	TRcs	35.72816647	-111.3263311	12	18	6010C DOD	Zinc	mg/kg	24 U	NR
459-TP23-0.5-1.0-120618	12/6/2018	TRcs	35.72805225	-111.326359	6	12	SW6020	Arsenic	mg/kg	8.2	NR
459-TP23-0.5-1.0-120618	12/6/2018	TRcs	35.72805225	-111.326359	6	12	SW7471	Mercury	mg/kg	0.032	NR
459-TP23-0.5-1.0-120618	12/6/2018	TRcs	35.72805225	-111.326359	6	12	SW6010	Molybdenum	mg/kg	55	NR
459-TP23-0.5-1.0-120618	12/6/2018	TRcs	35.72805225	-111.326359	6	12	713R14	Radium-226	pCi/g	19.7 M3,G	NR
459-TP23-0.5-1.0-120618	12/6/2018	TRcs	35.72805225	-111.326359	6	12	SW6010	Selenium	mg/kg	0.17 J	NR
459-TP23-0.5-1.0-120618	12/6/2018	TRcs	35.72805225	-111.326359	6	12	SW6020	Uranium	mg/kg	15	NR
459-TP23-0.5-1.0-120618	12/6/2018	TRcs	35.72805225	-111.326359	6	12	SW6010	Vanadium	mg/kg	9.8	NR
459-TP23-0-0.5-120618	12/6/2018	TRcs	35.72805225	-111.326359	0	6	SW6020	Arsenic	mg/kg	7.1	NR
459-TP23-0-0.5-120618	12/6/2018	TRcs	35.72805225	-111.326359	0	6	SW7471	Mercury	mg/kg	0.019 J	NR
459-TP23-0-0.5-120618	12/6/2018	TRcs	35.72805225	-111.326359	0	6	SW6010	Molybdenum	mg/kg	52	NR
459-TP23-0-0.5-120618	12/6/2018	TRcs	35.72805225	-111.326359	0	6	713R14	Radium-226	pCi/g	15.9 M3	NR
459-TP23-0-0.5-120618	12/6/2018	TRcs	35.72805225	-111.326359	0	6	SW6010	Selenium	mg/kg	0.047 U	NR
459-TP23-0-0.5-120618	12/6/2018	TRcs	35.72805225	-111.326359	0	6	SW6020	Uranium	mg/kg	8.3	NR
459-TP23-0-0.5-120618	12/6/2018	TRcs	35.72805225	-111.326359	0	6	SW6010	Vanadium	mg/kg	6.7	NR
459-TP23-0-0.5-120618 DUP	12/6/2018	TRcs	35.72805225	-111.326359	0	6	SW6020	Arsenic	mg/kg	7.4	NR
459-TP23-0-0.5-120618 DUP	12/6/2018	TRcs	35.72805225	-111.326359	0	6	SW7471	Mercury	mg/kg	0.0069 J	NR
459-TP23-0-0.5-120618 DUP	12/6/2018	TRcs	35.72805225	-111.326359	0	6	SW6010	Molybdenum	mg/kg	38	NR
459-TP23-0-0.5-120618 DUP	12/6/2018	TRcs	35.72805225	-111.326359	0	6	713R14	Radium-226	pCi/g	14 M3	NR
459-TP23-0-0.5-120618 DUP	12/6/2018	TRcs	35.72805225	-111.326359	0	6	SW6010	Selenium	mg/kg	0.053 U	NR
459-TP23-0-0.5-120618 DUP	12/6/2018	TRcs	35.72805225	-111.326359	0	6	SW6020	Uranium	mg/kg	9.7	NR
459-TP23-0-0.5-120618 DUP	12/6/2018	TRcs	35.72805225	-111.326359	0	6	SW6010	Vanadium	mg/kg	5.5	NR
459-TP23-2.5-3.0-120618	12/6/2018	TRcs	35.72805225	-111.326359	30	36	SW6020	Arsenic	mg/kg	8.3	NR
459-TP23-2.5-3.0-120618	12/6/2018	TRcs	35.72805225	-111.326359	30	36	SW7471	Mercury	mg/kg	0.02 J	NR
459-TP23-2.5-3.0-120618	12/6/2018	TRcs	35.72805225	-111.326359	30	36	SW6010	Molybdenum	mg/kg	28	NR
459-TP23-2.5-3.0-120618	12/6/2018	TRcs	35.72805225	-111.326359	30	36	713R14	Radium-226	pCi/g	10.1 M3,G	NR
459-TP23-2.5-3.0-120618	12/6/2018	TRcs	35.72805225	-111.326359	30	36	SW6010	Selenium	mg/kg	0.056 J	NR
459-TP23-2.5-3.0-120618	12/6/2018	TRcs	35.72805225	-111.326359	30	36	SW6020	Uranium	mg/kg	8.9	NR
459-TP23-2.5-3.0-120618	12/6/2018	TRcs	35.72805225	-111.326359	30	36	SW6010	Vanadium	mg/kg	13	NR
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	SW6020B	Aluminum	mg/kg	10,500	97700
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	SW6010D	Antimony	mg/kg	1.84 U	1840
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	SW6020B	Arsenic	mg/kg	4.39	977
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	SW6020B	Barium	mg/kg	142	782
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	SW6020B	Beryllium	mg/kg	1.57	97.7
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	SW6020B	Cadmium	mg/kg	0.244	195
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	SW6020B	Chromium	mg/kg	7.46	586
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	SW6020B	Cobalt	mg/kg	9.45	195
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	SW6020B	Copper	mg/kg	17.8	391
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	SW6020B	Iron	mg/kg	13,300	195000
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	SW6020B	Lead	mg/kg	12.9	391
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	SW6020B	Manganese	mg/kg	68.2	977
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	SW7471B	Mercury	mg/kg	0.118	23.7
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	SW6020B	Molybdenum	mg/kg	12.8	195
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	SW6020B	Nickel	mg/kg	7.04	391
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	EH300	Radium-226	pCi/g	10.4	0.253
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	SW6020B	Selenium	mg/kg	2.49	977
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	SW6010D	Silver	mg/kg	0.461 U	461
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	SW6020B	Thallium	mg/kg	0.768	391
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	SW6020B	Uranium	mg/kg	18	39.1
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	SW6020B	Vanadium	mg/kg	29.4	3910
APE-SS01-01-020624	2/6/2024	Qay	35.74127889	-111.3309996	0	6	SW6020B	Zinc	mg/kg	21.5	3910
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	SW6020B	Aluminum	mg/kg	6,560	9810
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	SW6010D	Antimony	mg/kg	1.79 U	1790
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	SW6020B	Arsenic	mg/kg	1.2	981
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	SW6020B	Barium	mg/kg	424	7850
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	SW6020B	Beryllium	mg/kg	0.571	98.1
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	SW6020B	Cadmium	mg/kg	0.0715 J	196
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	SW6020B	Chromium	mg/kg	8.28	589
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	SW6020B	Cobalt	mg/kg	5.03	196
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	SW6020B	Copper	mg/kg	9.36	393
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	SW6020B	Iron	mg/kg	15,200	196000
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	SW6020B	Lead	mg/kg	7.34	393
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	SW6020B	Manganese	mg/kg	385	9810
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	SW7471B	Mercury	mg/kg	0.0242 U	24.2
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	SW6020B	Molybdenum	mg/kg	0.413	196
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	SW6020B	Nickel	mg/kg	12.5	393
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	EH300	Radium-226	pCi/g	1.94	0.118
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	SW6020B	Selenium	mg/kg	1.5	981
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	SW6010D	Silver	mg/kg	0.447 U	447
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	SW6020B	Thallium	mg/kg	0.393 U	393
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	SW6020B	Uranium	mg/kg	2.87	39.3
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	SW6020B	Vanadium	mg/kg	32.9	3930

Attachment B-1. Data Used in the Risk Assessment

Sample ID	Sample Date	Geologic Unit	Latitude	Longitude	Sample Top Depth (inches bgs)	Sample Bottom Depth (inches bgs)	Analytical Method	Analyte	Units	Result and Qualifier	Reporting Limit
APE-SS02-01-020624	2/6/2024	TRcp	35.74136614	-111.3270867	0	6	SW6020B	Zinc	mg/kg	11.4	3930
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	SW6020B	Aluminum	mg/kg	12,100	98000
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	SW6010D	Antimony	mg/kg	1.85 U	1850
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	SW6020B	Arsenic	mg/kg	3.55	980
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	SW6020B	Barium	mg/kg	24.8	784
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	SW6020B	Beryllium	mg/kg	1.19	98
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	SW6020B	Cadmium	mg/kg	0.196 U	196
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	SW6020B	Chromium	mg/kg	5.01	588
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	SW6020B	Cobalt	mg/kg	4.95	196
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	SW6020B	Copper	mg/kg	8.2	392
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	SW6020B	Iron	mg/kg	17,400	196000
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	SW6020B	Lead	mg/kg	6.65	392
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	SW6020B	Manganese	mg/kg	50.1	980
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	SW7471B	Mercury	mg/kg	0.0224 U	22.4
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	SW6020B	Molybdenum	mg/kg	0.133 J	196
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	SW6020B	Nickel	mg/kg	5.26	392
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	EH300	Radium-226	pCi/g	2.83	0.162
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	SW6020B	Selenium	mg/kg	2.3	980
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	SW6010D	Silver	mg/kg	0.462 U	462
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	SW6020B	Thallium	mg/kg	0.283 J	392
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	SW6020B	Uranium	mg/kg	3.77	39.2
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	SW6020B	Vanadium	mg/kg	19.1	3920
APE-SS03-01-020624	2/6/2024	TRcp	35.73871225	-111.3362055	0	6	SW6020B	Zinc	mg/kg	23	3920
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	SW6020B	Aluminum	mg/kg	18,400	92700
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	SW6010D	Antimony	mg/kg	2.04 U	2040
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	SW6020B	Arsenic	mg/kg	1.71	927
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	SW6020B	Barium	mg/kg	347	7410
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	SW6020B	Beryllium	mg/kg	1.18	92.7
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	SW6020B	Cadmium	mg/kg	0.0378 J	185
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	SW6020B	Chromium	mg/kg	7.78	556
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	SW6020B	Cobalt	mg/kg	4.72	185
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	SW6020B	Copper	mg/kg	12.8	371
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	SW6020B	Iron	mg/kg	15,900	185000
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	SW6020B	Lead	mg/kg	9.86	371
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	SW6020B	Manganese	mg/kg	155	927
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	SW7471B	Mercury	mg/kg	0.0236 U	23.6
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	SW6020B	Molybdenum	mg/kg	1.26	185
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	SW6020B	Nickel	mg/kg	4.75	371
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	EH300	Radium-226	pCi/g	2.3	0.198
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	SW6020B	Selenium	mg/kg	2.23	927
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	SW6010D	Silver	mg/kg	0.51 U	510
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	SW6020B	Thallium	mg/kg	0.143 J	371
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	SW6020B	Uranium	mg/kg	3.56	37.1
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	SW6020B	Vanadium	mg/kg	32	3710
APE-SS04-01-020624	2/6/2024	Qay	35.73902991	-111.3262952	0	6	SW6020B	Zinc	mg/kg	19.9	3710
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	SW6020B	Aluminum	mg/kg	6,070	9210
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	SW6010D	Antimony	mg/kg	2.01 U	2010
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	SW6020B	Arsenic	mg/kg	1.71	921
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	SW6020B	Barium	mg/kg	198	7370
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	SW6020B	Beryllium	mg/kg	0.538	92.1
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	SW6020B	Cadmium	mg/kg	0.0241 J	184
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	SW6020B	Chromium	mg/kg	2.82	553
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	SW6020B	Cobalt	mg/kg	1.87	184
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	SW6020B	Copper	mg/kg	6.64	369
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	SW6020B	Iron	mg/kg	5,130	18400
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	SW6020B	Lead	mg/kg	4.48	369
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	SW6020B	Manganese	mg/kg	119	921
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	SW7471B	Mercury	mg/kg	0.0214 U	21.4
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	SW6020B	Molybdenum	mg/kg	0.258	184
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	SW6020B	Nickel	mg/kg	2.24	369
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	EH300	Radium-226	pCi/g	1.35	0.176
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	SW6020B	Selenium	mg/kg	3.15	921
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	SW6010D	Silver	mg/kg	0.501 U	501
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	SW6020B	Thallium	mg/kg	0.369 U	369
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	SW6020B	Uranium	mg/kg	1.58	36.9
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	SW6020B	Vanadium	mg/kg	12.9	3690
APE-SS05-01-020624	2/6/2024	TRcs	35.73613483	-111.3298466	0	6	SW6020B	Zinc	mg/kg	10.8	3690
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	SW6020B	Aluminum	mg/kg	6,710	9280
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	SW6010D	Antimony	mg/kg	1.81 U	1810
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	SW6020B	Arsenic	mg/kg	0.749 J	928
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	SW6020B	Barium	mg/kg	223	7430
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	SW6020B	Beryllium	mg/kg	0.726	92.8
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	SW6020B	Cadmium	mg/kg	0.122 J	186
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	SW6020B	Chromium	mg/kg	5	557
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	SW6020B	Cobalt	mg/kg	3.5	186
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	SW6020B	Copper	mg/kg	6.99	371
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	SW6020B	Iron	mg/kg	8,130	18600
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	SW6020B	Lead	mg/kg	5.4	371
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	SW6020B	Manganese	mg/kg	110	928
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	SW7471B	Mercury	mg/kg	0.0116 J	22.1
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	SW6020B	Molybdenum	mg/kg	0.4	186
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	SW6020B	Nickel	mg/kg	4.57	371
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	EH300	Radium-226	pCi/g	1.51	0.144
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	SW6020B	Selenium	mg/kg	0.795 J	928
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	SW6010D	Silver	mg/kg	0.454 U	454
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	SW6020B	Thallium	mg/kg	0.371 U	371
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	SW6020B	Uranium	mg/kg	1.73	37.1
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	SW6020B	Vanadium	mg/kg	17	3710

Attachment B-1. Data Used in the Risk Assessment

Sample ID	Sample Date	Geologic Unit	Latitude	Longitude	Sample Top Depth (inches bgs)	Sample Bottom Depth (inches bgs)	Analytical Method	Analyte	Units	Result and Qualifier		Reporting Limit
APE-SS06-01-020624	2/6/2024	Qay	35.73580051	-111.324986	0	6	SW6020B	Zinc	mg/kg	9.15		3710
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW6020B	Aluminum	mg/kg	2,210		9210
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW6010D	Antimony	mg/kg	1.8	U	1800
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW6020B	Arsenic	mg/kg	9.09		921
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW6020B	Barium	mg/kg	52.2		737
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW6020B	Beryllium	mg/kg	0.373		92.1
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW6020B	Cadmium	mg/kg	0.125	J	184
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW6020B	Chromium	mg/kg	3.05	J	553
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW6020B	Cobalt	mg/kg	0.641		184
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW6020B	Copper	mg/kg	5.48		368
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW7196A	xavalent Chromi	mg/kg	0.247	J	0.318
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW6020B	Iron	mg/kg	1,660		18400
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW6020B	Lead	mg/kg	4.03	J	368
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW6020B	Manganese	mg/kg	4.96		921
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW7471B	Mercury	mg/kg	0.0121	J	23.3
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW6020B	Molybdenum	mg/kg	110		184
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW6020B	Nickel	mg/kg	0.437		368
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	EH300	Radium-226	pCi/g	15.4		0.314
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW6020B	Selenium	mg/kg	1.28		921
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW6010D	Silver	mg/kg	0.45	U	450
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW6020B	Thallium	mg/kg	0.413		368
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW6020B	Uranium	mg/kg	18.3	J	36.8
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW6020B	Vanadium	mg/kg	5.09	J	3680
APE-SS07-01-020624	2/6/2024	TRcs	35.73422809	-111.3323634	0	6	SW6020B	Zinc	mg/kg	2.69	J	3680
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	SW6020B	Aluminum	mg/kg	3,650		9310
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	SW6010D	Antimony	mg/kg	1.89	U	1890
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	SW6020B	Arsenic	mg/kg	0.961		931
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	SW6020B	Barium	mg/kg	238		7450
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	SW6020B	Beryllium	mg/kg	0.333		93.1
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	SW6020B	Cadmium	mg/kg	0.186	U	186
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	SW6020B	Chromium	mg/kg	3.57		559
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	SW6020B	Cobalt	mg/kg	2.03		186
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	SW6020B	Copper	mg/kg	4.87		373
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	SW6020B	Iron	mg/kg	6,150		18600
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	SW6020B	Lead	mg/kg	4.27		373
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	SW6020B	Manganese	mg/kg	176		931
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	SW7471B	Mercury	mg/kg	0.0216	U	21.6
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	SW6020B	Molybdenum	mg/kg	0.245		186
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	SW6020B	Nickel	mg/kg	4.36		373
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	EH300	Radium-226	pCi/g	1.27		0.119
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	SW6020B	Selenium	mg/kg	1.49		931
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	SW6010D	Silver	mg/kg	0.0999	J-	473
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	SW6020B	Thallium	mg/kg	0.373	U	373
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	SW6020B	Uranium	mg/kg	0.99		37.3
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	SW6020B	Vanadium	mg/kg	12.4		3730
APE-SS08-01-020624	2/6/2024	TRcs	35.73262085	-111.3290006	0	6	SW6020B	Zinc	mg/kg	8.46		3730
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	SW6020B	Aluminum	mg/kg	3,670		9350
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	SW6010D	Antimony	mg/kg	1.81	U	1810
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	SW6020B	Arsenic	mg/kg	4.07		935
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	SW6020B	Barium	mg/kg	212		7480
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	SW6020B	Beryllium	mg/kg	0.408		93.5
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	SW6020B	Cadmium	mg/kg	0.187	U	187
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	SW6020B	Chromium	mg/kg	3.19		561
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	SW6020B	Cobalt	mg/kg	5.32		187
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	SW6020B	Copper	mg/kg	6.15		374
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	SW6020B	Iron	mg/kg	6,110		18700
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	SW6020B	Lead	mg/kg	6.33		374
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	SW6020B	Manganese	mg/kg	104		935
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	SW7471B	Mercury	mg/kg	0.016	J	21.2
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	SW6020B	Molybdenum	mg/kg	7.74		187
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	SW6020B	Nickel	mg/kg	3.69		374
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	EH300	Radium-226	pCi/g	5.67		0.164
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	SW6020B	Selenium	mg/kg	1.06		935
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	SW6010D	Silver	mg/kg	0.453	U	453
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	SW6020B	Thallium	mg/kg	0.389		374
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	SW6020B	Uranium	mg/kg	5.92		37.4
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	SW6020B	Vanadium	mg/kg	11.6		3740
APE-SS09-01-020624	2/6/2024	TRcs	35.73250079	-111.3257922	0	6	SW6020B	Zinc	mg/kg	13.2		3740
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW6020B	Aluminum	mg/kg	7,620		8620
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW6010D	Antimony	mg/kg	1.73	U	1730
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW6020B	Arsenic	mg/kg	1.28		862
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW6020B	Barium	mg/kg	273		6900
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW6020B	Beryllium	mg/kg	0.468		86.2
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW6020B	Cadmium	mg/kg	0.172	U	172
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW6020B	Chromium	mg/kg	8.51		517
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW6020B	Cobalt	mg/kg	4.98		172
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW6020B	Copper	mg/kg	8.69		345
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW7196A	xavalent Chromi	mg/kg	0.145	U	0.361
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW6020B	Iron	mg/kg	10,800		172000
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW6020B	Lead	mg/kg	5.29		345
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW6020B	Manganese	mg/kg	262		8620
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW7471B	Mercury	mg/kg	0.0224	U	22.4
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW6020B	Molybdenum	mg/kg	0.553		172
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW6020B	Nickel	mg/kg	13.2		345
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	EH300	Radium-226	pCi/g	1.41		0.111
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW6020B	Selenium	mg/kg	1.14		862
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW6010D	Silver	mg/kg	0.433	U	433
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW6020B	Thallium	mg/kg	0.345	U	345

Attachment B-1. Data Used in the Risk Assessment

Sample ID	Sample Date	Geologic Unit	Latitude	Longitude	Sample Top Depth (inches bgs)	Sample Bottom Depth (inches bgs)	Analytical Method	Analyte	Units	Result and Qualifier		Reporting Limit
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW6020B	Uranium	mg/kg	1.23		34.5
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW6020B	Vanadium	mg/kg	21		3450
APE-SS10-01-020624	2/6/2024	Qay	35.72981921	-111.32459	0	6	SW6020B	Zinc	mg/kg	16.4		3450
Drain-TP16-0-0.5-120318	12/3/2018	Qay	35.73125649	-111.3266748	0	6	SW6020	Arsenic	mg/kg	1.7		NR
Drain-TP16-0-0.5-120318	12/3/2018	Qay	35.73125649	-111.3266748	0	6	SW7471	Mercury	mg/kg	5.8E-05	U	NR
Drain-TP16-0-0.5-120318	12/3/2018	Qay	35.73125649	-111.3266748	0	6	SW6010	Molybdenum	mg/kg	0.27	J	NR
Drain-TP16-0-0.5-120318	12/3/2018	Qay	35.73125649	-111.3266748	0	6	713R14	Radium-226	pCi/g	1.23	M3	NR
Drain-TP16-0-0.5-120318	12/3/2018	Qay	35.73125649	-111.3266748	0	6	SW6010	Selenium	mg/kg	0.051	U	NR
Drain-TP16-0-0.5-120318	12/3/2018	Qay	35.73125649	-111.3266748	0	6	SW6020	Uranium	mg/kg	1.3		NR
Drain-TP16-0-0.5-120318	12/3/2018	Qay	35.73125649	-111.3266748	0	6	SW6010	Vanadium	mg/kg	24		NR
Drain-TP16-1.0-1.5-120318	12/3/2018	Qay	35.73125649	-111.3266748	12	18	SW6020	Arsenic	mg/kg	2		NR
Drain-TP16-1.0-1.5-120318	12/3/2018	Qay	35.73125649	-111.3266748	12	18	SW7471	Mercury	mg/kg	6.2E-05	U	NR
Drain-TP16-1.0-1.5-120318	12/3/2018	Qay	35.73125649	-111.3266748	12	18	SW6010	Molybdenum	mg/kg	0.2	J	NR
Drain-TP16-1.0-1.5-120318	12/3/2018	Qay	35.73125649	-111.3266748	12	18	713R14	Radium-226	pCi/g	1.2	M3,G	NR
Drain-TP16-1.0-1.5-120318	12/3/2018	Qay	35.73125649	-111.3266748	12	18	SW6010	Selenium	mg/kg	0.052	U	NR
Drain-TP16-1.0-1.5-120318	12/3/2018	Qay	35.73125649	-111.3266748	12	18	SW6020	Uranium	mg/kg	1.3		NR
Drain-TP16-1.0-1.5-120318	12/3/2018	Qay	35.73125649	-111.3266748	12	18	SW6010	Vanadium	mg/kg	29		NR
Drain-TP2-0.5-1.0-120418	12/4/2018	Qay	35.74170359	-111.3242333	6	12	SW6020	Arsenic	mg/kg	3.7		NR
Drain-TP2-0.5-1.0-120418	12/4/2018	Qay	35.74170359	-111.3242333	6	12	SW7471	Mercury	mg/kg	0.0065	J	NR
Drain-TP2-0.5-1.0-120418	12/4/2018	Qay	35.74170359	-111.3242333	6	12	SW6010	Molybdenum	mg/kg	3.5		NR
Drain-TP2-0.5-1.0-120418	12/4/2018	Qay	35.74170359	-111.3242333	6	12	713R14	Radium-226	pCi/g	2.82	M3,G	NR
Drain-TP2-0.5-1.0-120418	12/4/2018	Qay	35.74170359	-111.3242333	6	12	SW6010	Selenium	mg/kg	0.051	U	NR
Drain-TP2-0.5-1.0-120418	12/4/2018	Qay	35.74170359	-111.3242333	6	12	SW6020	Uranium	mg/kg	3.4		NR
Drain-TP2-0.5-1.0-120418	12/4/2018	Qay	35.74170359	-111.3242333	6	12	SW6010	Vanadium	mg/kg	41		NR
Drain-TP2-1.0-1.5-120418	12/4/2018	Qay	35.74170359	-111.3242333	12	18	SW6020	Arsenic	mg/kg	3.4		NR
Drain-TP2-1.0-1.5-120418	12/4/2018	Qay	35.74170359	-111.3242333	12	18	SW7471	Mercury	mg/kg	0.0012	J	NR
Drain-TP2-1.0-1.5-120418	12/4/2018	Qay	35.74170359	-111.3242333	12	18	SW6010	Molybdenum	mg/kg	2.1		NR
Drain-TP2-1.0-1.5-120418	12/4/2018	Qay	35.74170359	-111.3242333	12	18	713R14	Radium-226	pCi/g	2.69	M3,G	NR
Drain-TP2-1.0-1.5-120418	12/4/2018	Qay	35.74170359	-111.3242333	12	18	SW6010	Selenium	mg/kg	0.058	U	NR
Drain-TP2-1.0-1.5-120418	12/4/2018	Qay	35.74170359	-111.3242333	12	18	SW6020	Uranium	mg/kg	3.9		NR
Drain-TP2-1.0-1.5-120418	12/4/2018	Qay	35.74170359	-111.3242333	12	18	SW6010	Vanadium	mg/kg	42		NR
Drain-TP7-0-0.5-120418	12/4/2018	TRcs	35.73951855	-111.3235367	0	6	SW6020	Arsenic	mg/kg	2.7		NR
Drain-TP7-0-0.5-120418	12/4/2018	TRcs	35.73951855	-111.3235367	0	6	SW7471	Mercury	mg/kg	6.2E-05	U	NR
Drain-TP7-0-0.5-120418	12/4/2018	TRcs	35.73951855	-111.3235367	0	6	SW6010	Molybdenum	mg/kg	18		NR
Drain-TP7-0-0.5-120418	12/4/2018	TRcs	35.73951855	-111.3235367	0	6	713R14	Radium-226	pCi/g	5.71	M3	NR
Drain-TP7-0-0.5-120418	12/4/2018	TRcs	35.73951855	-111.3235367	0	6	SW6010	Selenium	mg/kg	0.12	J	NR
Drain-TP7-0-0.5-120418	12/4/2018	TRcs	35.73951855	-111.3235367	0	6	SW6020	Uranium	mg/kg	6		NR
Drain-TP7-0-0.5-120418	12/4/2018	TRcs	35.73951855	-111.3235367	0	6	SW6010	Vanadium	mg/kg	19		NR
Drain-TP7-1.0-1.5-120418	12/4/2018	TRcs	35.73951855	-111.3235367	12	18	SW6020	Arsenic	mg/kg	1.7		NR
Drain-TP7-1.0-1.5-120418	12/4/2018	TRcs	35.73951855	-111.3235367	12	18	SW7471	Mercury	mg/kg	5.8E-05	U	NR
Drain-TP7-1.0-1.5-120418	12/4/2018	TRcs	35.73951855	-111.3235367	12	18	SW6010	Molybdenum	mg/kg	7.9		NR
Drain-TP7-1.0-1.5-120418	12/4/2018	TRcs	35.73951855	-111.3235367	12	18	713R14	Radium-226	pCi/g	1.69	M3	NR
Drain-TP7-1.0-1.5-120418	12/4/2018	TRcs	35.73951855	-111.3235367	12	18	SW6010	Selenium	mg/kg	0.15	J	NR
Drain-TP7-1.0-1.5-120418	12/4/2018	TRcs	35.73951855	-111.3235367	12	18	SW6020	Uranium	mg/kg	3.6		NR
Drain-TP7-1.0-1.5-120418	12/4/2018	TRcs	35.73951855	-111.3235367	12	18	SW6010	Vanadium	mg/kg	17		NR
Drain-TP8-0.5-1.0-120418	12/4/2018	TRcs	35.7394395	-111.3233345	6	12	SW6020	Arsenic	mg/kg	12		NR
Drain-TP8-0.5-1.0-120418	12/4/2018	TRcs	35.7394395	-111.3233345	6	12	SW7471	Mercury	mg/kg	0.028	J	NR
Drain-TP8-0.5-1.0-120418	12/4/2018	TRcs	35.7394395	-111.3233345	6	12	SW6010	Molybdenum	mg/kg	53		NR
Drain-TP8-0.5-1.0-120418	12/4/2018	TRcs	35.7394395	-111.3233345	6	12	713R14	Radium-226	pCi/g	31.3	M3	NR
Drain-TP8-0.5-1.0-120418	12/4/2018	TRcs	35.7394395	-111.3233345	6	12	SW6010	Selenium	mg/kg	0.23	J	NR
Drain-TP8-0.5-1.0-120418	12/4/2018	TRcs	35.7394395	-111.3233345	6	12	SW6020	Uranium	mg/kg	21		NR
Drain-TP8-0.5-1.0-120418	12/4/2018	TRcs	35.7394395	-111.3233345	6	12	SW6010	Vanadium	mg/kg	23		NR
Drain-TP8-0-0.5-120418	12/4/2018	TRcs	35.7394395	-111.3233345	0	6	SW6020	Arsenic	mg/kg	6.3		NR
Drain-TP8-0-0.5-120418	12/4/2018	TRcs	35.7394395	-111.3233345	0	6	SW7471	Mercury	mg/kg	0.019	J	NR
Drain-TP8-0-0.5-120418	12/4/2018	TRcs	35.7394395	-111.3233345	0	6	SW6010	Molybdenum	mg/kg	37		NR
Drain-TP8-0-0.5-120418	12/4/2018	TRcs	35.7394395	-111.3233345	0	6	713R14	Radium-226	pCi/g	37.5	M3	NR
Drain-TP8-0-0.5-120418	12/4/2018	TRcs	35.7394395	-111.3233345	0	6	SW6010	Selenium	mg/kg	0.32	J	NR
Drain-TP8-0-0.5-120418	12/4/2018	TRcs	35.7394395	-111.3233345	0	6	SW6020	Uranium	mg/kg	14		NR
Drain-TP8-0-0.5-120418	12/4/2018	TRcs	35.7394395	-111.3233345	0	6	SW6010	Vanadium	mg/kg	25		NR
Drain-TP8-2.5-3.0-120418	12/4/2018	TRcs	35.7394395	-111.3233345	30	36	SW6020	Arsenic	mg/kg	2.2		NR
Drain-TP8-2.5-3.0-120418	12/4/2018	TRcs	35.7394395	-111.3233345	30	36	SW7471	Mercury	mg/kg	5.9E-05	U	NR
Drain-TP8-2.5-3.0-120418	12/4/2018	TRcs	35.7394395	-111.3233345	30	36	SW6010	Molybdenum	mg/kg	6.5		NR
Drain-TP8-2.5-3.0-120418	12/4/2018	TRcs	35.7394395	-111.3233345	30	36	713R14	Radium-226	pCi/g	1.76	M3	NR
Drain-TP8-2.5-3.0-120418	12/4/2018	TRcs	35.7394395	-111.3233345	30	36	SW6010	Selenium	mg/kg	0.057	J	NR
Drain-TP8-2.5-3.0-120418	12/4/2018	TRcs	35.7394395	-111.3233345	30	36	SW6020	Uranium	mg/kg	2.8		NR
Drain-TP8-2.5-3.0-120418	12/4/2018	TRcs	35.7394395	-111.3233345	30	36	SW6010	Vanadium	mg/kg	21		NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	6010C DOD	Aluminum	mg/kg	4,500	D	NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	6010C DOD	Antimony	mg/kg	6.5	U	NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	6010C DOD	Arsenic	mg/kg	3.2	U	NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	6010C DOD	Barium	mg/kg	180	D	NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	6010C DOD	Beryllium	mg/kg	1.7	U	NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	6010C DOD	Cadmium	mg/kg	1	U	NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	6010C DOD	Chromium	mg/kg	6.4	JD	NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	6010C DOD	Cobalt	mg/kg	14	JD	NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	6010C DOD	Copper	mg/kg	9.4	JD	NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	6010C DOD	Iron	mg/kg	13,000	D	NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	6010C DOD	Lead	mg/kg	6.2	JD	NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	6010C DOD	Manganese	mg/kg	270	D	NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	6010C DOD	Mercury	mg/kg	0.011	U	NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	6010C DOD	Molybdenum	mg/kg	10	U	NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	6010C DOD	Nickel	mg/kg	17	JD	NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	GA-01-R	Radium-226	pCi/g	1.3		NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	6010C DOD	Selenium	mg/kg	2.9	U	NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	6010C DOD	Silver	mg/kg	2.4	U	NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	6010C DOD	Thallium	mg/kg	15	U	NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	6010C DOD	Uranium	mg/kg	110	U	NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	6010C DOD	Vanadium	mg/kg	26	JD	NR
DRN-SD-1	8/8/2013	Qay	35.72931547	-111.3265101	0	6	6010C DOD	Zinc	mg/kg	20	U	NR

