St. Anthony Mine Site Closure-Closeout Plan (CCOP)

30% Design Report

October 7, 2022

Prepared for:

United Nuclear Corporation

Prepared by:

Stantec Consulting Services, Inc. and INTERA, Inc.

Rev.	Description	Author		Quality Check		Independent Review	
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Executive Summary

This St. Anthony Mine Site Closure-Closeout Plan - 30% Design Report (30% CCOP) for the former United Nuclear Corporation (UNC) St. Anthony Mine Site (Site) was prepared to fulfill the requirements pertaining to the reclamation of the St. Anthony Mine (permit tracking No. MK006RE) in accordance with the New Mexico Mining Act Reclamation Program and the New Mexico Administrative Code (NMAC) 19.10.5. This 30% CCOP was prepared to comply with applicable regulations and conditions in the New Mexico Mining Act (NMMA), the Mining Act Rules for Existing Mining Operations (NMAC 19.10.5), and the New Mexico Water Quality Act.

The 30% CCOP is being submitted to support a revision to incorporate a closeout plan into the permit for St. Anthony Mine (MK006RE). It is also being submitted as an attachment to the Stage 2 Abatement Plan Modification to present the modified reclamation design. As discussed in the Stage 2 Abatement Plan Modification, the reclamation design presented in the prior Stage 2 Abatement Plan (INTERA, 2015) would create an artificial pathway for poor-quality water that, if implemented, would allow impacted groundwater to migrate into the Dakota Sandstone as the groundwater rebounds and result in adverse impact to human health and the environment. The 30% CCOP replaces the CCOP submitted in March 2019 (Stantec, 2019), which is hereby withdrawn.

The Site is located in Cibola County, New Mexico, in a remote, sparsely populated area of the Cebolleta Land Grant approximately 40 miles west of Albuquerque and 4.6 miles southeast of Seboyeta. UNC operated the St. Anthony Mine, comprised of an open pit and underground shaft uranium mine, from 1975 to 1981. The Site includes underground workings for the St. Anthony Mine comprising one mine shaft and one vent shaft that are now sealed at the surface, underground workings for the Old St. Anthony Mine, two open pits (one containing water), seven piles of non-economic mine materials, numerous smaller piles of non-economical mine materials, and three topsoil and/or overburden piles.

Site Characterization

The proposed reclamation for the Site includes excavation and consolidation of soil exceeding the Ra-226 Soil Action Level (SAL) of 6.6 pCi/g for radium 226 (Ra-226) that is based on a guidance targeting a final surface concentration of 5.0 pCi/g Ra-226 plus the 1.6 pCi/g Ra-226 Site background area concentration level as determined by the 2007 Materials Characterization (MWH, 2007b). The Materials Characterization included a radiological survey of non-economic materials at the Site, drilling and sampling of non-economic materials, and sampling of potential cover material borrow sources. The 2007 radiological characterization focused on the borrow and stockpile sources, non-economic materials piles, and mine facilities within the Western Shaft Area.

A Supplemental Radiological Characterization conducted in 2018 included areas within the approximate mine permit boundary that were excluded from the 2007 Materials Characterization. This supplemental Site characterization was also performed to estimate the outer boundary (lateral extent) of the mine waste or affected areas. Results of the Supplemental Radiological Characterization are presented in the

Summary of Supplemental Materials Characterization memorandum (Stantec, 2018b) and in the *Supplemental Radiologic Characterization Report* (AVM, 2018), which is included in Appendix B.

A third radiological characterization was conducted on the Pit 1 infill piles in November 2019. This investigation was performed to estimate the Ra-226 concentrations of the piles in Pit 1 to evaluate placement location for these materials. The characterization was performed by collecting soil samples from test pits and conducting onsite ex-situ gamma radiation soil screening and vendor laboratory analysis on the samples. Results of the test pit characterization are presented in the *Pit 1 Pile Investigation* report (AVM, 2020), which is included in Appendix B.

Stantec initiated a supplemental radiological characterization in May 2022 to estimate the lateral and vertical extent of mine waste in an approximately 22-acre area south of Pit 1 at the Site, where the Old St. Anthony Mine was located and operated from 1956 to 1960. The walkover radiological gamma survey conducted at the Site in 2018 indicated a small portion of this area, near the Old St. Anthony Mine underground workings, may exceed the SAL (6.6 pCi/g for radium 226 (Ra-226)). The 2022 characterization includes static gamma radiologic survey measurements, Global Positioning System (GPS) based scan surveys, ex-situ gamma radiation soil screening, soil sampling and laboratory analysis. The supplemental characterization and laboratory testing is estimated to be completed in December 2022. The results will be incorporated into the next phase of design.

Plan Summary

The proposed Reclamation Design includes regrading and covering several waste piles in-place (Piles 1, 2, 3, 4, 5, and Topsoil/Overburden). Sodium tripolyphosphate (STPP) will be used to stabilize the existing sediments in Pit 1 and the Pit 1 infill piles will be moved to the bottom of Pit 1, graded, and covered during stabilization of Pit 1. The waste materials on site that include; Ore Storage 1 and 2, Pile 7, Pile 6, the Shaft Area Access Road, the Mine Dump area, the Crusher Stockpile, the West Disturbance Area, and impacted surface soils throughout the Site, will be hauled and placed into Pit 2 and covered with soil. The design also includes rockfall mitigation for safety in Pit 1; engineering controls and signage; revegetation; and stormwater controls within the Site.

Post mining land uses, depending on the specific area or feature, will include grazing and wildlife habitat, similar to current use of the land located outside the approximate mine permit boundary. Restricted access areas may also exist post-closure. Engineering controls may be necessary to limit access to specific areas of the Site.

Abbreviations

μR/hr	microroentgen per hour
AAS	Alternative Abatement Standard
AJD	Approved Jurisdictional Determination
bgs	below ground surface
CCOP	Closure-Closeout Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLG	Cebolleta Land Grant
cm	centimeter
COC	constituent of concern
cpm	counts per minute
CWA	Clean Water Act
cy	cubic yard(s)
EPA	U.S. Environmental Protection Agency
IL	investigation level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MMD	New Mexico Mining and Mineral Division
NM	New Mexico
NMAC	New Mexico Administrative Code
NMDOT	New Mexico Department of Transportation
NMED	New Mexico Environment Department
NMMA	New Mexico Mining Act
NMOSE	New Mexico Office of the State Engineer

NMWQA	New Mexico Water Quality Act
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRC	US Nuclear Regulatory Commission
MARP	Mining Act Reclamation Program
pCi/g	picocuries per gram
$pCi/m^2/s$	picocuries per square meter per second
PLMU	post-mining land use
PPE	personal protective equipment
Ra-226	Radium-226
RCC	roller-compacted concrete
SAL	Soil Action Level
SOP	Standard Operating Procedure
SPLP	synthetic precipitation leaching procedure
STPP	sodium tripolyphosphate
SWPPP	Stormwater Pollution Prevention Plan
UNC	United Nuclear Corporation
USACE	US Army Corps of Engineers
WQCC	New Mexico Water Quality Control Commission

1.0 INTRODUCTION

1.1 TERMS OF REFERENCE

This 30% CCOP was prepared to fulfill the requirements of mine site reclamation (permit tracking No. MK006RE) at the Site in accordance with the New Mexico Mining Act Reclamation Program, the New Mexico Water Quality Act, and associated rules in the New Mexico Administrative Code (NMAC). The plan was prepared by a professional civil engineer registered in the State of New Mexico.

1.2 PLAN OBJECTIVES

This 30% CCOP replaces the plan previously submitted to the New Mexico Mining and Minerals Division (MMD) in March 2019 (Stantec, 2019). The 30% CCOP describes the work required to reclaim the Site to a condition that allows for establishing a self-sustaining ecosystem (SSE), appropriate for the life zone of the surrounding areas, and not in conflict with the post-mining land uses (PMLU) of livestock grazing and/or wildlife habitat. Industrial use for specific areas is also under consideration. Engineering controls may be necessary to limit access to specific areas of the Site where it is environmentally unsound, or it is not technically or economically feasible, to re-establish a SSE or a PMLU use.

The objectives of the 30% CCOP are to prepare engineering plans and technical specifications for the reclamation of the permit area consistent with the requirements of the NMMA and to demonstrate compliance with applicable requirements of the NMWQA. The design described in this 30% CCOP is presented at a minimum 30% design level, meaning that it presents overall concepts and sufficient design detail to support design decisions and provide estimates of construction costs and timelines. For reference, the USACE (USACE, 2009) defines a 30 to 35% design as a Conceptual Design, with sufficient detail to:

- demonstrate how the end user's functional and technical requirements will be met,
- indicate the designer's approach to the solution of technical problems,
- show compliance with design criteria, or provide justification for non-compliance, and
- provide a valid basis for estimate of cost

Once agreement is reached as to the design basis and general design concepts, the design will be advanced to a final design level.

1.3 PLAN SUMMARY

Sections 1 through 3 of the 30% CCOP include a general overview of the project Site and sections 4 through 6 describe the closure-closeout activities and the design details to support the proposed plan. The Appendices to this 30% CCOP comprise the detailed data collection efforts for the Site as well as the design calculations that support the closeout design. The design drawings are listed in Table 1-1.

Table 1-1. List of Drawings

Drawing No.	Drawing Title
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3	Site Layout Existing Conditions
4	Surface Characterization
5	Removal Excavation Plan (1 of 2)
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1.4 HISTORY OF PLANNING EFFORT

The following presents a chronological list of closure planning activities conducted to date including submittals to MMD, NMED and other agencies:

- In January 2006, a Closeout Plan and a Materials Characterization Plan were submitted for the St. Anthony Mine site.
- In April 2006, Lone Mountain prepared a Cultural Resource Survey for the Site.

- In May 2006 a report on Vegetation and Wildlife Evaluations/Recommendations was prepared by Cedar Creek.
- The materials characterization field program was conducted in 2006 and 2007 and the Materials Characterization Report was submitted in October 2007.
- The St. Anthony Mine Closeout Plan was revised and resubmitted to MMD in July 2010.
- A Closeout Plan Cost Estimate was submitted in September 2010.
- In 2013, UNC provided Interim Financial Assurance for the 2010 Closeout Plan.
- On May 7, 2015, NMED conditionally approved the St. Anthony Mine Stage 2 abatement plan submitted February 9, 2015.
- An anticipated schedule for the submittal of a Closeout Plan was submitted in January 2016.
- In 2017, UNC provided updated Interim Financial Assurance for the 2010 Closeout Plan.
- A final order (approval) for the petition for alternative abatement standards (AASs) for the Jackpile sandstone was submitted in September 2017.
- The WQCC approved the AAS Petition on September 29, 2017.
- In February 2018, a workplan for supplemental investigations was submitted. Technical comments were provided by MMD and the New Mexico Environmental Department (NMED) in April 2018, and responses to comments were provided in June 2018.
- In 2018, supplemental investigations were carried out that included supplemental materials characterization and a geotechnical investigation.
- A geotechnical investigation memorandum and a supplemental materials characterization memorandum summarizing the field work and results were submitted in August and September 2018, respectively.
- The Closeout Plan was revised, updated, and submitted in March 2019.
- A request for Agency comments on the Closeout Plan was submitted by MMD to NMED in April 2019, requesting additional NMED comments on the updated plan.
- NMED provided comments on the Closeout Plan in August 2019 and stated that it was inconsistent with NMED’s approval of the Stage 2 Abatement Plan.
- MMD provided comments on the Closeout Plan in September 2019 and concluded that the closeout plan was not approvable as submitted.
- In 2019, UNC informed MMD and NMED of technical and environmental challenges associated with the reclamation design proposed in the 2019 Closeout Plan and met with MMD and NMED to discuss an alternative reclamation design to address these challenges.

- In January 2020, Stantec provided an updated opinion of construction cost estimates for the reclamation of the Site based on the alternative reclamation design.
- On February 14, 2020, UNC met with MMD and NMED via conference call to outline an approach for the alternative reclamation design.
- In February 2021, UNC increased the interim financial assurance based on the 2020 updated construction cost estimates.
- USACE issued an AJD determining no Waters of the United States within the St. Anthony Mine Site in March 2021.
- UNC submitted technical memoranda on the technical and environmental infeasibility of backfilling Pit 1 above the elevation of the Jackpile – Dakota contact in November of 2021.
- On March 31, 2022, UNC informed MMD of the supplemental radiological characterization of an area south of Pit 1 at the Site, where the Old St. Anthony Mine was located and operated. The field work initiated in May 2022 and the associated laboratory testing is estimated to be completed by December 2022.

2.0 REGULATORY FRAMEWORK

2.1 MMD REQUIREMENTS

This 30% CCOP was prepared to comply with applicable provisions of the New Mexico Mining Act (NMMA), the Mining Act Rules for Existing Mining Operations (NMAC 19.10.5), the New Mexico Water Quality Act (NMWQA) (NMAC 20.6.4), and associated regulations.

The NMMA is administered by the MMD. The MMD's Mining Act Rules and MARP Closeout Plan Guidelines were used to develop this closeout plan. NMAC 19.10.5.506.A states that *"... closeout plans shall be based on site-specific characteristics and the anticipated life of the mining operation. Site-specific characteristics include, but are not limited to, disturbances from previous mining operations, past and current mining methods utilized, geology, hydrology and climatology of the area."*

NMAC 19.10.5.506.B states *"A proposed closeout plan or a proposed closeout plan for a portion of the mine shall include a detailed description of how the permit area will be reclaimed to meet the requirements of Section 69-36-11B(3) of the Act and the performance and reclamation standards and requirements of 19.10.5 NMAC."*

The closeout must be designed to achieve a SSE compatible with the PMLU. If "…*achieving a self-sustaining ecosystem or post-mining land use is not technically or economically feasible or is environmentally unsound, the Director may waive the requirement to achieve a self-sustaining ecosystem or post-mining land use for an open pit or waste unit if measures will be taken to ensure that the open pit or waste unit will meet all applicable federal and state laws, regulations and standards for air, surface water, and groundwater protection following closure and will not pose a current or future hazard to public health or safety*." 19.10.5.506.C.

MMD requires financial assurance prior to CCOP approval. A financial assurance proposal is required when the applicant receives notice from MMD that the closeout plan is approvable; however, a financial assurance estimate may be submitted with the CCOP. The financial assurance shall be provided in an amount adequate to complete the proposed reclamation. The financial assurance estimate will reflect the probable difficulty of reclamation or closure and include, at a minimum, the following costs:

- Mobilization and demobilization
- Engineering redesign
- Profit and overhead
- Procurement costs
- Reclamation or closeout management
- Contingencies

As noted in Section 1.4, UNC provided interim financial assurance in 2013 and updated it in 2021. UNC will update the surety estimate after MMD and NMED provide feedback on the final CCOP and MMD determines that the plan is approvable.

2.2 NMED REQUIREMENTS

The NMMA contemplates that, before MMD approval of a CCOP, NMED must make a written determination that the activities under the CCOP “will be expected to achieve compliance with all applicable air and water quality and other environmental standards.” In addition to the requirements of the NMMA and associated rules, this 30% CCOP is also designed to meet closure requirements under the New Mexico Water Quality Control Commission Regulations Ground and Surface Water Protection 20.6.2 NMAC.

2.3 ABATEMENT PLAN AND PERMITS

NMED conditionally approved a Stage 2 Abatement Plan for St. Anthony Mine on May 7, 2015, (the Stage 2 Plan) (INTERA, 2015) to address poor quality water in the Jackpile sandstone (Jackpile) and Pit 1 attributable to mining activities. The Stage 2 Plan contemplated compliance with Alternative Abatement Standards (“AAS”) (discussed below). A modified Stage 2 Abatement Plan is being submitted to NMED concurrent with this CCOP that incorporates the maintenance of a hydraulic sink rather than the creation of a flow-through system to address long-term groundwater containment. The modified Stage 2 Abatement Plan does not contemplate changes to the AAS.

The U.S. Army Corps of Engineers issued an AJD on March 2, 2021, that no Waters of the United States exist within the St Anthony Mine Site. The AJD expires on March 2, 2026. Accordingly, Clean Water Act (CWA) permits, Section 404 permit and Section 402 permit, are currently not required for activities within the site arroyos. Application of CWA permits to activities within the Site will be reevaluated upon expiration of the AJD, and any permits required by the CWA at that time will be obtained.

Unless a specific activity related to the proposed construction will result in a stationary source with emissions that exceed those outlined in NMAC 20.2.72.200, a permit will not be required for emissions. No such stationary source is anticipated. The earthwork contractor will be required to develop, and submit to UNC for approval, a dust control and mitigation plan to manage fugitive dust on the site haul roads while trafficking the site, excavating, and grading.