Attachment B-1. Data Used in the Risk Assessment

Sample ID	Sample Date	Geologic Unit	Latitude	Longitude	Sample Top Depth (inches bgs)	Sample Bottom Depth (inches bgs)	Analytical Method	Analyte	Units	Result and Qualifier		Reporting Limit
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	6010C DOD	Aluminum	mg/kg	4,200	D	NR
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	6010C DOD	Antimony	mg/kg	6.3	U	NR
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	6010C DOD	Arsenic	mg/kg	3.1	U	NR
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	6010C DOD	Barium	mg/kg	210	D	NR
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	6010C DOD	Beryllium	mg/kg	1.7	U	NR
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	6010C DOD	Cadmium	mg/kg	0.99	U	NR
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	6010C DOD	Chromium	mg/kg	4.9	JD	NR
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	6010C DOD	Cobalt	mg/kg	10	JD	NR
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	6010C DOD	Copper	mg/kg	9.2	JD	NR
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	6010C DOD	Iron	mg/kg	12,000	D	NR
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	6010C DOD	Lead	mg/kg	5.8	JD	NR
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	6010C DOD	Manganese	mg/kg	260	D	NR
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	6010C DOD	Mercury	mg/kg	0.011	U	NR
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	6010C DOD	Molybdenum	mg/kg	9.9	U	NR
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	6010C DOD	Nickel	mg/kg	14	JD	NR
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	GA-01-R	Radium-226	pCi/g	0.977		NR
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	6010C DOD	Selenium	mg/kg	2.9	U	NR
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	6010C DOD	Silver	mg/kg	2.3	U	NR
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	6010C DOD	Thallium	mg/kg	15	U	NR
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	6010C DOD	Uranium	mg/kg	72	U	NR
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	6010C DOD	Vanadium	mg/kg	24	JD	NR
DRN-SD-2	8/8/2013	Qay	35.73094747	-111.3273461	0	6	6010C DOD	Zinc	mg/kg	20	U	NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Aluminum	mg/kg	3,000	D	NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Antimony	mg/kg	6	U	NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Arsenic	mg/kg	3	U	NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Barium	mg/kg	100	D	NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Beryllium	mg/kg	1.6	U	NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Cadmium	mg/kg	0.94	U	NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Chromium	mg/kg	4.7	JD	NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Cobalt	mg/kg	8.8	U	NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Copper	mg/kg	7.9	JD	NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Iron	mg/kg	10,000	D	NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Lead	mg/kg	4	JD	NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Manganese	mg/kg	360	D	NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Mercury	mg/kg	0.011	U	NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Molybdenum	mg/kg	9.4	U	NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Nickel	mg/kg	13	JD	NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	GA-01-R	Radium-226	pCi/g	1.37		NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Selenium	mg/kg	2.7	U	NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Silver	mg/kg	2.2	U	NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Thallium	mg/kg	14	U	NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Uranium	mg/kg	52	U	NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Vanadium	mg/kg	22	JD	NR
DRN-SD-3	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Zinc	mg/kg	19	U	NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Aluminum	mg/kg	3,300	D	NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Antimony	mg/kg	6.4	U	NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Arsenic	mg/kg	3.2	U	NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Barium	mg/kg	180	D	NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Beryllium	mg/kg	1.7	U	NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Cadmium	mg/kg	1	U	NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Chromium	mg/kg	5.3	JD	NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Cobalt	mg/kg	9.4	U	NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Copper	mg/kg	7.9	JD	NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Iron	mg/kg	11,000	D	NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Lead	mg/kg	5.9	JD	NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Manganese	mg/kg	540	D	NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Mercury	mg/kg	0.011	U	NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Molybdenum	mg/kg	10	U	NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Nickel	mg/kg	14	JD	NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	GA-01-R	Radium-226	pCi/g	3.74		NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Selenium	mg/kg	2.9	U	NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Silver	mg/kg	2.3	U	NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Thallium	mg/kg	15	U	NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Uranium	mg/kg	86	U	NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Vanadium	mg/kg	24	JD	NR
DRN-SD-4	8/8/2013	Qay	35.73128747	-111.3262291	0	6	6010C DOD	Zinc	mg/kg	20	U	NR
LCR-TP11-2.0-2.5-120318	12/3/2018	TRcs	35.73897172	-111.3227054	24	30	SW6020	Arsenic	mg/kg	2.4		NR
LCR-TP11-2.0-2.5-120318	12/3/2018	TRcs	35.73897172	-111.3227054	24	30	SW7471	Mercury	mg/kg	0.0099	J	NR
LCR-TP11-2.0-2.5-120318	12/3/2018	TRcs	35.73897172	-111.3227054	24	30	SW6010	Molybdenum	mg/kg	0.77	J	NR
LCR-TP11-2.0-2.5-120318	12/3/2018	TRcs	35.73897172	-111.3227054	24	30	713R14	Radium-226	pCi/g	1.81	M3,G	NR
LCR-TP11-2.0-2.5-120318	12/3/2018	TRcs	35.73897172	-111.3227054	24	30	SW6010	Selenium	mg/kg	0.061	U	NR
LCR-TP11-2.0-2.5-120318	12/3/2018	TRcs	35.73897172	-111.3227054	24	30	SW6020	Uranium	mg/kg	1.5		NR
LCR-TP11-2.0-2.5-120318	12/3/2018	TRcs	35.73897172	-111.3227054	24	30	SW6010	Vanadium	mg/kg	23		NR
LCR-TP12-0-0.5-120318	12/3/2018	TRcs	35.73867986	-111.3226603	0	6	SW6020	Arsenic	mg/kg	2.4		NR
LCR-TP12-0-0.5-120318	12/3/2018	TRcs	35.73867986	-111.3226603	0	6	SW7471	Mercury	mg/kg	7.1E-05	U	NR
LCR-TP12-0-0.5-120318	12/3/2018	TRcs	35.73867986	-111.3226603	0	6	SW6010	Molybdenum	mg/kg	0.71	J	NR
LCR-TP12-0-0.5-120318	12/3/2018	TRcs	35.73867986	-111.3226603	0	6	713R14	Radium-226	pCi/g	1.48	M3,G	NR
LCR-TP12-0-0.5-120318	12/3/2018	TRcs	35.73867986	-111.3226603	0	6	SW6010	Selenium	mg/kg	0.06	U	NR
LCR-TP12-0-0.5-120318	12/3/2018	TRcs	35.73867986	-111.3226603	0	6	SW6020	Uranium	mg/kg	1.8		NR
LCR-TP12-0-0.5-120318	12/3/2018	TRcs	35.73867986	-111.3226603	0	6	SW6010	Vanadium	mg/kg	25		NR
LCR-TP12-1.0-1.5-120318	12/3/2018	TRcs	35.73867986	-111.3226603	12	18	SW6020	Arsenic	mg/kg	2.6		NR
LCR-TP12-1.0-1.5-120318	12/3/2018	TRcs	35.73867986	-111.3226603	12	18	SW7471	Mercury	mg/kg	0.0089	J	NR
LCR-TP12-1.0-1.5-120318	12/3/2018	TRcs	35.73867986	-111.3226603	12	18	SW6010	Molybdenum	mg/kg	0.71	J	NR
LCR-TP12-1.0-1.5-120318	12/3/2018	TRcs	35.73867986	-111.3226603	12	18	713R14	Radium-226	pCi/g	1.86	M3,G	NR
LCR-TP12-1.0-1.5-120318	12/3/2018	TRcs	35.73867986	-111.3226603	12	18	SW6010	Selenium	mg/kg	0.056	U	NR
LCR-TP12-1.0-1.5-120318	12/3/2018	TRcs	35.73867986	-111.3226603	12	18	SW6020	Uranium	mg/kg	2		NR
LCR-TP12-1.0-1.5-120318	12/3/2018	TRcs	35.73867986	-111.3226603	12	18	SW6010	Vanadium	mg/kg	26		NR
LCR-TP9-2.0-2.5-120318	12/3/2018	TRcs	35.73935962	-111.3228092	24	30	SW6020	Arsenic	mg/kg	10		NR

Attachment B-1. Data Used in the Risk Assessment

Sample ID	Sample Date	Geologic Unit	Latitude	Longitude	Sample Top Depth (inches bgs)	Sample Bottom Depth (inches bgs)	Analytical Method	Analyte	Units	Result and Qualifier		Reporting Limit
LCR-TP9-2.0-2.5-120318	12/3/2018	TRcs	35.73935962	-111.3228092	24	30	SW7471	Mercury	mg/kg	0.17		NR
LCR-TP9-2.0-2.5-120318	12/3/2018	TRcs	35.73935962	-111.3228092	24	30	SW6010	Molybdenum	mg/kg	78		NR
LCR-TP9-2.0-2.5-120318	12/3/2018	TRcs	35.73935962	-111.3228092	24	30	713R14	Radium-226	pCi/g	58.2	M3	NR
LCR-TP9-2.0-2.5-120318	12/3/2018	TRcs	35.73935962	-111.3228092	24	30	SW6010	Selenium	mg/kg	0.047	U	NR
LCR-TP9-2.0-2.5-120318	12/3/2018	TRcs	35.73935962	-111.3228092	24	30	SW6020	Uranium	mg/kg	28		NR
LCR-TP9-2.0-2.5-120318	12/3/2018	TRcs	35.73935962	-111.3228092	24	30	SW6010	Vanadium	mg/kg	16		NR
LCR-TP9-3.0-3.5-120318	12/3/2018	TRcs	35.73935962	-111.3228092	36	42	SW6020	Arsenic	mg/kg	7.9		NR
LCR-TP9-3.0-3.5-120318	12/3/2018	TRcs	35.73935962	-111.3228092	36	42	SW7471	Mercury	mg/kg	0.16		NR
LCR-TP9-3.0-3.5-120318	12/3/2018	TRcs	35.73935962	-111.3228092	36	42	SW6010	Molybdenum	mg/kg	34		NR
LCR-TP9-3.0-3.5-120318	12/3/2018	TRcs	35.73935962	-111.3228092	36	42	713R14	Radium-226	pCi/g	55.7	M3	NR
LCR-TP9-3.0-3.5-120318	12/3/2018	TRcs	35.73935962	-111.3228092	36	42	SW6010	Selenium	mg/kg	0.074	J	NR
LCR-TP9-3.0-3.5-120318	12/3/2018	TRcs	35.73935962	-111.3228092	36	42	SW6020	Uranium	mg/kg	37		NR
LCR-TP9-3.0-3.5-120318	12/3/2018	TRcs	35.73935962	-111.3228092	36	42	SW6010	Vanadium	mg/kg	21		NR
LCR-TP9-4.5-5.0-120318	12/3/2018	TRcs	35.73935962	-111.3228092	54	60	SW6020	Arsenic	mg/kg	3.6		NR
LCR-TP9-4.5-5.0-120318	12/3/2018	TRcs	35.73935962	-111.3228092	54	60	SW7471	Mercury	mg/kg	0.028	J	NR
LCR-TP9-4.5-5.0-120318	12/3/2018	TRcs	35.73935962	-111.3228092	54	60	SW6010	Molybdenum	mg/kg	18		NR
LCR-TP9-4.5-5.0-120318	12/3/2018	TRcs	35.73935962	-111.3228092	54	60	713R14	Radium-226	pCi/g	7.37	M3,G	NR
LCR-TP9-4.5-5.0-120318	12/3/2018	TRcs	35.73935962	-111.3228092	54	60	SW6010	Selenium	mg/kg	0.063	U	NR
LCR-TP9-4.5-5.0-120318	12/3/2018	TRcs	35.73935962	-111.3228092	54	60	SW6020	Uranium	mg/kg	16		NR
LCR-TP9-4.5-5.0-120318	12/3/2018	TRcs	35.73935962	-111.3228092	54	60	SW6010	Vanadium	mg/kg	22		NR
MHR-TP17-0-0.5-120618	12/6/2018	TRcs	35.73049136	-111.3259239	0	6	SW6020	Arsenic	mg/kg	8.2		NR
MHR-TP17-0-0.5-120618	12/6/2018	TRcs	35.73049136	-111.3259239	0	6	SW7471	Mercury	mg/kg	0.0027	J	NR
MHR-TP17-0-0.5-120618	12/6/2018	TRcs	35.73049136	-111.3259239	0	6	SW6010	Molybdenum	mg/kg	27		NR
MHR-TP17-0-0.5-120618	12/6/2018	TRcs	35.73049136	-111.3259239	0	6	713R14	Radium-226	pCi/g	8.7	M3	NR
MHR-TP17-0-0.5-120618	12/6/2018	TRcs	35.73049136	-111.3259239	0	6	SW6010	Selenium	mg/kg	0.054	U	NR
MHR-TP17-0-0.5-120618	12/6/2018	TRcs	35.73049136	-111.3259239	0	6	SW6020	Uranium	mg/kg	11		NR
MHR-TP17-0-0.5-120618	12/6/2018	TRcs	35.73049136	-111.3259239	0	6	SW6010	Vanadium	mg/kg	20		NR
MHR-TP17-2.0-2.5-120618	12/6/2018	TRcs	35.73049136	-111.3259239	24	30	SW6020	Arsenic	mg/kg	2		NR
MHR-TP17-2.0-2.5-120618	12/6/2018	TRcs	35.73049136	-111.3259239	24	30	SW7471	Mercury	mg/kg	6.2E-05	U	NR
MHR-TP17-2.0-2.5-120618	12/6/2018	TRcs	35.73049136	-111.3259239	24	30	SW6010	Molybdenum	mg/kg	13		NR
MHR-TP17-2.0-2.5-120618	12/6/2018	TRcs	35.73049136	-111.3259239	24	30	713R14	Radium-226	pCi/g	1.64	M3	NR
MHR-TP17-2.0-2.5-120618	12/6/2018	TRcs	35.73049136	-111.3259239	24	30	SW6010	Selenium	mg/kg	0.047	U	NR
MHR-TP17-2.0-2.5-120618	12/6/2018	TRcs	35.73049136	-111.3259239	24	30	SW6020	Uranium	mg/kg	3.9		NR
MHR-TP17-2.0-2.5-120618	12/6/2018	TRcs	35.73049136	-111.3259239	24	30	SW6010	Vanadium	mg/kg	21		NR
MHR-TP22-0-0.5-120518	12/5/2018	TRcp	35.72912061	-111.3315926	0	6	SW6020	Arsenic	mg/kg	2.1		NR
MHR-TP22-0-0.5-120518	12/5/2018	TRcp	35.72912061	-111.3315926	0	6	SW7471	Mercury	mg/kg	0.065		NR
MHR-TP22-0-0.5-120518	12/5/2018	TRcp	35.72912061	-111.3315926	0	6	SW6010	Molybdenum	mg/kg	0.2	J	NR
MHR-TP22-0-0.5-120518	12/5/2018	TRcp	35.72912061	-111.3315926	0	6	713R14	Radium-226	pCi/g	2.69	M3	NR
MHR-TP22-0-0.5-120518	12/5/2018	TRcp	35.72912061	-111.3315926	0	6	SW6010	Selenium	mg/kg	0.054	U	NR
MHR-TP22-0-0.5-120518	12/5/2018	TRcp	35.72912061	-111.3315926	0	6	SW6020	Uranium	mg/kg	2.7		NR
MHR-TP22-0-0.5-120518	12/5/2018	TRcp	35.72912061	-111.3315926	0	6	SW6010	Vanadium	mg/kg	13		NR
MHR-TP22-1.0-1.5-120518	12/5/2018	TRcp	35.72912061	-111.3315926	12	18	SW6020	Arsenic	mg/kg	2.4		NR
MHR-TP22-1.0-1.5-120518	12/5/2018	TRcp	35.72912061	-111.3315926	12	18	SW7471	Mercury	mg/kg	0.082		NR
MHR-TP22-1.0-1.5-120518	12/5/2018	TRcp	35.72912061	-111.3315926	12	18	SW6010	Molybdenum	mg/kg	0.37	J	NR
MHR-TP22-1.0-1.5-120518	12/5/2018	TRcp	35.72912061	-111.3315926	12	18	713R14	Radium-226	pCi/g	4.14	M3	NR
MHR-TP22-1.0-1.5-120518	12/5/2018	TRcp	35.72912061	-111.3315926	12	18	SW6010	Selenium	mg/kg	0.17	J	NR
MHR-TP22-1.0-1.5-120518	12/5/2018	TRcp	35.72912061	-111.3315926	12	18	SW6020	Uranium	mg/kg	3.9		NR
MHR-TP22-1.0-1.5-120518	12/5/2018	TRcp	35.72912061	-111.3315926	12	18	SW6010	Vanadium	mg/kg	8.4		NR
MRD-TP1-0.5-1.0-120518	12/5/2018	Qay	35.74119642	-111.3312742	6	12	SW6020	Arsenic	mg/kg	1.3		NR
MRD-TP1-0.5-1.0-120518	12/5/2018	Qay	35.74119642	-111.3312742	6	12	SW7471	Mercury	mg/kg	0.081		NR
MRD-TP1-0.5-1.0-120518	12/5/2018	Qay	35.74119642	-111.3312742	6	12	SW6010	Molybdenum	mg/kg	8		NR
MRD-TP1-0.5-1.0-120518	12/5/2018	Qay	35.74119642	-111.3312742	6	12	713R14	Radium-226	pCi/g	31.6	M3	NR
MRD-TP1-0.5-1.0-120518	12/5/2018	Qay	35.74119642	-111.3312742	6	12	SW6010	Selenium	mg/kg	0.054	U	NR
MRD-TP1-0.5-1.0-120518	12/5/2018	Qay	35.74119642	-111.3312742	6	12	SW6020	Uranium	mg/kg	45		NR
MRD-TP1-0.5-1.0-120518	12/5/2018	Qay	35.74119642	-111.3312742	6	12	SW6010	Vanadium	mg/kg	16		NR
MRD-TP1-1.5-2.0-120518	12/5/2018	Qay	35.74119642	-111.3312742	18	24	SW6020	Arsenic	mg/kg	1.7		NR
MRD-TP1-1.5-2.0-120518	12/5/2018	Qay	35.74119642	-111.3312742	18	24	SW7471	Mercury	mg/kg	0.33		NR
MRD-TP1-1.5-2.0-120518	12/5/2018	Qay	35.74119642	-111.3312742	18	24	SW6010	Molybdenum	mg/kg	0.84	J	NR
MRD-TP1-1.5-2.0-120518	12/5/2018	Qay	35.74119642	-111.3312742	18	24	713R14	Radium-226	pCi/g	71.8	M3	NR
MRD-TP1-1.5-2.0-120518	12/5/2018	Qay	35.74119642	-111.3312742	18	24	SW6010	Selenium	mg/kg	0.35	J	NR
MRD-TP1-1.5-2.0-120518	12/5/2018	Qay	35.74119642	-111.3312742	18	24	SW6020	Uranium	mg/kg	180		NR
MRD-TP1-1.5-2.0-120518	12/5/2018	Qay	35.74119642	-111.3312742	18	24	SW6010	Vanadium	mg/kg	21		NR
MRD-TP1-2.5-3.0-120518	12/5/2018	Qay	35.74119642	-111.3312742	30	36	SW6020	Arsenic	mg/kg	0.92		NR
MRD-TP1-2.5-3.0-120518	12/5/2018	Qay	35.74119642	-111.3312742	30	36	SW7471	Mercury	mg/kg	0.002	J	NR
MRD-TP1-2.5-3.0-120518	12/5/2018	Qay	35.74119642	-111.3312742	30	36	SW6010	Molybdenum	mg/kg	1.5		NR
MRD-TP1-2.5-3.0-120518	12/5/2018	Qay	35.74119642	-111.3312742	30	36	713R14	Radium-226	pCi/g	3.94	M3	NR
MRD-TP1-2.5-3.0-120518	12/5/2018	Qay	35.74119642	-111.3312742	30	36	SW6010	Selenium	mg/kg	0.052	U	NR
MRD-TP1-2.5-3.0-120518	12/5/2018	Qay	35.74119642	-111.3312742	30	36	SW6020	Uranium	mg/kg	21		NR
MRD-TP1-2.5-3.0-120518	12/5/2018	Qay	35.74119642	-111.3312742	30	36	SW6010	Vanadium	mg/kg	49		NR
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Aluminum	mg/kg	2,000	D	NR
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Antimony	mg/kg	6.2	U	NR
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Arsenic	mg/kg	11	D	NR
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Barium	mg/kg	360	D	NR
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Beryllium	mg/kg	1.6	U	NR
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Cadmium	mg/kg	0.96	U	NR
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Chromium	mg/kg	3	U	NR
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Cobalt	mg/kg	9	U	NR
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Copper	mg/kg	7	U	NR
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Iron	mg/kg	10,000	D	NR
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Lead	mg/kg	12	D	NR
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Manganese	mg/kg	250	D	NR
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Mercury	mg/kg	0.25		NR
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Molybdenum	mg/kg	34	JD	NR
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Nickel	mg/kg	2.7	JD	NR
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	GA-01-R	Radium-226	pCi/g	21.2		NR
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Selenium	mg/kg	2.8	U	NR
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Silver	mg/kg	2.3	U	NR
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Thallium	mg/kg	15	U	NR

Attachment B-1. Data Used in the Risk Assessment

Sample ID	Sample Date	Geologic Unit	Latitude	Longitude	Sample Top Depth (inches bgs)	Sample Bottom Depth (inches bgs)	Analytical Method	Analyte	Units	Result and Qualifier		Reporting Limit
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Uranium	mg/kg	160	U	NR
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Vanadium	mg/kg	26	JD	NR
RIV-SD-2	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Zinc	mg/kg	19	U	NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Aluminum	mg/kg	2,300	D	NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Antimony	mg/kg	6.7	U	NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Arsenic	mg/kg	7.6	JD	NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Barium	mg/kg	210	D	NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Beryllium	mg/kg	1.8	U	NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Cadmium	mg/kg	1	U	NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Chromium	mg/kg	3.2	U	NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Cobalt	mg/kg	9.8	U	NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Copper	mg/kg	7.6	U	NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Iron	mg/kg	11,000	D	NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Lead	mg/kg	10	D	NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Manganese	mg/kg	370	D	NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Mercury	mg/kg	0.29		NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Molybdenum	mg/kg	21	JD	NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Nickel	mg/kg	3.2	JD	NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	GA-01-R	Radium-226	pCi/g	18.1		NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Selenium	mg/kg	3	U	NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Silver	mg/kg	2.4	U	NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Thallium	mg/kg	16	U	NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Uranium	mg/kg	180	U	NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Vanadium	mg/kg	26	JD	NR
RIV-SD-6	8/8/2013	Qay	35.73954747	-111.3224681	0	6	6010C DOD	Zinc	mg/kg	21	U	NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	6010C DOD	Aluminum	mg/kg	3,000	D	NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	6010C DOD	Antimony	mg/kg	6.1	U	NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	6010C DOD	Arsenic	mg/kg	13	D	NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	6010C DOD	Barium	mg/kg	75	D	NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	6010C DOD	Beryllium	mg/kg	1.6	U	NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	6010C DOD	Cadmium	mg/kg	0.96	U	NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	6010C DOD	Chromium	mg/kg	2.9	U	NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	6010C DOD	Cobalt	mg/kg	9	U	NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	6010C DOD	Copper	mg/kg	21	JD	NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	6010C DOD	Iron	mg/kg	4,700	D	NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	6010C DOD	Lead	mg/kg	38	D	NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	6010C DOD	Manganese	mg/kg	25	D	NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	6010C DOD	Mercury	mg/kg	0.2		NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	6010C DOD	Molybdenum	mg/kg	160	D	NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	6010C DOD	Nickel	mg/kg	2.2	U	NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	GA-01-R	Radium-226	pCi/g	13		NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	6010C DOD	Selenium	mg/kg	2.8	U	NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	6010C DOD	Silver	mg/kg	2.2	U	NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	6010C DOD	Thallium	mg/kg	14	U	NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	6010C DOD	Uranium	mg/kg	150	U	NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	6010C DOD	Vanadium	mg/kg	12	U	NR
S9L-SS-1A	8/6/2013	TRcp	35.73785247	-111.3252901	0	6	6010C DOD	Zinc	mg/kg	19	U	NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Aluminum	mg/kg	2,900	D	NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Antimony	mg/kg	6.4	U	NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Arsenic	mg/kg	11	D	NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Barium	mg/kg	260	D	NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Beryllium	mg/kg	1.7	U	NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Cadmium	mg/kg	0.99	U	NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Chromium	mg/kg	3.4	JD	NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Cobalt	mg/kg	20	JD	NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Copper	mg/kg	10	JD	NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Iron	mg/kg	11,000	D	NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Lead	mg/kg	29	D	NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Manganese	mg/kg	160	D	NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Mercury	mg/kg	0.073		NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Molybdenum	mg/kg	31	JD	NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Nickel	mg/kg	8.3	JD	NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	GA-01-R	Radium-226	pCi/g	65.2		NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Selenium	mg/kg	2.9	U	NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Silver	mg/kg	2.3	U	NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Thallium	mg/kg	15	U	NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Uranium	mg/kg	170	U	NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Vanadium	mg/kg	25	JD	NR
S9L-SS-2A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Zinc	mg/kg	20	U	NR
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Aluminum	mg/kg	3,200	D	NR
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Antimony	mg/kg	5.5	U	NR
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Arsenic	mg/kg	15	D	NR
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Barium	mg/kg	330	D	NR
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Beryllium	mg/kg	1.5	U	NR
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Cadmium	mg/kg	0.86	U	NR
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Chromium	mg/kg	4.7	JD	NR
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Cobalt	mg/kg	16	JD	NR
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Copper	mg/kg	12	JD	NR
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Iron	mg/kg	12,000	D	NR
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Lead	mg/kg	34	D	NR
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Manganese	mg/kg	170	D	NR
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Mercury	mg/kg	0.056		NR
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Molybdenum	mg/kg	32	JD	NR
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Nickel	mg/kg	9.5	JD	NR
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	GA-01-R	Radium-226	pCi/g	57.3		NR
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Selenium	mg/kg	2.5	U	NR
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Silver	mg/kg	2	U	NR
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Thallium	mg/kg	13	U	NR

Attachment B-1. Data Used in the Risk Assessment

Sample ID	Sample Date	Geologic Unit	Latitude	Longitude	Sample Top Depth (inches bgs)	Sample Bottom Depth (inches bgs)	Analytical Method	Analyte	Units	Result and Qualifier		Reporting Limit
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Uranium	mg/kg	140	U	NR
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Vanadium	mg/kg	25	JD	NR
S9L-SS-4A	8/7/2013	TRcs	35.73061747	-111.3261391	0	6	6010C DOD	Zinc	mg/kg	18	JD	NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	6010C DOD	Aluminum	mg/kg	3,600	D	NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	6010C DOD	Antimony	mg/kg	7.5	U	NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	6010C DOD	Arsenic	mg/kg	29	D	NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	6010C DOD	Barium	mg/kg	130	D	NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	6010C DOD	Beryllium	mg/kg	2	U	NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	6010C DOD	Cadmium	mg/kg	1.2	U	NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	6010C DOD	Chromium	mg/kg	4.7	JD	NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	6010C DOD	Cobalt	mg/kg	25	JD	NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	6010C DOD	Copper	mg/kg	17	JD	NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	6010C DOD	Iron	mg/kg	7,600	D	NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	6010C DOD	Lead	mg/kg	26	D	NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	6010C DOD	Manganese	mg/kg	130	D	NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	6010C DOD	Mercury	mg/kg	0.039		NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	6010C DOD	Molybdenum	mg/kg	220	D	NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	6010C DOD	Nickel	mg/kg	9.8	JD	NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	GA-01-R	Radium-226	pCi/g	64.4		NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	6010C DOD	Selenium	mg/kg	3.4	U	NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	6010C DOD	Silver	mg/kg	2.8	U	NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	6010C DOD	Thallium	mg/kg	18	U	NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	6010C DOD	Uranium	mg/kg	180	U	NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	6010C DOD	Vanadium	mg/kg	15	U	NR
WET-SD-3	8/7/2013	TRcs	35.73033157	-111.3306429	0	6	6010C DOD	Zinc	mg/kg	32	JD	NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	6010C DOD	Aluminum	mg/kg	8,800	D	NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	6010C DOD	Antimony	mg/kg	8.4	U	NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	6010C DOD	Arsenic	mg/kg	15	D	NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	6010C DOD	Barium	mg/kg	320	D	NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	6010C DOD	Beryllium	mg/kg	2.2	U	NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	6010C DOD	Cadmium	mg/kg	1.3	U	NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	6010C DOD	Chromium	mg/kg	4	U	NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	6010C DOD	Cobalt	mg/kg	12	U	NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	6010C DOD	Copper	mg/kg	10	JD	NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	6010C DOD	Iron	mg/kg	13,000	D	NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	6010C DOD	Lead	mg/kg	22	D	NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	6010C DOD	Manganese	mg/kg	360	D	NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	6010C DOD	Mercury	mg/kg	0.031	J	NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	6010C DOD	Molybdenum	mg/kg	37	JD	NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	6010C DOD	Nickel	mg/kg	7.4	JD	NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	GA-01-R	Radium-226	pCi/g	7.29		NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	6010C DOD	Selenium	mg/kg	3.8	U	NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	6010C DOD	Silver	mg/kg	3.1	U	NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	6010C DOD	Thallium	mg/kg	20	U	NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	6010C DOD	Uranium	mg/kg	160	U	NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	6010C DOD	Vanadium	mg/kg	25	JD	NR
WET-SD-4	8/8/2013	TRcs	35.73927696	-111.3227143	0	6	6010C DOD	Zinc	mg/kg	30	JD	NR

Notes:

*	Duplicate analysis not within control limits
bgs	Below ground surface
D	Reported value is from a dilution
DOD	U.S. Department of Defense
G	Gamma spectroscopy
J	Estimated concentration
J-	Estimated concentration, biased low
JD	Estimated concentration based on dilution
M3	The requested minimum detected concentration was not met, but the reported activity is greater than the reported minimum detected concentration
mg/kg	Milligram per kilogram
N	Matrix spike sample recovery is not within specified control limits
NR	Not reported
pCi/g	Picocurie per gram
Qay	Quaternary alluvium
TRcp	Petrified Forest Member of the Chinle formaation
TRcs	Shinarump Member of the Chinle Formation
U	Not detected
UJ	Not detected, reporting limit is estimated

ATTACHMENT B-2

PRELIMINARY DETERMINATION OF SECULAR EQUILIBRIUM AT THE SECTION 9 LEASE MINES

1.0 PURPOSE AND PROCEDURE FOR SECULAR EQUILIBRIUM ANALYSIS

The assumption of uranium-238 (U-238) in secular equilibrium (SE) for most abandoned uranium mines (AUM) where neither waste rock nor ore was processed is likely appropriate and protective (Galloway and others 2020). However, verification of this SE assumption should be verified using site data following the Navajo abandoned uranium mine risk assessment methodology (USEPA 2024). A preliminary determination of whether a site is in SE be conducted by comparing the paired concentrations of U-238 and radium-226 (Ra-226) at a site.

If the site is in secular equilibrium, the paired concentrations will have concentration ratios of 1. However, the ratios of the soil concentrations will vary from 1; thus, an upper-bound threshold value for mean of the ratios of paired concentrations of 1.4 was determined to be sufficiently protective for risk assessment (Tetra Tech, Inc. 2024) because there is a potential for the risk to be underestimated is less than 5 percent. If the site-specific disequilibrium factor (DF), calculated as the average of the ratios of paired U-238 and Ra-226 concentrations within the site, is less than or equal to 1.4, the site can be considered in SE for the purposes of the risk assessment. This attachment to the risk assessment summarizes the preliminary determination for SE in soils sampled at the Section 9 Lease Mines.

2.0 DESCRIPTION OF SITE AND SOIL SAMPLING

This evaluation includes all samples in the risk assessment dataset with both Ra-226 and U-238 results. The sample results used are provided in Table B2-1. For each sample, soil concentrations of U-238 and Ra-226 were measured using alpha and gamma spectroscopy, respectively. The reporting limit was used as the value for nondetected results of U-238. Soil samples were collected from AUM 457, AUM 458, a small portion of AUM 459 within Section 9, and several other technologically enhanced naturally occurring radioactive material (TENORM) locations such as drainages, roads, and disturbed sites (see Figure B-5 of Appendix B of the Section 9 Lease Mines engineering evaluation and cost analysis). These TENORM sites include waste rock piles, burial cells, contaminated access roads, areas contaminated by eroding waste and windblown dust, and adjacent drainages receiving potentially contaminated runoff. These AUMs are geographically distinct; however, based on the site evaluation, the Section 9 Lease Mines are being evaluated as a single exposure unit for the human health risk assessment and ecological risk assessment.

3.0 STATISTICAL ANALYSIS FOR SECULAR EQUILIBRIUM

The ratio of U-238/Ra-226 (that is, a DF) is used as a metric for testing the SE assumption. A site in SE has an average DF is 1. Summary statistics of the DFs were calculated, and the mean DF was compared to the upper-bound screening value of 1.4. Quality assurance was also performed to confirm that enough samples were taken to support a statistically robust conclusion. Table B2-2 provides the summary statistics. Figure B2-1 presents a box and whisker plot of the ratios.

The following conclusions were reached:

- A range of equilibrium conditions were observed; however, the average site DF was 0.7, below the upper-bound screening level.
- The total number of samples taken (n=61) was sufficient for concluding that the DF estimation is statistically defensible.
- The site is in SE among U-238 and its decay products is protective for the risk assessment.

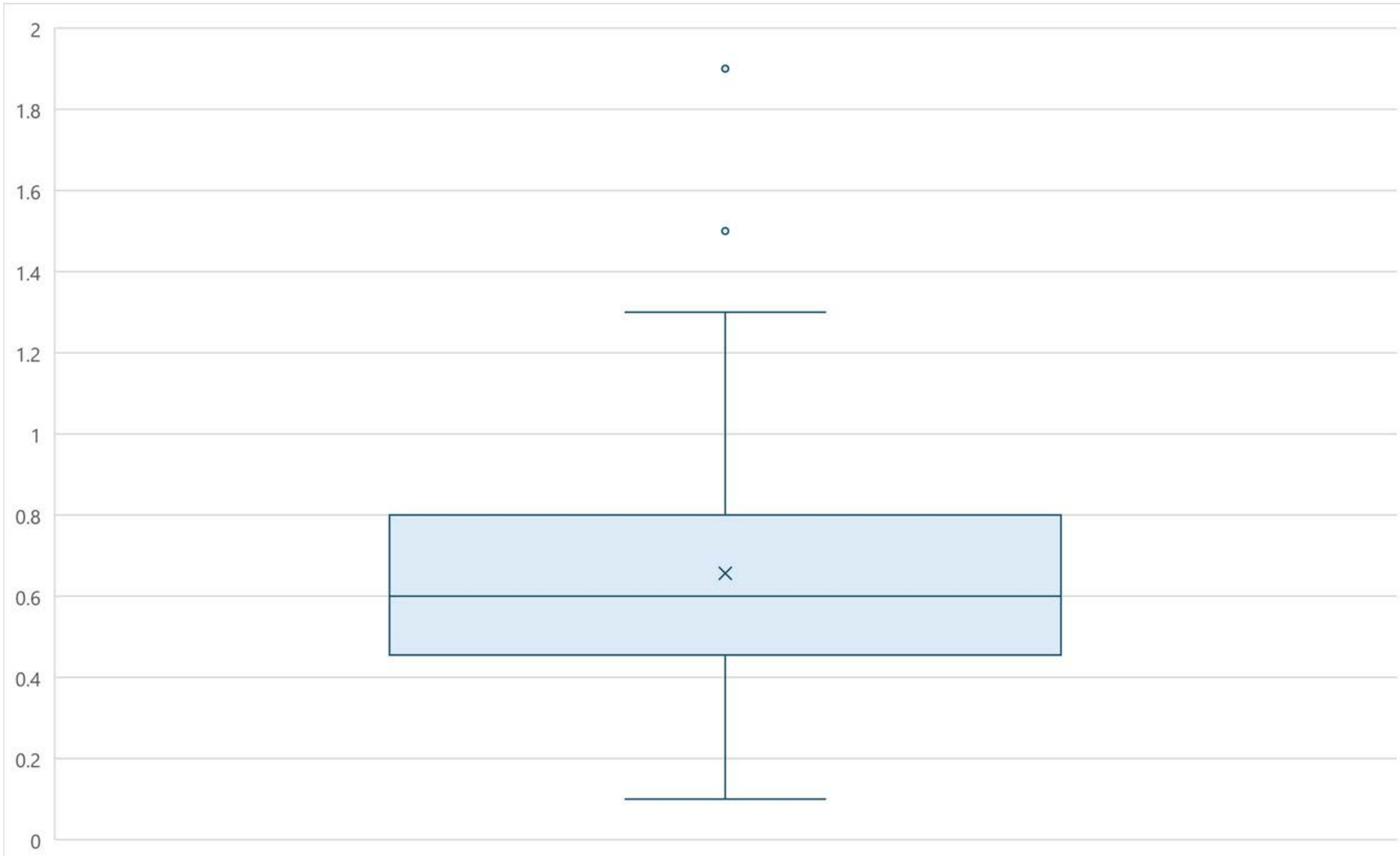
4.0 REFERENCES

Galloway, L.D., M.B. Bellamy, F.G. Dolislager, H.J. Ringer, E.A. Asano, D.J. Stewart, K.A. Noto, and others. 2020. "Bateman Equation Adaptation for Solving and Integrating Peak Activity into EPA ELCR and Dose Models." Prepared by Oak Ridge National Laboratory. Managed by UT-Batelle, LLC for the U.S. Department of Energy. Contract DE-AC05-00OR22725. ORNL/TM-2020/1780. October.

Tetra Tech, Inc. 2024. "Assessment of Secular Equilibrium for the Uranium-238 Decay Chain in Soil Standard Operating Procedure." April.

U.S. Environmental Protection Agency (USEPA). 2024. "Navajo Abandoned Uranium Mine Risk Assessment Methodology." Draft Final. March.

FIGURE



Note: The middle line in the box represents the median; the “X” is the mean, the lower and upper bounds of the blue box represent the 1st and 3rd quartiles; the whisker indicates the upper and lower ratios within 1.5 times the interquartile range; and the outliers (single data points) are ratios exceeding 1.5 times the interquartile range beyond the 1st and 3rd quartiles.

Figure B2-1. Box and Whisker Plot of the Ratio of the Uranium-238 to Radium-226 Soil Concentrations

TABLES

Table B2-1. Preliminary Determination of Secular Equilibrium for the Section 9 Lease Mines and Calculation of Site Disequilibrium Factor

Sample ID	Bottom Depth (inches bgs)	Location Zone	Ra-226 (pCi/g)	Ra-226 Qualifier	U-238 (pCi/g)	U-238 Qualifier	U-238/ Ra-226 (DF)
457-SS01-01-020624	6	Waste Pile	18.6		22.4		1.2
457-SS02-01-020624	6	Waste Pile	66.7		35.4		0.53
457-SS03-01-020624	6	PMD	18.9		8.91		0.47
457-SS04-01-020624	6	Waste Pile	160		31.6		0.2
457-SS-1A	6	PMD	156		76.1		0.49
457-SS-10A	6	PMD	2.87		3.07		1.1
457-SS-12A	6	PMD	3.19		2.04	U	0.64
457-SS-11A	6	PMD	411		164		0.4
457-SS-6A	6	PMD	382		167		0.44
457-SS-2A	6	PMD	30.1		7.53		0.25
457-SS-2B	12	PMD	3.06		4.45		1.5
457-SS-2C	18	PMD	2.47		4.67		1.9
457-SS-3A	6	PMD	57.1		21.9		0.38
457-SS-4A	6	PMD	3.32		2.47		0.74
457-SS-4B	12	PMD	1.93		1.06	U	0.55
457-SS-4C	18	PMD	1.07		1.43	U	1.3
457-SS-5A	6	PMD	8.37		5.47		0.7
457-SS-7A	6	PMD	945		328		0.35
457-SS-8A	6	PMD	747		266		0.4
457-SS-9A	6	PMD	27.2		8.16		0.3
458-SS-1A	6	PMD	51.8		18.7		0.4
458-SS-2A	6	PMD	9.84		8.36		0.8
458-SS-2B	12	PMD	6.01		4.38		0.7
458-SS-2C	18	PMD	22.8		11.3		0.5
458-SS-3A	6	PMD	39.1		34.4		0.9
458-SS-4A	6	PMD	11.1		7.04		0.6
458-SS-4B	12	PMD	18.7		11.1		0.6
458-SS-4C	18	PMD	21.5		16.6		0.8
458-SS-5A	6	PMD	28.7		16.2		0.6
458-SS-6A	6	PMD	83.5		72.9		0.9
458-SS-7A	6	PMD	93.4		76.3		0.8
458-SS-8A	6	PMD	16.7		7.73		0.5
458-SS01-01-020624	6	PMD	30.9		16.7		0.5
458-SS02-01-020624	6	PMD	37.7		23		0.6
458-SS03-01-020624	6	Waste Pile	134		39.8		0.3
458-SS04-01-020624	6	Waste Pile	48.3		35.5		0.7

Table B2-1. Preliminary Determination of Secular Equilibrium for the Section 9 Lease Mines and Calculation of Site Disequilibrium Factor (Continued)

Sample ID	Bottom Depth (inches bgs)	Location Zone	Ra-226 (pCi/g)	Ra-226 Qualifier	U-238 (pCi/g)	U-238 Qualifier	U-238/ Ra-226 (DF)
458-SS05-01-020624	6	PMD	12.2		6.39		0.5
458-SS06-01-020624	6	Waste Pile	34.5	J	20.9		0.6
459-SS-2A	6	PMD	9.23		4.36		0.5
459-SS-2B	12	PMD	10.1		5.8		0.6
459-SS-2C	18	PMD	9.76		6.57		0.7
APE-SS01-01-020624	6	PMD	10.4		7.4		0.7
APE-SS02-01-020624	6	General	1.94		1.32		0.7
APE-SS03-01-020624	6	Road	2.83		2.53		0.9
APE-SS04-01-020624	6	Road	2.3		2.19		1.0
APE-SS05-01-020624	6	General	1.35		0.749		0.6
APE-SS06-01-020624	6	PMD	1.51		1.05		0.7
APE-SS07-01-020624	6	PMD	15.4		11.3		0.7
APE-SS08-01-020624	6	Drainage	1.27		1.41		1.1
APE-SS09-01-020624	6	PMD	5.67		2.93		0.5
APE-SS10-01-020624	6	Drainage	1.41		1.31		0.9
DRN-SD-1	6	Drainage	1.3		0.618	U	0.5
DRN-SD-2	6	Drainage	0.977		0.552	U	0.6
DRN-SD-3	6	Drainage	1.37		0.967	U	0.7
DRN-SD-4	6	Drainage	3.74		1.04	U	0.3
RIV-SD-2	6	General	21.2		8.16		0.4
S9L-SS-1A	6	General	13		15		1.2
S9L-SS-2A	6	General	65.2		13.3		0.2
S9L-SS-4A	6	General	57.3		15		0.3
WET-SD-3	6	General	64.4		62.8		1.0
WET-SD-4	6	General	7.29		0.758	U	0.1

Notes:
The evaluation includes all samples in the risk assessment dataset with both Ra-226 and U-238 results available.
The reporting limit was used as the value for nondetected results of U-238.

bgs Below ground surface
DF Disequilibrium factor
J Estimated value
pCi/g Picocurie per gram
PMD Potential mining disturbance
Ra-226 Radium-226
U Not detected
U-238 Uranium-238

Table B2-2. Summary Statistics of the U-238/Ra-226 Ratio and Results of the Quality Assurance Test

Statistic	Ratio U-238/Ra-226 Soil Concentrations (DF)
Mean of the Ratio	0.7
Standard Deviation	0.3
Number of Samples[1]	61
Quality Assurance Test for Adequate Number of Samples	
Width of Grey Region (Δ)	1.4 - 1.0= 0.4
Standard Deviation of Data (σ)	0.3
Relative Shift	0.4/0.3 = 1.33
Number of Samples Required in Exposure Unit for Relative Shift of 1.33 and p_α and p_β =0.05	21

Notes:

[1] The evaluation includes all samples in the risk assessment dataset with both Ra-226 and U-238 results available. The reporting limit was used as the value for nondetected results of U-238.

DF Disequilibrium factor

p_α Probability of a Type 1 error (incorrect rejection of the null hypothesis)

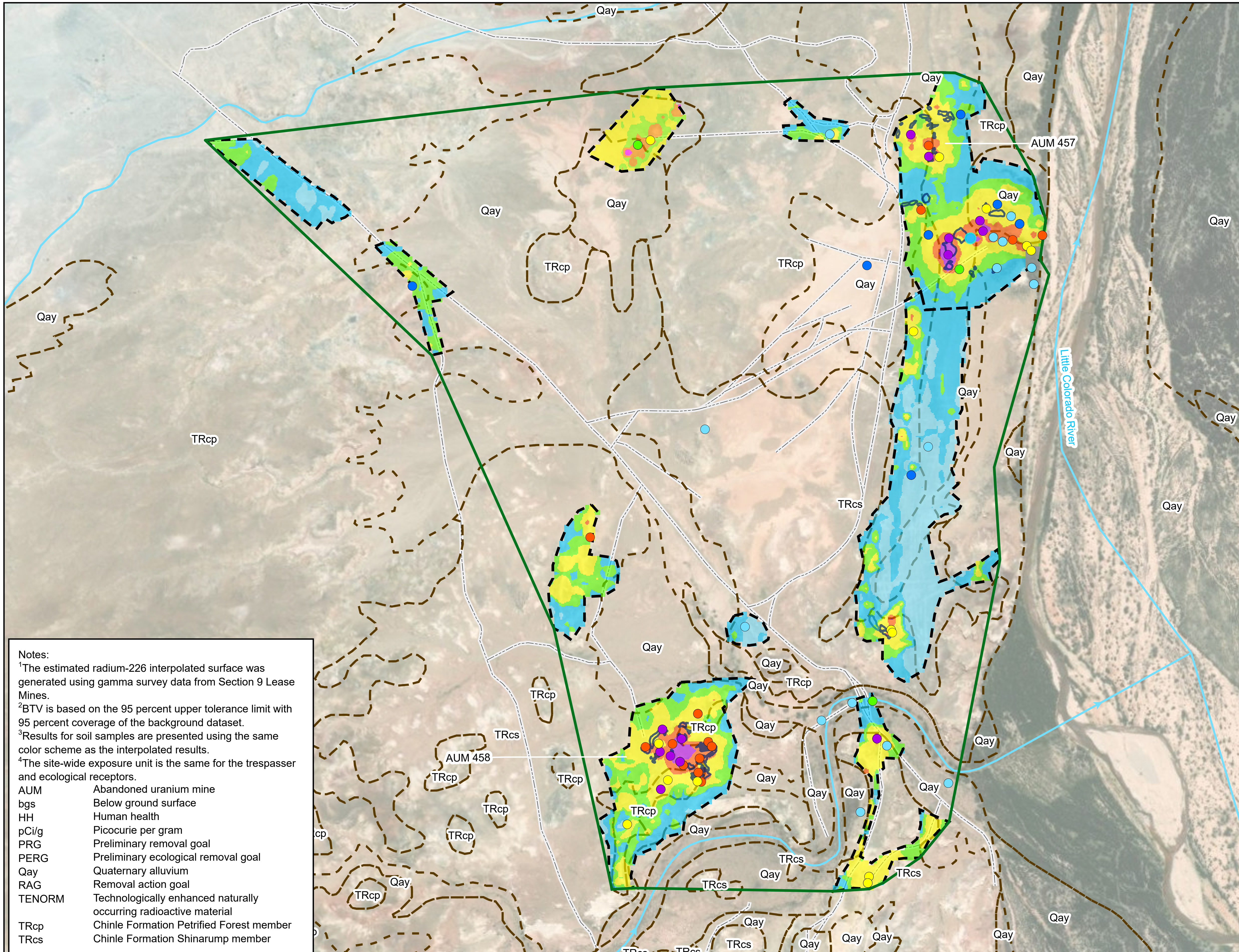
p_β Probability of a Type 2 error (incorrect acceptance of the null hypothesis)

Ra-226 Radium-226

U-238 Uranium-238

APPENDIX C

CONTAMINANT DISTRIBUTION



Estimated Radium-226 (pCi/g)[1]

≤ 2.0	≤ TRcs BTV
2.0 - 3.0	TRcs BTV - Qay BTV
3.0 - 4.0	Qay BTV - TRcp BTV
4.0 - 13	TRcp BTV - RAG (HH PRG)
13 - 40	RAG (HH PRG) - PERG
> 40	> PERG

Soil Sample Locations[1]

- Surface Soil (0-3 and 0-6 inches bgs)
- TENORM Boundary
- Exposure Unit Boundary

Site Features

- Accumulation / Deposition Area (Surficial / Volumetric)
- Waste Pile (Surficial / Volumetric)
- Geologic Contact
- Access Road
- Drainage

1 inch = 620 Feet

1:7,440

620 310 0 620 Feet

N W E S

Notes:

[1]The estimated radium-226 interpolated surface was generated using gamma survey data from Section 9 Lease Mines.

[2]BTV is based on the 95 percent upper tolerance limit with 95 percent coverage of the background dataset.

[3]Results for soil samples are presented using the same color scheme as the interpolated results.

[4]The site-wide exposure unit is the same for the trespasser and ecological receptors.