2.4 ALTERNATIVE ABATEMENT STANDARDS OVERVIEW

The New Mexico Water Quality Control Commission (WQCC) approved AAS for the Jackpile on September 29, 2017. These AAS apply within an approximately 1,072-acre area, as generally depicted on Figure 3-1. Within this area, the following standards in Table 2-1 apply:

Table 2-1. Alternative Abatement Standards for Constituents of Concern

Constituent	Amount
Uranium	12.4 mg/L
Radium (combined radium 226 and radium 228)	2913 pCi/L
Fluoride	10.7 mg/L
Sulfate	77,000 mg/L
Total Dissolved Solids	113,000 mg/L
Boron	5.05 mg/L
Chloride	908 mg/L

As described in the modified Stage 2 Abatement Plan, groundwater within the approximate mine permit boundary and within the AAS boundary will comply with these AAS.

3.0 SITE BACKGROUND AND DESCRIPTION

3.1 LOCATION AND LAND STATUS

The Site is located in Cibola County, New Mexico, in a remote, sparsely populated area on the Cebolleta Land Grant approximately 40 miles west of Albuquerque and 4.6 miles southeast of Seboyeta. UNC operated the St. Anthony Mine, comprised of an open pit and underground shaft uranium mine, from 1975 to 1981, pursuant to a mineral lease with the Cebolleta Land Grant, the current surface and mineral rights owner. The original lease covered approximately 2,560 acres. This lease was obtained on February 10, 1964 and was surrendered by a Release of Mineral Lease dated October 24, 1988. UNC has access to the Site with the permission of the Cebolleta Land Grant and Lobo Partners, LLC.

The Site includes a pair of underground workings. The St. Anthony Mine workings comprise one mine shaft and one vent shaft that are sealed at the surface; two open pits (one containing groundwater); seven piles of non-economic mine materials; numerous smaller piles of non-economic mine materials; and three topsoil and/or overburden piles. The two open pits and the Old St. Anthony underground workings at the Site are located in Sections 19 and 30, Township 11 North, Range 4 West, and the entrance to the newer St. Anthony underground mine is located in Section 24, Township 11 North, Range 5 West. Land area disturbed during mining encompasses approximately 430 acres and includes roads, building and shaft pads, and former settling ponds along with the open pits and non-economic mine material piles. The majority of mine-related perturbations were confined to the permit area. Other than access roads that were in a significant state of disrepair (typical of rangeland two-tracks), there was little evidence of mining activity external to the permit area. The Site layout showing these features is shown on Drawing 3.

UNC owns the property to the north of the mine area which consists of approximately 292 acres and soils on this parcel have been characterized for use as a source of borrow soil for Site reclamation. The land tract is located outside of the approximate mine permit boundary and is not included within the Site itself. The UNC property is used only for cattle grazing.

3.2 CLIMATE

The climate of the region, as summarized by measurements taken between 1905 and 2006 at the nearby Laguna, NM weather monitoring station (WRCC, 2019), has an average annual precipitation of 9.89 inches, with the heaviest precipitation falling as thunderstorms during July, August, and September**.** Pan evaporation rates obtained at the Los Lunas Station between 1962 and 1975 show an average annual evaporation approaching 52 inches (NOAA, 1982), or approximately five times the average annual precipitation.

The Site climate is arid to semi-arid with variable precipitation that is consistently exceeded by evaporation and transpiration demands (INTERA, 2015). Based on climatic records for Laguna, New Mexico (Station No. 294719), average annual precipitation is 9.9 inches, with the majority falling between

July and September (SWCA, 2020), whereas mean pan evaporation equals 63 inches per year and potential evaporation is estimated to be about 52 inches per year (INTERA, 2015).

3.3 GEOLOGY AND SEISMICITY

The Site is on the Colorado Plateau physiographic province, broadly characterized by plateaus of stratified sedimentary rock overlying tectonically stable Precambrian basement. The relatively high relief and dramatic topography of the Colorado Plateau formed as canyons were incised within thick sedimentary sequences. Within the southeastern portion of the Colorado Plateau lies the San Juan Basin, a structural depression encompassing most of northwestern New Mexico and adjoining parts of Colorado and Utah. The strata of the San Juan Basin dip gently to the north (approximately 2 degrees), although small faults and folds alter the dip of the strata locally. The San Juan Basin is truncated on its southeastern margin by the Jemez lineament, a northeasterly trending structural boundary between the Colorado Plateau to the northwest and the Rio Grande Rift to the south and east. The Site is within the Grants uranium district that lies on this transitional margin amidst many prominent Late Cenozoic volcanic fields that demarcate the Jemez lineament and the southeast margin of the San Juan Basin.

The contemporary seismicity of the Colorado Plateau physiographic province has been investigated by seismic monitoring (Wong and Humphrey, 1989). Their study characterized the seismicity of the plateau as small to moderate magnitude with a low to moderate rate of widely distributed earthquakes. The United States Geological Survey unified hazard tool yields a peak ground acceleration of 0.14 g for the 2,475-year return period earthquake at the Site coordinates. This assessment is based on a shear-wave velocity in the upper 100 ft of the subsurface of 760 m/s for the Site Class B/C boundary condition. Site-specific shear wave velocity data has not been collected.

Sediments in the Grants area were deposited in various continental environments. During late Permian time, the area now defined by the San Juan basin was an active seaway connecting the central New Mexico Sea with the Paradox basin in Utah. During this time, the Glorieta sandstone and San Andreas limestone were deposited. The region was subsequently uplifted in Laramide time and fluvial, lacustrine, and aeolian sediments of the respective Chinle Formation, San Rafael Group, and Morrison Formation were deposited. Upper Cretaceous strata consist of marine shore zone sandstones, marine shales, and various continental deposits. In ascending order, these are represented by the Dakota Sandstone, Mancos Shale, and the Mesaverde Group.

Stratigraphy of interest at the Site includes the Mancos Formation (Late Cretaceous), the Dakota Formation (Early and Late Cretaceous) and the Morrison Formation (Late Jurassic). The surficial geologic unit at the Site is the Mancos Formation consisting of three sandstone units and interbedded shale units with a maximum thickness of 465 feet. The upper sandstone caps Gavilan Mesa to the south of the pits. The Dakota Formation sandstone is 6 to 20 feet thick in the Site area. The Morrison Formation is approximately 600 feet thick and is comprised of the Jackpile Member (sandstone), the Brushy Basin Member (interlayered mudstone and sandstone), the Westwater Canyon Member (sandstone), and the Recapture member (interbedded claystone and sandstone).

Uranium production at the Site was from the Jackpile Member with each pit penetrating approximately 75 feet into this unit. The thickness of the Jackpile sandstone in the Site vicinity varies from 80 to 120 feet and is representative of deposition in a braided stream environment.

3.4 SURFACE WATER HYDROLOGY

The surface topography at the Site and the surrounding area is a combination of steep-sided mesas separated by broad, gently sloping valleys. The drainage channels incised into these valleys were infilled with alluvial and colluvial deposits. Most if not all drainage channels at the Site are ephemeral and only flow during and shortly after a precipitation event.

The greatest stormwater runoff rates result from thunderstorms that occur between the summer and early fall months. As described by Sabol et al. (1982), typical New Mexico thunderstorms have three phases: (1) a short-duration, low-intensity phase, (2) a higher intensity period, and (3) a longer, low-intensity period. The initial, low-intensity period fills potential rainfall loss reservoirs such as interception, depression storage in soils, and reducing the water storage capacity of soils. In extreme rainfall events, the short-duration, high-intensity rainfall often exceeds the infiltration capacity of the soil.

All St. Anthony underground workings, waste piles, the larger Pit 1, and smaller Pit 2 are located within the Arroyo del Valle Subwatershed of the Arroyo Conchas Watershed (Figure 3-1). As defined by the USGS National Watershed Boundary Dataset, the Arroyo Conchas Watershed has a 10-digit hydrologic unit (HU) code of 1302020708 and the Arroyo del Valle Subwatershed has a 12-digit hydrologic unit (HU) code of 130202070802. The Subwatershed contains the ephemeral Meyer Draw, which separates the overburden piles from the two open pits, and its Arroyo del Valle ephemeral tributary, which joins Meyer Draw downgradient of Pit 1 (Figure 3-1). Arroyo del Valle Subwatershed empties to the Rio San Jose, which empties to the Rio Puerco, which empties to the Rio Grande. The channel length between the Meyer Draw Arroyo at the downstream end of the Site and the confluence of the Rio Puerco with the Rio Grande is 93 miles. Nearly all of the area within the St. Anthony Alternative Abatement Standards (AAS) boundary is contained within the Arroyo del Valle Subwatershed except the southwest corner that falls within the Rio Moquino Subwatershed (Figure 3-1).

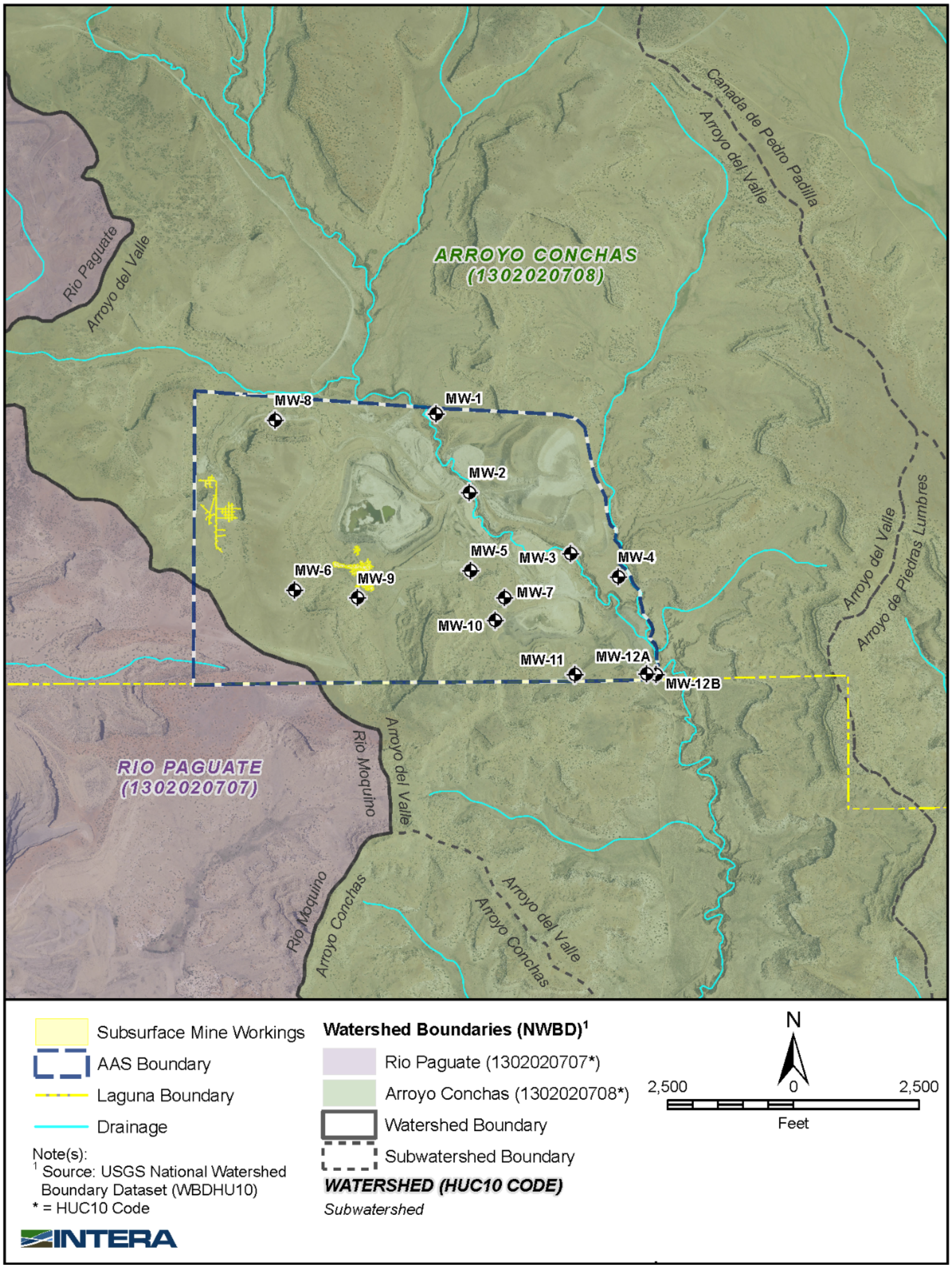

Figure 3-1. Watersheds and Subwatersheds Surrounding St. Anthony

At the Site scale, water in Meyer Draw, and its Arroyo del Valle tributary, typically only flows or pools in direct response to a significant precipitation event. Water from precipitation rarely appears in either Meyer Draw or the Arroyo del Valle tributary (INTERA, 2015). In recent years, unpredictable, non-continuous upstream water discharges, attributable to pumped groundwater used for agricultural and stock watering, have been observed in Meyer Draw (SWCA, 2020). Expressed water ponds within Pit 1 and is completely contained within the pit (INTERA, 2015).

3.5 HYDROGEOLOGY AND WATER SUPPLY

The Site is located in the southeastern part of the San Juan Basin, a large structural basin that encompasses roughly 21,000 square miles within New Mexico, Colorado, Arizona, and Utah (Kelley, 1963; Craigg, 2001). Like other areas in the San Juan Basin, the groundwater for the Site and the surrounding region derives primarily from recharge in the topographically high areas and flows toward discharge areas at lower elevations (Stone et al., 1983). Locally, recharge likely occurs to the northwest of the Site in the San Mateo Mountains, which comprise Mt. Taylor and the Mesa Chivato volcanic field. At a regional scale, groundwater in the Dakota Sandstone and sandstone units of the Morrison Formation, including the Jackpile sandstone, flows from the north across the Site to the south/southeast. Regional groundwater contours, developed by the New Mexico Office of the State Engineer (NMOSE) (NMOSE, 2002) highlight groundwater recharge in the San Mateo mountains and flow to the southeast in the vicinity of the Site (INTERA, 2015).

Groundwater in extractable quantities has been observed in the Cretaceous Dakota Sandstone and the Jackpile Sandstone and Westwater Canyon Member (Westwater) of the Jurassic Morrison Formation. At the Site, both the Dakota Sandstone and the Jackpile unit are exposed but not the Westwater, which lies roughly 200 feet below the Jackpile. Given its greater depth, the Westwater contains groundwater within the Site and its vicinity. Groundwater is found in the Jackpile across nearly all the Site apart from the southern areas where the Jackpile is essentially unsaturated (INTERA, 2015). The Dakota Sandstone is unsaturated where it surrounds Pit 1 and to the south (INTERA, 2015). However, field notes and bore logs record observations of groundwater in the Dakota at St. Anthony monitoring well MW-8, located about 1,900 feet north of Pit 1, and at three monitoring wells for the JJ mine site, located between 4,500 and 7,600 feet northwest of the Site (INTERA, 2021). Other studies in the St. Anthony area indicate that there are discontinuous water-bearing zones in the Cretaceous Mancos Shale's sandstone intervals commonly referred to as "Tres Hermanos" (INTERA, 2006).

The Jackpile Sandstone is the hydrostratigraphic unit of primary interest to the CCOP because it contains naturally mineralized, poor quality groundwater, some of which flows into Pit 1. Consisting of a 70 to 200-foot-thick lens of relatively well-lithified, medium- to coarse-grained, arkosic sandstone, the Jackpile sandstone has a relatively low hydraulic conductivity (0.005 to 0.9 foot/day) and, where saturated, generally has low yields of groundwater (Owen, et al., 1984; Zehner, 1985; INTERA, 2015).

The Jackpile Sandstone is bounded by adjacent layers with much lower hydraulic conductivity that act as confining layers. Confining layers can impede vertical flow out from the confined groundwater unit. The Brushy Basin mudstone that underlies the Jackpile acts as the lower confining layer because the mudstone has a much lower hydraulic conductivity than the Jackpile (INTERA, 2015). The upper confining layer comprises the kaolinitic cements in the upper Jackpile and, where present, a mudstone or clay interval at the bottom of the Dakota Sandstone (INTERA 2015). The upper part of the Jackpile has kaolinitic cements that fill the pore space, and as discussed below, appear to create a confining interval within the Jackpile itself (Schlee and Moench, 1961; Kittel, 1963; Sections 3.3.4 and 5.1.1 in INTERA, 2015).