AUM	Abandoned uranium mine
bgs	Below ground surface
HH	Human health
pCi/g	Picocurie per gram
PRG	Preliminary removal goal
PERG	Preliminary ecological removal goal
Qay	Quaternary alluvium
RAG	Removal action goal
TENORM	Technologically enhanced naturally occurring radioactive material
TRcp	Chinle Formation Petrified Forest member
TRcs	Chinle Formation Shinarump member

SECTION 9 LEASE RADIUM-226 SAMPLE RESULTS AND ESTIMATED RADIUM-226 CONCENTRATIONS WITHIN THE TENORM BOUNDARY

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612

Task Order No.: 0020

Contract No.: 68HE0923D0002

Location: COCONINO COUNTY, AZ

Date: 6/21/2024

Coordinate System: NAD 1983 State Plane Arizona Central FIPS 0202 Feet Transverse Mercator

Figure No.: C-1

Arsenic Surface Soil Concentration (mg/kg)

≤ 5.0	≤ TRcp BTV[1]
5.0 - 5.9	TRcp BTV - Qay BTV
5.9 - 18	Qay BTV - TRcs BTV
18 - 68	TRcs BTV - PERG
> 68	> PERG

Laboratory or Instrumental Nondetect Result

Radium-226 Removal Action Extent

TENORM Boundary

Exposure Unit Boundary[2]

Site Features

Accumulation / Deposition Area (Surficial / Volumetric)

Waste Pile (Surficial / Volumetric)

Geologic Contact

Access Road

Drainage

Notes:

[1]BTV is based on the 95 percent upper tolerance limit with 95 percent coverage of the background dataset.

[2]The site-wide exposure unit is the same for the trespasser and ecological receptors.

AUM	Abandoned uranium mine
BTV	Background threshold value
mg/kg	Milligram per kilogram
PERG	Preliminary ecological removal goal
Qay	Quaternary alluvium
TENORM	Technologically enhanced naturally occurring radioactive material
TRcp	Chinle Formation Petrified Forest member
TRcs	Chinle Formation Shinarump member

1 inch = 620 Feet

1:7,440

620 310 0 620 Feet

N W E S

SECTION 9 LEASE ARSENIC SURFACE SOIL RESULTS WITHIN THE TENORM BOUNDARY

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612

Task Order No.: 0020

Contract No.: 68HE0923D0002

Location: COCONINO COUNTY, AZ

Date: 6/19/2024

Coordinate System: NAD 1983 State Plane Arizona Central FIPS 0202 Feet Transverse Mercator

Figure No.: C-3

Mercury Surface Soil Concentration (mg/kg)[1]

- ≤ 0.5 (PERG)
- > 0.5 (PERG)
- Laboratory or Instrumental Nondetect Result
- Radium-226 Removal Action Extent
- TENORM Boundary
- Exposure Unit Boundary[2]

Site Features

- Accumulation / Deposition Area (Surficial / Volumetric)
- Waste Pile (Surficial / Volumetric)
- Geologic Contact
- Access Road
- Drainage

Notes:

[1]The Western AUM Region background dataset does not include mercury data.

[2]The site-wide exposure unit is the same for the trespasser and ecological receptors.

AUM	Abandoned uranium mine
mg/kg	Milligram per kilogram
PERG	Preliminary ecological removal goal
Qay	Quaternary alluvium
TENORM	Technologically enhanced naturally occurring radioactive material
TRcp	Chinle Formation Petrified Forest member
TRcs	Chinle Formation Shinarump member

1 inch = 620 Feet

1:7,440

620 310 0 620 Feet

N W E S

SECTION 9 LEASE MERCURY SURFACE SOIL RESULTS WITHIN THE TENORM BOUNDARY

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612

Task Order No.: 0020

Contract No.: 68HE0923D0002

Location: COCONINO COUNTY, AZ

Date: 6/21/2024

Coordinate System: NAD 1983 State Plane Arizona Central FIPS 0202 Feet Transverse Mercator

Figure No.: C-3

Molybdenum Surface Soil Concentration (mg/kg)

≤ 0.7	≤ TRcs BTV[1]
0.7 - 1.8	TRcs BTV - TRcp BTV
1.8 - 2.6	TRcp BTV - Qay BTV
2.6 - 430	Qay BTV - PERG
> 430	> PERG

Laboratory or Instrumental Nondetect Result

Radium-226 Removal Action Extent

TENORM Boundary

Exposure Unit Boundary[2]

Site Features

Accumulation / Deposition Area (Surficial / Volumetric)

Waste Pile (Surficial / Volumetric)

Geologic Contact

Access Road

Drainage

Notes:

[1]BTV is based on the 95 percent upper tolerance limit with 95 percent coverage of the background dataset.

[2]The site-wide exposure unit is the same for the trespasser and ecological receptors.

AUM	Abandoned uranium mine
BTV	Background threshold value
mg/kg	Milligram per kilogram
PERG	Preliminary ecological removal goal
Qay	Quaternary alluvium
TENORM	Technologically enhanced naturally occurring radioactive material
TRcp	Chinle Formation Petrified Forest member
TRcs	Chinle Formation Shinarump member

1 inch = 620 Feet

1:7,440

620 310 0 620 Feet

N W E S

SECTION 9 LEASE MOLYBDENUM SURFACE SOIL RESULTS WITHIN THE TENORM BOUNDARY

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612

Task Order No.: 0020

Contract No.: 68HE0923D0002

Location: COCONINO COUNTY, AZ

Date: 6/21/2024

Coordinate System: NAD 1983 State Plane Arizona Central FIPS 0202 Feet Transverse Mercator

Figure No.: C-4

Selenium Surface Soil Concentration (mg/kg)

●	≤ 2.0	≤ TRcp BTV[1]
●	2.0 - 3.4	TRcp BTV - PERG
●	3.4 - 3.5	PERG - TRcs BTV
●	3.5 - 7.0	TRcs BTV - Qay BTV
●	> 7.0	> Qay BTV
○	Laboratory or Instrumental Nondetect Result	

Radium-226 Removal Action Extent

TENORM Boundary

Exposure Unit Boundary[2]

Site Features

Accumulation / Deposition Area (Surficial / Volumetric)

Waste Pile (Surficial / Volumetric)

Geologic Contact

Access Road

Drainage

Notes:

[1]BTV is based on the 95 percent upper tolerance limit with 95 percent coverage of the background dataset.

[2]The site-wide exposure unit is the same for the trespasser and ecological receptors.

AUM	Abandoned uranium mine
BTV	Background threshold value
mg/kg	Milligram per kilogram
PERG	Preliminary ecological removal goal
Qay	Quaternary alluvium
TENORM	Technologically enhanced naturally occurring radioactive material
TRcp	Chinle Formation Petrified Forest member
TRcs	Chinle Formation Shinarump member

1 inch = 620 Feet

1:7,440

620 310 0 620 Feet

N W E S

SECTION 9 LEASE SELENIUM SURFACE SOIL RESULTS WITHIN THE TENORM BOUNDARY

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612

Task Order No.: 0020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 6/21/2024
Coordinate System: NAD 1983 State Plane Arizona Central FIPS 0202 Feet Transverse Mercator	Figure No.: C-5

Thallium Surface Soil Concentration (mg/kg)[1]
- ≤ 0.5 (PERG)
- > 0.5 (PERG)
- Laboratory or Instrumental Nondetect Result
- Radium-226 Removal Action Extent
- TENORM Boundary
- Exposure Unit Boundary[2]

Site Features
- Accumulation / Deposition Area (Surficial / Volumetric)
- Waste Pile (Surficial / Volumetric)
- Geologic Contact
- Access Road
- Drainage

Notes:
[1]The Western AUM Region background dataset does not include thallium data.
[2]The site-wide exposure unit is the same for the trespasser and ecological receptors.

AUM	Abandoned uranium mine
mg/kg	Milligram per kilogram
PERG	Preliminary ecological removal goal
Qay	Quaternary alluvium
TENORM	Technologically enhanced naturally occurring radioactive material
TRcp	Chinle Formation Petrified Forest member
TRcs	Chinle Formation Shinarump member

1 inch = 620 Feet

1:7,440

620 310 0 620 Feet

N W E S

SECTION 9 LEASE THALLIUM SURFACE SOIL RESULTS WITHIN THE TENORM BOUNDARY

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 0020	Contract No.: 68HE0923D0002
Location: COCONINO COUNTY, AZ	Date: 6/21/2024
Coordinate System: NAD 1983 State Plane Arizona Central FIPS 0202 Feet Transverse Mercator	Figure No.: C-6

Uranium Surface Soil Concentration (mg/kg)

≤ 1.6	≤ TRcs BTV[1]
1.6 - 3.9	TRcs BTV - Qay BTV
3.9 - 7.7	Qay BTV - TRcp BTV
7.7 - 250	TRcp BTV - PERG
> 250	> PERG

Laboratory or Instrumental Nondetect Result

Radium-226 Removal Action Extent

TENORM Boundary

Exposure Unit Boundary[2]

Site Features

Accumulation / Deposition Area (Surficial / Volumetric)

Waste Pile (Surficial / Volumetric)

Geologic Contact

Access Road

Drainage

Notes:

[1]BTV is based on the 95 percent upper tolerance limit with 95 percent coverage of the background dataset.

[2]The site-wide exposure unit is the same for the trespasser and ecological receptors.

AUM	Abandoned uranium mine
BTV	Background threshold value
mg/kg	Milligram per kilogram
PERG	Preliminary ecological removal goal
Qay	Quaternary alluvium
TENORM	Technologically enhanced naturally occurring radioactive material
TRcp	Chinle Formation Petrified Forest member
TRcs	Chinle Formation Shinarump member

1 inch = 620 Feet

1:7,440

620 310 0 620 Feet

N W E S

SECTION 9 LEASE URANIUM SURFACE SOIL RESULTS WITHIN THE TENORM BOUNDARY

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH, 1999 Harrison Street, Suite 500, Oakland, CA 94612

Task Order No.: 0020

Contract No.: 68HE0923D0002

Location: COCONINO COUNTY, AZ

Date: 6/21/2024

Coordinate System: NAD 1983 State Plane Arizona Central FIPS 0202 Feet Transverse Mercator

Figure No.: C-7

Vanadium Surface Soil Concentration (mg/kg)

≤ 56	≤ TRcp BTV[1]
56 - 62	TRcp BTV - TRcs BTV
62 - 80	TRcs BTV - PERG
80 - 83	PERG - Qay BTV
> 83	> Qay BTV

Laboratory or Instrumental Nondetect Result

Radium-226 Removal Action Extent

TENORM Boundary

Exposure Unit Boundary[2]

Site Features

Accumulation / Deposition Area (Surficial / Volumetric)

Waste Pile (Surficial / Volumetric)

Geologic Contact

Access Road

Drainage

Notes:

[1]BTV is based on the 95 percent upper tolerance limit with 95 percent coverage of the background dataset.

[2]The site-wide exposure unit is the same for the trespasser and ecological receptors.

AUM	Abandoned uranium mine
BTV	Background threshold value
mg/kg	Milligram per kilogram
PERG	Preliminary ecological removal goal
Qay	Quaternary alluvium
TENORM	Technologically enhanced naturally occurring radioactive material
TRcp	Chinle Formation Petrified Forest member
TRcs	Chinle Formation Shinarump member

1 inch = 620 Feet

1:7,440

620 310 0 620 Feet

N W E S

SECTION 9 LEASE VANADIUM SURFACE SOIL RESULTS WITHIN THE TENORM BOUNDARY

Prepared For: U.S. EPA Region 9

Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612

Task Order No.: 0020

Contract No.: 68HE0923D0002

Location: COCONINO COUNTY, AZ

Date: 6/21/2024

Coordinate System: NAD 1983 State Plane Arizona Central FIPS 0202 Feet Transverse Mercator

Figure No.: C-8

APPENDIX D

COST ANALYSIS

Table D-1. Section 9 Lease Mines, Comparison of Costs for Each Alternative

Alternative	Capital Cost	Inspection and Maintenance Costs (NPV of 10 Years)[1]	Cap O&M Cost (NPV of 30 Years)	Net Present Value (3.5%)
Section 9 Lease Mines				
Alternative 2	$ 3,451,000	$ 78,000	$ 95,000	$ 3,624,000
Alternative 3	$ 3,821,000	$ 102,000	$ 95,000	$ 4,018,000
Alternative 4	$ 12,676,000	$ 78,000	$ -	$ 12,754,000

Note:

1	Excludes cap maintenance
--	Not applicable
NPV	Net present value
O&M	Operation and maintenance

Table D-2. Section 9 Lease Mines, Cost Rollup for Alternative 2

Cost Component	Section 9 Lease Mines Totals	
Excavated Surface Area (SF)	283,449	
Excavated Volume (LCY)	14,784	
Capital Costs		
Access Road Construction	$	74,495
Waste Excavation and Hauling	$	257,619
Site and Road Restoration	$	314,516
Onsite Consolidation and Cap Construction	$	1,466,272
Subtotal Construction	**$**	**2,112,903**
Non-Construction	$	1,337,739
Total Capital Costs	**$**	**3,450,642**
NPV Costs (3.5% discount rate) [1]		
Capital Costs	$	3,450,642
10-Year Site Inspection	$	28,107
10-Year Maintenance	$	49,657
30-Year Onsite Cap	$	95,080
Total NPV Costs	**$**	**3,623,486**

Notes:

1	Present worth analysis produces a single figure representing the amount of money that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the alternative. For projects that will last less than 1 year (generally, projects that do not require O&M), the present worth is simply the one time cost of performing the action.
LCY	Loose cubic yard
NPV	Net present value
O&M	Operation and maintenance
SF	Square foot

Table D-3. Section 9 Lease Mines, Cost Rollup for Alternative 3

Cost Component	Section 9 Lease Mines Totals	
Excavated Surface Area (SF)	283,449	
Excavated Volume (LCY)	14,784	
Capital Costs		
Access Road Construction	$	108,881
Waste Excavation and Hauling	$	346,551
Site and Road Restoration	$	415,282
Onsite Consolidation and Cap Construction	$	1,466,272
Subtotal Construction	**$**	**2,336,986**
Non-Construction	$	1,484,432
Total Capital Costs	**$**	**3,821,418**
NPV Costs (3.5% discount rate) [1]		
Capital Costs	$	3,821,418
10-Year Site Inspection	$	36,540
10-Year Maintenance	$	64,973
30-Year Onsite Cap	$	95,080
Total NPV Costs	**$**	**4,018,010**

Notes:

1	Present worth analysis produces a single figure representing the amount of money that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the alternative. For projects that will last less than 1 year (generally, projects that do not require O&M), the present worth is simply the one time cost of performing the action.
LCY	Loose cubic yard
NPV	Net present value
O&M	Operation and maintenance
SF	Square foot

Table D-4. Section 9 Lease Mines, Cost Rollup for Alternative 4

Cost Component	Section 9 Lease Mines Totals	
Excavated Surface Area (SF)	283,449	
Excavated Volume (CY)	14,784	
Capital Costs		
Access Road Construction	$	74,495
Waste Excavation and Loading	$	1,049,405
Site and Road Restoration	$	248,897
Waste Hauling to LLRW Facility	$	2,974,929
Disposal at LLRW Facility	$	6,431,040
Subtotal Construction	**$**	**10,778,766**
Non-Construction	$	1,897,620
Total Capital Costs	**$**	**12,676,386**
NPV Costs (3.5% discount rate) [1]		
Capital Costs	$	12,676,386
10-Year Site Inspection	$	28,107
10-Year Maintenance	$	49,657
Total NPV Costs	**$**	**12,754,150**

Notes:

1	Present worth analysis produces a single figure representing the amount of money that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the alternative. For projects that will last less than 1 year (generally, projects that do not require O&M), the present worth is simply the one time cost of performing the action.
LCY	Loose cubic yard
LLRW	Low-level radioactive waste
NPV	Net present value
O&M	Operation and maintenance
SF	Square foot

Table D-5. Section 9 Lease Mines, Cost Estimate Scenario Assumptions for Alternative 2, Multiple Locations Consolidate and Cap on Site

Technology	Assumptions	Cost Effects
Excavation Methods	Waste removed will be removed with a large excavator unless specified.	Excavators can operate on steeper terrain than bulldozers and are better at moving waste uphill. Bulldozers cost less to operate. Spider excavators or other specialized equipment are more expensive.
	Any disturbed surface will be restored using grading and erosion controls.	Quantities of erosion control materials and grading may be lower than estimated.
	All waste specified in the risk assessment will be excavated.	Volumes of excavated waste may be lower than estimated.
	The site is accessible to haul trucks and trucks can be easily loaded.	Accessing difficult-to-reach mines increases costs.
	O&M inspection of the mine site will be completed for 10 years.	More O&M inspections increase costs.
Soil and Waste Sorting	Waste will be sorted based on grain size; rock greater than 3 inches will be segregated.	N/A
	Waste will be processed through the screening plant using an excavator.	N/A
Consolidation and Cap	Waste will consolidated nearby on-site and capped at consolidation area.	Greater distance to consolidate waste increases costs.
	Waste will be consolidated into two areas: a 3.5-acre and a 2.5-acre areas, both of which will be graded.	Consolidation into a larger area decreases the cost for relocating the waste; however, it increases cost for cover soil.
	Waste will be consolidated from multiple locations.	Consolidating waste from multiple locations increases costs.
	A bulldozer will be used to excavate borrow soil.	Use of an excavator may increase costs.
	Multiple cells will be required to be opened and closed.	Multiple mobilizations to open/close cells increases costs.
	ET cap will be 3 feet of soil with a biobarrier and capillary break, but no liner.	Adding biobarrier, capillary break, or liner increases costs.
	No bottom liner or leachate collection system will be installed.	Adding bottom liner or leachate collection system increases costs
	Bulldozer will be used to move borrow soil to form cap.	Use of an excavator may increase costs.
	O&M inspection of the cap will be conducted for 30 years.	More O&M inspections will increase costs.
Water	Water will be hauled in from Cameron, Arizona.	Drilling a water well would incur additional capital costs, but lower operating costs.

Notes:

ET	Evapotranspiration
N/A	Not applicable - inherent assumption
O&M	Operation and maintenance

Table D-6. Section 9 Lease Mines, Crew Time Productivity Calculations for Alternative 2, Multiple Locations Consolidate and Cap on Site

Step	Section 9 Lease Mines Haul / Access Road Installation				
1	**Action**	**Qty**	**Unit**	**Production/Day**	**Days**
	Section 9 Lease Mines Access Road Building	9,445	LCY	3,089	3.1
				Control Days	**3**
Step	**Section 9 Lease Mines Excavation and Hauling**				
2	**Action**	**Qty**	**Unit**	**Production/Day**	**Days**
	Waste Removal AUM 458 (AUM 459 portion 807 LCY) - Standard Excavator or Dozer / Loader	1,580	LCY	3,027	0.9
	Waste Removal placed at AUM 457 - Standard Excavator or Dozer / Loader	16,900	LCY	3,027	6.2
		18,480	**LCY**	**Control Days**	**7**
Step	**Section 9 Lease Mines Site Reclamation**				
3	**Action**	**Qty**	**Unit**	**Production/Day**	**Days**
	Dozer Contour Grading	37,462	SY	4,000	9.4
	Soil Backfill	18,480	LCY	3,027	7.2
	Water Bars	1,275	CY	536	2.4
	Rock-Lined Ditch (6 Feet by 3 Feet)	671	CY	1,099	0.6
	Rock Berm (4 Feet by 3 Feet)	549	CY	1,099	0.5
	Rock Fields and Rock Cover (1 Foot High)	319	CY	1,099	0.3
				Control Days	**19**
				TOTAL PROJECT DAYS	**28**
				Slowest Rate Project Days	15

Notes:

AC Acre
AUM Abandoned uranium mine
CY Cubic yard
LCY Loose cubic yard
QTY Quantity
SY Square yard

Table D-7. Section 9 Lease Mines, Cost Estimate Details for Alternative 2, Multiple Locations Consolidate and Cap on Site

Engineering Design	Crew	Unit	Amount	Price	Cost
Project Manager	N/A	Hour	200	$ 187.45	$ 37,490
Project Engineer	N/A	Hour	800	$ 144.74	$ 115,793
Design Engineer	N/A	Hour	400	$ 187.45	$ 74,980
CAD/GIS Operator	N/A	Hour	200	$ 121.01	$ 24,203
Admin	N/A	Hour	80	$ 79.49	$ 6,359
Reproduction	N/A	LS	3	$ 593.20	$ 1,780
					$ 260,605
Planning Documents	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Project Manager	N/A	Hour	100	$ 187.45	$ 18,745
Project Engineer	N/A	Hour	400	$ 144.74	$ 57,896
CAD/GIS Operator	N/A	Hour	100	$ 121.01	$ 12,101
Admin	N/A	Hour	40	$ 79.49	$ 3,180
Reproduction	N/A	LS	3	$ 593.20	$ 1,780
					$ 93,702
Resource Surveys	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Cultural Resources Mitigation	N/A	Each	0	$ 44,366.94	$ -
Biological Resources Mitigation	N/A	Each	1	$ 88,733.88	$ 88,734
Geotechnical Testing and Report	N/A	Each	1	$ 88,733.88	$ 88,734
Pre-Project Aerial LiDAR Survey	N/A	Each	0	$ 35,592.00	$ -
Post-Project Aerial LiDAR Survey	N/A	Each	1	$ 133,100.82	$ 133,101
					$ 310,569
Confirmation Sampling	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Developing Sampling and Analysis Plan					
Project Geologist	N/A	Hour	180	$ 187.45	$ 33,741
Project Manager	N/A	Hour	90	$ 131.69	$ 11,852
CAD/GIS Operator	N/A	Hour	90	$ 144.74	$ 13,027
Project Chemist	N/A	Hour	180	$ 131.69	$ 23,704
Health and Safety Manager	N/A	Hour	90	$ 179.15	$ 16,123
Admin	N/A	Hour	36	$ 79.49	$ 2,862
Reproduction	N/A	LS	3	$ 296.60	$ 890
Sampling - Gamma Only					
Sampling Team - Staff Geologist	N/A	Hour	40	$ 91.35	$ 3,690
Sampling Team - Staff Engineer	N/A	Hour	40	$ 96.10	$ 3,881
Travel	N/A	Day	8	$ 201.69	$ 1,670
Per Diem (96/55)	N/A	Day	8	$ 179.15	$ 1,483
Miscellaneous Field Supplies and Expenses	N/A	LS	1	$ 22,680.38	$ 22,680
Lab Analysis	N/A	LS	0	$ 7,307.23	$ -
XRF Surveying					
Sampling Team - Staff Geologist	N/A	Hour	0	$ 91.35	$ -
Sampling Team - Staff Engineer	N/A	Hour	0	$ 96.10	$ -
Travel	N/A	Day	0	$ 201.69	$ -
Per Diem (96/55)	N/A	Day	0	$ 179.15	$ -
Miscellaneous Field Supplies and Expenses	N/A	LS	0	$ 22,680.38	$ -
Lab Analysis	N/A	LS	0	$ 7,307.23	$ -
Frisking Equipment	N/A	Month	0	$ 170.84	$ -
					$ 135,603

Table D-7. Section 9 Lease Mines, Cost Estimate Details for Alternative 2, Multiple Locations Consolidate and Cap on Site

Reporting	Crew	Unit	Amount	Price	Cost
Project Geologist	N/A	Hour	158	$ 124.57	$ 19,682
Project Manager	N/A	Hour	79	$ 207.62	$ 16,402
Project Engineer	N/A	Hour	237	$ 144.74	$ 34,304
Chemist	N/A	Hour	79	$ 131.69	$ 10,404
CAD/GIS Operator	N/A	Hour	79	$ 121.01	$ 9,560
Admin	N/A	Hour	32	$ 79.49	$ 2,504
Reproduction	N/A	LS	3	$ 593.20	$ 1,780
					$ 94,635
Mobilization/Demobilization	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Crew Mileage	N/A	Mile	1,568	$ 0.67	$ 1,051
Per Diem	N/A	Day	15	$ 182.00	$ 2,730
Labor	N/A	Day	15	$ 355.92	$ 5,339
Standard Equipment Mileage	N/A	Mile	1,568	$ 0.67	$ 1,051
Standard Equipment Rental	N/A	Day	2	$ 20,948.76	$ 41,898
					$ 52,067
Haul Road Building	**Crew**	**Daily**	**Unit #**	**Days**	**Cost**
Excavator 3.5 CY ~ 80K-100K lb.	B12D	$ 4,346.97	1	3	$ 13,292
Dozer D6	B10M	$ 3,478.17	1	3	$ 10,636
Grader 30,000 lb.	B11L	$ 2,863.38	1	3	$ 8,756
Water Truck	B45	$ 1,054.71	4	3	$ 12,900
Brush Chipper	B7	$ 3,119.05	1	3	$ 9,537
Loader 5cy+	B10U	$ 2,411.88	1	3	$ 7,375
Off Road Haul Truck (17 CY)	B34F	$ 1,962.09	2	3	$ 11,999
				Total	**$ 74,495**
Excavation & Hauling	**Crew**	**Daily**	**Unit #**	**Days**	**Cost**
Loader 5CY+	B10U	$ 2,411.88	2	6	$ 24,826
Off Road Haul Truck (17 CY)	B34A	$ 1,962.09	6	6	$ 60,588
Grader 30,000 lb.	B11L	$ 2,863.38	2	6	$ 29,473
Water Truck	B45	$ 1,054.71	4	6	$ 21,712
Dozer D6	B10M	$ 3,478.17	2	6	$ 35,801
Excavator 3.5 CY ~ 80K-100K lb.	B12D	$ 4,346.97	2	6	$ 44,744
				Total	**$ 217,144**
Onsite Restoration	**Crew**	**Daily**	**Unit #**	**Days**	**Cost**
Off Road Haul Truck (17 CY)	B34F	$ 1,962.09	4	6	$ 47,921
Loader 5CY+	B10U	$ 2,411.88	2	6	$ 29,453
Grader 30,000 lb.	B11L	$ 2,863.38	1	2	$ 6,810
Excavator 3.5 CY ~ 80K-100K lb.	B12D	$ 4,346.97	2	6	$ 53,084
Dozer D6	B10M	$ 3,478.17	2	12	$ 81,694
Water Truck	B45	$ 1,054.71	4	12	$ 49,545
Rip Rap Class II 18"-24"	NA	$ 53.37	862.0	1	$ 46,009
				Total	**$ 314,516**

Table D-7. Section 9 Lease Mines, Cost Estimate Details for Alternative 2,
Multiple Locations Consolidate and Cap on Site