On a regional scale, groundwater in the Jackpile flows from the north and northwest, where groundwater heads are highest, toward the south and southeast, where groundwater heads are lowest (Figure 3-2). Evaporation of the expressed water present in Pit 1 acts like a well pumping from the Jackpile and continues to decrease groundwater heads around the pit, creating a groundwater cone of depression (INTERA, 2006, 2015, 2017, 2019; see Figure 3-2 groundwater head contours in and around Pit 1). Jackpile groundwater flows into Pit 1 because evaporation removes inflowing groundwater at a rate sufficient to keep the elevation of the expressed water very close to the pit floor's lowest elevation of about 5,850 feet above mean sea level (ft amsl). Groundwater flows out from the Jackpile sandstone into the subsurface alluvial sediments of Meyer Draw, where it is lost to transpiration by tamarisk trees (INTERA, 2015). The alluvial sediments have an estimated thickness of 15 to 25 ft and were deposited into a channel incised into the Jackpile by erosion (INTERA, 2015). Based on data for the Jackpile top elevation and 2011-2013 groundwater heads (INTERA, 2015, 2017, 2019), confined conditions extend across the JJ mine area (green overlay color in Figure 3-3) whereas unconfined conditions extend across most of the Jackpile-Paguate and St. Anthony mines (purple overlay color in Figure 3-3). Unconfined conditions in the Jackpile at St. Anthony Mine are caused mainly by the gradual rise in the Jackpile's bottom elevation and, locally, by the Pit 1 hydraulic sink. The Jackpile is unsaturated southeast of the unconfined conditions (Figure 3-3), including at the St. Anthony MW-12a and MW-12b monitoring wells (Figure 3-2), because the bottom elevation of the Jackpile is higher than groundwater heads to the north and northwest (Figure 3-3). Given the observed, confined conditions for Jackpile groundwater at some monitoring wells, the Jackpile's kaolinitic cements and the mudstone at the base of the Dakota Sandstone, where present, have a lower vertical and horizontal hydraulic conductivity than that in the rest of the Jackpile (INTERA, 2015, 2017, 2019, 2021).

The Dakota Sandstone is the second hydrostratigraphic unit of interest to the 30% CCOP because it overlies the Jackpile Sandstone and is used as a drinking water supply outside the Site. Although the Dakota Sandstone is relatively thin locally - ranging in thickness from 6 to 20 ft, its representative thickness is about 50 ft at the regional scale. The Dakota Sandstone is a white and light gray, fine- to medium-grained, sugary-textured, well-cemented sandstone. However, examination of its exposures in Pit 1 reveals that the Dakota Sandstone tends to be highly fractured.

As noted above, the Dakota is completely unsaturated around the two St. Anthony pits and the southern part of the Site, but it is saturated farther to the north. There are no monitoring wells screened in the Dakota to provide measurements of Dakota groundwater heads at the St. Anthony.

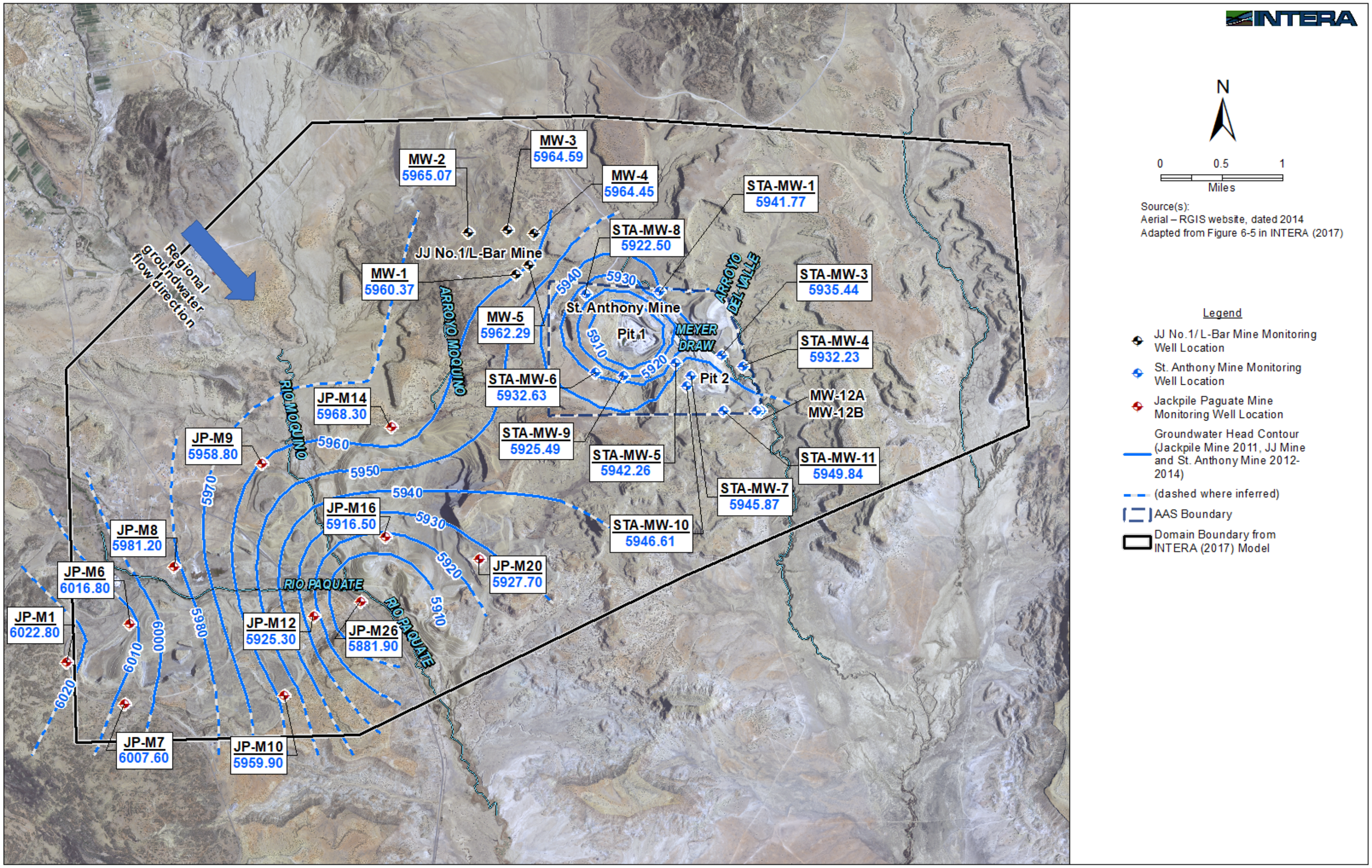

Figure 3-2. Estimated Contours for Groundwater Heads under 2011-2013 Conditions (adapted from Figure 6-5 in INTERA, 2017)

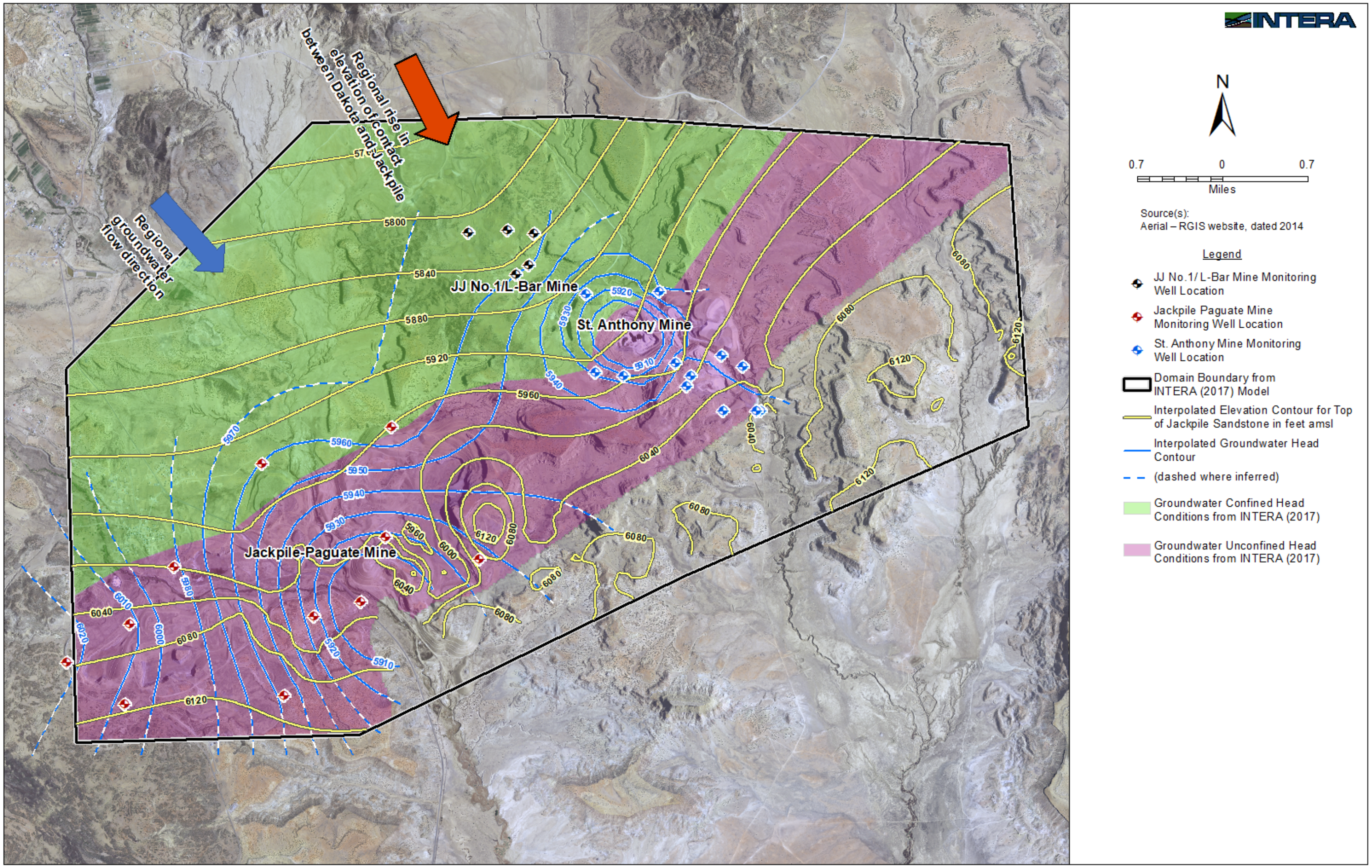

Figure 3-3. Top Elevation of Jackpile Sandstone, Estimated Groundwater Head Contours, and Estimated Areas with Confined and Unconfined Groundwater Conditions (adapted from Figure 6-7 in INTERA, 2017)

3.5.1 Water Supply

Supply wells in the area typically extract water from one or more of the sandstone units, including the Tres Hermanos in the Mancos Shale, the Dakota Sandstone, the Jackpile, a sandstone lens in the Brushy Basin mudstone, and the Westwater. Wells with multiple open intervals indicate that the shallower sandstone units, e.g., Tres Hermanos, Dakota Sandstone, and Jackpile, do not yield sufficient amounts of water, thus necessitating extraction from the deeper and more productive Westwater.

Information compiled from a recent query of the NMOSE's Waters Database revealed there are sixteen water supply wells that are screened in the Jackpile Sandstone and may withdraw Jackpile groundwater within a 5-mile radius of the Site (Figure 3-4). Evidence of pumping is available for ten of the sixteen wells. Where available, the reported screened intervals were compared to INTERA's geologic model to interpret the targeted stratigraphic units. At least five of these wells intercept three to four sandstone units including sandstone intervals found in the Dakota, Jackpile, Brushy Basin, and Westwater stratigraphic units (Table 3-1). Other wells may intercept fewer stratigraphic units. NMED and NMOSE have restricted the construction of new supply wells or changes to the point of diversion of existing supply wells within the site AAS boundary (NMOSE, 2018).

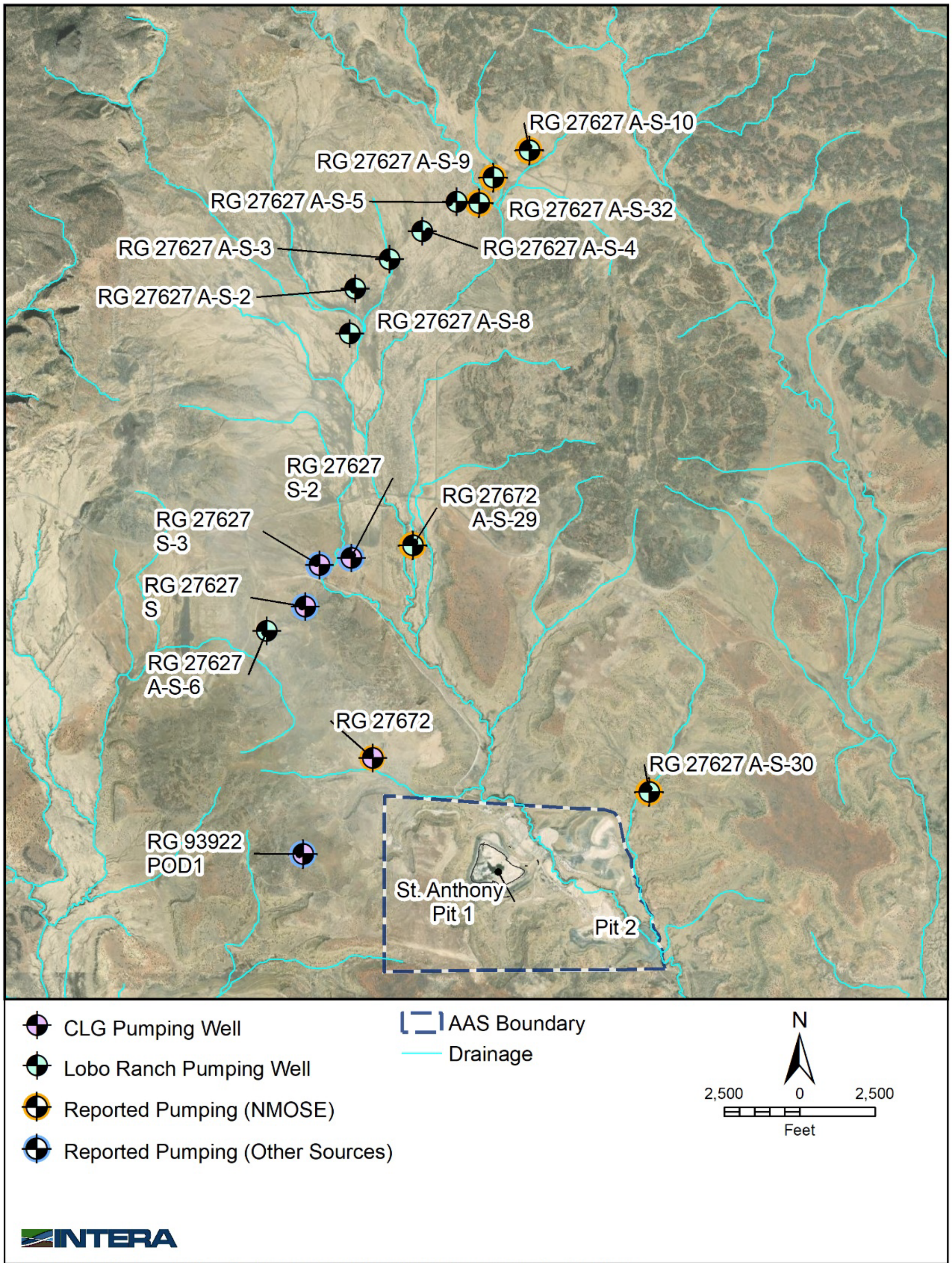

Figure 3-4. Active or Potentially Active Water Supply Wells near St. Anthony

The query revealed records for sixteen wells, owned by either the Cebolleta Land Grant (CLG) or the former Lobo Ranch Partners, LLC (Lobo Ranch) within five miles of the Site. The new owners of the Lobo Ranch are reported to be Lupo Land LLC. Of the sixteen well records, eight water supply wells are found within a 2.5-mile radius of the Site, and nine others are found three to five miles from the Site (Table 3-1 and Figure 3-4). All wells in the Waters Database within five miles of the Site are located upgradient of the Site, relative to the direction of groundwater flow, under current conditions in which Pit 1 acts as a hydraulic sink. Wells RG 93922 and RG 27672 A-S-30 are within 2.5 miles of the Site and are used for stock watering (Table 3-1), whereas RG 27672 A-S-29 is within 2.5 miles of the Site and is used for irrigation. Well RG 27672 has NMOSE production records and is also within 2.5 miles of the site, but neither the water usage nor construction information are listed within the NMOSE Waters Database. Well RG 27627 A-S-6 is within 2.5 miles of the site but has no production, or construction information, and is therefore considered a water supply well with potential withdrawal from the Jackpile Sandstone. The remaining three wells within 2.5 miles of the Site are RG 27672 S, RG 27672 S-2, and RG 27672 S-3. These wells do not have production or screen interval information, but personal communication with the Cebolleta Land Grant (CLG) personnel indicates that these wells have been pumped over the past decade.