Construction Contractor Site Overhead	Crew	Unit	Amount	Price	Cost
Project Manager (10% of time)	N/A	Hour	15	$ 207.62	$ 3,170
Site Superintendent	N/A	Hour	153	$ 226.60	$ 34,601
H&S Officer	N/A	Hour	153	$ 100.84	$ 15,398
QA/QC Officer	N/A	Hour	153	$ 100.84	$ 15,398
Field Clerk	N/A	Hour	153	$ 22.54	$ 3,442
Fuel for Site Vehicles	N/A	Month	4	$ 581.34	$ 2,515
Port-o-let Rental (4)	N/A	Month	3	$ 246.77	$ 754
Job Trailers (1)	N/A	Month	1	$ 319.14	$ 244
Storage Boxes (1)	N/A	Month	1	$ 112.11	$ 86
Field Office Lights/HVAC (1)	N/A	Month	1	$ 212.37	$ 162
Generator (1)	N/A	Month	2	$ 2,847.36	$ 4,348
Fuel for Generator	N/A	Gallons	458	$ 4.75	$ 2,174
Telephone/internet (1)	N/A	Month	1	$ 455.58	$ 348
Field Office Equipment	N/A	Month	1	$ 272.87	$ 208
Field Office Supplies	N/A	Month	1	$ 113.89	$ 87
Trash (1 dumpster)	N/A	Month	1	$ 1,079.62	$ 824
Clin 1034 High Volume Air Sampling (4)	N/A	Month	3	$ 454.39	$ 1,388
Clin 1025 Ludlum 2121 and 43-10-1	N/A	Month	1	$ 326.26	$ 249
Air Monitoring Lab Confirmation Sampling (5 samples per day)	N/A	Day	61	$ 711.84	$ 43,478
Clin 1036 Personal Air Monitor	N/A	Month	8	$ 242.03	$ 2,003
Clin 1038 Personal Dust Monitor	N/A	Month	8	$ 1,844.85	$ 15,272
Clin 1068 Personal Dosimeter Badge	N/A	Month	8	$ 70.00	$ 579
Truck Scales	N/A	Month	1	$ 355.92	$ 272
					$ 147,000
Third-Party Oversight	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Travel and Lodging (1 person)	N/A	Day	15	$ 179.15	$ 2,735
Labor	N/A	Hour	153	$ 94.91	$ 14,493
Car Rental (1 car)	N/A	Month	1	$ 474.56	$ 362
Car Fuel	N/A	Month	1	$ 901.66	$ 688
					$ 18,279
Level of Accuracy (20%)	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
20% of Construction Cost	N/A	N/A	N/A	N/A	**$ 129,326**
				GRAND TOTAL	**$ 1,984,370**

Table D-7. Section 9 Lease Mines, Cost Estimate Details for Alternative 2, Multiple Locations Consolidate and Cap on Site

Onsite O&M Costs	Crew	Unit	Amount	Price	Cost
Annual Inspection (1 person crew, 1 day, 10 hrs/day)	N/A	Hour	10	$ 100.84	$ 1,008
Inspection Crew Travel and Lodging	N/A	LS	1	$ 791.31	$ 791
Preperation of Semi-annual Reports (Professional Engineer)	N/A	Hour	8	$ 142.37	$ 1,139
Inspection Event Cost					**$ 2,939**
Inspection Contingency (15%)					**$ 171**
Total Inspection Event Cost					**$ 3,110**
Maintenance Crew Travel and Lodging	N/A	LS	1	$ 2,434.49	$ 2,434
Mobilization and Demobilization of Dozer, and 17 CY Articulated Dump Truck	N/A	LS	1	$ 20,654.80	$ 20,655
Dozer Rental and Labor	B81	Day	3	$ 3,478.52	$ 10,436
Articulated Dump Truck (17 CY) Rental and Labor	B34F	Day	3	$ 1,962.09	$ 5,886
Riprap Class II	N/A	CY	64	$ 53.39	$ 3,409
Construction Overhead	N/A	LS	1	$ 18,090.70	$ 18,091
O&M Annual Cost					**$ 60,911**
O&M Contingency (15%)					**$ 9,137**
Total O&M Annual Cost					**$ 70,047**
Contractor Site Overhead O&M	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Site Superintendent	N/A	Hour	30	$ 226.60	$ 6,798.07
H&S Officer	N/A	Hour	30	$ 100.84	$ 3,025.32
Fuel for Site Vehicles	N/A	Month	0.5	$ 6,976.03	$ 3,139.21
Port-o-let Rental (1)	N/A	Month	0.2	$ 246.77	$ 37.02
Generator (1)	N/A	Month	0.15	$ 2,847.36	$ 427.10
Fuel for Generator	N/A	Gallons	90	$ 4.75	$ 427.10
Telephone/internet (1)	N/A	Month	0.15	$ 455.58	$ 68.34
Trash (1 dumpster)	N/A	Month	0.15	$ 1,079.62	$ 161.94
Clin 1034 High Volume Air Sampling (3)	N/A	Month	0.5	$ 454.39	$ 204.48
Clin 1025 Ludlum 2121 and 43-10-1	N/A	Month	0.15	$ 326.26	$ 48.94
Air Monitoring Lab Confirmation Sampling (3 samples per day)	N/A	Day	3	$ 711.84	$ 2,135.52
Clin 1036 Personal Air Monitor	N/A	Month	0.8	$ 242.03	$ 181.52
Clin 1038 Personal Dust Monitor	N/A	Month	0.8	$ 1,844.85	$ 1,383.64
Clin 1068 Personal Dosimeter Badge	N/A	Month	0.8	$ 70.00	$ 52.50
					$ 18,090.70

Table D-7. Section 9 Lease Mines, Cost Estimate Details for Alternative 2, Multiple Locations Consolidate and Cap on Site

Notes:

"	Inch
CAD	Computer-aided design
CY	Cubic yard
GIS	Geographic information system
H&S	Health and safety
HP	Horsepower
hr	Hour
HVAC	Heating, ventilation, and air conditioning
K	Thousand
lb.	Pound
LF	Linear foot
LiDAR	Light detection and ranging
LS	Lump sum
N/A	Not applicable
O&M	Operation and maintenance
QA/QC	Quality assurance/quality control
SY	Square yard
XRF	X-ray fluorescence

**Table D-8. Section 9 Lease Mines, Cost Estimate Summary for Alternative 2,
Multiple Locations Consolidate and Cap on Site**

Haul Road Building	Unit Cost	
Excavator 3.5 cy ~ 80K-100K lb.	$	13,292
Dozer D6	$	10,636
Grader 30,000 lb.	$	8,756
Water Truck	$	12,900
Off Road Haul Truck	$	11,999
Loader 5cy+	$	7,375
Brush Chipper	$	9,537
Subtotals Step 1	**$**	**74,495**
Excavation and Hauling	**Unit Cost**	
Loader 5cy+	$	29,453
Off Road Haul Truck (17 CY)	$	71,881
Grader 30,000 lb.	$	34,967
Water Truck	$	25,760
Dozer D6	$	42,474
Excavator 3.5 cy ~ 80K-100K lb.	$	53,084
Subtotals Step 2	**$**	**257,619**
Onsite Restoration	**Unit Cost**	
Off Road Haul Truck (17 CY)	$	47,921
Loader 5cy+	$	29,453
Grader 30,000 lb.	$	6,810
Excavator 3.5 cy ~ 80K-100K lb.	$	53,084
Dozer D6	$	81,694
Water Truck	$	49,545
Rip Rap Class II 18"-24"	$	46,009
Subtotals Step 3	**$**	**314,516**
Subtotal Construction	**$**	**646,631**
Other Costs	**Unit Cost**	
Non-Construction Costs		
Engineering Design	$	260,605
Planning Documents	$	93,702
Resource Surveys	$	310,569
Confirmation Sampling	$	135,603
Reporting	$	94,635
Contractor Site Overhead and Miscellaneous Costs	$	147,000
Mobilization / Demobilization	$	52,067
Travel+ Lodging (Construction Workers)	$	95,954
Level of Accuracy (20%)	$	129,326
Third-Party Oversight	$	18,279
Subtotals Step 6	**$**	**1,337,739**
Total Site Capital Costs	**$**	**1,984,370**
Inspections and Maintenance Event Costs	**Unit Cost**	
Annual Inspection (1 person crew, 1 day, 10 hrs/day)	$	1,008
Inspection Crew Travel and Lodging	$	791
Preperation of Report (Professional Engineer)	$	1,139
Subtotal Inspection Costs	**$**	**2,939**
Inspection Contingencies (15%)	$	441
Total Yearly Inspection Costs	**$**	**3,380**

Table D-8. Section 9 Lease Mines, Cost Estimate Summary for Alternative 2, Multiple Locations Consolidate and Cap on Site

Present Value of Inspection Costs Based on 10-Year Life at 3.50% (PV Factor = 8.317)	**$**	**28,107**
Maintenance Crew Travel and Lodging	$	2,434
Mobilization and Demobilization of Dozer, Loader, and 17 CY Articulated Dump Truck	$	20,655
Dozer Rental and Labor	$	10,436
Articulated Dump Truck (17 CY) Rental and Labor	$	5,886
Riprap Class II	$	3,409
Construction Overhead	$	18,091
Subtotal Maintenance Costs	**$**	**60,911**
Maintenance Contingencies (15%)	$	9,137
Total Maintenance Costs	**$**	**70,047**
Maintenance Cost (Year 10)		
Present Value of Maintenance Costs Based on 10-Year Life at 3.50% (PV Factor = 0.7089)	**$**	**49,657**
AUM 458 ET Cap		
AUM 458 Cap Construction Cost	**$**	**599,949**
AUM 458 Cap Total O&M Costs (30 Years)	**$**	**47,419**
AUM 458 ET Cap Cost per CY (Construction, 10-Year Operations, and 30-Year O&M Cost)	**$**	**512**
AUM 458 ET Cap Total Cost	**$**	**647,369**
AUM 457 ET Cap		
AUM 457 Cap Construction Cost	**$**	**866,322**
AUM 457 Cap Total O&M Costs (30 Years)	**$**	**47,661**
AUM 457 ET Cap Cost per CY (Construction, 10-Year Operations, and 30-Year O&M Cost)	**$**	**68**
AUM 457 ET Cap Total Cost	**$**	**913,983**
Grand Total Capital Costs	**$**	**3,450,642**
Total Inspection and Maintenance Cost	**$**	**77,764**
Total Cap O&M Cost (30 Years)	**$**	**95,080**
Total Costs	**$**	**3,623,486**

Notes:

"	Inch
AC	Acre
AUM	Abandoned uranium mine
CY	Cubic yard
ET	Evapotranspiration
HP	Horsepower
hr	Hour
K	Thousand
lb.	Pound
O&M	Operation and maintenance
PV	Present value

Table D-9. Section 9 Lease Mines, AUM 458 Cap Cost Details for Alternative 2, Multiple Locations Consolidate and Cap on Site

Site Measurements	QTY	Unit	QTY	Unit		
Repository Area	2.46	AC	107,326	SF		
Repository Topsoil 3"	994	CY				
Borrow Topsoil 3" (1.5 AC)	605	CY				
Clean Fill Volume (Volume From Estimate calculator)	11,927	CY				
Waste Volume	2,271	CY				
Laydown Area (google earth)	1.6	AC	69,696	SF		
Laydown topsoil 3"	645	CY				
Engineering Design	**Equipment List**	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Project Manager			Hour	33	$ 187.45	$ 6,188
Project Engineer			Hour	131.8	$ 144.74	$ 19,078
Design Engineer			Hour	65.9	$ 187.45	$ 12,354
CAD/GIS Operator			Hour	33.0	$ 121.01	$ 3,995
Admin			Hour	13	$ 79.49	$ 1,048
Reproduction			LS	3	$ 593.20	$ 1,513
						$ 44,175
Site Prep	**Equipment List**	**Crew**	**Daily**	**Unit**	**Days**	**Cost**
Storm Drain Channel Excavation (includes laydown +25%)	Excavator 3.5 CY = 300 CY/hr.	B-12D	$ 4,347.92	1	1.1	**$ 4,806**
Storm Drain Channel Armoring (Riprap) (includes laydown and Pond +25%)	Riprap Class II 18"-24"		$ 61.69	461		$ 28,431
	Excavator 3.5 CY = 300 CY/hr.	B-12D	$ 4,347.92	1	0.2	$ 933
	Loader 5.5 CY	B-10U	$ 2,411.88	1	0.2	$ 517
						$ 29,881
Storm Drain Pond Excavation (includes laydown +25%)	Excavator 3.5 CY = 300 CY/hr.	B-12D	$ 4,347.92	1	1.8	**$ 7,861**
						$ 42,548

Table D-9. Section 9 Lease Mines, AUM 458 Cap Cost Details for Alternative 2, Multiple Locations Consolidate and Cap on Site

Excavation	Equipment List	Crew	Daily	Unit	Days	Cost
Repository and Soil Borrow Excavation and Stockpiling	Excavator 3.5 CY = 300 CY/hr.	B-12D	$ 4,347.92	1	5.7	$ 24,889
	Off-Road Haul Truck 22 CY	B34F	$ 1,962.09	2	5.7	$ 22,463
	Dozer 300 HP	B-10M	$ 3,478.17	1	5.7	$ 19,910
	Water Truck	B-59	$ 1,334.69	1	5.7	$ 7,640
						$ 74,903
Borrow Material Screening	Loader 5.5 CY	B-10U	$ 2,411.88	1	5.7	$ 13,806
	Screen Plant		$ 5,605.74	1	5.7	$ 32,089
	Water Truck	B-59	$ 1,334.69	1	5.7	$ 7,640
						$ 53,536
						$ 128,438
Operation	**Equipment List**	**Crew**	**Daily**	**Unit**	**Days**	**Cost**
Waste Screening	Loader 5. 5 CY	B-10U	$ 2,411.88	1	1.7	$ 4,156
	Screen Plant		$ 5,605.74	1	1.7	$ 9,660
	Off-Road Haul Truck	B34F	$ 1,962.09	1	1.7	$ 3,381
	Dozer 300 HP	B-10M	$ 3,478.17	1	1.7	$ 5,994
	Water Truck	B-59	$ 1,334.69	1	1.7	$ 2,300
						$ 25,492
Waste Grading of Each Lift + Waste Compaction of Each Lift	30,000 lb. Grader	B-32A	$ 4,574.76	1	1.7	$ 7,884
	Water Truck	B-59	$ 1,334.69	1	1.7	$ 2,300
						$ 10,184
						$ 35,676
Closure	**Equipment List**	**Crew**	**Daily**	**Unit**	**Days**	**Cost**
Waste Final Grading	30,000 lb. Grader	B-11L	$ 2,863.38	1	0.7	$ 1,999
	Water Truck	B-59	$ 1,334.69	1	0.7	$ 932
						$ 2,931
Cap Cover Installation	Loader 5.5 CY	B-10U	$ 2,411.88	1	4.8	$ 11,643
	Off-Road Haul Truck	B34F	$ 1,962.09	1	4.8	$ 9,472
	Dozer 300 HP	B-10M	$ 3,478.17	1	4.8	$ 16,791
	30,000 lb. Grader	B-11L	$ 2,863.38	1	4.8	$ 13,823
	Water Truck	B-59	$ 1,334.69	1	4.8	$ 6,443
						$ 58,172
						$ 61,102

Table D-9. Section 9 Lease Mines, AUM 458 Cap Cost Details for Alternative 2, Multiple Locations Consolidate and Cap on Site

Reclamation	Equipment List	Crew	Unit	Amount	Price	Cost
Hay Bales/Wattles and Silt Fence			LF	635	$ 10.14	$ 6,441
Fertilizer, Seed, and Mulch			SY	3,442	$ 4.77	$ 16,417
						$ 22,859
Other Line Items	**Equipment List**	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Fence			LF	1,322	$ 7.15	$ 9,456
Survey			AC	2.1	$ 4,063.42	$ 8,510
						$ 17,966
Subtotal Construction Costs						**$ 308,588**
Contractor Site Overhead						**$ 104,299**
Travel + Lodging:						**$ 49,076**
Mobilization / Demobilization:						**$ 73,661**
Level of Accuracy (20%)						**$ 61,718**
Total Construction Cost:						**$ 599,949**
30-Year Maintenance Costs Every 10 Years						
Operation	**Equipment List**	**Crew**	**Unit**	**Unit Cost**	**Amount**	**Cost**
Site Inspections		N/A	EA	$ 1,483.00	1	$ 1,483
Annual Maintenance Travel and Lodging		N/A	LS	$ 595.57	1	$ 596
Mobilization / Demobilization		N/A	LS	$ 7,531.74	1	$ 7,532
Construction Overhead		N/A	LS	$ 5,350.72	1	$ 5,351
Standard Excavator Rental and Labor	Excavator 3.5 CY = 300 CY/hr.	B-12D	Day	$ 4,346.97	1	$ 4,347
Articulated Dump Truck Rental and Labor	Off-Road Haul Truck	B-34F	Day	$ 1,962.31	1	$ 1,962
Range Fencing Repair		N/A	LF	$ 7.15	156	$ 1,112
Riprap Material and Hauling		N/A	CY	$ 65.25	54	$ 3,538
Subtotal Maintenance Event Costs						**$ 25,921**
Maintenance Contingencies			15%			$ 3,888
Total Maintenance Event Cost						**$ 29,809**

Table D-9. Section 9 Lease Mines, AUM 458 Cap Cost Details for Alternative 2, Multiple Locations Consolidate and Cap on Site

30-Year Maintenance Costs (Years 1-10)						
Present Value of Maintenance Costs Based on 10-Year Life at 3.50%			PV Factor = 0.7089			**$ 21,131**
30-Year Maintenance Costs (Years 11-20)						
Present Value of Maintenance Costs Based on 20-Year Life at 3.50%			PV Factor = 0.5026			**$ 14,982**
30-Year Maintenance Costs (Years 21-30)						
Present Value of Maintenance Costs Based on 30-Year Life at 3.50%			PV Factor = 0.3563			**$ 10,621**
Total Maintenance Cost						**$ 46,734**
Total Present Worth						**$ 647,369**
Cost Per CY:						**$ 512**

Notes:

'	Foot
"	Inch
AC	Acre
AUM	Abandoned uranium mine
CAD	Computer-aided design
CY	Cubic yard
EQ	Equipment
GIS	Geographic information system
hr	Hour
lb.	Pound
LF	Linear foot
LS	Lump sum
N/A	Not applicable
O&M	Operation and maintenance
PV	Present value
SY	Square yard

Table D-10. Section 9 Lease Mines, AUM 457 Cost Details for Alternative 2, Multiple Locations Consolidate and Cap on Site

Site Measurements	QTY	Unit	QTY	Unit		
Repository Area	2.54	AC	110,731	SF		
Repository Topsoil 3"	1,025	CY				
Borrow Topsoil 3" (1.5 AC)	605	CY				
Clean Fill Volume (Volume From Estimate calculator)	12,312	CY				
Waste Volume	15,089	CY				
Laydown Area (google earth)	1.3	AC	54,886	SF		
Laydown topsoil 3"	508	CY				
Engineering Design	**Equipment List**	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Project Manager			Hour	33	$ 187.45	$ 6,188
Project Engineer			Hour	131.8	$ 144.74	$ 19,078
Design Engineer			Hour	65.9	$ 187.45	$ 12,354
CAD/GIS Operator			Hour	33.0	$ 121.01	$ 3,995
Admin			Hour	13	$ 79.49	$ 1,048
Reproduction			LS	3	$ 593.20	$ 1,513
					$ -	**$ 44,175**
Site Prep	**Equipment List**	**Crew**	**Daily**	**Unit**	**Days**	**Cost**
Storm Drain Channel Excavation (includes laydown +25%)	Excavator 3.5 CY = 300 CY/hr.	B-12D	$ 4,347.92	1	1.11	**$ 4,806**
Storm Drain Channel Armoring (Riprap) (includes laydown and Pond +25%)	Riprap Class II 18"-24"		$ 61.69	464		$ 28,651
	Excavator 3.5 CY = 300 CY/hr.	B-12D	$ 4,347.92	1	0.22	$ 962
	Loader 5.5 CY	B-10U	$ 2,411.88	1	0.22	$ 534
						$ 30,147
Storm Drain Pond Excavation (includes laydown +25%)	Excavator 3.5 CY = 300 CY/hr.	B-12D	$ 4,347.92	1	1.81	**$ 7,861**
						$ 43,175

Table D-10. Section 9 Lease Mines, AUM 457 Cost Details for Alternative 2, Multiple Locations Consolidate and Cap on Site

Excavation	Equipment List	Crew	Daily	Unit	Days	Cost
Repository and Soil Borrow Excavation and Stockpiling	Excavator 3.5 CY = 300 CY/hr.	B-12D	$ 4,347.92	1	5.82	$ 25,318
	Off-Road Haul Truck 22 CY	B34F	$ 1,962.09	2	5.82	$ 22,850
	Dozer 300 HP	B-10M	$ 3,478.17	1	5.82	$ 20,253
	Water Truck	B-59	$ 1,334.69	1	5.82	$ 7,772
						$ 76,193
Borrow Material Screening	Loader 5.5 CY	B-10U	$ 2,411.88	1	5.82	$ 14,044
	Screen Plant		$ 5,605.74	1	5.82	$ 32,642
	Water Truck	B-59	$ 1,334.69	1	5.82	$ 7,772
						$ 54,458
						$ 130,651
Operation	**Equipment List**	**Crew**	**Daily**	**Unit**	**Days**	**Cost**
Waste Screening	Loader 5.5 CY	B-10U	$ 2,411.88	1	11.5	$ 27,620
	Screen Plant		$ 5,605.74	1	11.5	$ 64,194
	Off-Road Haul Truck	B34F	$ 1,962.09	1	11.5	$ 22,469
	Dozer 300 HP	B-10M	$ 3,478.17	1	11.5	$ 39,830
	Water Truck	B-59	$ 1,334.69	1	11.5	$ 15,284
						$ 169,398
Waste Grading of Each Lift + Waste Compaction of Each Lift	30,000 lb. Grader	B-32A	$ 4,574.76	1	11.5	$ 52,388
	Water Truck	B-59	$ 1,334.69	1	11.5	$ 15,284
						$ 67,672
						$ 201,509
Closure	**Equipment List**	**Crew**	**Daily**	**Unit**	**Days**	**Cost**
Waste Final Grading	30,000 lb. Grader	B-11L	$ 2,863.38	1	0.7	$ 2,062
	Water Truck	B-59	$ 1,334.69	1	0.7	$ 961
						$ 3,024
Cap Cover Installation	Loader 5.5 CY	B-10U	$ 2,411.88	1	5.0	$ 12,020
	Off-Road Haul Truck	B34F	$ 1,962.09	1	5.0	$ 9,778
	Dozer 300 HP	B-10M	$ 3,478.17	1	5.0	$ 17,334
	30,000 lb. Grader	B-11L	$ 2,863.38	1	5.0	$ 14,270
	Water Truck	B-59	$ 1,334.69	1	5.0	$ 6,652
						$ 60,053
						$ 53,615

Table D-10. Section 9 Lease Mines, AUM 457 Cost Details for Alternative 2, Multiple Locations Consolidate and Cap on Site

Reclamation	Equipment List	Crew	Unit	Amount	Price	Cost
Hay Bales/Wattles and Silt Fence			LF	655	$ 10.14	$ 6,646
Fertilizer, Seed, and Mulch			SY	3,551	$ 4.77	$ 16,938
						$ 23,584
Other Line Items	**Equipment List**	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Fence			LF	1,900	$ 7.15	$ 13,591
Survey			AC	2	$ 4,063.42	$ 8,780
						$ 22,371
Subtotal Construction Costs						**$ 519,567**
Contractor Site Overhead						**$ 106,265**
Travel + Lodging:						**$ 54,125**
Mobilization / Demobilization:						**$ 73,661**
Level of Accuracy (20%)						**$ 103,913**
Total Construction Cost:						**$ 866,322**
30-Year Annual PRSC Costs (Years 1-10)						
Operation	**Equipment List**	**Crew**	**Unit**	**Unit Cost**	**Amount**	**Cost**
Site Inspections		N/A	EA	$ 1,483.00	1	$ 1,483
Annual Maintenance Travel and Lodging		N/A	LS	$ 595.57	1	$ 596
Mobilization / Demobilization		N/A	LS	$ 7,531.74	1	$ 7,532
Construction Overhead		N/A	LS	$ 5,350.72	1	$ 5,351
Standard Excavator Rental and Labor	Excavator 3.5 CY = 300 CY/hr.	B-12D	Day	$ 4,346.97	1	$ 4,347
Articulated Dump Truck Rental and Labor	Off-Road Haul Truck	B-34F	Day	$ 1,962.31	1	$ 1,962
Range Fencing Repair		N/A	LF	$ 7.15	224	$ 1,599
Rip-Rap Material and Hauling		N/A	CY	$ 65.25	55	$ 3,565
Subtotal Maintenance Costs						**$ 26,434**
Maintenance Contingencies			15%			$ 3,965
Total Maintenance Event Cost						**$ 30,400**

Table D-10. Section 9 Lease Mines, AUM 457 Cost Details for Alternative 2, Multiple Locations Consolidate and Cap on Site

30-Year Maintenance Costs (Years 1-10)						
Present Value of Maintenance Costs Based on 10-Year Life at 3.50%			PV Factor = 0.7089			**$ 21,550**
30-Year Maintenance Costs (Years 11-20)						
Present Value of Maintenance Costs Based on 20-Year Life at 3.50%			PV Factor = 0.5026			**$ 15,279**
30-Year Maintenance Costs (Years 21-30)						
Present Value of Maintenance Costs Based on 30-Year Life at 3.50%			PV Factor = 0.3563			**$ 10,831**
Total Maintenance Cost						**$ 47,661**
Total Present Worth						**$ 913,983**
Cost Per CY:						**$ 68**

Notes:

'	Foot
"	Inch
AUM	Abandoned uranium mine
AC	Acre
CAD	Computer-aided design
CY	Cubic yard
EQ	Equipment
GIS	Geographic information system
hr	Hour
lb.	Pound
LF	Linear foot
LS	Lump sum
N/A	Not applicable
O&M	Operation and maintenance
PV	Present value
SY	Square yard

Table D-11. Section 9 Lease Mines, Cost Estimate Scenario Assumptions for Alternative 3, Single Location Consolidate and Cap on Site

Technology	Assumptions	Cost Effects
Excavation Methods	Waste removed by a large excavator unless specified.	Excavators can operate on steeper terrain than bulldozers and are better at moving waste uphill. Bulldozers cost less to operate. Spider excavators or other specialized equipment are more expensive.
	Any disturbed surface restored using grading and erosion controls.	Quantities of erosion control materials and grading may be lower than estimated.
	All waste specified in the risk assessment will be excavated.	Volumes of excavated waste may be lower than estimated.
	The site is accessible to haul trucks and trucks will be easily loaded.	Accessing difficult-to-reach mines increases costs.
	O&M inspection of the mine site will be completed for 10 years.	More O&M inspections will increase costs.
Soil and Waste Sorting	Waste will be sorted based on grain size; rock greater than 3 inches will be segregated.	N/A
	Waste will be processed through the screening plant using an excavator.	N/A
Consolidation and Cap	Waste will be consolidated nearby on-site and capped at consolidation area.	Greater distance to consolidate increases costs.
	Waste will be consolidated into a 1.2-acre area and graded.	Consolidation into a larger area decreases the cost for relocating the waste; however, it increases cost for cover soil.
	Waste will be consolidated from multiple locations.	Consolidating waste from multiple locations increases costs.
	A bulldozer will be used to excavate borrow soil.	Use of an excavator may increase costs.
	Multiple cells will be required to be opened and closed.	Multiple mobilizations to open/close cells increases costs.
	ET cap will be 3 feet of soil with a biobarrier and capillary break, but no liner.	Adding biobarrier, capillary break, or liner will increase costs
	No bottom liner or leachate collection system will be installed.	Adding bottom liner or leachate collection system increases costs.
	Bulldozer will be used to move borrow soil to form cap.	Use of an excavator may increase costs
	O&M inspection of the cap will be conducted for 30 years.	More O&M inspections increases costs.
Water	Water will be hauled in from Cameron, Arizona.	Drilling a water well would incur additional capital costs, but lower operating costs.