The query revealed limited information well construction and production rates for the CLG wells near the Site. CLG well RG 93922 is listed as having its entire length (0 to 745 ft) perforated. Totalizer data obtained from RG 93922 suggests pumping from at least 2019 through 2020. The query result of another CLG water well, RG 27672, has NMOSE pumping records that span 2011 through 2013, but no well construction information is available. Personal communication with CLG staff about RG 27672 pumping indicates that its reported pumped volume more likely came from CLG wells RG 27672 S, RG 27672 S-2, and/or RG 27672 S-3 as opposed to RG 27672.

Well construction and production information is available for several Lobo Ranch supply wells near the Site. Well RG 27627 A-S-30, located less than one mile east of the Site, is listed as having a 20-foot-long screen interval with intermittent pumping spanning 2015 through 2020. Comparison of the well's reported screen interval depth to INTERA's Jackpile geologic model (see Section 5.1.5 in INTERA, 2015) suggests that this well is likely screened in the Jackpile Sandstone. Well RG 27627 A-S-29, located just under two miles from the Site, has reported pumping from 2017 through 2020 and its shallowest screen interval intercepts the Jackpile Sandstone. Four Lobo Ranch wells with pumping and/or construction information are located within a three-to-five-mile radius of the Site and include RG 27627 A-S-8, A-S-9, A-S-10, and A-S-32. The Jackpile Sandstone, based on modeled top and bottom elevations, is located just below the shallowest screened interval for wells A-S-8, A-S-9, and A-S-10. Intermittent pumping from 2010 through 2020 is reported for A-S-9 and A-S-10, and there are no pumping records at well A-S-8. RG 27627 A-S-32 has production (2015 through 2020) but no construction information, although it is expected that the well is constructed similarly to nearby wells RG 27627 A-S-9 and RG 27627 A-S-10. The five remaining Lobo Ranch wells have neither construction nor production information, but are considered potential water supply wells because their production within Jackpile Sandstone cannot be ruled out. These wells include RG 27627 A-S-2, A-S-3, A-S-4, A-S-5, and A-S-6.

The well construction information in Table 3-1 is consistent with the characterization of the Jackpile Sandstone as a low-permeability unit that yields low flows to wells. The two wells nearest the Site are used only for stock watering, one of which, RG 93922, has a 745-foot-long perforated interval. Although many of the RG 27627 wells intercept the Jackpile Sandstone, they were drilled an additional 300 to 400 ft below the bottom of the Jackpile Sandstone and constructed with two or three screened intervals below the Jackpile Sandstone to intercept higher yields of groundwater.

As explained above, water supply wells also extract water from the Dakota Sandstone. The Village of Moquino used a Dakota Sandstone supply well at a depth of about 300 to 350 ft, approximately 3.7 miles west-northwest and upgradient of the Site. The Moquino well was supplemented in approximately 1990 by a deeper well into the Westwater Canyon sandstone.

Table 3-1. Jackpile Sandstone Water Wells Within 5 Miles of the St. Anthony Mine

Well ID	Approximate Distance and Orientation from Pit 1	Total Depth (ft)	Depth to Screened Intervals (ft)	Reported Source Unit	Interpreted Stratigraphic Source Unit[1]	Water Usage	Owner	Source of Reported Pumping
RG 93922	6,200 feet west	745	0-745	--	Tres Hermanos, Dakota, Jackpile, & Brushy Basin or Westwater	Stock	CLG	Field Totalizer
RG 27672	5,400 feet northwest	--	--	--	--	--	CLG	NMOSE
RG 27672 S	10,600 feet north/northwest	510	--	--	--	--	CLG	CLG personal comm
RG 27672 S-2	11,300 feet north/northwest	535	--	--	--	--	CLG	CLG personal comm
RG 27672 S-3	11,500 feet north/northwest	353	--	--	--	--	CLG	CLG personal comm
RG 27672 A-S-2	19,600 feet north/northwest	1,050	--	--	--	Irrigation	Lobo Partners	--
RG 27672 A-S-3	20,400 feet north/northwest	1,085	--	--	--	Irrigation	Lobo Partners	--
RG 27672 A-S-4	21,100 feet north/northwest	1,150	--	--	--	Irrigation	Lobo Partners	--
RG 27672 A-S-5	22,000 feet north/northwest	1,120	--	--	--	Irrigation	Lobo Partners	--
RG 27672 A-S-6	11,000 feet west/northwest	1,660	--	--	--	Irrigation--	Lobo Partners	--
RG 27627 A-S-8	18,170 feet north	1,215	595-725 845-910 1,050-1,072	Sandstone/ Gravel/ Conglomerate	Jackpile Sandstone, Brushy Basin, & Westwater	Irrigation	Lobo Partners	--
RG 27627 A-S-9	22,800 feet north	1,110	640-720	Jackpile Sandstone	Dakota & Jackpile Sandstone	Irrigation	Lobo Partners	NMOSE
			852-885	Sandstone	Brushy Basin			
			970-1097	Westwater Sandstone	Westwater Sandstone			
RG 27627 A-S-10	23,740 feet north	1,140	640-730	Jackpile Sandstone	Dakota & Jackpile Sandstone	Irrigation	Lobo Partners	NMOSE
			820-880	Sandstone	Brushy Basin			
			980-1100	Westwater Sandstone	Westwater Sandstone			
RG 27627 A-S-29	11,000 feet north	800	400-475	Jackpile Sandstone	Dakota & Jackpile Sandstone	Irrigation	Lobo Partners	NMOSE
			650-675	Brushy Basin Sandstone	Westwater Sandstone			
			710-800	Westwater Sandstone				
RG 27627 A-S-30	5,680 feet northeast	400	160-180	Other/Unknown	Jackpile Sandstone	Stock	Lobo Partners	NMOSE
RG 27627 A-S-32	21,900 feet north	--	--	--	--	--	Lobo Partners	NMOSE

[1] Based on INTERA Geologic Model

3.6 VEGETATION

Three vegetation ecotypes dominate the area surrounding the project Site: 1) grassland ecotypes, 2) juniper scrub ecotype, and 3) bottomland ecotype. A sub-ecotype, riparian drainage bottom (Tamarisk), is also present in drainage bottoms within the bottomland ecotype. A Site-specific evaluation by Cedar Creek Associates (Cedar Creek, 2006) found that mine development occurred primarily within the grassland, Juniper scrub, and bottomland ecotypes. Aside from occasional road crossings, the riparian drainage bottom ecotype was largely avoided by past mining activities.

Grasslands are herbaceous communities dominated by grasses and occasional forbs that can sometimes be seasonally dominant. Trees and larger shrubs are largely absent from this type except for the occasional invader of local sites. Grasslands in this part of New Mexico may be dominated by annual grasses, perennial bunchgrasses, or perennial sod-forming grasses and typically of the warm-season group. In the area of the Site the grasslands are of this latter warm-season perennial sod-forming group. Soils tend to be deep (greater than 6 feet). Typical geomorphic features are floodplains, alluvial fans, and fan remnants.

The Juniper scrub ranges between a “savanna” of scattered trees within the benched high-plains grassland, to dense, woody-dominated areas with very poor herbaceous understories. The Juniper scrub ecotype is usually associated with rock outcroppings and thin and skeletal soils, often with a sandy texture. Occasional Piñon are found throughout the ecotype.

The bottomland ecotype is primarily characterized as having higher available water within the soil profile (more loamy, less sandy). Also, the higher available water is due to the ecotype being physically located in the arroyo bottoms that tend to collect surface runoff and fine-textured erodible materials. The increased soil moisture and loamy texture lead to increased vegetative cover from herbaceous taxa. Visible salt crusts were noted within the drainage bottom and along the cut banks. The arroyo is deeply incised, and the upland grasslands immediately adjacent to the arroyo are not subject to flooding from typical precipitation events. On occasion, the bottomland community can exhibit areas of shrub domination by four-wing saltbush in areas exhibiting moderately elevated salt accumulations but can also exhibit areas of dominance by winterfat or Bigelow’s sagebrush. Other areas may be nearly absent of shrubs, and grasses (and rarely forbs) are dominant. Tamarisk and other noxious weeds were also noted in the drainage bottoms as part of the riparian drainage bottom ecotype. This ecotype was observed to be in a deteriorated condition due to natural disturbances (e.g., frequent flooding and dominance of Tamarisk and other weedy taxa) unrelated to past mining activity. Physical effects associated with frequent, severe flooding along the riparian drainage bottom were readily evident and included features such as deeply incised channels, large deposits of sediment, flood debris at elevated locations, and poorly consolidated soils.

3.7 WILDLIFE AND CULTURAL RESOURCES

3.7.1 Wildlife

A wildlife survey was completed as part of the original closeout plan (Cedar Creek, 2006). The survey findings are summarized here, and the full report is included in Appendix A. Wildlife habitats observed on the Site included Rim Rock & Cliff Faces (rim rock), seasonal water sources (stock tanks and remnant ponded water of pits), and the four vegetation ecotypes including grassland, bottomland, juniper scrub, and a sub-ecotype tamarisk dominated riparian drainage bottom. Habitats not within the former mine disturbance footprint were observed to be of good quality, except for the riparian drainage bottom. The rim rock habitat offered opportunities for cliff nesting raptors and smaller avifauna, though no nests were observed along transects through this habitat. The boulder and cobble fields below the cliff escarpments provide escape cover to small mammals and herpetofauna. Grasslands and juniper scrub habitats exhibited light to moderate utilization by domestic livestock. In contrast, the riparian drainage bottom offered poor quality wildlife habitat due to the significant stands of tamarisk and other invasive vegetation species that degrade the quality of habitat for wildlife foraging and nesting.

Big game species observed on site included elk, mule deer, and black bear. Signs of wild horses and burrows were noted. Smaller mammals and their signs observed onsite included prairie dogs, rabbits, and mice. Small raptors were observed flying through, or foraging on, the Site, including sharp-shinned hawks, prairie falcons, and red-tailed hawks. Other indigenous fauna observed throughout most habitats included common migratory bird species, lizards, and snakes.

Only three seasonal water sources (livestock watering facilities or stock tanks) were observed within the study area aside from the ponded water remnant in the bottom of Pit 1. Shorebird and mule deer tracks were observed along the mudflats of a livestock watering facility located outside of the Site.

Although a few observations of raptors occurred during Cedar Creek’s work at St. Anthony, no evidence of nests along cliff faces was observed within the rim rock immediately adjacent to the permit area. According to the wildlife survey report, it is likely that the observed raptors had nests elsewhere in the general area given the vast number of opportunities for nest construction.

3.7.2 Cultural Resources

Lone Mountain Archaeological Services performed cultural resources surveys of the Site and proposed borrow areas in 2006 (LMA, 2006). The reports are included as Appendix A. The cultural resource surveys included record searches of known historic sites in the vicinity of the St. Anthony Mine and a complete pedestrian survey of proposed disturbance areas. The surveys were performed under NMCRIS No. 98419, State Permit No. NM 06-073 and NMCRIS No. 108738, State Permit No. 08-073. Sixteen archaeological sites, one previously reported archaeological site, and numerous isolated occurrences were recorded during the survey. Six of these identified sites and isolated occurrences are in proximity to soil excavation areas and one occurrence is within a proposed soil borrow area. Because the sites are near the perimeters of the work areas, Stantec proposes establishing a minimum 50-foot buffer around the locations prior to initiating earthwork. A qualified archaeologist will review sites located within soil reclamation areas once the buffers have been established. The locations of the identified sites and isolated occurrences are not shown in this document and have been redacted from the report in Appendix A.

3.8 MINING HISTORY AND CURRENT STATUS

The St. Anthony Mine was operated by UNC from 1975 to 1981 (NMED, 1995). The Site property was leased by UNC from the Cebolleta Land Grant during mine operations and the lease was terminated in 1988. Excavation of the Pit 2 was initiated in November 1975 and excavation of the Pit 1 was initiated during the summer of 1976. Both of the pits extended approximately 75 feet into the Jackpile sandstone (Baird et al., 1980).

UNC also operated an underground mine, approximately 2,500 feet west of Pit 1. The shaft for the underground mine was in a short canyon that is separated from the rest of the Site by a portion of the Gavilan Mesa. The shaft construction for the underground workings began in January 1977 and was completed to a depth of approximately 357 feet, deep enough to extend below the Jackpile sandstone to the top of the Brushy Basin Member of the Morrison Formation. A second underground mine, not operated by UNC, was present on site and located south of Pit 1. Limited historical details are available for this mine and its operation pre-dates the underground workings west of Pit 1 and the development of the open pits.

The UNC underground operation was suspended in June 1980 and the open pit operation ceased in August 1980. Stockpiled ore was hauled from the Site to area mills until 1981. The St. Anthony mine produced approximately 280 tons of triuranium octaoxide (U_3O_8) in 1979 and approximately 288 tons U_3O_8 in 1980 (NMED, 1995).

Closure activities at the mine were completed in 1984 and 1985, and the mineral lease was surrendered in 1988. Closure consisted of capping the St. Anthony mine shaft and vent hole at the surface and removing equipment and buildings, trash cleanup and fence repair. Closure of the shaft and vent were documented in a letter to MMD in December 2006 (UNC, 2006).

A preliminary Site Assessment was performed in 1995 by the NMED in accordance with CERCLA (Superfund) regulations (NMED, 1995). The results were submitted to the Environmental Protection Agency (EPA), which concluded that further investigation was not warranted under the Superfund regulations. In 2000, water samples obtained from Pit 1 by the MMD and NMED during two Site visits revealed elevated levels of several constituents. Elevated levels were attributed primarily to the concentration of naturally-occurring groundwater constituents occasioned by evaporation of water in the pit bottom.

UNC has no plans for future mining activities at the Site.

4.0 SITE CHARACTERIZATION

4.1 RADIOLOGICAL DATA SUMMARY (2007 AND 2018-2019)

4.1.1 2007 Site Characterization

A surface and subsurface Materials Characterization was conducted at the Site between April 2006 and July 2007, as described in the Materials Characterization Report (MWH, 2007b). The 2007 Materials Characterization included investigation of surface and subsurface materials at various areas within, and near, the Site in accordance with the approved Materials Characterization Work Plan (MWH, 2007a). The purpose of the 2007 Materials Characterization was to evaluate soil suitability as a growth media and radiological risk. The Materials Characterization included a radiological survey of non-economic materials at the Site; drilling and sampling of non-economic materials; and sampling of potential cover material borrow sources. The radiological characterization focused on the borrow and stockpile sources, non-economic materials piles, and mine facilities within the Western Shaft Area.

Several methods were employed in the 2007 Materials Characterization. A gamma exposure rate survey was conducted in each area on a regular grid and judgmental gamma measurements were collected in Pits 1 and 2 to characterize small non-economic piles located within the pits, using a Ludlum Model 19 μR meter. Following the gamma survey, surface and subsurface soil samples were collected from the ground surface, test pits and drill hole samples and analyzed for:

- Radiochemical parameters (uranium, gross alpha, Ra-226, thorium 230)
- Metals in leachate (13 metals, gross alpha, Ra-226, Ra-228)
- Agronomic properties

Over 300 gamma measurements were collected at the Site, including the main mine area (where the open pits are located) and the Western Shaft Area. Gamma measurements ranged from 5 to 800 μR/hr with a mean of 55 to 100 μR/hr, depending on the measurement method (i.e., shielded, or unshielded). The highest gamma measurements (145 to 600 μR/hr) came from the following areas:

- Pile 7 (east of Pit 1)
- Crusher Stockpile Area (northeast of Pit 1)
- West Disturbance Area (southeast of Pit 1)
- Mine Dump (underground area)
- Ore Storage Areas 1 and 2 (underground area)
- Ponds 1 and 4 (underground area)

- Shaft Access Road (underground area)

Gamma measurement (contact shielded) from the background area ranged from 5 to 13 μR/hr (mean 8 μR/hr). Gamma measurements from the borrow areas and the topsoil piles ranged from 4 to 13 μR/hr (mean 7 μR/hr). The Materials Characterization Report (MWH, 2007b) presents measurements from the background reference area and the borrow areas.

Approximately 100 surface and subsurface soil samples were collected for analysis. Results were as follows:

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

Background concentrations for Ra-226 and uranium ranged from non-detect to 3.4 pCi/g (mean 1.6 pCi/g) and from non-detect to 9.2 mg/kg (mean 3.8 mg/kg), respectively. The highest Ra-226 concentrations (52.2 to 611 pCi/g) came from the following areas:

- Piles 5, 6 and 7 (east of Pit 1)
- Mine Dump (underground area)
- Ore Storage Area 2 (underground area)
- Ponds 1 through 4 (underground area)
- Shaft Access Road (underground area)

The SPLP method was used to evaluate the relative potential for leaching of metals from the samples. The results of the analyses for the SPLP samples are included in the Materials Characterization Report (MWH, 2007b). Further description and interpretation of SPLP results is included in the Stage 1 Abatement plan (INTERA, 2006).

4.1.2 2018 Site Characterization

A Supplemental Radiological Characterization conducted in 2018 included areas within the approximate permit boundary that were excluded from the 2007 Materials Characterization. During the 2007 Materials Characterization, soils in the areas between the main mine site features (e.g., waste piles) were not characterized and a defined perimeter of the mine impacted soils was not determined. This 2018 supplemental Site characterization was performed to characterize surface materials between the waste piles and estimate the outer boundary (lateral extent) of the mine waste or affected areas.

The Supplemental Radiological Characterization was conducted in accordance with the Supplemental Investigations Work Plan (Stantec, 2018a). Results of the Supplemental Radiological Characterization are presented in the *Summary of Supplemental Materials Characterization* memorandum (Stantec, 2018b) and in the *Supplemental Radiologic Characterization Report* (AVM, 2018), which is Appendix B. The *Supplemental Radiologic Characterization Report* describes the field investigation methods and detailed results of the investigation (gamma survey measurements, subsurface sampling and analytical results, and a correlation between gamma radiation and Ra-226 concentrations).

The field investigation included static gamma radiologic survey measurements, ex-situ and in-situ gamma radiation soil screening, soil sampling and laboratory analysis. Direct gamma radiation level measurements were conducted using 2x2 NaI scintillation detectors (Eberline SPA-3 and Ludlum 44-10), paired with a Ludlum 2221 or 2241 scale/rate meter. Gamma measurements were collected along transects spaced 30 feet apart, with the detector held one foot above the ground surface. In addition, gamma measurements were collected in step-out areas (e.g., areas outside the approximate mine permit boundary) where gamma measurements exceeded the IL for Ra-226.

Based on gamma survey results, 24 locations with the highest Ra-226 levels were selected for subsurface sampling and analysis from test pits. Field personnel conducted ex-situ gamma radiation soil screening from the test pits and collected 44 soil samples for laboratory analysis of Ra-226 concentrations.

A Site-specific correlation was developed using regression analysis for the collimated and bare 2x2 NaI detectors to convert the detector gamma radiation levels (in counts per minute [cpm]) to surface soil Ra-226 concentration (in pCi/g). Fourteen correlation samples were sent to the laboratory for Ra-226 analysis.

The gamma radiation measurements in cpm were converted to Ra-226 concentrations (activity) in pCi/g using the Site-specific correlation. The 2007 Materials Characterization was conducted using exposure rate measurements, which were also converted to Ra-226 concentrations using the Site-specific correlation.

Results of the gamma survey indicated that surface soils with Ra-226 concentrations greater than the investigation level (IL) were generally located within the approximate mine permit boundary (see Figure 5 in Appendix B, Attachment A), except for the access road and other relatively small areas (less than 10 acres total) as described below. The access road extending to the north of the approximate mine permit boundary had consistently high gamma measurements (generally between 10 and 100 pCi/g) as far as approximately 2.2 miles along the road from the approximate mine permit boundary (see Figure 6 in Appendix B, Attachment A). The remaining areas where IL exceedances were measured outside the approximate mine permit boundary, as well as the approximate sizes of the affected areas, included:

- South of Shale Pile 1 (<0.1 acre)
- South of Pit 1 (0.5 acre)
- Around the Western Shaft Area and north of the Shaft Area Access Road (2 acres)
- North of Pit 1 near the Site entrance (7 acres)

The highest Ra-226 concentrations within the Site were measured in the central portion of the Site adjacent to the west side of Pile 6, within the Crusher/Stockpile area, and within Pile 7. Gamma radiation was measured above 100 pCi/g at numerous small waste piles in an area adjacent to Pile 6. The gamma radiation levels tended to decrease with increased distance from the piles and towards the permit boundaries. Ponds 1 through 4 in the Western Shaft Area had similarly elevated readings that were generally contained within the pond boundaries. Additionally, the arroyo (Meyer Draw) had readings of approximately 10 to 100 pCi/g in the deepest parts of the channel and readings of 6.6 to 10 pCi/g on the banks and adjacent areas.

4.1.3 2019 Pit 1 Piles Characterization

Following initial discussions around engineering design to stabilize the piles located within Pit 1, a radiological characterization was conducted on the Pit 1 infill piles in November 2019. The purpose of this investigation was to estimate the Ra-226 concentrations of the piles in Pit 1 to evaluate placement location for these materials. The characterization was performed by collecting soil samples from test pits and conducting onsite ex-situ gamma radiation soil screening and vendor laboratory analysis on the samples. The ex-situ gamma radiation field soil screening results for Ra-226 conformed with the vendor laboratory Ra-226 results. Ra-226 concentrations in the individual soil samples from the piles ranged from 7.5 pCi/g to 125.5 pCi/g. The average Ra-226 concentration in individual test pits ranged from 13.7 pCi/g to 103.5 pCi/g, and the average Ra-226 concentration in the piles ranged from 25.0 pCi/g to 77.2 pCi/g. Uranium concentrations in the individual samples sent to the vendor laboratory from the test pits ranged from 19 mg/kg to 130 mg/kg. The report for this investigation is Appendix B.

4.1.4 2022 Surface Characterization

A Supplemental Surface Radiological Characterization was initiated in May 2022 in the area south of Pit 1 and extending into the proposed West Borrow Area. This characterization is being performed to characterize the surficial materials and some observed mine materials located in an area beyond the approximate mine permit boundary to the south, near the Old St. Anthony Mine underground workings. The work area is outlined in green in Figure 4-1. The supplemental characterization and laboratory testing is estimated to be completed by December 2022. The results will be incorporated into the next phase of design.

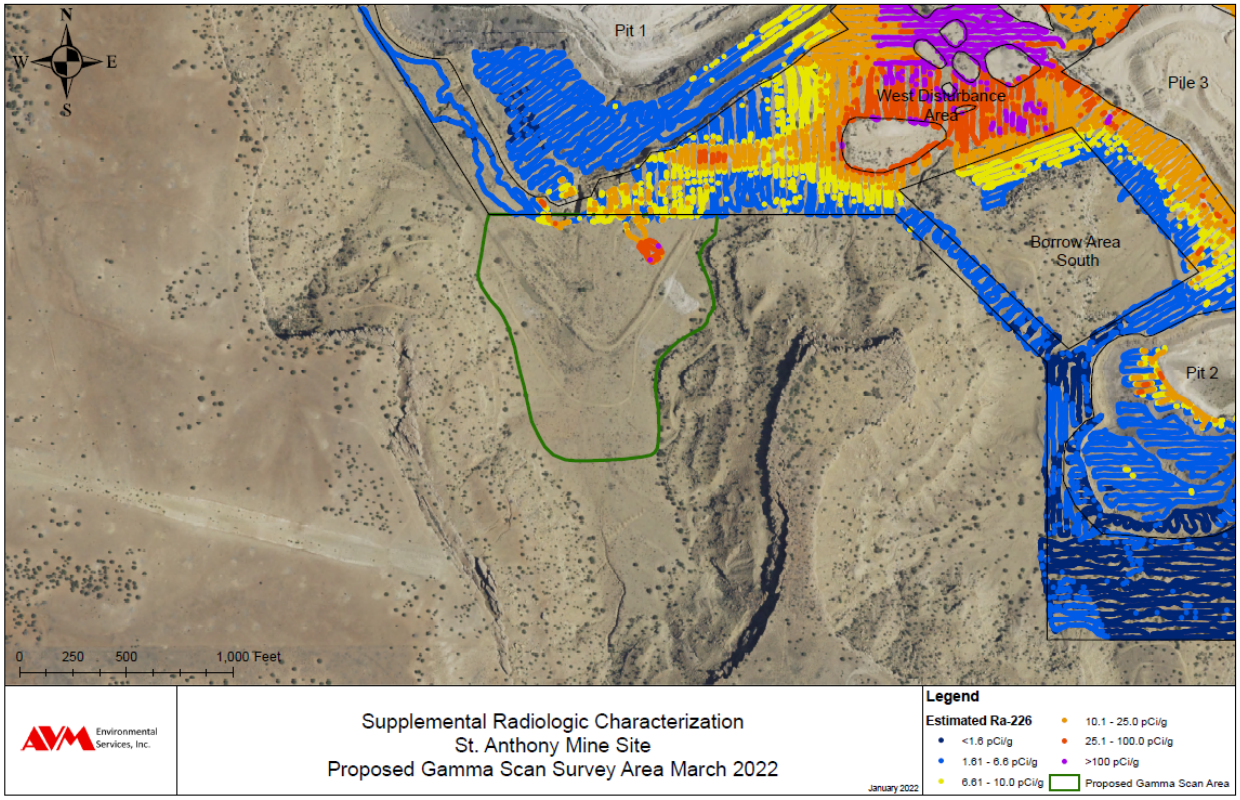

Figure 4-1. Proposed 2022 Characterization Area

The 2022 Supplemental Surface Radiological Characterization will be conducted in accordance with the Supplemental Investigations Work Plan (Stantec, 2018a). The field investigation will include static gamma radiologic survey measurements, ex-situ and in-situ gamma radiation soil screening, soil sampling and laboratory analysis. Direct gamma radiation level measurements will be conducted using 2x2 NaI scintillation detectors (Eberline SPA-3 and Ludlum 44-10), paired with a Ludlum 2221 or 2241 scale/rate meter. Gamma measurements will be collected along transects spaced 30 feet apart, with the detector held one foot above the ground surface. In addition, gamma measurements will be collected in step-out areas (e.g., areas outside the approximate mine permit boundary) where gamma measurements exceeded the IL for Ra-226. The gamma radiation measurements in cpm will be converted to Ra-226 concentrations (activity) in pCi/g using the Site-specific correlation.

4.2 GEOTECHNICAL INVESTIGATIONS

Geotechnical data was collected in 2018 to supplement the data set of material properties collected in 2007 from the waste piles. The 2018 boreholes were primarily focused on the existing piles and areas where data was not previously collected. In 2021 and early 2022, additional geotechnical drilling was completed around the Pit 1 highwall to collect soil and rock data to evaluate highwall stability. The drawings show the borehole and test pit locations from all three investigations.

4.2.1 2007 Investigation

From April 2006 to July 2007, MWH now Stantec conducted a geotechnical investigation as part of the materials characterization work to determine soil suitability for use as growth media, potential borrow and cover material, and radiological risk. Areas of focus for the investigation included borrow and stockpile sources, non-economic materials piles, and mine facilities in the western shaft area. A radiological survey was conducted prior to excavating test pits and drilling boreholes in the investigation areas. Geotechnical laboratory data collected included gradations and moisture contents of the soil samples. The *Materials Characterization Report Saint Anthony Mine Site* describes the methods and findings of the investigation and is included in Appendix B.

Radiological Survey Results

Gamma exposure rate measurements were collected by a certified Radiation Safety Officer (RSO) using a Ludlum Model 19 µR Meter. Survey measurements were taken in a grid pattern at each location. The survey procedure and results are included in the *Materials Characterization Report Saint Anthony Mine Site* (MWH, 2007b) document.

Analytical Testing Results - Soils

Lab testing for the field program focused on radiochemical properties, metals in leachate, and agronomic properties. A minimum of 2 samples were selected from each borehole and sent to Energy Laboratories, Inc. (ELI) in Casper, Wyoming. Details and results of the laboratory testing are included in the *Materials Characterization Report Saint Anthony Mine Site* (MWH, 2007b) document.

4.2.2 2018 Investigation

Stantec conducted a geotechnical investigation at the Site during March and April 2018 to collect subsurface information to characterize soil and rock in the piles and evaluate the suitability of potential borrow sources as cover materials. Field activities comprised drilling and soil sampling of select non-economic waste rock piles and potential borrow areas around the Site and included 51 boreholes advanced using the hollow-stem auger drilling technique. The *St. Anthony Mine Geotechnical Investigation 2018* memo (Appendix D) describes the methods and findings of the investigation.

Geotechnical Testing Results

Daniel B. Stephens & Associates (DB Stephens), a geotechnical testing laboratory in Albuquerque, NM, performed laboratory testing on samples collected during the geotechnical investigation. Tests included sieve analyses, hydrometer, Atterberg limits, moisture and density, standard Proctor compaction, and consolidated undrained triaxial shear. A summary of the sampling program, testing procedures, and results, as well as DB Stephens' complete laboratory testing report, are included with the memo in Appendix D.

Analytical Testing Results - Soils

ALS Environmental performed analytical testing on 17 bulk soil samples collected from boreholes in Shale Piles 1 and 2, Pile 4, and the Borrow West area during the geotechnical investigation. Samples were tested for Ra-226, Uranium, Thorium-230, and Gross-Alpha concentrations. Sample results were used in conjunction with analytical testing results from the 2007 field investigation (MWH, 2007b) to evaluate Ra-226 activity levels throughout the Site, including areas that were not sampled for analytical testing during the 2018 investigation. These results are also included with the geotechnical memo in Appendix D.

4.2.3 2020 Geotechnical Laboratory Testing

Stantec selected additional samples from those previously collected in the proposed borrow areas to be tested for evaluation of cover design parameters.

Geotechnical Testing Results

Daniel B. Stephens & Associates (DB Stephens), a geotechnical testing laboratory in Albuquerque, NM, performed laboratory testing on samples collected during the 2018 geotechnical investigation. Tests included gravimetric and volumetric water content, saturated hydraulic conductivity, soil water characteristic curves, and particle-size distribution with hydrometer.

4.2.4 2021-22 Highwall Investigation

From November 2021 to January 2022, Stantec conducted a geotechnical field investigation along the Pit 1 highwall to collect rock strength and joint data for stability analysis. Four boreholes were drilled at locations spread between the north, west and south highwalls. The boreholes were advanced using mud-rotary rock coring methods with continuous core samples collected and logged by Stantec personnel.

Geotechnical Testing Results

Stantec is in the process of completing this work and the results will be included in the final CCOP.

Analytical Testing Results

Stantec is in the process of completing this work and the results will be included in the final CCOP.

4.3 GROUNDWATER QUALITY CHARACTERIZATION

Groundwater quality monitoring was performed as part of the Stage I and Stage 2 Abatement investigations at the St. Anthony Mine and has continued to the present. The most recent site-specific groundwater quality monitoring data (2018-2022) for the Site has been collected as part of the ongoing groundwater monitoring associated with the abatement process.

5.0 POST-MINING LAND USE

5.1 AVAILABLE REGULATORY OPTIONS

Per the definitions in NMAC 19.10.1.7 (A), land use at the majority of the Site following closure is intended to be livestock grazing (agricultural) and/or wildlife habitat, similar to the land currently located around the approximate mine permit boundary area. Future use as an industrial facility is also being considered. A vegetation survey has been conducted in nearby areas by Cedar Creek Associates of Fort Collins, Colorado to determine the existing native species scribe plant communities and corresponding vegetation characteristics for undisturbed areas. The goal at closeout for grazing is to reclaim to a range condition of “good or better” by comparison to a vegetation reference area, by the time of bond release sampling, based on the definitions in the Revegetation Sections of the Mining Act Reclamation Program (MARP) (MMD, 1996). The post-mining land use design criteria are summarized in Table 5-1.

Table 5-1. Post-Mining Land Use Design Criteria

Design Element	Design Criteria	Design Guidance
Post-Mining Land Use	Post-mining land use is livestock grazing (agricultural)	MARP Closeout Plan Guidelines
	Post-mining land use is wildlife habitat for the pit walls	
	Post-mining land use may include industrial in, or near, Pit 1	

5.2 GRAZING AREAS

Following reclamation of the piles and pits, and the period of reestablishing native vegetation, the reclaimed site will be open to grazing of livestock. Following earthwork, the mine permit area will be fenced to exclude livestock for 12 years while the native plant communities reestablish. Due to the highwalls, limited access, and potential for future expressed water in Pit 1, grazing will not be the PMLU for Pit 1 and livestock will be excluded from the pit bottom.