Notes:

ET	Evapotranspiration
N/A	Not applicable - inherent assumption
O&M	Operation and maintenance

Table D-12. Section 9 Lease Mines, Crew Time Productivity Calculations for Alternative 3, Single Location Consolidate and Cap on Site

Step	Action	Qty	Unit	Production/Day	Days
Step	**Section 9 Lease Mines Haul / Access Road Installation**				
1	**Action**	**Qty**	**Unit**	**Production/Day**	**Days**
	Section 9 Lease Mines Access Road Building	11,499	LCY	2,573	4.5
				Control Days	**4**
Step	**Section 9 Lease Mines Excavation and Hauling**				
2	**Action**	**Qty**	**Unit**	**Production/Day**	**Days**
	Waste Removal AUM 458 (AUM 459 portion 807 LCY) - Standard Excavator or Dozer / Loader	1,580	LCY	2,250	0.7
	Waste Removal placed at AUM 457 - Standard Excavator or Dozer / Loader	16,900	LCY	2,250	7.5
		18,480	**LCY**	**Control Days**	**8**
Step	**Section 9 Lease Mines Site Reclamation**				
3	**Action**	**Qty**	**Unit**	**Production/Day**	**Days**
	Dozer Contour Grading	52,901	SY	4,000	13.2
	Soil Backfill	18,480	LCY	3,027	8.2
	Water Bars	1,552	CY	536	2.9
	Rock-Lined Ditch (6 Feet by 3 Feet)	771	CY	1,099	0.7
	Rock Berm (4 Feet by 3 Feet)	616	CY	1,099	0.6
	Rock Fields and Rock Cover (1 Foot High)	356	CY	1,099	0.3
				Control Days	**26**
				TOTAL PROJECT DAYS	**39**
				Slowest Rate Project Days	21

Notes:

AC Acre
AUM Abandoned uranium mine
CY Cubic yard
LCY Loose cubic yard
QTY Quantity
SY Square yard

Table D-13. Section 9 Lease Mines, Cost Estimate Details for Alternative 3, Single Location Consolidate and Cap on Site

Engineering Design	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Project Manager	N/A	Hour	200	$ 187.45	$ 37,490
Project Engineer	N/A	Hour	800	$ 144.74	$ 115,793
Design Engineer	N/A	Hour	400	$ 187.45	$ 74,980
CAD/GIS Operator	N/A	Hour	200	$ 121.01	$ 24,203
Admin	N/A	Hour	80	$ 79.49	$ 6,359
Reproduction	N/A	LS	3	$ 593.20	$ 1,780
					$ 260,605
Planning Documents	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Project Manager	N/A	Hour	100	$ 187.45	$ 18,745
Project Engineer	N/A	Hour	400	$ 144.74	$ 57,896
CAD/GIS Operator	N/A	Hour	100	$ 121.01	$ 12,101
Admin	N/A	Hour	40	$ 79.49	$ 3,180
Reproduction	N/A	LS	3	$ 593.20	$ 1,780
					$ 93,702
Resource Surveys	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Cultural Resources Mitigation	N/A	Each	0	$ 44,366.94	$ -
Biological Resources Mitigation	N/A	Each	1	$ 88,733.88	$ 88,734
Geotechnical Testing and Report	N/A	Each	1	$ 88,733.88	$ 88,734
Pre-Project Aerial LiDAR Survey	N/A	Each	0	$ 35,592.00	$ -
Post-Project Aerial LiDAR Survey	N/A	Each	1	$ 133,100.82	$ 133,101
					$ 310,569
Confirmation Sampling	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Developing Sampling and Analysis Plan					
Project Geologist	N/A	Hour	180	$ 187.45	$ 33,741
Project Manager	N/A	Hour	90	$ 131.69	$ 11,852
CAD/GIS Operator	N/A	Hour	90	$ 144.74	$ 13,027
Project Chemist	N/A	Hour	180	$ 131.69	$ 23,704
Health and Safety Manager	N/A	Hour	90	$ 179.15	$ 16,123
Admin	N/A	Hour	36	$ 79.49	$ 2,862
Reproduction	N/A	LS	3	$ 296.60	$ 890
Sampling					
Sampling Team - Staff Geologist	N/A	Hour	40	$ 91.35	$ 3,690
Sampling Team - Staff Engineer	N/A	Hour	40	$ 96.10	$ 3,881
Travel	N/A	Day	8	$ 201.69	$ 1,670
Per Diem (96/55)	N/A	Day	8	$ 179.15	$ 1,483
Miscellaneous Field Supplies and Expenses	N/A	LS	1	$ 22,680.38	$ 22,680
Lab Analysis	N/A	LS	0	$ 7,307.23	$ -
XRF Surveying					
Sampling Team - Staff Geologist	N/A	Hour	0	$ 91.35	$ -
Sampling Team - Staff Engineer	N/A	Hour	0	$ 96.10	$ -
Travel	N/A	Day	0	$ 201.69	$ -
Per Diem (96/55)	N/A	Day	0	$ 179.15	$ -
Miscellaneous Field Supplies and Expenses	N/A	LS	0	$ 22,680.38	$ -
Lab Analysis	N/A	LS	0	$ 7,307.23	$ -
Frisking Equipment	N/A	Month	0	$ 170.84	$ -
					$ 135,603

Table D-13. Section 9 Lease Mines, Cost Estimate Details for Alternative 3, Single Location Consolidate and Cap on Site

Reporting	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Project Geologist	N/A	Hour	158	$ 124.57	$ 19,682
Project Manager	N/A	Hour	79	$ 207.62	$ 16,402
Project Engineer	N/A	Hour	237	$ 144.74	$ 34,304
Chemist	N/A	Hour	79	$ 131.69	$ 10,404
CAD/GIS Operator	N/A	Hour	79	$ 121.01	$ 9,560
Admin	N/A	Hour	32	$ 79.49	$ 2,504
Reproduction	N/A	LS	3	$ 593.20	$ 1,780
					$ 94,635
Mobilization/Demobilization	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Crew Mileage	N/A	Mile	1,568	$ 0.67	$ 1,051
Per Diem	N/A	Day	15	$ 182.00	$ 2,730
Labor	N/A	Day	15	$ 355.92	$ 5,339
Standard Equipment Mileage	N/A	Mile	1,568	$ 0.67	$ 1,051
Standard Equipment Rental	N/A	Day	2	$ 24,853.61	$ 49,707
					$ 59,877
Haul Road Building	**Crew**	**Daily**	**Unit #**	**Days**	**Cost**
Excavator 3.5 CY ~ 80K-100K lb.	B12D	$ 4,346.97	1	4	$ 19,427
Dozer D6	B10M	$ 3,478.17	1	4	$ 15,545
Grader 30,000 lb.	B11L	$ 2,863.38	1	4	$ 12,797
Water Truck	B45	$ 1,054.71	4	4	$ 18,855
Brush Chipper	B7	$ 3,119.05	1	4	$ 13,940
Loader 5cy+	B10U	$ 2,411.88	1	4	$ 10,779
Off Road Haul Truck (17 CY)	B34F	$ 1,962.09	2	4	$ 17,538
				Total	**$ 108,881**
Excavation & Hauling	**Crew**	**Daily**	**Unit #**	**Days**	**Cost**
Loader 5CY+	B10U	$ 2,411.88	2	8	$ 39,621
Off Road Haul Truck (17 CY)	B34A	$ 1,962.09	6	8	$ 96,695
Grader 30,000 lb.	B11L	$ 2,863.38	2	8	$ 47,037
Water Truck	B45	$ 1,054.71	4	8	$ 34,652
Dozer D6	B10M	$ 3,478.17	2	8	$ 57,137
Excavator 3.5 CY ~ 80K-100K lb.	B12D	$ 4,346.97	2	8	$ 71,409
				Total	**$ 346,551**
Onsite Restoration	**Crew**	**Daily**	**Unit #**	**Days**	**Cost**
Off Road Haul Truck (17 CY)	B34F	$ 1,962.09	4	8	$ 64,464
Loader 5CY+	B10U	$ 2,411.88	2	8	$ 39,621
Grader 30,000 lb.	B11L	$ 2,863.38	1	3	$ 8,291
Excavator 3.5 CY ~ 80K-100K lb.	B12D	$ 4,346.97	2	8	$ 71,409
Dozer D6	B10M	$ 3,478.17	2	16	$ 112,141
Water Truck	B45	$ 1,054.71	4	16	$ 68,011
Rip Rap Class II 18"-24"	NA	$ 53.37	862.0	1	$ 51,346
				Total	**$ 415,282**

Table D-13. Section 9 Lease Mines, Cost Estimate Details for Alternative 3, Single Location Consolidate and Cap on Site

Construction Contractor Site Overhead	Crew	Unit	Amount	Price	Cost
Project Manager (10% of time)	N/A	Hour	21	$ 207.62	$ 4,339
Site Superintendent	N/A	Hour	209	$ 226.60	$ 47,352
H&S Officer	N/A	Hour	209	$ 100.84	$ 21,073
QA/QC Officer	N/A	Hour	209	$ 100.84	$ 21,073
Field Clerk	N/A	Hour	209	$ 22.54	$ 4,710
Fuel for Site Vehicles	N/A	Month	6	$ 581.34	$ 3,442
Port-o-let Rental (4)	N/A	Month	4	$ 246.77	$ 1,031
Job Trailers (1)	N/A	Month	1	$ 319.14	$ 333
Storage Boxes (1)	N/A	Month	1	$ 112.11	$ 117
Field Office Lights/HVAC (1)	N/A	Month	1	$ 212.37	$ 222
Generator (1)	N/A	Month	2	$ 2,847.36	$ 5,950
Fuel for Generator	N/A	Gallons	627	$ 4.75	$ 2,975
Telephone/internet (1)	N/A	Month	1	$ 455.58	$ 476
Field Office Equipment	N/A	Month	1	$ 272.87	$ 285
Field Office Supplies	N/A	Month	1	$ 113.89	$ 119
Trash (1 dumpster)	N/A	Month	1	$ 1,079.62	$ 1,128
Clin 1034 High Volume Air Sampling (4)	N/A	Month	4	$ 454.39	$ 1,899
Clin 1025 Ludlum 2121 and 43-10-1	N/A	Month	1	$ 326.26	$ 341
Air Monitoring Lab Confirmation Sampling (5 samples per day)	N/A	Day	81	$ 711.84	$ 57,458
Clin 1036 Personal Air Monitor	N/A	Month	11	$ 242.03	$ 2,668
Clin 1038 Personal Dust Monitor	N/A	Month	11	$ 1,844.85	$ 20,335
Clin 1068 Personal Dosimeter Badge	N/A	Month	11	$ 70.00	$ 772
Truck Scales	N/A	Month	1	$ 355.92	$ 372
					$ 198,470
Third-Party Oversight	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Travel and Lodging (1 person)	N/A	Day	21	$ 179.15	$ 3,744
Labor	N/A	Hour	209	$ 94.91	$ 19,833
Car Rental (1 car)	N/A	Month	1	$ 474.56	$ 496
Car Fuel	N/A	Month	1	$ 901.66	$ 942
					$ 25,015
Level of Accuracy (20%)	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
20% of Construction Cost	N/A	N/A	N/A	N/A	**$ 174,143**
				GRAND TOTAL	**$ 2,355,146**

Table D-13. Section 9 Lease Mines, Cost Estimate Details for Alternative 3, Single Location Consolidate and Cap on Site

Onsite O&M Costs	Crew	Unit	Amount	Price	Cost
Annual Inspection (1 person crew, 1 day, 10 hrs/day)	N/A	Hour	10	$ 110.50	$ 1,105
Inspection Crew Travel and Lodging	N/A	LS	1	$ 867.08	$ 867
Preperation of Semi-annual Reports (Professional Engineer)	N/A	Hour	8	$ 156.00	$ 1,248
Inspection Event Cost					**$ 3,220**
Inspection Contingency (15%)					**$ 483**
Total Inspection Event Cost					**$ 3,703**
Maintenance Crew Travel and Lodging	N/A	LS	1	$ 2,667.60	$ 2,668
Mobilization and Demobilization of Dozer, and 17 CY Articulated Dump Truck	N/A	LS	1	$ 19,425.28	$ 19,425
Dozer Rental and Labor	B81	Day	3	$ 3,811.60	$ 11,435
Articulated Dump Truck (17 CY) Rental and Labor	B34F	Day	3	$ 2,149.97	$ 6,450
Riprap Class II	N/A	CY	93	$ 45.00	$ 4,169
Construction Overhead	N/A	LS	1	$ 19,822.92	$ 19,823
O&M Annual Cost					**$ 63,969**
O&M Contingency (15%)					**$ 9,595**
Total O&M Annual Cost					**$ 73,565**
Contractor Site Overhead O&M	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Site Superintendent	N/A	Hour	39	$ 191.00	$ 7,449.00
H&S Officer	N/A	Hour	39	$ 85.00	$ 3,315.00
Fuel for Site Vehicles	N/A	Month	0.6	$ 5,880.00	$ 3,439.80
Port-o-let Rental (1)	N/A	Month	0.2	$ 208.00	$ 40.56
Generator (1)	N/A	Month	0.20	$ 2,400.00	$ 468.00
Fuel for Generator	N/A	Gallons	117	$ 4.00	$ 468.00
Telephone/internet (1)	N/A	Month	0.20	$ 384.00	$ 74.88
Trash (1 dumpster)	N/A	Month	0.20	$ 910.00	$ 177.45
Clin 1034 High Volume Air Sampling (3)	N/A	Month	0.6	$ 383.00	$ 224.06
Clin 1025 Ludlum 2121 and 43-10-1	N/A	Month	0.20	$ 275.00	$ 53.63
Air Monitoring Lab Confirmation Sampling (3 samples per day)	N/A	Day	4	$ 600.00	$ 2,340.00
Clin 1036 Personal Air Monitor	N/A	Month	1.0	$ 204.00	$ 198.90
Clin 1038 Personal Dust Monitor	N/A	Month	1.0	$ 1,555.00	$ 1,516.13
Clin 1068 Personal Dosimeter Badge	N/A	Month	1.0	$ 59.00	$ 57.53
					$ 19,822.92

Table D-13. Section 9 Lease Mines, Cost Estimate Details for Alternative 3, Single Location Consolidate and Cap on Site

Notes:

"	Inch
CAD	Computer-aided design
CY	Cubic yard
GIS	Geographic information system
H&S	Health and safety
HP	Horsepower
hr	Hour
HVAC	Heating, ventilation, and air conditioning
K	Thousand
lb.	Pound
LF	Linear foot
LiDAR	Light detection and ranging
LS	Lump sum
N/A	Not applicable
O&M	Operation and maintenance
QA/QC	Quality assurance/quality control
SY	Square yard
XRF	X-ray fluorescence

Table D-14. Section 9 Lease Mines, Cost Estimate Summary for Alternative 3, Single Location Consolidate and Cap on Site

Haul Road Building	Unit Cost
Excavator 3.5 cy ~ 80K-100K lb.	$ 19,427
Dozer D6	$ 15,545
Grader 30,000 lb.	$ 12,797
Water Truck	$ 18,855
Off Road Haul Truck	$ 17,538
Loader 5cy+	$ 10,779
Brush Chipper	$ 13,940
Subtotals Step 1	**$ 108,881**
Excavation and Hauling	**Unit Cost**
Loader 5cy+	$ 39,621
Off Road Haul Truck (17 CY)	$ 96,695
Grader 30,000 lb.	$ 47,037
Water Truck	$ 34,652
Dozer D6	$ 57,137
Excavator 3.5 cy ~ 80K-100K lb.	$ 71,409
Subtotals Step 2	**$ 346,551**
Onsite Restoration	**Unit Cost**
Off Road Haul Truck (17 CY)	$ 64,464
Loader 5cy+	$ 39,621
Grader 30,000 lb.	$ 8,291
Excavator 3.5 cy ~ 80K-100K lb.	$ 71,409
Dozer D6	$ 112,141
Water Truck	$ 68,011
Rip Rap Class II 18"-24"	$ 51,346
Subtotals Step 3	**$ 415,282**
Subtotal Construction	**$ 870,714**
Other Costs	**Unit Cost**
Non-Construction Costs	
Engineering Design	$ 260,605
Planning Documents	$ 93,702
Resource Surveys	$ 310,569
Confirmation Sampling	$ 135,603
Reporting	$ 94,635
Contractor Site Overhead and Miscellaneous Costs	$ 198,470
Mobilization / Demobilization	$ 59,877
Travel+ Lodging (Construction Workers)	$ 131,814
Level of Accuracy (20%)	$ 174,143
Third-Party Oversight	$ 25,015
Subtotals Step 6	**$ 1,484,432**
Total Site Capital Costs	**$ 2,355,146**
Inspections and Maintenance Event Costs	**Unit Cost**
Annual Inspection (1 person crew, 1 day, 10 hrs/day)	$ 1,311
Inspection Crew Travel and Lodging	$ 1,029
Preperation of Report (Professional Engineer)	$ 1,481
Subtotal Inspection Costs	**$ 3,820**
Inspection Contingencies (15%)	$ 573
Total Yearly Inspection Costs	**$ 4,393**

Table D-14. Section 9 Lease Mines, Cost Estimate Summary for Alternative 3, Single Location Consolidate and Cap on Site

Present Value of Inspection Costs Based on 10-Year Life at 3.50% (PV Factor = 8.317)	**$**	**36,540**
Maintenance Crew Travel and Lodging	$	3,165
Mobilization and Demobilization of Dozer, Loader, and 17 CY Articulated Dump Truck	$	26,851
Dozer Rental and Labor	$	13,566
Articulated Dump Truck (17 CY) Rental and Labor	$	7,652
Riprap Class II	$	4,946
Construction Overhead	$	23,518
Subtotal Maintenance Costs	**$**	**79,698**
Maintenance Contingencies (15%)	$	11,955
Total Maintenance Costs	**$**	**91,653**
Maintenance Cost (Year 10)		
Present Value of Maintenance Costs Based on 10-Year Life at 3.50% (PV Factor = 0.7089)	**$**	**64,973**
AUM 458 ET Cap		
AUM 458 Cap Construction Cost	**$**	**705,827**
AUM 458 Cap Total O&M Costs (30 Years)	**$**	**47,419**
AUM 458 ET Cap Cost per CY (Construction, 10-Year Operations, and 30-Year O&M Cost)	**$**	**596**
AUM 458 ET Cap Total Cost	**$**	**753,246**
AUM 457 ET Cap		
AUM 457 Cap Construction Cost	**$**	**1,019,208**
AUM 457 Cap Total O&M Costs (30 Years)	**$**	**47,661**
AUM 457 ET Cap Cost per CY (Construction, 10-Year Operations, and 30-Year O&M Cost)	**$**	**79**
AUM 457 ET Cap Total Cost	**$**	**1,066,869**
Grand Total Capital Costs	**$**	**4,080,181**
Total Inspection and Maintenance Cost	**$**	**101,512**
Total Cap O&M Cost (30 Years)	**$**	**95,080**
Total Costs	**$**	**4,276,773**

Notes:

"	Inch
AC	Acre
AUM	Abandoned uranium mine
CY	Cubic yard
ET	Evapotranspiration
HP	Horsepower
hr	Hour
K	Thousand
lb.	Pound
O&M	Operation and maintenance
PV	Present value

Table D-15. Section 9 Lease Mines, AUM 458 Cap Cost Details for Alternative 3, Single Location Consolidate and Cap on Site

Site Measurements	QTY	Unit	QTY	Unit		
Repository Area	2.46	AC	107,326	SF		
Repository Topsoil 3"	994	CY				
Borrow Topsoil 3" (1.5 AC)	605	CY				
Clean Fill Volume (Volume From Estimate calculator)	11,927	CY				
Waste Volume	2,271	CY				
Laydown Area (google earth)	1.6	AC	69,696	SF		
Laydown topsoil 3"	645	CY				
Engineering Design	**Equipment List**	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Project Manager			Hour	33	$ 187.45	$ 6,188
Project Engineer			Hour	131.8	$ 144.74	$ 19,078
Design Engineer			Hour	65.9	$ 187.45	$ 12,354
CAD/GIS Operator			Hour	33.0	$ 121.01	$ 3,995
Admin			Hour	13	$ 79.49	$ 1,048
Reproduction			LS	3	$ 593.20	$ 1,513
						$ 44,175
Site Prep	**Equipment List**	**Crew**	**Daily**	**Unit**	**Days**	**Cost**
Storm Drain Channel Excavation (includes laydown +25%)	Excavator 3.5 CY = 300 CY/hr.	B-12D	$ 4,347.92	1	1.1	**$ 4,806**
Storm Drain Channel Armoring (Riprap) (includes laydown and Pond +25%)	Riprap Class II 18"-24"		$ 61.69	461		$ 28,431
	Excavator 3.5 CY = 300 CY/hr.	B-12D	$ 4,347.92	1	0.2	$ 933
	Loader 5.5 CY	B-10U	$ 2,411.88	1	0.2	$ 517
						$ 29,881
Storm Drain Pond Excavation (includes laydown +25%)	Excavator 3.5 CY = 300 CY/hr.	B-12D	$ 4,347.92	1	1.8	**$ 7,861**
						$ 42,548

Table D-15. Section 9 Lease Mines, AUM 458 Cap Cost Details for Alternative 3, Single Location Consolidate and Cap on Site

Excavation	Equipment List	Crew	Daily	Unit	Days	Cost
Repository and Soil Borrow Excavation and Stockpiling	Excavator 3.5 CY = 300 CY/hr.	B-12D	$ 4,347.92	1	5.7	$ 24,889
	Off-Road Haul Truck 22 CY	B34F	$ 1,962.09	2	5.7	$ 22,463
	Dozer 300 HP	B-10M	$ 3,478.17	1	5.7	$ 19,910
	Water Truck	B-59	$ 1,334.69	1	5.7	$ 7,640
						$ 74,903
Borrow Material Screening	Loader 5.5 CY	B-10U	$ 2,411.88	1	5.7	$ 13,806
	Screen Plant		$ 5,605.74	1	5.7	$ 32,089
	Water Truck	B-59	$ 1,334.69	1	5.7	$ 7,640
						$ 53,536
						$ 128,438
Operation	**Equipment List**	**Crew**	**Daily**	**Unit**	**Days**	**Cost**
Waste Screening	Loader 5. 5 CY	B-10U	$ 2,411.88	1	1.7	$ 4,156
	Screen Plant		$ 5,605.74	1	1.7	$ 9,660
	Off-Road Haul Truck	B34F	$ 1,962.09	1	1.7	$ 3,381
	Dozer 300 HP	B-10M	$ 3,478.17	1	1.7	$ 5,994
	Water Truck	B-59	$ 1,334.69	1	1.7	$ 2,300
						$ 25,492
Waste Grading of Each Lift + Waste Compaction of Each Lift	30,000 lb. Grader	B-32A	$ 4,574.76	1	1.7	$ 7,884
	Water Truck	B-59	$ 1,334.69	1	1.7	$ 2,300
						$ 10,184
						$ 35,676
Closure	**Equipment List**	**Crew**	**Daily**	**Unit**	**Days**	**Cost**
Waste Final Grading	30,000 lb. Grader	B-11L	$ 2,863.38	1	0.7	$ 1,999
	Water Truck	B-59	$ 1,334.69	1	0.7	$ 932
						$ 2,931
Cap Cover Installation	Loader 5.5 CY	B-10U	$ 2,411.88	1	4.8	$ 11,643
	Off-Road Haul Truck	B34F	$ 1,962.09	1	4.8	$ 9,472
	Dozer 300 HP	B-10M	$ 3,478.17	1	4.8	$ 16,791
	30,000 lb. Grader	B-11L	$ 2,863.38	1	4.8	$ 13,823
	Water Truck	B-59	$ 1,334.69	1	4.8	$ 6,443
						$ 58,172
						$ 61,102

Table D-15. Section 9 Lease Mines, AUM 458 Cap Cost Details for Alternative 3, Single Location Consolidate and Cap on Site

Reclamation	Equipment List	Crew	Unit	Amount	Price	Cost
Hay Bales/Wattles and Silt Fence			LF	635	$ 10.14	$ 6,441
Fertilizer, Seed, and Mulch			SY	3,442	$ 4.77	$ 16,417
						$ 22,859
Other Line Items	**Equipment List**	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Fence			LF	1,322	$ 7.15	$ 9,456
Survey			AC	2.1	$ 4,063.42	$ 8,510
						$ 17,966
Subtotal Construction Costs						**$ 308,588**
Contractor Site Overhead						**$ 104,299**
Travel + Lodging:						**$ 49,076**
Mobilization / Demobilization:						**$ 73,661**
Level of Accuracy (20%)						**$ 61,718**
Total Construction Cost:						**$ 599,949**
30-Year Maintenance Costs Every 10 Years						
Operation	**Equipment List**	**Crew**	**Unit**	**Unit Cost**	**Amount**	**Cost**
Site Inspections		N/A	EA	$ 1,483.00	1	$ 1,483
Annual Maintenance Travel and Lodging		N/A	LS	$ 595.57	1	$ 596
Mobilization / Demobilization		N/A	LS	$ 7,531.74	1	$ 7,532
Construction Overhead		N/A	LS	$ 5,350.72	1	$ 5,351
Standard Excavator Rental and Labor	Excavator 3.5 CY = 300 CY/hr.	B-12D	Day	$ 4,346.97	1	$ 4,347
Articulated Dump Truck Rental and Labor	Off-Road Haul Truck	B-34F	Day	$ 1,962.31	1	$ 1,962
Range Fencing Repair		N/A	LF	$ 7.15	156	$ 1,112
Riprap Material and Hauling		N/A	CY	$ 65.25	54	$ 3,538
Subtotal Maintenance Event Costs						**$ 25,921**
Maintenance Contingencies			15%			$ 3,888
Total Maintenance Event Cost						**$ 29,809**

Table D-15. Section 9 Lease Mines, AUM 458 Cap Cost Details for Alternative 3, Single Location Consolidate and Cap on Site

30-Year Maintenance Costs (Years 1-10)						
Present Value of Maintenance Costs Based on 10-Year Life at 3.50%			PV Factor = 0.7089			**$ 21,131**
30-Year Maintenance Costs (Years 11-20)						
Present Value of Maintenance Costs Based on 20-Year Life at 3.50%			PV Factor = 0.5026			**$ 14,982**
30-Year Maintenance Costs (Years 21-30)						
Present Value of Maintenance Costs Based on 30-Year Life at 3.50%			PV Factor = 0.3563			**$ 10,621**
Total Maintenance Cost						**$ 46,734**
Total Present Worth						**$ 647,369**
Cost Per CY:						**$ 512**

Notes:

'	Foot
"	Inch
AC	Acre
AUM	Abandoned uranium mine
CAD	Computer-aided design
CY	Cubic yard
EQ	Equipment
GIS	Geographic information system
hr	Hour
lb.	Pound
LF	Linear foot
LS	Lump sum
N/A	Not applicable
O&M	Operation and maintenance
PV	Present value
SY	Square yard

Table D-16. Section 9 Lease Mines, AUM 457 Cost Details for Alternative 3, Single Location Consolidate and Cap on Site