5.3 WILDLIFE HABITAT

As described in Section 3.7.1, post-reclamation habitat is expected to consist of a variety of wildlife typical of the Arizona/New Mexico Plateau tablelands ecoregion. Signs of big game including mule deer, elk, and black bear were observed on the Site. Small mammals and herptiles were observed to be using rock piles associated with rim rock habitat. Small raptors (red-tailed hawks, sharp-shinned hawks, and prairie falcons) were observed flying over or foraging onsite, but no raptor nests were observed during the wildlife survey.

5.4 PIT WAIVER

Following reclamation, water is predicted to seasonally express within Pit 1 after several years. Avoiding water expression is not economically or technically feasible, and it would be environmentally unsound to attempt to do so (Stantec 2021b and INTERRA 2021). The reclaimed surface within Pit 1 is anticipated to support a SSE. However, the expressed water, may not be suitable for wildlife use, and engineering controls may be required to restrict access to the seasonal water. Consideration of whether such engineering controls are necessary and, if so, whether the engineering controls would require a pit waiver, will continue as the 30% CCOP advances to a final design. Before submitting a final closeout/closure plan, UNC will submit, consistent with NMAC 19.10.5.507.B, a request to MMD for a pit waiver for any portions of the Site where reclamation will not achieve a SSE or PMLU.

6.0 CLOSURE/CLOSEOUT PLAN OBJECTIVES AND TASKS

6.1 PLAN SUMMARY

The Reclamation Design includes regrading and covering several waste piles in-place (Piles 1, 2, 3, 4, 5, and Topsoil/Overburden). The Pit 1 infill piles will be moved to the bottom of Pit 1 and covered. The remaining waste piles and excavated areas outside of Pit 1 will be hauled and placed into Pit 2 and covered with soil. The Reclamation Design also includes sodium tripolyphosphate (STPP) stabilization of existing sediments in Pit 1; Pit 1 highwall stabilization; fencing and signage; revegetation; and stormwater controls. Drawings 8 through 12 show the proposed grading plans for the piles and pits. These drawings are preliminary and subject to change.

6.2 EXCAVATION AND PLACEMENT

The objective of the excavation and placement plan is to combine select waste piles and other mine-impacted materials within the two open pits and stabilize materials that are to remain in-place. Appendix E includes a material balance summary and calculations that describe sources of the existing material volumes onsite and links these volumes to the placement locations in one of the two open pits. The existing power lines along the approximate northern mine permit boundary are operating and will either be relocated prior to regrading of Pile 4 by the utility company or the grading plan will be adjusted in this area to place fill to the north of these lines and avoid them.

Due to the presence of potentially harmful gases encountered during drilling in 2018 (see Appendix D for details), Stantec recommends additional safety precautions during future earthwork at the Site. Prior to the start of construction, the Site Health and Safety Plans will be revised to include a personnel air monitoring plan in the immediate work area. The Contractor will also be required to develop a Hot Work Plan to ensure safe construction operations in the presence of accumulated gases, and an Emergency Plan detailing actions to be taken if air monitoring indicates hazardous conditions exist. Furthermore, before work begins, construction workers will receive awareness training on the types of gases that may be encountered during excavation activities. Special considerations during construction may include the use of personal H_2S detectors by personnel near the earthwork, as well as the use of a 4-gas meter to routinely monitor the work areas for elevated gas concentrations, and to determine whether implementation of the Emergency Plan is needed. Additional personal protective equipment (PPE) and/or engineering controls may be required under certain circumstances and conditions should be reevaluated prior to the start of earthwork.

6.2.1 Surface Soil Action Level (SAL)

The proposed reclamation approach for the Site includes excavation and consolidation of soil exceeding the Ra-226 Soil Action Level (SAL). The SAL for excavation and consolidation of soil at the Site is 6.6 pCi/g for radium 226 (Ra-226) which is based on 5.0 pCi/g Ra-226 plus the 1.6 pCi/g Ra-226 Site background area concentration level as determined by the 2007 Materials Characterization (MWH, 2007b), as described in Section 4.2 and Appendix B. The soil excavation and reclamation Design Criteria are summarized in Table 6-1.

Table 6-1. Excavation and Soil Action Level Design Criteria

Design Element	Design Criteria	Design Guidance
Soil Action Criteria	The concentration of Ra-226 in land averaged over any area of 100 square meters shall not exceed the background level by more than • 5 pCi/g, averaged over the first 15 cm of soil below the surface, and • 15 pCi/g, average over 15 cm thick layers of soil more than 15 cm below the surface	Joint Guidance for the Cleanup and Reclamation of Existing Uranium Mining Operations in NM

6.2.2 Verification

Soil exceeding the 6.6 pCi/g SAL (including the areas discussed in Section 4.1.2) will be excavated, hauled, and placed onsite in Pit 2 or regraded in-place and covered. Excavation control will be performed to support soil excavation. The Site characterization identified an approximate area of 360 acres where soils exceeding the SAL are present, including mine features such as waste ore piles and roads. The assessed lateral and vertical extent of soil excavation exceeding the SAL over an area of approximately 225 acres is shown on Drawings 5 and 6. The additional estimated 135 acres of area with soil exceeding the SAL are primarily within Pile 4, Pile 5, and the Topsoil/Overburden pile. These piles will be regraded into one large pile, stabilized, and covered in place.

An Excavation Control Plan is provided as Appendix C.1 to support the excavation and consolidation of soils that exceed the SAL. Upon completion of the soil excavation and placement, a Verification Survey will be performed in the excavated areas to confirm the SAL has been met. A Verification Plan is provided as Appendix C.2. Standard Operating Procedures (SOPs) for implementing the Excavation Control and Verification Plans are provided in the appendices to those documents.

6.2.3 Excavation Volumes

Material will be excavated from the waste storage piles and other mine-impacted facilities at the Site prior to placement in Pit 2. Material transport from the excavation areas to the pits is expected to occur along the proposed haul routes using trucks. Loose rock and soils on the Pit 1 benches are planned to be scraped from the Pit 1 walls and benches in select areas to provide a safe work zone for earthwork in the pit bottom. This material will be temporarily stockpiled in the pit bottom for use in the cover. The Pit 1 infill waste piles, on the north, south, and east sides, and within Pit 1, will be excavated and placed in the bottom of Pit 1 in compacted lifts. Material from stabilization of the Pit 1 highwalls and benches will be placed as engineered fill above the Pit 1 waste in the pit bottom prior to placement of soil cover. No material will be transported from Pit 1 to other Site facilities.

The on-site ex-situ soil screening results, laboratory analytical results, and observations made in the 2018 test pits (see Section 4.1.2), were used to estimate the depths of SAL exceedances. These depth estimates were used to interpolate the depth of SAL exceedances for the remainder of the Site. The maximum depths of SAL exceedances were 5.0 ft to greater than 6.5 ft (the maximum excavation depth of the test pits) below ground surface (bgs) in the following areas (see Figure 3 of Appendix B, Attachment A):

- Greater than 6.5 ft bgs between Pile 3 and Pit 2 at Test Pit 24 (note: this test pit was excavated to a final depth of 6.5 ft without encountering the maximum depth of SAL exceedance)
- 6 ft bgs near Borrow Area South at Test Pit 23
- 5 ft bgs west of the Crusher/Stockpile Area at Test Pits 4 and 5
- 5 to 6 ft bgs between Pit 1 and Pile 6 at Test Pits 11 and 13

The lateral extent (limits of excavation) and depths of SAL exceedances (excavation depths) are shown on Drawings 5 and 6. The Site excavation surface was interpolated from these depths and the estimated lateral extents.

Stantec used the ground surface elevations, the lateral extent (outer boundary) of Ra-226 above the SAL, the depths of SAL exceedances (including the mine features characterized in 2007) and the interpolated depths in other areas of the Site to estimate the volume of mine waste with Ra-226 concentrations above the SAL (6.6 pCi/g). There is a total estimated volume of 1.98 million cubic yards (cy) of mine-impacted material (including approximately 645,000 cy of surface excavation material from intermediate areas between the mine features) to be moved to Pit 2, and approximately 21.5 million cy to be regraded in-place.

Material within Meyer Draw and along Pile 4 that exceeds the SAL will be addressed as shown on Drawing 5. Impacted material in, and along, the arroyo will be excavated, placed, and compacted in Pit 2 with other excavated impacted surface materials prior to conducting pile regrading and channel stabilization measures. The volume of impacted material to be excavated from the arroyo is included in the estimated 645,000 cy of surface excavation.

Waste pile volumes were estimated by comparing the existing (Cooper, 2011) and pre-mining (Archuleta et al., 2017) ground surface topographies, with the exception of the surface excavation volume which was estimated using the methods described above. Excavations for all facilities will extend to non-impacted ground (i.e., soil less than the SAL) such that the existing material at the facilities that exceeds the SAL is removed and stabilized, and the new, exposed ground surface may be directly revegetated.

Approximately 1.98 million cy of mine-impacted waste material from the piles and intermediate areas will be excavated and transported to Pit 2. Table 6-2 lists individual volumes for each facility. The material to be placed in the bottom of Pit 1 includes approximately 528,000 cy of material currently located within Pit 1 plus approximately 200,000 cy of material from the highwall excavation, which will be confirmed following completion of the highwall investigation. Stantec performed volume reduction calculations to account for the compaction of excavated material within the pits (see Appendix E).

A negligible amount (less than 500 cy) of concrete debris, mainly from the remains of structural foundations, is present in the Shaft Pad area. This material will be disposed in Pit 2 and buried with the soil and rock being placed there.

Table 6-2. Earthwork Volumes

Facility	Estimated Volumes (cy)	Destination
Pile 1	925,912	Regrade in-place
Pile 2	761,907	Regrade in-place
Pile 3	2,080,033	Regrade in-place
Pile 4	16,559,844	Regrade in-place
Topsoil/Overburden	661,286	Regrade in-place (Pile 4)
Pile 5	633,214	Regrade in-place (Pile 4)
Pile 6	254,375	Pit 2
Pile 7	87,086	Pit 2
South Topsoil	368,502	Pit 2
Surface Excavation	645,000	Pit 2
West Disturbance Area	83,575	Pit 2
Crusher Stockpile	573,847	Pit 2
Access Road	26,401	Pit 2
Mine Dump	37,658	Pit 2
Ore Storage 1	16,087	Pit 2
Ore Storage 2	12,943	Pit 2
Highwall Loose Materials	100,000 (estimated)	Pit 1
Pit 1 Infill Piles	527,600	Pit 1

6.2.4 Pit Backfill Volumes

Pits 1 and 2 will be partially backfilled using the materials and fill sequencing described in the following sections. Pit 1 will be partially backfilled with the infill waste piles within Pit 1 and the material to be excavated from the highwall benches or scraped from the face of the walls, whereas Pit 2 will be filled primarily with the waste materials in the existing stockpiles on Site. The materials to backfill Pit 2 will come from the soil excavation and site excavation as well as existing materials in the waste piles. The sum volume (compacted) of the materials listed in Table 6-2 as destined for Pit 2 is less than the total backfill volume required to reach the design grading surface shown in the drawings. There is an available contingency volume of approximately 41,000 cy for additional waste backfill in the pit. Table 6-3 lists the estimated backfill volumes for the two pits. These volumes comprise compacted waste materials only and do not include the final borrow cover volume to be placed atop each pit backfill. Note that the Pit 2 volume represents the full waste backfill volume required to attain the design waste elevation to facilitate cover construction for surface water management, and thus includes the 41,000-cy contingency volume. Cover design is described in Section 6.6.

Table 6-3. Pit Backfill Volumes

Facility	Estimated Waste Backfill Volume (cy)
Pit 1	649,478
Pit 2	1,980,754

6.2.5 Pit 2 Backfill Design

Pit 2 will be backfilled to a minimum elevation of approximately 6038 ft for surface water drainage to the southeast; on the regraded pit cover surface from the pit and back to Meyer Draw. The regraded waste surface will slope to the south and east at approximately 1.5 percent. The material to be backfilled in Pit 2 includes, listed in “bottom up” order: material from Ore Storage 1 and 2; Pile 7; Pile 6; Shaft Area Access Road; Mine Dump area: Crusher Stockpile; West Disturbance Area; and excavated impacted surface soil throughout the Site. The waste profile for the backfilled Pit 2 is shown in Figure 6-1. Final sequencing will be determined at the time of construction.

The cover materials will consist of material from the South Topsoil pile and West Borrow area and the soil cover (described in Section 6.6) will be graded to a slope of approximately 1.5 percent across the full area of the pit to mitigate erosion due to surface runoff. The western highwall and southwestern corner of the pit will be left undisturbed, as these areas were found to contain no mine-impacted materials (see Appendix B) and are not expected to be areas of concern with regard to slope stability once the pit is backfilled.

An area of approximately 30 feet (vertically) on the northwestern Pit 2 highwall will remain exposed after the pit is backfilled. The area west of the northwest highwall generally slopes to the north, carrying surface runoff away from the open pit and toward the northeast. The proposed Pit 2 diversion channel is expected to reduce flow back to the final cover by diverting run on (which would otherwise flow into the pit) along the southwestern and southern edges of the pit. Erosion protection for the cover below the remaining highwall will be added as part of the final design. Protection measures will prevent erosion of the Pit 2 cover associated with concentrated runon from the limited catchment area.

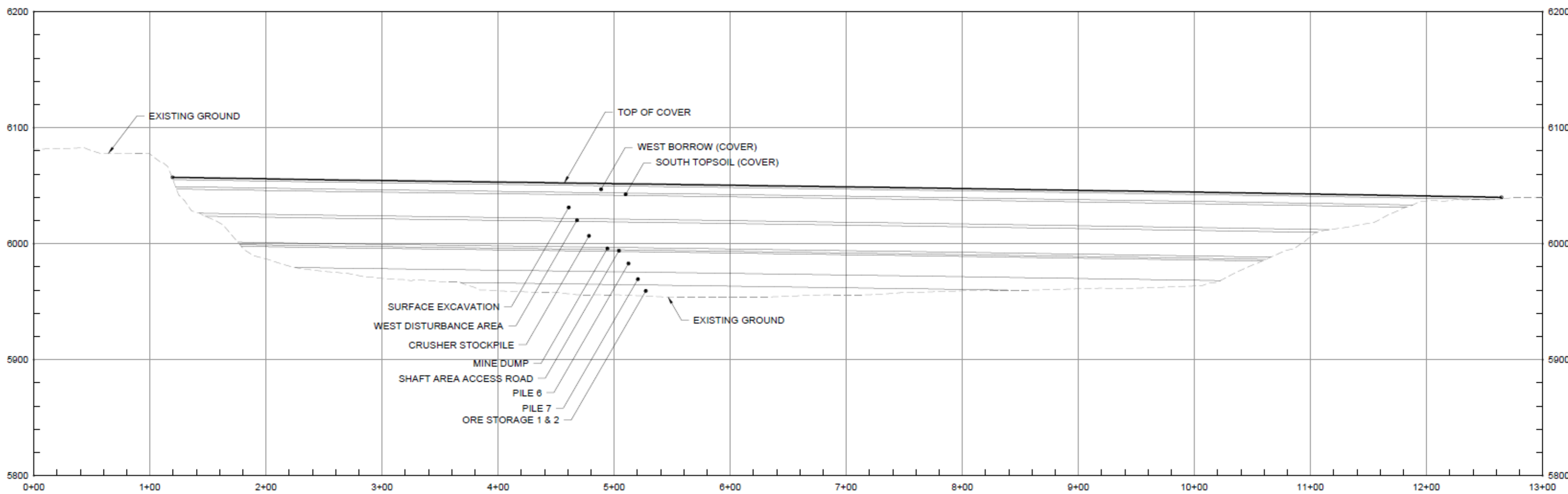

Figure 6-1. Pit 2 Backfill Profile

6.3 PIT 1 DESIGN

The design for long-term stabilization of Pit 1 includes components to maintain the hydraulic sink in the pit and prevent impacts to local groundwater, stabilize the existing waste piles in the pit and cover the waste with a revegetated cover that will enhance evapotranspiration, remove loose materials from the highwall and benches for safety and stability, and manage surface water in and around the pit to prevent erosion. Engineering controls, such as barriers or fencing and signage, are anticipated to restrict ungulate and human access to the pit bottom. The specific nature and location of the engineering controls will be refined in the final design but are anticipated to limit access down the ramps into the pit.

6.3.1 Performance Objectives and Design Criteria

The proposed closure design for Pit 1 is intended to achieve the following hydrologic and geotechnical objectives:

1. Maintain the pit's long-term capture of local groundwater (act as a hydraulic sink) through strategic design of the pit backfill so that groundwater daylights into the pit (if at all) and does not flow out of the area of expression.
2. Increase transpiration of surface water from the pit bottom, through re-vegetation on a cover system that is erosionally stable long-term.
3. Reduce surface water runon to the pit from the watershed surrounding the pit.
4. Modify the Pit 1 highwall to an erosionally and structurally stable configuration.
5. Address potential rockfall hazard for workers in the pit.

The closure design will maintain the pit's long-term behavior as a hydraulic sink, which prevents groundwater and solutes from leaving the pit. Pit 1 will continue to act as a hydraulic sink for groundwater by maintaining a backfill elevation as far below the existing ground surface as possible, while still addressing applicable waste and stability needs concerning the pit. The existing waste piles within the pit are currently exposed to meteoric water and wind and subject to erosion. In addition, erosion and rockfall from the highwalls occurs. After implementation of the proposed closure design, the seasonal expression of pit water is expected to be significantly reduced in both extent and duration compared with current conditions. Establishing the proposed vegetation communities on the pit cover material will increase transpiration from the cover surface. Surface water runon into the pit will be significantly reduced by the construction of diversion channels that will intercept and divert rainfall-driven flows from the catchment area surrounding the pit. Seasonal variations in the expression of pit water and associated extents are expected to occur; however, under the proposed design, the pit is anticipated to be dry during certain periods such as during fall and summer months. Table 6-4 is a summary of the Pit 1 Highwall design criteria.

Table 6-4. Pit 1 Highwall Design Criteria

Design Element	Design Criteria	Design Guidance
Highwall - Global Stability	• Seismic annual exceedance probability (AEP) of $1x10^{-4}$ • Factor of safety (FoS) of 1.3 for long-term static conditions • FoS of 1.1 for pseudo-static conditions	Selection based on similar mine closure projects throughout the Western US
Highwall - Rockfall	• Minimize rockfall hazards for safety during remediation work • Minimize rockfall impacts on slope erosion for long-term stability	N/A

6.3.2 Design

The current condition of the Pit 1 highwalls includes loose rock and eroded soils and rock that have accumulated on the benches. In order to protect workers during reclamation, some initial work will be required to remove boulders, clear select areas on the existing benches, and create a rockfall zone below the high walls in the bottom of the pit. Material excavated during this stabilization process from the highwall will be stockpiled for placement as a bridging lift over the ponded water areas in the bottom.

Following removal of loose materials from the Pit 1 highwalls, STPP stabilization of the existing pond water and sediments will be initiated. Based on the success of the St. Anthony field pilot test using STPP to sequester uranium and radium, UNC and its consultants are planning a full-scale application of STPP to the pit water area prior to backfilling the pit bottom. Following STPP application, materials removed from the highwalls will be placed to bridge the remaining wet areas in the pit bottom to establish a working surface for the equipment. This material is expected to serve as bridging layer for the Contractor to be able to place additional fill material over the STPP treated water areas. In some areas, the thickness of the initial lift will be increased to establish a stable working platform for additional fill. Any remaining volume of material from the highwall, after establishment of the working surface, will be placed on top of the waste from the infill piles.

The material in the Pit 1 infill piles, currently within Pit 1, will then be excavated and placed at the bottom. These piles consist of about 527,000 CY of mine waste in three separate piles on benches above the pit bottom. Ra-226 concentrations of test pit soil samples collected from the piles during the 2019 characterization ranged from 7.5 pCi/g to 125.5 pCi/g. Once moved, placed, and compacted in the pit, the layer of mine waste from these piles will be up to approximately 18 feet thick.

A soil cover with a minimum thickness of 2 feet will be placed on top of the infill and highwall materials for revegetation. Soil will be excavated from the Topsoil North pile and the West Borrow area to be used as cover soil for Pit 1. The grading plan for the Pit 1 cover will optimize evaporation and transpiration with a shallow stormwater basin located in the center of the cover to collect surface water flow and facilitate evaporation.

6.3.3 Pit 1 Highwall Stabilization

The top of the highwall in Pit 1 ranges in elevation from 6050 to 6140 feet. The existing slope of the highwall ranges from approximately 1/3:1 to 2/3:1 for the area above the elevation of 6000 feet. There is an existing bench in the wall at about 5980 feet elevation. The proposed design would include removal of loose rock and materials from the walls and benches within the Dakota formation from the top of the wall on the west side of the pit and working downward. Since the material on the face shows signs of erosion, weathering, and cracking; removal of loose material from the highwall face will help to alleviate the potential safety risks to workers during earthwork in the pit bottom. Slope stability for long-term stability and rockfall runout is currently being evaluated using the data being collected from the 2021-22 Geotechnical Investigation and the design will be further developed based on results of the slope stability and runout analyses. Stantec anticipates that a fall zone and rockfall berm will be included in the final design to limit rockfall hazard. Figure 6-2 shows a portion of the planned design for the Pit 1 highwall.

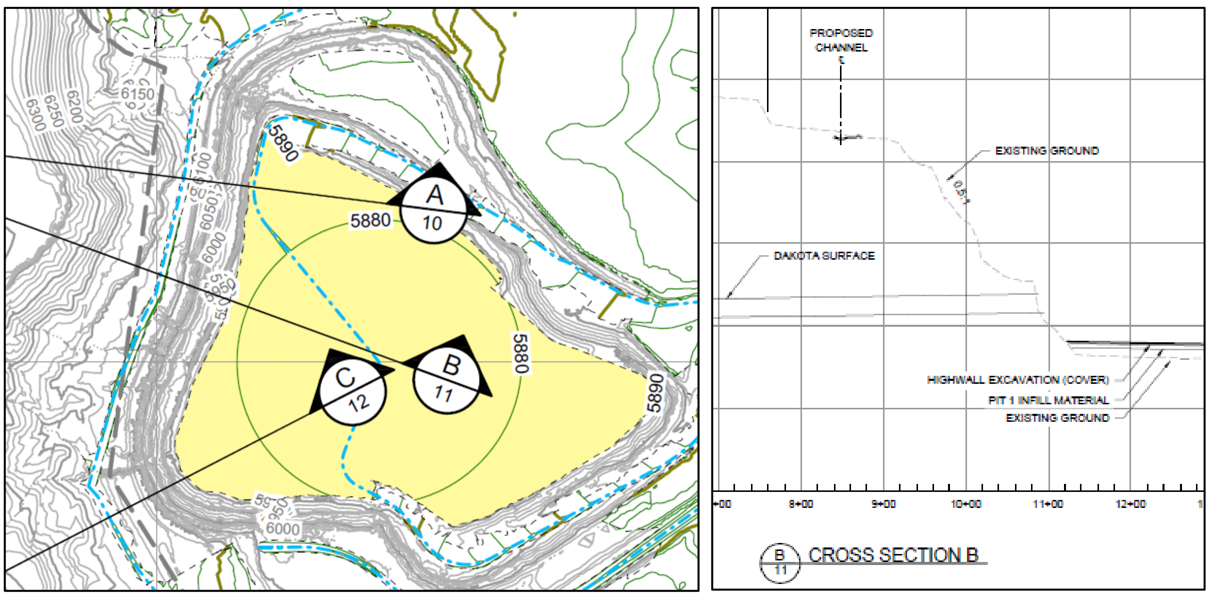

Figure 6-2. Pit 1 Highwall Excavation and Stabilization

A geotechnical assessment of the existing conditions of the highwall is being conducted to gain an understanding of the highwall integrity and potential triggers for instability. Data gaps have been identified to complete this work and Stantec is addressing these data gaps by conducting a two-phase study.

In 2020 and 2021 Stantec completed a background study with a field reconnaissance study and survey, followed by data processing and analysis in support of a future geotechnical design for the mine pit highwalls. The desktop study included review of the available geotechnical information including drill hole, well log, and test pit data, and aerial imagery to identify site specific and regional drivers of instability. The field study included a Site visit by a Stantec geologist and a geotechnical engineer to complete a geological field map of the slopes along with high-resolution survey, digital photogrammetry, and LiDAR of the highwall. The geotechnical mapping and photogrammetry survey data was processed and analyzed using ShapeMetrixUAV software to generate a three-dimensional image of the rock slopes. Stantec used the structural data to assess the rock mass and complete a kinematic analysis to identify potential failure modes and perform a preliminary slope stability analysis (Stantec, 2021a).

Based on the preliminary findings, a geomechanical/geotechnical drilling program was developed to collect samples of the rock profile for visual classification and to test samples in the laboratory for mechanical strength properties, to be used to complete stability modeling of the highwalls. This program was initiated in November 2021 and includes four boreholes along Pit 1 to depths of between 250 and 300 feet. Borehole locations are shown on Drawing 4. Two of the holes are angled holes and two are vertical. Downhole geophysics is also being performed that includes dilatometer strength testing of the weak Mancos shales and televiewer to evaluate fractures.

Design options for variation on the reclamation of the Pit 1 highwalls will be developed using an approach focused on short- and long-term safety and stability as it pertains to the construction process during closure and the PMLU.

6.3.4 Slope Stability

The Pit 1 highwall, will be evaluated for slope stability against a static long-term factor of safety equal to or greater than 1.3 and a pseudo-static factor of safety equal to or greater than 1.1. Strength and fracture data obtained for the highwall rock mass from site geotechnical investigations and laboratory testing will be used to model stability of the existing walls along a series of cross-sections to estimate factors of safety for the current and proposed configurations. Limit equilibrium models will be developed to calculate factors of safety for stability of the highwall cross-sections.

6.3.5 Rockfall Mitigation

[to be included in final design]

6.3.6 STPP Application for COC Stabilization

As described in the STPP pilot test memo (INTERA, 2020), application of STPP to the Pit 1 water for stabilization of the constituents of concern (COCs), uranium and radium, was found to be very effective through prior bench scale studies. STPP is a soluble, slow-release source of phosphate. The STPP hydrolyzes (reacts with pit water and groundwater) at a rate determined by pH and temperature and breaks apart to form individual phosphate molecules. These phosphate molecules can react with calcium to form apatite minerals including uranium-bearing autunite-like minerals. The STPP pilot test memo (INTERA, 2020) describes this process and the results of the bench scale studies in detail.

STPP was used in a field pilot test to evaluate its effectiveness for immobilizing uranium and radium in the Pit 1 water. In April 2019, a hydraulic barrier was constructed with Site materials to separate the current expressed water into two regions. One region was treated with STPP and the other region was maintained as a control. After four months, uranium decreased by 83 percent and $^{226}Ra + ^{228}Ra$ decreased by 77 percent in the treated region. All other constituents in the treated region remained below the AAS. Several constituent concentrations, including uranium, increased in the untreated region. This is likely the result of evapo-concentration over the spring and summer period of the pilot test. At the time the last sample was taken in the untreated region, uranium was the only constituent that exceeded its AAS.

Based on the success of the St. Anthony field pilot test utilizing STPP to sequester uranium and radium, UNC and its consultants are planning a full-scale application of STPP to the pit water area. The full-scale design will be presented in a subsequent design submittal.

6.4 REGRADED WASTE PILES

Several of the existing waste piles will be recontoured in place. The existing volume of material in Pile 4, the largest pile onsite, will be combined with Pile 5 and the Topsoil/Overburden pile, also located along the east side of the Meyer Draw. To avoid the easement associated with the power lines, some of this volume will be regraded on the north side of the utility corridor. Additionally, Piles 1 and 2 (shale piles) and Pile 3, located near Pit 2, will be regraded and stabilized in place, prior to being covered.

6.4.1 Performance Objectives and Design Criteria

Table 6-5 summarizes the design criteria being applied to regrading of site waste piles in place. The primary objective is to achieve erosionally stable slope grades and lengths; further design criteria for the completed waste piles with covers are in Section 6.6. The surface regarding design criteria are included in Table 6-5.

Table 6-5. Surface Regrading Design Criteria

Design Element	Design Criteria	Design Guidance
Surface Re-grading	• Stable configuration that minimizes ponding and promotes conveyance of surface water • Slopes to be revegetated should be graded to no steeper than 3H:1V • Erosional stability for design slope lengths	MARP Closeout Plan Guidelines

6.4.2 Grading

The Reclamation Design includes regrading and covering several piles in-place. The largest pile on site (Pile 4) will be regraded into a new, covered pile that also comprises regraded material from Pile 5 and Topsoil/Overburden within a merged footprint. The regraded Pile 4, Pile 5, and Topsoil/Overburden material will be contoured to stable slopes in between Meyer Draw and Arroyo del Valle. The proposed plan for Pile 4 is to push the material to the borders of Meyer Draw and Arroyo del Valle (with a 50-foot buffer) and grade the side slopes to a design grade of between 20 percent (5H:1V) and 25 percent (4H:1V) with a 2 percent top slope. The existing powerlines on the northern edge of the approximate mine boundary of the site create a restriction for regrading Pile 4 to the north. Continental Divide Electric Cooperative (CDEC) requests a 20-foot circumferential buffer area around each power pole (i.e., 10-feet in each direction). The grading limits of Pile 4 were kept to 10 feet south of the powerlines to avoid the power poles. A portion of material from the Pile 4 regrade will be excavated and relocated to a small pile north of the existing topsoil/overburden pile and beyond the power lines in order to accommodate CDEC's request for the buffer area around the power lines. The pile slopes will be broken by benches to capture and convey rainfall runoff from the interbench slopes to minimize erosion potential. The maximum length of the interbench slopes on Pile 4 will be 400 feet.

Piles 1, 2, and 3 will also be regraded in-place. The side slopes of the piles will be graded to a maximum design grade of 33 percent (3H:1V). Pile slopes adjacent to Meyer Draw will be the most steeply graded (approximately 3H:1V), whereas slopes on the opposite sides of the piles (i.e., facing Pit 2 and away from Meyer Draw) will be graded to shallower slopes as low as 5.2 percent for Piles 1 and 2 and 16 percent (6.3H:1V) for Pile 3. The maximum length of the slopes for the regraded configuration of Piles 1 and 2 will be 320 feet. The maximum slope length on the regraded Pile 3 is 390 feet. The Pit 2 diversion channel runs between Piles 1 and 2. A summary of the design slope grades and lengths is included in Table 6-6. Following completion of grading, the waste piles will be covered for long-term stabilization as described in Section 6.6.

Table 6-6. Summary of Regraded Waste Pile Slopes

Pile	Slopes Range (min to max)	Maximum Slope Lengths (feet)
1 and 2	20H:1V to 3H:1V	320
3	6.3H:1V to 3H:1V	390
4	50H:1V to 4H:1V	400

6.4.3 Slope Stability

The regraded and covered waste piles will be evaluated for slope stability and designed for a static long-term factor of safety equal to or greater than 1.3 and a pseudo-static factor of safety equal to or greater than 1.1. Laboratory strength testing has been performed on samples collected from the borrow soils to obtain shear strength parameters for the potential cover materials. These parameters will then be used during the final design to model stability of the post-closeout configuration of the covered piles.

6.5 SURFACE WATER HYDROLOGY

The design includes a series of surface water channels to direct upstream runon around each of the two pits and to Meyer Draw. Stormwater management structures have been designed to manage stormwater from the bench in Pit 1 and along the haul ramps in Pit 1. Additionally, the hydrologic design includes the arroyo stabilization measures for Meyer Draw.

6.5.1 Performance Objectives and Design Criteria

Table 6-7 summarizes the design criteria being applied to surface water design and management for the Site. These criteria for surface water are being applied to channel design, arroyo stabilization, and erosion protection designs for the Site features.

Table 6-7. Hydrology Design Criteria

Design Element	Design Criteria	Design Guidance
Design Storm Event	• 100-year return interval • 24-hour storm duration based on maximum peak flow generated by the 100-year storm event	Selection based on similar mine closure projects throughout the Western US (Also, NMDOT for channel design and Albuquerque Dev. Process Manual for Site Development, Stormwater)

6.5.2 Design Discharge

For hydrologic evaluations, Stantec developed hydrologic models to predict flows at various points of interest around the project Site for existing and proposed conditions. Modeling was completed using United States Army Corps of Engineers (USACE) Hydrologic Engineering Center's – Hydrologic Modeling System (HEC-HMS) version 4.2.1, build 28.