Site Measurements	QTY	Unit	QTY	Unit		
Repository Area	2.54	AC	110,731	SF		
Repository Topsoil 3"	1,025	CY				
Borrow Topsoil 3" (1.5 AC)	605	CY				
Clean Fill Volume (Volume From Estimate calculator)	12,312	CY				
Waste Volume	15,089	CY				
Laydown Area (google earth)	1.3	AC	54,886	SF		
Laydown topsoil 3"	508	CY				
Engineering Design	**Equipment List**	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Project Manager			Hour	33	$ 187.45	$ 6,188
Project Engineer			Hour	131.8	$ 144.74	$ 19,078
Design Engineer			Hour	65.9	$ 187.45	$ 12,354
CAD/GIS Operator			Hour	33.0	$ 121.01	$ 3,995
Admin			Hour	13	$ 79.49	$ 1,048
Reproduction			LS	3	$ 593.20	$ 1,513
					$ -	**$ 44,175**
Site Prep	**Equipment List**	**Crew**	**Daily**	**Unit**	**Days**	**Cost**
Storm Drain Channel Excavation (includes laydown +25%)	Excavator 3.5 CY = 300 CY/hr.	B-12D	$ 4,347.92	1	1.11	**$ 4,806**
Storm Drain Channel Armoring (Riprap) (includes laydown and Pond +25%)	Riprap Class II 18"-24"		$ 61.69	464		$ 28,651
	Excavator 3.5 CY = 300 CY/hr.	B-12D	$ 4,347.92	1	0.22	$ 962
	Loader 5.5 CY	B-10U	$ 2,411.88	1	0.22	$ 534
						$ 30,147
Storm Drain Pond Excavation (includes laydown +25%)	Excavator 3.5 CY = 300 CY/hr.	B-12D	$ 4,347.92	1	1.81	**$ 7,861**
						$ 43,175

Table D-16. Section 9 Lease Mines, AUM 457 Cost Details for Alternative 3, Single Location Consolidate and Cap on Site

Excavation	Equipment List	Crew	Daily	Unit	Days	Cost
Repository and Soil Borrow Excavation and Stockpiling	Excavator 3.5 CY = 300 CY/hr.	B-12D	$ 4,347.92	1	5.82	$ 25,318
	Off-Road Haul Truck 22 CY	B34F	$ 1,962.09	2	5.82	$ 22,850
	Dozer 300 HP	B-10M	$ 3,478.17	1	5.82	$ 20,253
	Water Truck	B-59	$ 1,334.69	1	5.82	$ 7,772
						$ 76,193
Borrow Material Screening	Loader 5.5 CY	B-10U	$ 2,411.88	1	5.82	$ 14,044
	Screen Plant		$ 5,605.74	1	5.82	$ 32,642
	Water Truck	B-59	$ 1,334.69	1	5.82	$ 7,772
						$ 54,458
						$ 130,651
Operation	**Equipment List**	**Crew**	**Daily**	**Unit**	**Days**	**Cost**
Waste Screening	Loader 5.5 CY	B-10U	$ 2,411.88	1	11.5	$ 27,620
	Screen Plant		$ 5,605.74	1	11.5	$ 64,194
	Off-Road Haul Truck	B34F	$ 1,962.09	1	11.5	$ 22,469
	Dozer 300 HP	B-10M	$ 3,478.17	1	11.5	$ 39,830
	Water Truck	B-59	$ 1,334.69	1	11.5	$ 15,284
						$ 169,398
Waste Grading of Each Lift + Waste Compaction of Each Lift	30,000 lb. Grader	B-32A	$ 4,574.76	1	11.5	$ 52,388
	Water Truck	B-59	$ 1,334.69	1	11.5	$ 15,284
						$ 67,672
						$ 201,509
Closure	**Equipment List**	**Crew**	**Daily**	**Unit**	**Days**	**Cost**
Waste Final Grading	30,000 lb. Grader	B-11L	$ 2,863.38	1	0.7	$ 2,062
	Water Truck	B-59	$ 1,334.69	1	0.7	$ 961
						$ 3,024
Cap Cover Installation	Loader 5.5 CY	B-10U	$ 2,411.88	1	5.0	$ 12,020
	Off-Road Haul Truck	B34F	$ 1,962.09	1	5.0	$ 9,778
	Dozer 300 HP	B-10M	$ 3,478.17	1	5.0	$ 17,334
	30,000 lb. Grader	B-11L	$ 2,863.38	1	5.0	$ 14,270
	Water Truck	B-59	$ 1,334.69	1	5.0	$ 6,652
						$ 60,053
						$ 53,615

Table D-16. Section 9 Lease Mines, AUM 457 Cost Details for Alternative 3, Single Location Consolidate and Cap on Site

Reclamation	Equipment List	Crew	Unit	Amount	Price	Cost
Hay Bales/Wattles and Silt Fence			LF	655	$ 10.14	$ 6,646
Fertilizer, Seed, and Mulch			SY	3,551	$ 4.77	$ 16,938
						$ 23,584
Other Line Items	**Equipment List**	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Fence			LF	1,900	$ 7.15	$ 13,591
Survey			AC	2	$ 4,063.42	$ 8,780
						$ 22,371
Subtotal Construction Costs						**$ 519,567**
Contractor Site Overhead						**$ 106,265**
Travel + Lodging:						**$ 54,125**
Mobilization / Demobilization:						**$ 73,661**
Level of Accuracy (20%)						**$ 103,913**
Total Construction Cost:						**$ 866,322**
30-Year Annual PRSC Costs (Years 1-10)						
Operation	**Equipment List**	**Crew**	**Unit**	**Unit Cost**	**Amount**	**Cost**
Site Inspections		N/A	EA	$ 1,483.00	1	$ 1,483
Annual Maintenance Travel and Lodging		N/A	LS	$ 595.57	1	$ 596
Mobilization / Demobilization		N/A	LS	$ 7,531.74	1	$ 7,532
Construction Overhead		N/A	LS	$ 5,350.72	1	$ 5,351
Standard Excavator Rental and Labor	Excavator 3.5 CY = 300 CY/hr.	B-12D	Day	$ 4,346.97	1	$ 4,347
Articulated Dump Truck Rental and Labor	Off-Road Haul Truck	B-34F	Day	$ 1,962.31	1	$ 1,962
Range Fencing Repair		N/A	LF	$ 7.15	224	$ 1,599
Rip-Rap Material and Hauling		N/A	CY	$ 65.25	55	$ 3,565
Subtotal Maintenance Costs						**$ 26,434**
Maintenance Contingencies			15%			$ 3,965
Total Maintenance Event Cost						**$ 30,400**

Table D-16. Section 9 Lease Mines, AUM 457 Cost Details for Alternative 3, Single Location Consolidate and Cap on Site

30-Year Maintenance Costs (Years 1-10)						
Present Value of Maintenance Costs Based on 10-Year Life at 3.50%			PV Factor = 0.7089			**$ 21,550**
30-Year Maintenance Costs (Years 11-20)						
Present Value of Maintenance Costs Based on 20-Year Life at 3.50%			PV Factor = 0.5026			**$ 15,279**
30-Year Maintenance Costs (Years 21-30)						
Present Value of Maintenance Costs Based on 30-Year Life at 3.50%			PV Factor = 0.3563			**$ 10,831**
Total Maintenance Cost						**$ 47,661**
Total Present Worth						**$ 913,983**
Cost Per CY:						**$ 68**

Notes:

'	Foot
"	Inch
AUM	Abandoned uranium mine
AC	Acre
CAD	Computer-aided design
CY	Cubic yard
EQ	Equipment
GIS	Geographic information system
hr	Hour
lb.	Pound
LF	Linear foot
LS	Lump sum
N/A	Not applicable
O&M	Operation and maintenance
PV	Present value
SY	Square yard

Table D-17. Section 9 Lease Mines, Cost Estimate Scenario Assumptions for Alternative 4, Disposal in Offsite RCRA-Licensed Facility

Technology	Assumptions	Cost Effects
Excavation Methods	Waste will be removed with a large excavator unless specified.	Excavators can operate on steeper terrain than bulldozers and are better at moving waste uphill. Bulldozers cost less to operate. Spider excavators or other specialized equipment are more expensive.
	Any disturbed surface will be restored using grading and erosion controls.	Quantities of erosion control materials and grading may be lower than estimated.
	All waste specified in the risk assessment will be excavated	Volumes of excavated waste may be lower than estimated.
	The site is accessible to haul trucks and trucks can be easily loaded.	Accessing difficult-to-reach mines increases costs.
	The waste excavation area will require cover soil or amendment	If cover soil or amendments are required, costs will increase.
	O&M inspection of the mine site will be completed for 10 years.	More O&M inspections increases costs.
Hazardous Waste Landfill or Licensed Low-Level Radioactive Waste Facility	Waste will go to Deer Trail, Colorado (690 miles); Andrews, Texas (730 miles); Grand View, Idaho (800 miles); or Clive, Utah (515 miles).	Waste will go to the closest facility that is accepting waste: Clive, Utah.
	Waste will be transported 565 miles in highway-legal trucks from the site to the disposal facility in Clive, Utah.	Greater distance to repository increases costs.
	Waste weighs 1.5 tons per cubic yard.	Higher density waste increases costs.
	Tipping fee at Deer Trail, Colorado ($435/CY); could not acquire tipping fee from Clive, Utah.	Higher tipping fee increases costs; current tipping fees are from previous cost estimate.
	Assumes up to 20 trucks every 3 days are available	Realistic quantity of trucks may be less. Fewer trucks reduces production time and requires more time on the site, increasing costs.

Notes:

CY	Cubic yard
O&M	Operation and maintenance
RCRA	Resource Conservation and Recovery Act

Table D-18. Section 9 Lease Mines, Crew Time Productivity Calculations for Alternative 4, Disposal in Offsite RCRA-Licensed Facility

Step	Section 9 Lease Mines Haul / Access Road Installation				
1	**Action**	**Qty**	**Unit**	**Production/Day**	**Days**
	Section 9 Lease Mines Access Road Building	9,445	LCY	3,089	3.1
				Control Days	**3**
Step	**Section 9 Lease Mines Excavation and Hauling**				
2	**Action**	**Qty**	**Unit**	**Production Rate**	**Days**
	Waste Removal, Areas 1-12 (AUM 459 portion 807 LCY) - Standard Excavator or Dozer / Loader	1,580	LCY	1,513	1.0
	Waste Removal, Areas 13-29 - Standard Excavator or Dozer / Loader	16,900	LCY	1,513	11.2
		18,480	**LCY**	**Control Days**	**12**
Step	**Section 9 Lease Mines Site Reclamation**				
3	**Action**	**Qty**	**Unit**	**Production/Day**	**Days**
	Dozer Contour Grading	37,462	SY	4,000	9.4
	Soil Backfill	18,480	LCY	1,513	12.2
	Water Bars	1,275	CY	536	2.4
	Rock-Lined Ditch (6 Feet by 3 Feet)	671	CY	1,099	0.6
	Rock Berm (4 Feet by 3 Feet)	549	CY	1,099	0.5
	Rock Fields and Rock Cover (1 Foot High)	319	CY	1,099	0.3
				Control Days	**25**
				TOTAL PROJECT DAYS	**41**
				Slowest Rate Project Days	27
Step	**Haul from Section 9 Lease Mines to Low-Level Radioactive Waste Facility**				
4	**Action**	**Qty**	**Unit**	**Production/Day**	**Days**
	Available Number of Trucks:	20			
	Number of Trips per day per truck (515 miles round trip, 43 MPH, 8 hour work day):	0.33	Trips		
	Total CY Hauled per day (16.7 CY Trucks)	110	CY		
	Number of Days to Haul Waste	18,480	CY	110	168
				Control Days	**168**

Notes:

AC Acre
AUM Abandoned uranium mine
CY Cubic yard
LCY Loose cubic yard
QTY Quantity
RCRA Resource Conservation and Recovery Act
SY Square yard

Table D-19. Section 9 Lease Mines, Cost Estimate Details for Alternative 4, Disposal in Offsite RCRA-Licensed Facility

Engineering Design	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Project Manager	N/A	Hour	200	$ 187.45	$ 37,490
Project Engineer	N/A	Hour	800	$ 144.74	$ 115,793
Design Engineer	N/A	Hour	400	$ 187.45	$ 74,980
CAD/GIS Operator	N/A	Hour	200	$ 121.01	$ 24,203
Admin	N/A	Hour	80	$ 79.49	$ 6,359
Reproduction	N/A	LS	3	$ 593.20	$ 1,780
					$ 260,605
Planning Documents	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Project Manager	N/A	Hour	100	$ 187.45	$ 18,745
Project Engineer	N/A	Hour	400	$ 144.74	$ 57,896
CAD/GIS Operator	N/A	Hour	100	$ 121.01	$ 12,101
Admin	N/A	Hour	40	$ 79.49	$ 3,180
Reproduction	N/A	LS	3	$ 593.20	$ 1,780
					$ 93,702
Resource Surveys	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Cultural Resources Mitigation	N/A	Each	0	$ 44,366.94	$ -
Biological Resources Mitigation	N/A	Each	1	$ 88,733.88	$ 88,734
Geotechnical Testing and Report	N/A	Each	1	$ 88,733.88	$ 88,734
Pre-Project Aerial LiDAR Survey	N/A	Each	0	$ 35,592.00	$ -
Post-Project Aerial LiDAR Survey	N/A	Each	1	$ 133,100.82	$ 133,101
					$ 310,569
Confirmation Sampling	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Developing Sampling and Analysis Plan					
Project Geologist	N/A	Hour	180	$ 187.45	$ 33,741
Project Manager	N/A	Hour	90	$ 131.69	$ 11,852
CAD/GIS Operator	N/A	Hour	90	$ 144.74	$ 13,027
Project Chemist	N/A	Hour	180	$ 131.69	$ 23,704
Health and Safety Manager	N/A	Hour	90	$ 179.15	$ 16,123
Admin	N/A	Hour	36	$ 79.49	$ 2,862
Reproduction	N/A	LS	3	$ 296.60	$ 890
Sampling					
Sampling Team - Staff Geologist	N/A	Hour	40	$ 91.35	$ 3,690
Sampling Team - Staff Engineer	N/A	Hour	40	$ 96.10	$ 3,881
Travel	N/A	Day	8	$ 201.69	$ 1,670
Per Diem (96/55)	N/A	Day	8	$ 179.15	$ 1,483
Miscellaneous Field Supplies and Expenses	N/A	LS	1	$ 22,680.38	$ 22,680
Lab Analysis	N/A	LS	0	$ 7,307.23	$ -
XRF Surveying					
Sampling Team - Staff Geologist	N/A	Hour	0	$ 91.35	$ -
Sampling Team - Staff Engineer	N/A	Hour	0	$ 96.10	$ -
Travel	N/A	Day	0	$ 201.69	$ -
Per Diem (96/55)	N/A	Day	0	$ 179.15	$ -
Miscellaneous Field Supplies and Expenses	N/A	LS	0	$ 22,680.38	$ -
Lab Analysis	N/A	LS	0	$ 7,307.23	$ -
Frisking Equipment	N/A	Month	0	$ 170.84	$ -
					$ 135,603

Table D-19. Section 9 Lease Mines, Cost Estimate Details for Alternative 4, Disposal in Offsite RCRA-Licensed Facility

Reporting	Crew	Unit	Amount	Price	Cost
Project Geologist	N/A	Hour	158	$ 124.57	$ 19,682
Project Manager	N/A	Hour	79	$ 207.62	$ 16,402
Project Engineer	N/A	Hour	237	$ 144.74	$ 34,304
Chemist	N/A	Hour	79	$ 131.69	$ 10,404
CAD/GIS Operator	N/A	Hour	79	$ 121.01	$ 9,560
Admin	N/A	Hour	32	$ 79.49	$ 2,504
Reproduction	N/A	LS	3	$ 593.20	$ 1,780
					$ 94,635
Mobilization/Demobilization	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Crew Mileage	N/A	Mile	1,568	$ 0.67	$ 1,051
Per Diem	N/A	Day	15	$ 182.00	$ 2,730
Labor	N/A	Day	15	$ 355.92	$ 5,339
Standard Equipment Mileage	N/A	Mile	1,568	$ 0.67	$ 1,051
Standard Equipment Rental	N/A	Day	2	$ 20,948.76	$ 41,898
					$ 52,067
Haul Road Building	**Crew**	**Daily**	**Unit #**	**Days**	**Cost**
Excavator 3.5 CY ~ 80K-100K lb.	B12D	$ 4,346.97	1	3	$ 13,292
Dozer D6	B10M	$ 3,478.17	1	3	$ 10,636
Grader 30,000 lb.	B11L	$ 2,863.38	1	3	$ 8,756
Water Truck	B45	$ 1,054.71	4	3	$ 12,900
Brush Chipper	B7	$ 3,119.05	1	3	$ 9,537
Loader 5cy+	B10U	$ 2,411.88	1	3	$ 7,375
Off Road Haul Truck (17 CY)	B34F	$ 1,962.09	2	3	$ 11,999
				Total	**$ 74,495**
Excavation & Loading	**Crew**	**Daily**	**Unit #**	**Days**	**Cost**
Loader 5CY+	B10U	$ 2,411.88	1	12	$ 29,453
Off Road Haul Truck (16.7 CY)	B34A	$ 1,962.09	1	12	$ 23,960
Grader 30,000 lb.	B11L	$ 2,863.38	1	12	$ 34,967
Water Truck	B45	$ 1,054.71	2	90	$ 189,717
Dozer D6	B10M	$ 3,478.17	1	12	$ 42,474
Excavator 3.5 CY ~ 80K-100K lb.	B12D	$ 4,346.97	1	168	$ 728,833
				Total	**$ 1,049,405**
Site Reclamation	**Crew**	**Daily**	**Unit #**	**Days**	**Cost**
Off Road Haul Truck (17 CY)	B34F	$ 1,962.09	2	12	$ 47,921
Loader 5CY+	B10U	$ 2,411.88	1	12	$ 29,453
Grader 30,000 lb.	B11L	$ 2,863.38	1	2	$ 6,810
Excavator 3.5 CY ~ 80K-100K lb.	B12D	$ 4,346.97	1	12	$ 53,084
Dozer D6	B10M	$ 3,478.17	1	12	$ 40,847
Water Truck	B45	$ 1,054.71	2	12	$ 24,773
Rip Rap Class II 18"-24"	NA	$ 53.37	862	1	$ 46,009
				Total	**$ 248,897**

Table D-19. Section 9 Lease Mines, Cost Estimate Details for Alternative 4, Disposal in Offsite RCRA-Licensed Facility

Construction Contractor Site Overhead	Crew	Unit	Amount	Price	Cost
Project Manager (10% of time)	N/A	Hour	27	$ 207.62	$ 5,706
Site Superintendent	N/A	Hour	275	$ 226.60	$ 62,273
H&S Officer	N/A	Hour	275	$ 100.84	$ 27,713
QA/QC Officer	N/A	Hour	275	$ 100.84	$ 27,713
Field Clerk	N/A	Hour	275	$ 22.54	$ 6,195
Fuel for Site Vehicles	N/A	Month	8	$ 581.34	$ 4,526
Port-o-let Rental (4)	N/A	Month	5	$ 246.77	$ 1,356
Job Trailers (1)	N/A	Month	1	$ 319.14	$ 439
Storage Boxes (1)	N/A	Month	1	$ 112.11	$ 154
Field Office Lights/HVAC (1)	N/A	Month	1	$ 212.37	$ 292
Generator (1)	N/A	Month	3	$ 2,847.36	$ 7,825
Fuel for Generator	N/A	Gallons	824	$ 4.75	$ 3,912
Telephone/internet (1)	N/A	Month	1	$ 455.58	$ 626
Field Office Equipment	N/A	Month	1	$ 272.87	$ 375
Field Office Supplies	N/A	Month	1	$ 113.89	$ 156
Trash (1 dumpster)	N/A	Month	1	$ 1,079.62	$ 1,483
Clin 1034 High Volume Air Sampling (4)	N/A	Month	5	$ 454.39	$ 2,497
Clin 1025 Ludlum 2121 and 43-10-1	N/A	Month	1	$ 326.26	$ 448
Air Monitoring Lab Confirmation Sampling (5 samples per day)	N/A	Day	86	$ 711.84	$ 61,208
Clin 1036 Personal Air Monitor	N/A	Month	12	$ 242.03	$ 2,905
Clin 1038 Personal Dust Monitor	N/A	Month	12	$ 1,844.85	$ 22,142
Clin 1068 Personal Dosimeter Badge	N/A	Month	12	$ 70.00	$ 840
Truck Scales	N/A	Month	1	$ 355.92	$ 489
					$ 241,275
Third-Party Oversight	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Travel and Lodging (1 person)	N/A	Day	27	$ 179.15	$ 4,923
Labor	N/A	Hour	275	$ 94.91	$ 26,083
Car Rental (1 car)	N/A	Month	1	$ 474.56	$ 652
Car Fuel	N/A	Month	1	$ 901.66	$ 1,239
					$ 32,897
Level of Accuracy (20%)	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
20% of Construction Cost	N/A	N/A	N/A	N/A	**$ 274,559**
				GRAND TOTAL	**$ 3,270,418**

Table D-19. Section 9 Lease Mines, Cost Estimate Details for Alternative 4, Disposal in Offsite RCRA-Licensed Facility

Onsite O&M Costs	Crew	Unit	Amount	Price	Cost
Annual Inspection (1 person crew, 1 day, 10 hrs/day)	N/A	Hour	10	$ 100.84	$ 1,008
Inspection Crew Travel and Lodging	N/A	LS	1	$ 791.31	$ 791
Preperation of Semi-annual Reports (Professional Engineer)	N/A	Hour	8	$ 142.37	$ 1,139
Inspection Event Cost					**$ 2,939**
Inspection Contingency (15%)					**$ 171**
Total Inspection Event Cost					**$ 3,110**
Maintenance Crew Travel and Lodging	N/A	LS	1	$ 2,434.49	$ 2,434
Mobilization and Demobilization of Dozer, and 17 CY Articulated Dump Truck	N/A	LS	1	$ 20,654.80	$ 20,655
Dozer Rental and Labor	B81	Day	3	$ 3,478.52	$ 10,436
Articulated Dump Truck (17 CY) Rental and Labor	B34F	Day	3	$ 1,962.09	$ 5,886
Riprap Class II	N/A	CY	64	$ 53.39	$ 3,409
Construction Overhead	N/A	LS	1	$ 18,090.70	$ 18,091
O&M Annual Cost					**$ 60,911**
O&M Contingency (15%)					**$ 9,137**
Total O&M Annual Cost					**$ 70,047**
Contractor Site Overhead O&M	**Crew**	**Unit**	**Amount**	**Price**	**Cost**
Site Superintendent	N/A	Hour	30	$ 226.60	$ 6,798.07
H&S Officer	N/A	Hour	30	$ 100.84	$ 3,025.32
Fuel for Site Vehicles	N/A	Month	0.5	$ 6,976.03	$ 3,139.21
Port-o-let Rental (1)	N/A	Month	0.2	$ 246.77	$ 37.02
Generator (1)	N/A	Month	0.15	$ 2,847.36	$ 427.10
Fuel for Generator	N/A	Gallons	90	$ 4.75	$ 427.10
Telephone/internet (1)	N/A	Month	0.15	$ 455.58	$ 68.34
Trash (1 dumpster)	N/A	Month	0.15	$ 1,079.62	$ 161.94
Clin 1034 High Volume Air Sampling (3)	N/A	Month	0.5	$ 454.39	$ 204.48
Clin 1025 Ludlum 2121 and 43-10-1	N/A	Month	0.15	$ 326.26	$ 48.94
Air Monitoring Lab Confirmation Sampling (3 samples per day)	N/A	Day	3	$ 711.84	$ 2,135.52
Clin 1036 Personal Air Monitor	N/A	Month	0.8	$ 242.03	$ 181.52
Clin 1038 Personal Dust Monitor	N/A	Month	0.8	$ 1,844.85	$ 1,383.64
Clin 1068 Personal Dosimeter Badge	N/A	Month	0.8	$ 70.00	$ 52.50
					$ 18,090.70

Table D-19. Section 9 Lease Mines, Cost Estimate Details for Alternative 4, Disposal in Offsite RCRA-Licensed Facility

Notes:

"	Inch
CAD	Computer-aided design
CY	Cubic yard
GIS	Geographic information system
H&S	Health and safety
HP	Horsepower
hr	Hour
HVAC	Heating, ventilation, and air conditioning
K	Thousand
lb.	Pound
LF	Linear foot
LiDAR	Light detection and ranging
LS	Lump sum
N/A	Not applicable
O&M	Operation and maintenance
QA/QC	Quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
SY	Square yard
XRF	X-ray fluorescence

Table D-20. Section 9 Lease Mines, Cost Estimate Summary for Alternative 4, Disposal in Offsite RCRA-Licensed Facility

Haul Road Building	Unit Cost	
Excavator 3.5 CY ~ 80K-100K lb.	$	13,292
Dozer D6	$	10,636
Grader 30,000 lb.	$	8,756
Water Truck	$	12,900
Off Road Haul Truck	$	11,999
Loader 5 CY+	$	7,375
Brush Chipper	$	9,537
Subtotals Step 1	**$**	**74,495**
Excavation and Loading	**Unit Cost**	
Loader 5 CY+	$	29,453
Off-Road Haul Truck (17 CY)	$	23,960
Grader 30,000 lb.	$	34,967
Water Truck	$	189,717
Dozer D6	$	42,474
Excavator 3.5 CY ~ 80K-100K lb.	$	728,833
Subtotals Step 2	**$**	**1,049,405**
Onsite Restoration	**Unit Cost**	
Off-Road Haul Truck (17 CY)	$	47,921
Loader 5 CY+	$	29,453
Grader 30,000 lb.	$	6,810
Excavator 3.5 CY ~ 80K-100K lb.	$	53,084
Dozer D6	$	40,847
Water Truck	$	24,773
Riprap Class II 18"-24"	$	46,009
Subtotals Step 3	**$**	**248,897**
Subtotal Construction	**$**	**1,372,797**
Other Costs	**Unit Cost**	
Non-Construction Costs		
Engineering Design	$	260,605
Planning Documents	$	93,702
Resource Surveys	$	310,569
Confirmation Sampling	$	135,603
Reporting	$	94,635
Contractor Site Overhead	$	241,275
Mobilization / Demobilization	$	52,067
Travel+ Lodging (Construction Workers)	$	401,708
Level of Accuracy (20%)	$	274,559
Third-Party Oversight	$	32,897
Subtotals Step 6	**$**	**1,897,620**
Total Site Capital Costs	**$**	**3,270,418**
Inspections and Maintenance Event Costs	**Unit Cost**	
Annual Inspection (1 person crew, 1 day, 10 hrs/day)	$	1,008
Inspection Crew Travel and Lodging	$	791
Preperation of Report (Professional Engineer)	$	1,139
Subtotal O&M Costs	**$**	**2,939**
Contingencies (15%)	$	441
Total Inspection Event Cost	**$**	**3,380**

Table D-20. Section 9 Lease Mines, Cost Estimate Summary for Alternative 4, Disposal in Offsite RCRA-Licensed Facility

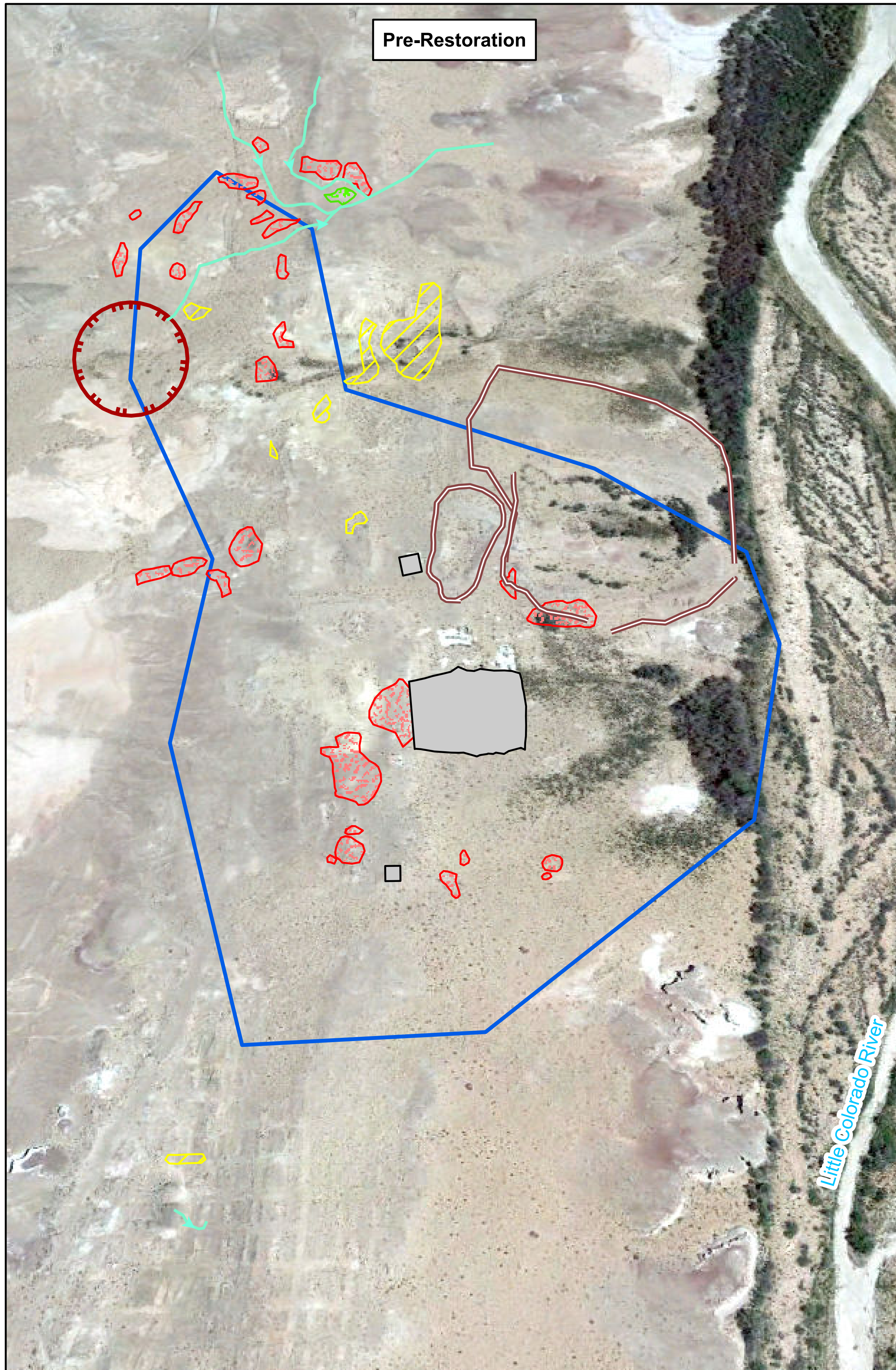
Present Value of Inspection Costs Based on 10-Year Life at 3.50% (PV Factor = 8.317)	**$**	**28,107**
Maintenance Crew Travel and Lodging	$	2,434
Mobilization and Demobilization of Dozer and 17 CY Articulated Dump Truck	$	20,655
Dozer Rental and Labor	$	10,436
Articulated Dump Truck (17 CY) Rental and Labor	$	5,886
Riprap Class II	$	3,409
Construction Overhead	$	18,091
Subtotal Maintenance Event Costs	**$**	**60,911**
Maintenance Contingencies (15%)	$	9,137
Total Maintenance Event Costs	**$**	**70,047**
Maintenance Cost (Year 10)		
Present Value of Maintenance Costs Based on 10-Year Life at 3.50% (PV Factor = 0.7089)	**$**	**49,657**
Waste Hauling Cost		
Waste Hauling Cost per CY	**$**	**201**
Waste Total Hauling Cost	**$**	**2,974,929**
Low-Level Radioactive Waste Disposal Cost		
Low-Level Radioactive Waste Cost per CY	**$**	**435**
Low-Level Radioactive Waste Disposal Cost	**$**	**6,431,040**
Grand Total Capital Costs	**$**	**12,676,386**
Total Onsite Inspection and Maintenance Cost	**$**	**77,764**
Total Costs	**$**	**12,754,150**

Notes:

"	Inch
AC	Acre
CY	Cubic yard
ET	Evapotranspiration
HP	Horsepower
hr	Hour
K	Thousand
lb.	Pound
O&M	Operation and maintenance
PV	Present value
RCRA	Resource Conservation and Recovery Act

APPENDIX E

POST-REMOVAL VISUALIZATION



Site Features

- Berm
- Surface Water Drainage Pathway
- Concrete Pad
- Dozer Cut
- Pit Area Identified in RSE
- Shallow Mine Waste
- Waste Pile
- Area of Potential Effect
- AUM Boundary
- Road
- Little Colorado River

Notes:

AUM	Abandoned uranium mine
RSE	Removal site evaluation

1 inch = 200 Feet

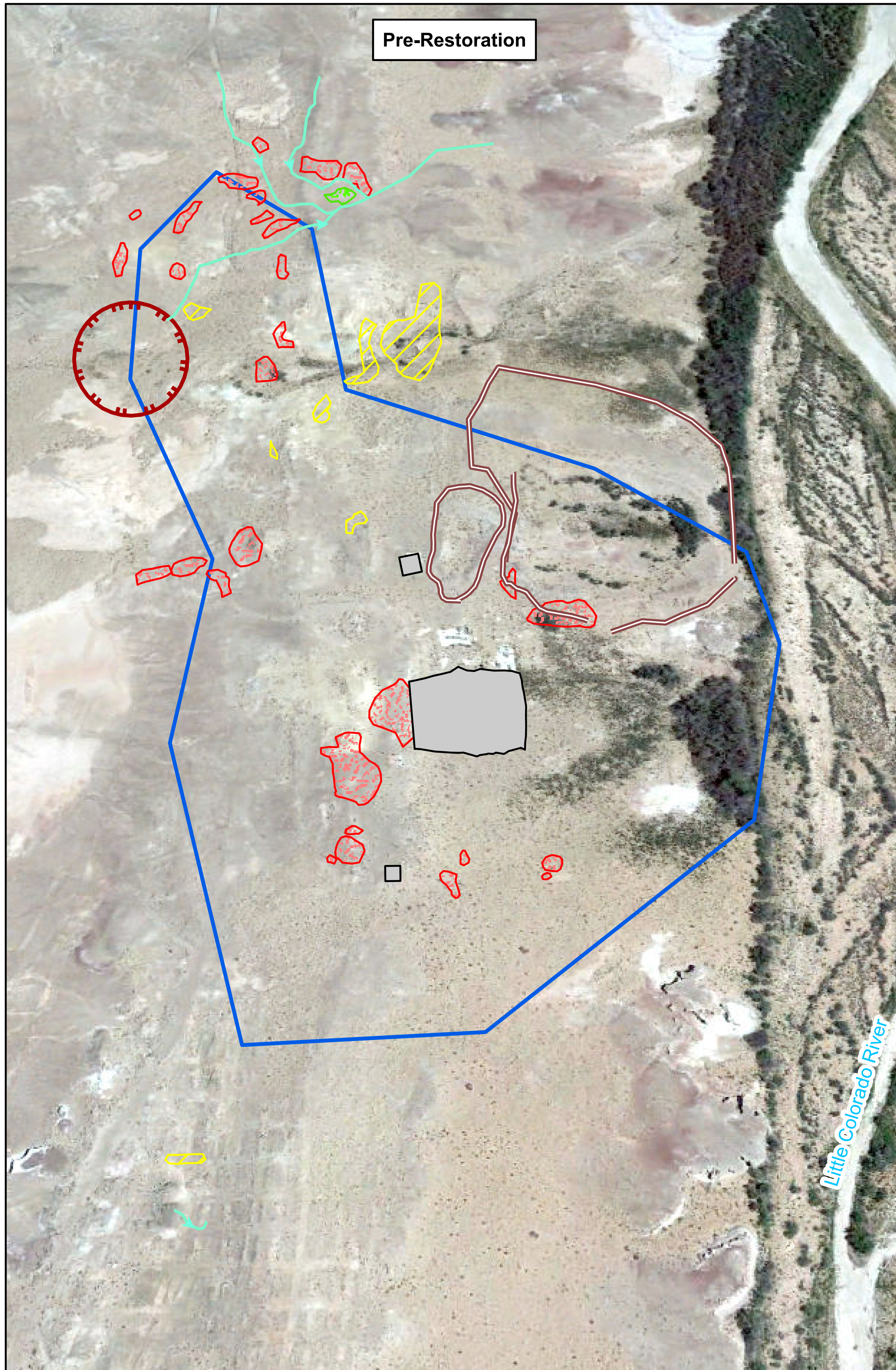
1:2,400

200 100 0 200 Feet

N W E S

SECTION 9 LEASE MINES PROPOSED POST-SURFICIAL RESTORATION ACTIVITIES: AUM 457, ALTERNATIVE 2 (MULTIPLE LOCATION CONSOLIDATE AND CAP)

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 020	Contract No.: 68HE0923D0002
Location: COALMINE CANYON CHAPTER NAVAJO NATION	Date: 7/16/2024
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: E-1



Site Features

- Berm
- Surface Water Drainage Pathway
- Concrete Pad
- Dozer Cut
- Pit Area Identified in RSE
- Shallow Mine Waste
- Waste Pile
- Area of Potential Effect
- AUM Boundary
- Road
- Little Colorado River

Notes:

AUM Abandoned uranium mine
RSE Removal site evaluation

1 inch = 200 Feet

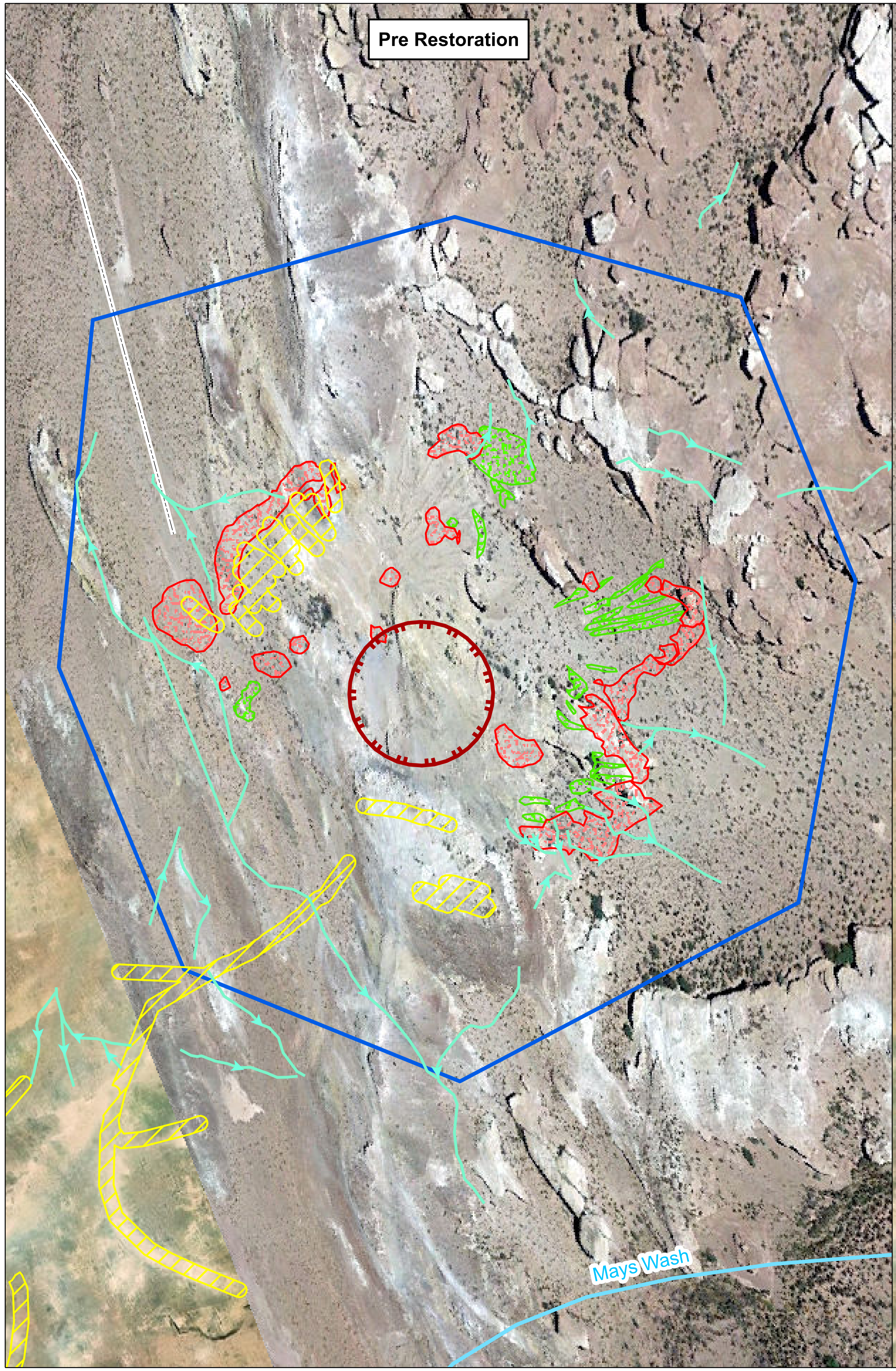
1:2,400

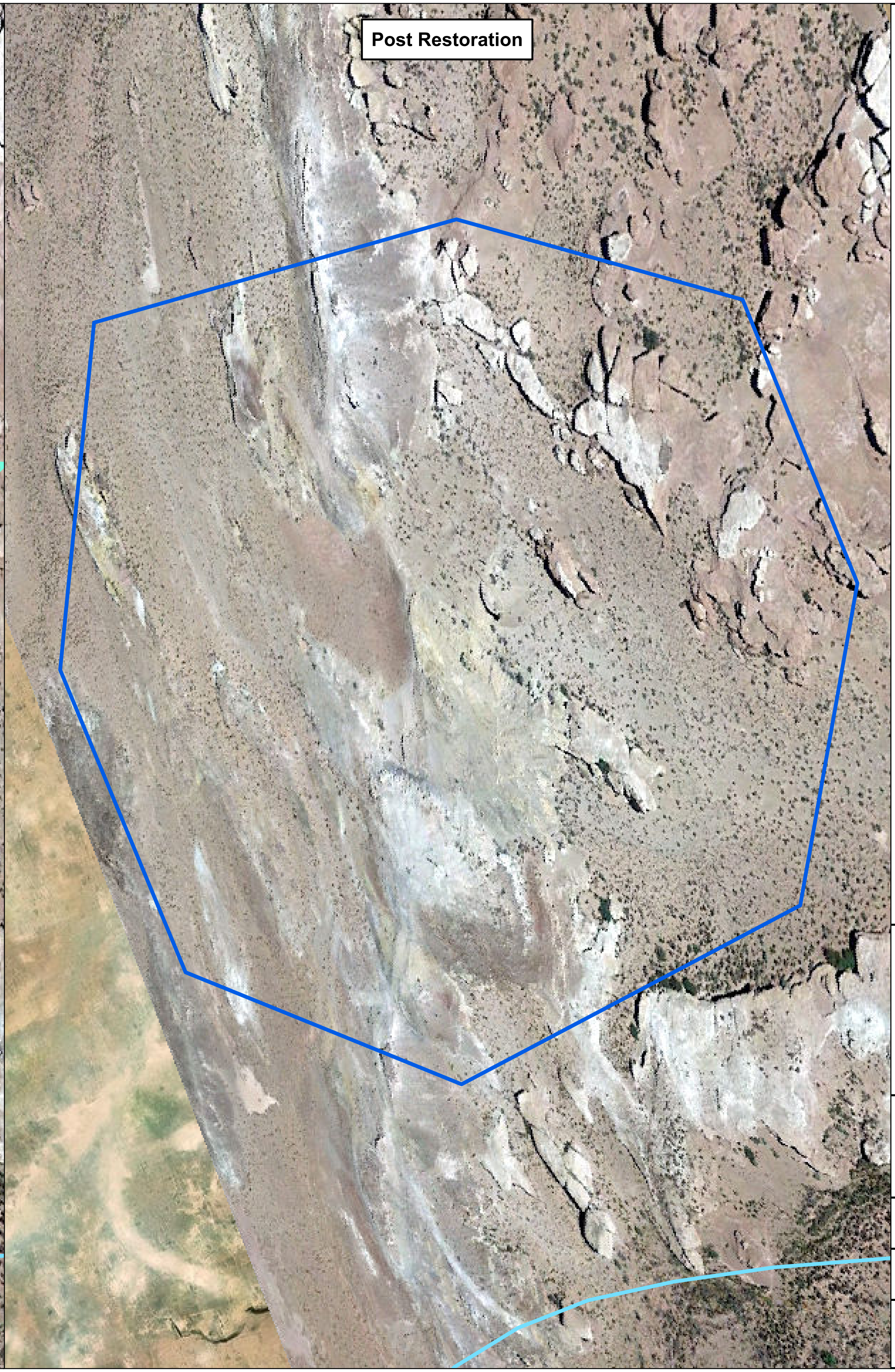
200 100 0 200 Feet

N W E S

SECTION 9 LEASE MINES PROPOSED POST-SURFICIAL RESTORATION ACTIVITIES: AUM 457, ALTERNATIVE 3 (SINGLE LOCATION CONSOLIDATE AND CAP) AND ALTERNATIVE 4 (OFFSITE DISPOSAL)

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 020	Contract No.: 68HE0923D0002
Location: COALMINE CANYON CHAPTER NAVAJO NATION	Date: 7/16/2024
Coordinate System: NAD 1983 State Plane Arizona East FIPS 0201 Feet Transverse Mercator	Figure No.: E-2





Site Features

- Surface Water Drainage Pathway
- Dozer cuts
- Pit Area Identified in RSE
- Shallow Mine Waste
- Waste Pile
- Area of Potential Effect
- AUM Site Boundary
- Road
- Mays Wash

Notes:
AUM Abandoned uranium mine
RSE Removal site evaluation

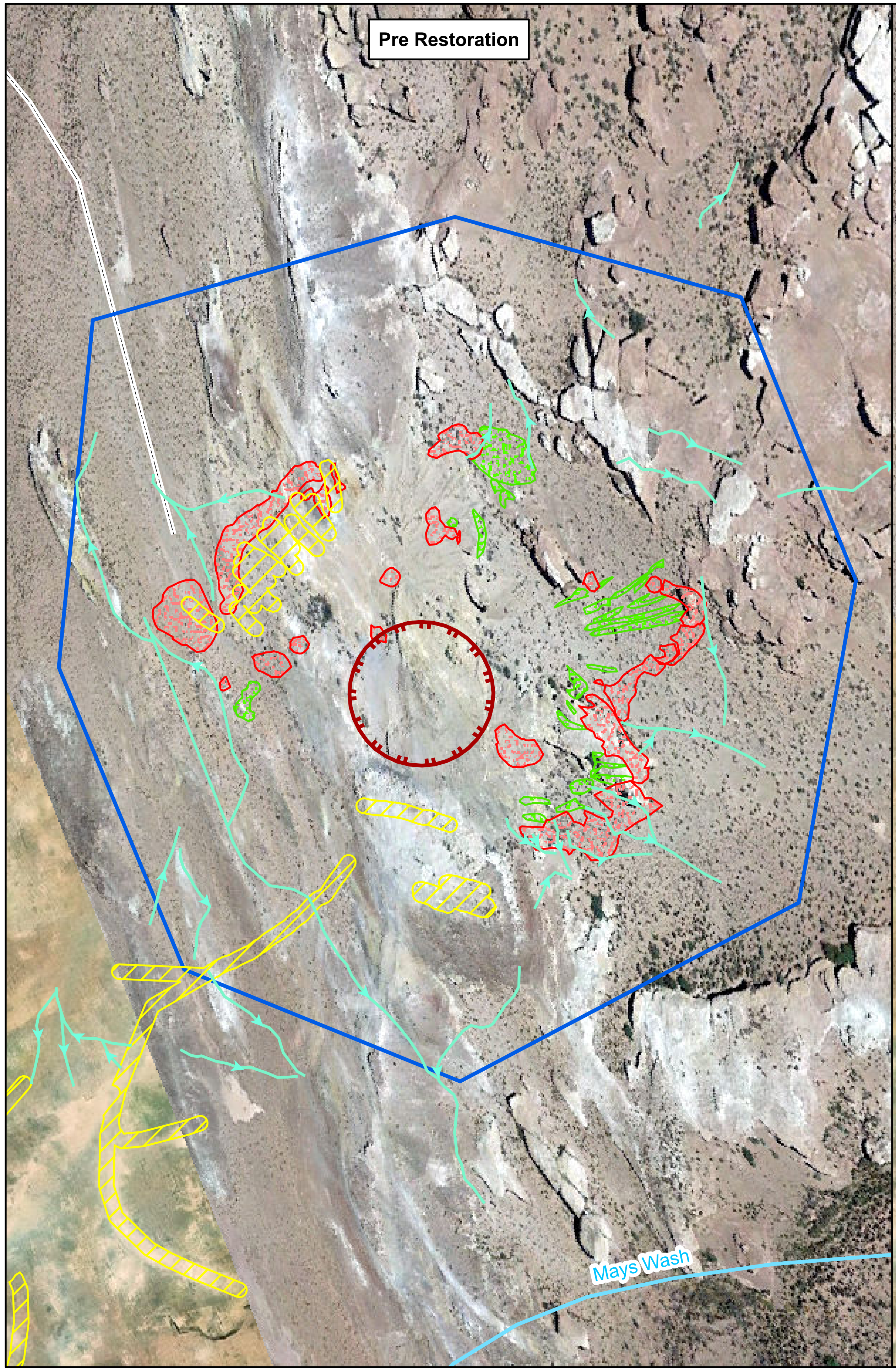
1 inch = 120 Feet

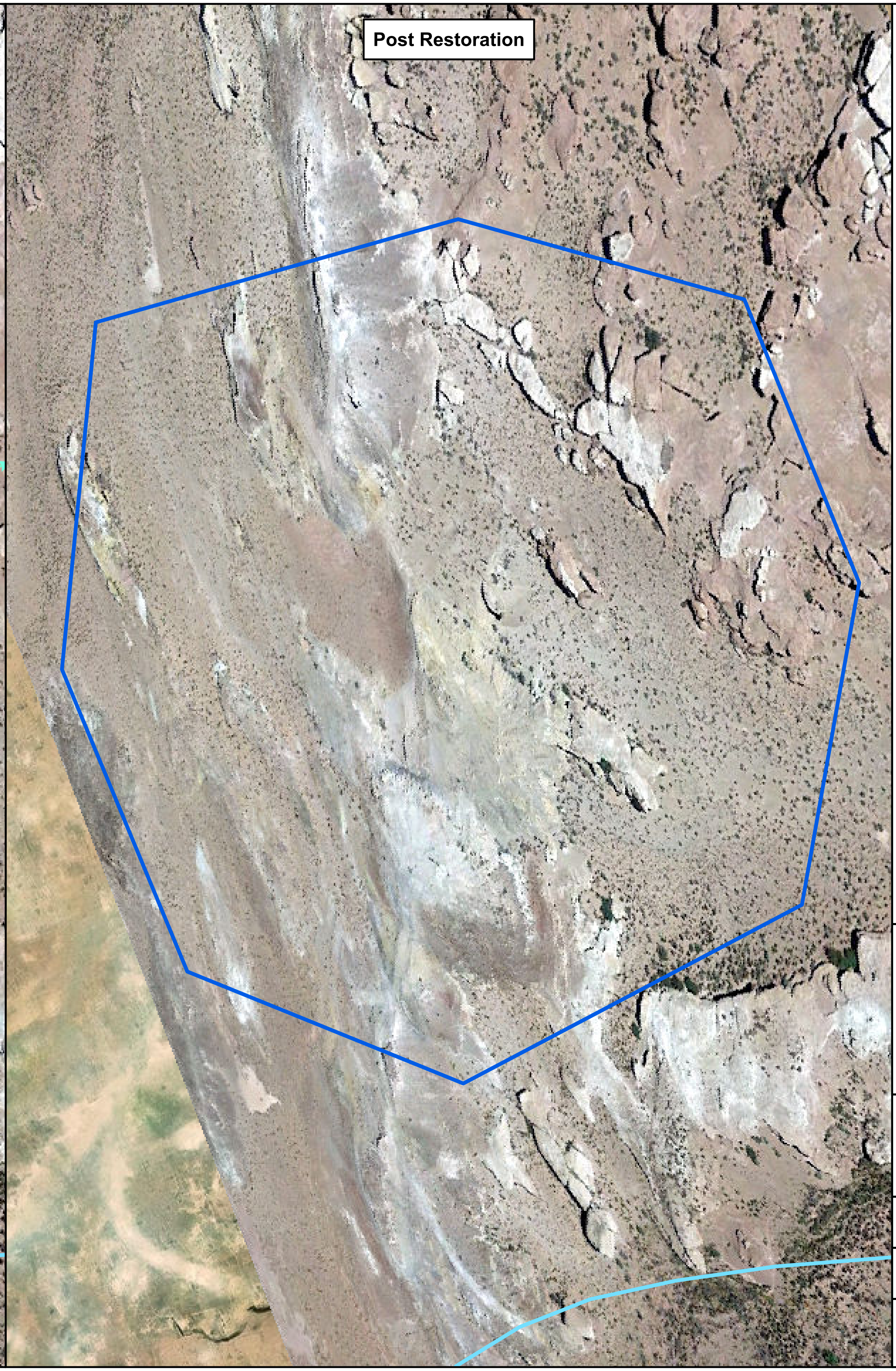
N W E S

120 60 0 120 Feet

SECTION 9 LEASE MINES PROPOSED POST-SURFICIAL RESTORATION ACTIVITIES: AUM 458, ALTERNATIVE 2 (MULTIPLE LOCATION CONSOLIDATE AND CAP)

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 020	Contract No.: 68HE0923D0002
Location: COALMINE CANYON CHAPTER NAVAJO NATION	Date: 7/2/2024
Coordinate System: NAD 1983 State Plane Arizona Central FIPS 0202 Feet Transverse Mercator	Figure No.: E-3





Site Features

- Surface Water Drainage Pathway
- Dozer cuts
- Pit Area Identified in RSE
- Shallow Mine Waste
- Waste Pile
- Area of Potential Effect
- AUM Site Boundary
- Road
- Mays Wash

Notes:

AUM	Abandoned uranium mine
RSE	Removal site evaluation

1 inch = 120 Feet

1:1,440

120 60 0 120 Feet

N W E S

SECTION 9 LEASE MINES PROPOSED POST-SURFICIAL RESTORATION ACTIVITIES: AUM 458, ALTERNATIVE 3 (SINGLE LOCATION CONSOLIDATE AND CAP) AND ALTERNATIVE 4 (OFFSITE DISPOSAL)

Prepared For: U.S. EPA Region 9	Prepared By: TETRA TECH 1999 Harrison Street, Suite 500 Oakland, CA 94612
Task Order No.: 020	Contract No.: 68HE0923D0002
Location: COALMINE CANYON CHAPTER NAVAJO NATION	Date: 7/2/2024
Coordinate System: NAD 1983 State Plane Arizona Central FIPS 0202 Feet Transverse Mercator	Figure No.: E-4