Stormwater conveyance facilities proposed in this plan were designed using the peak discharge rates with an estimated 1 percent annual occurrence probability (1 in 100-year storm). The study also evaluated the 2-year, 5-year and 10-year storm events under existing Site conditions. The peak discharge at each point of interest on the project Site was determined by simulating runoff hydrographs using a center peaking rainfall distribution that included the peak rainfall intensities for time intervals between 5-minutes and 24 hours.

The stormwater models considered rainfall losses from depression storage and infiltration. The hydrologic model used constant depression storage values consistent with values recommended for regional watersheds. Losses due to infiltration were computed using the Green and Ampt (1911) method which provides physically based estimates of losses during different storm intensities and storm durations. Appendix F contains further discussion and justification of the methods and assumptions used to develop the peak flow rates used for design of stormwater conveyance facilities.

6.5.3 Native Arroyo

Meyer Draw is located between several mine waste rock piles and channel stabilization measures have been designed to prevent long-term downcutting erosion in the arroyo. Stantec believes that the arroyo through the Site is vertically unstable and future channel downcutting is predicted to occur if preventative measures are not taken. Deeply incised drainages with unstable sides are common features of natural arroyos in the Site vicinity. Highly erodible, native soils in the drainage bottoms are susceptible to continued channel downcutting due to frequent, intense flooding that is characteristic of western arroyos.

The proposed arroyo improvements are designed to mitigate erosion and destabilization (e.g., undercutting and slope oversteepening) of the re-graded and covered waste piles that will remain more than 50 feet from the centerline of the arroyo. Stabilization measures will prevent continued arroyo downcutting that would compromise the slope stability and soil cover integrity of the adjacent waste pile slopes. The stabilization strategy is to re-establish a "quasi-equilibrium" condition in the arroyo; that is, a condition in which the arroyo reach through the Site can transport flows without substantial loss or accumulation of sediments from long-term scour or sediment deposition, respectively. This condition is achieved by mirroring local, native cross-sectional channel dimensions and profile gradients so that the design reach will effectively convey sediment loads transported to the project area without disrupting the natural channel functions in the upstream and downstream reaches.

The proposed design includes construction of eight drop structures that will lower the channel thalweg, or the line connecting the lowest point of elevation along each cross section of the arroyo, by 3 feet each. The drop structures are designed to resist vertical and lateral channel migration and will be constructed using roller compacted concrete that is designed to be stable during a 100-year flood event and to resist erosive forces. The arroyo banks will be lined with riprap between the drop structures where regraded waste pile materials are adjacent to the arroyo. The channel alignments and sections are illustrated in the Closeout Plan Drainage Design Drawings and further discussion of methods used in, and justification of, the channel designs is provided in Appendix F.

6.5.4 Pile 4 Bench Channels and Downdrain

The proposed closure plan for Pile 4 is to spread the pile material to the borders of Meyer Draw and the East Tributary arroyo that flanks the southwest and eastern edges of the pile. From the arroyo edges, the pile will be sloped at a design grade of approximately 23.3 percent (4.3H:1V). The pile slopes will be broken by benches that capture and convey rainfall runoff from the Pile interbench slopes. The maximum length of the interbench slopes will be 400 feet. Stormwater conveyance channels constructed on the regraded benches will extend from the North face of the pile at approximately 2 percent grade toward an armored downdrain channel at the Southern end of the pile. The downdrain channel will convey flow at a slope that decreases from approximately 14 percent at the upstream portion to approximately 5 percent at the downstream portion. The bench and downdrain channels will be armored to resist channel degradation with riprap. The downdrain will convey non-contact, meteoric flows off the regraded pile and will discharge near the confluence of the Meyer Draw and East Tributary arroyos. The channel alignments and sections are illustrated in the Closeout Plan Drainage Design Drawings and further discussion of methods used and justification of the channel designs is provided in Appendix F. Table 6-8 includes a summary of the channel dimensions and riprap sizing for the Pile 4 channels.

Table 6-8. Pile 4 Channel Design Summary

Channel	Dimensions*		Median (D_{50}) Riprap Size (inches)
	Bottom Width (ft)	Channel Depth (ft)	
Pile 4 Bench Channels	4	2	3
Pile 4 Downdrain Channel	10	2	6
Pile 4 North Channel	5	2.5	6

*channels have 3:1 sideslopes

6.5.5 Diversion Channels

Upstream diversion channels have been designed to capture surface runon water to minimize drainage flowing into Pit 1, and to capture and convey drainage around the proposed, covered waste rock material. The diversion channels utilize a combination of trapezoidal channels and flow diversion berms. The diversions will direct flow of meteoric water (originating from the catchment area surrounding the pit) around the pit areas and into the Meyer Draw channel. Median riprap diameters ranging in size between 3 inches and 12 inches will be installed to prevent scour/erosion along the diversion channel alignment.

Within Pit 1, drainage channels will be incorporated into the access ramps. The channels will be located on the outside edge of each ramp (where the ramp meets the pit wall above) and the ramps will be cross-sloped at a 3 percent grade for surface water to drain into the channel. At the bottom of the ramps, the channels will continue to the center of the covered Pit 1 area and converge at a riprap-lined dissipation structure designed to mitigate erosion of the cover material. The bench area on the north side of Pit 1 will also be graded to drain into the Pit 1 Ramp Channel North. Water collected on the bench will be conveyed in a controlled manner to the bottom of the pit. These details are not currently provided on the design drawings and will be added to a subsequent submittal after completion of the highwall study.

The channel alignments and sections are illustrated in the Closeout Plan Design Drawings and further discussion of methods used in, and justification of, the channel designs is provided in Appendix F. Table 6-9 includes a summary of the channel dimensions and riprap sizing for the Site diversion channels.

Table 6-9. Diversion Channels Design Summary

Channel	Dimensions*		Median (D_{50}) Riprap Size (inches)
	Bottom Width (ft)	Channel Depth (ft)	
Pit 1 Channel North	5	2.3 to 3.0	3 to 9
Pit 1 Channel West	10	2.0 to 3.5	3 to 12
Pit 1 Ramp Channel North	3	2.0 to 2.5	6 to 9
Pit 1 Ramp Channel South	3	2.0 to 2.5	3 to 6
Pit 1 Channel South	4	2.0 to 2.5	3 to 6
Pit 2 Diversion	10 to 15	2.5	3 to 12
Pile 3 Channel	5	2.0	6

*channels have 3H:1V sideslopes

6.6 SOIL COVERS

Both the finished surfaces of the pits and the waste piles to be regraded in place will be covered with non-impacted soils and stabilized during Site reclamation.

6.6.1 Performance Objectives and Design Criteria

Table 6-10 summarizes the design criteria being applied to soil cover design both for the pit backfill and the covers to be placed over the regraded waste piles.

Table 6-10. Cover System Design Criteria

Design Element	Design Criteria	Design Guidance
Cover System	• Maintain erosional stability of pit and pile covers under the design storm event • Cover material to be of sufficient thickness and texture to remain in place and not allow for re-exposure of buried material • Use suitable materials described by soil and topsoil suitability ratings • Model cover slopes with Revised Universal Soil Loss Equations (RUSLE) • Cover materials must achieve radon flux equal to, or less than, 20 pCi/m²/s	• MARP Closeout Plan Guidelines and Attachment #1 • Joint Guidance for the Cleanup and Reclamation of Existing Uranium Mining Operations in NM
Surface Re-grading	• Stable configuration that minimizes ponding and promotes conveyance of surface water • Slopes to be revegetated should be graded to no steeper than 3H:1V • Erosional stability for design slope lengths	• MARP Closeout Plan Guidelines

6.6.2 Cover Materials

Soil will be borrowed from the West Borrow and Lobo Tract borrow areas and be used as cover soils for the backfilled open pits and regraded piles. Additional cover soil will be excavated from the North Topsoil pile located north of Pit 1. The borrow areas are described in the following sections and Appendix D describes the soils encountered in each area during the geotechnical investigation and summarizes material properties and classifications. Table 6-11 details the Ra-226 concentrations, available borrow volume, topsoil suitability, and Cedar Creek preference ranking for each potential borrow area. Each of the material in the sections below is considered suitable for cover borrow.

Table 6-11. Borrow Area Characteristics Borrow Area Characteristics

Borrow Area	Ra-226 Concentration (pCi/g)	Available Borrow Volume (cy)	Topsoil Suitability[1]	Cedar Creek Recommendation Ranking[2]
Lobo Tract	≤1 (from 2007)	780,000+ up to 286,000 from west lobo tract	Poor to Good (poor areas due to high clay content)	3
West Borrow Area	<1.2 (from 2018)	752,000	Good	2
North Topsoil Pile	<1 (from 2007)	43,500	Good	1 (best)

Notes:

1. Topsoil suitability categories were evaluated based on soil texture, using Table 1 in Attachment #1 (MMD, 1996).
2. Cedar Creek Associates, Inc. Site revegetation plan (see Section 6.8).

6.6.2.1 Lobo Tract Borrow Area

The Lobo Tract is owned by UNC and will provide a soil borrow source for the project. The borrow area is on adjacent property to the north of the approximate mine permit boundary, generally east of the access road to the Site, and within a wide valley-bottom floodplain. Meyer Draw forms the base of the valley prior to moving south through the Site. Soil samples were collected from potential borrow sources on both sides of the arroyo during the 2018 geotechnical investigation. Analytical testing results from the 2007 materials characterization indicated Ra-226 concentrations of approximately 1 pCi/g or less, confirming the potential use of the area as a source of borrow material. A majority of the soil appears to be good for plant establishment according to MARP texture guidelines. Some soil samples within the Lobo tract fall into the fair to poor category due to higher clay contents, which will be more erosive.

Approximately 780,000 cy of borrow material is available within the Lobo Tract Borrow East area, to the east of the arroyo. The outlined area (shown on Drawing 5) contains the best quality borrow material for use as soil cover compared to areas closer to the rock outcroppings along the eastern edge of the valley. Approximately 286,000 cy of additional borrow material is available, if necessary, from the Lobo Tract Borrow West area to the west of the arroyo. The Lobo Tract West area is not expected to be used for borrow material, and will remain a contingency borrow area, since the east area contains sufficient borrow volume for the Pile 4 cover requirements. The east area is also closer to Pile 4 and will allow for reduced haulage distances compared to using the west area. The Lobo Tract Borrow east area may be expanded further north within the boundaries of the Lobo Tract for contingency volume, although this will increase haulage distances and ground disturbance.

6.6.2.2 West Borrow Area

The West Borrow Area is outside of the approximate mine permit boundary to the south of Pit 1 and contains alluvial deposits with depths as great as 30 to 40 ft. The proximity of this area to Site facilities, especially Pit 1, makes it desirable as a potential borrow source and Stantec expanded the scope of the 2018 site investigation to include collection of additional geotechnical data in this area. Measured Ra-226 concentrations for the soil samples were less than 1.2 pCi/g for soil samples collected during 2018, indicating the area contained materials suitable for soil cover. The west borrow area soil appears to be good for plant establishment according to MARP texture guidelines. Approximately 752,000 cy of soil is available for excavation in this area, all of which is expected to be used for soil covers. Use of this material would likely require permission from CLG since this area is part of the mining lease area but not within the approximate mine permit boundary.

6.6.2.3 North Topsoil Pile

The North Topsoil pile is immediately above the northern Pit 1 highwall and presumed to contain topsoil excavated from the Pit 1 overburden during initial mining operations. The soil contained Ra-226 concentrations less than 1 pCi/g during the 2007 materials characterization and is another potential non-impacted source of borrow material. The west borrow area soil appears to be good for plant establishment according to MARP texture guidelines. Of the three borrow sources, Cedar Creek listed the

North Topsoil pile as the preferred material for cover or planting media based on a comparison of soil textures. Approximately 43,500 cy of material is available for borrow excavation from the North Topsoil pile. Stantec considers the North Topsoil pile a mine feature to be reclaimed, however use of this material may require the consent of CLG since this area is located on CLG property.

6.6.3 Cover Designs

As previously stated, one of the primary objectives of placing a soil cover over the backfilled pits is to reduce radon flux from the waste to less than 20 pCi/m^2/s. Radon attenuation was analyzed using the US Nuclear Regulatory Commission (NRC) RADON model (NRC, 1989), which uses the physical and radiological characteristics of the waste and overlying materials to calculate the rate of radon emanation through the cover. Appendix G describes the methods used to develop the model input parameters and summarizes the model results.

Geotechnical properties for the materials are based on the laboratory data from the Site samples. Stantec has assumed a placed density of 90% of the standard Proctor density for the borrow and the waste. Moisture contents for the materials were either based on laboratory data or the NRC-recommended long-term moisture content of 6 percent was used for cover soils if the lab results were greater than 6 percent. Radium-226 activity concentration input values are estimated based on the results of the 2007, 2018, and 2019 analytical testing.

Erosional stability was analyzed for a vegetated cover surface using the Temple Method as recommended in “Design of Erosion Protection for Long-Term Stabilization” published by the NRC (Johnson, 2002). This method uses physical characteristics of the cover material and expected vegetation properties to calculate the factor of safety against erosion due to the peak runoff from the 100-year design storm event. Appendix G.2 describes the methods used to develop the model input parameters and summarizes the results. Stantec used a reference factor of safety of greater than or equal to 1.5 for acceptable erosional stability with vegetation established. The factor of safety represents the ratio of the allowable stresses (the resisting strength of the cover vegetation and soils) to the effective stresses (the stresses imparted by the runoff flowing over the cover). The surfaces were evaluated for two conditions: (1) resistance of poor vegetation, and (2) resistance of fair vegetation, which represent varying degrees of vegetation establishment on the cover.

Soil loss as a result of surficial erosion was estimated using the revised universal soil loss equation (RUSLE) for the cover designs. Stantec performed calculations for each of the covered areas (Pits 1 and 2 and Piles 1 through 4). The RUSLE calculations account for the effects of rainfall, soil erodibility, slope length and steepness, cover management practices, and conservation support practices on cover surface erosion. The resulting amount of soil loss (in tons per acre per year) can be used to evaluate the need for temporary or permanent erosion control measures on the reclaimed slopes. Appendix G.2 describes the methods used to develop input parameters for the RUSLE calculations and summarizes the results.

6.6.3.1 Pit 1

The Pit 1 cover will be contoured to slope gently from the outer edges of the pit towards the center at slopes ranging from 0.5 percent to 2.0 percent. Per Cedar Creek's recommendations, the thickness of the topmost cover layer will be 24 inches to create more favorable growth conditions for successful revegetation. The uppermost portion of the cover will come from the North Topsoil pile and the West Borrow area. This upper layer of cover will be placed over an approximate 2-5 foot-thick layer of cover material removed from the pit highwall, which will increase the ability of the cover to attenuate radon emanation from the underlying Pit 1 Infill waste. The estimated thickness of material to be removed from the highwall and placed in the pit will be updated based on the highwall stability analysis results. Figure 6-3 shows an example of the cover detail for the Pit 1 cover, which will be refined for the final design.

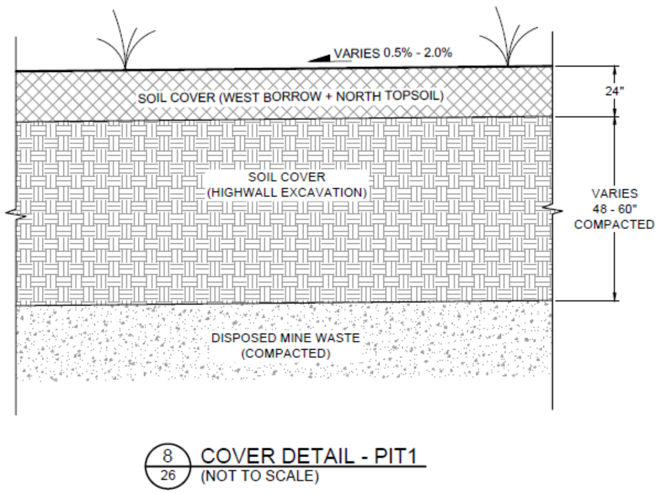

Figure 6-3. Pit 1 Cover Detail

Radon Emanation

Input values for the Pit 1 infill piles were estimated as the 75th percentile of the values measured during analytical testing for samples collected from the piles. The activity of the Pit 1 Highwall Excavation materials were estimated using a weighted average of the activities for clean topsoil/alluvium and Piles 1 and 2 materials based on material similarities and the expected proportion of each material in the design profile (60% shale, 40% topsoil/alluvium). The resulting flux for the proposed Pit 1 cover design was 15.2 pCi/m^2/s, indicating the cover will effectively reduce radon emanation below the threshold value of 20 pCi/m^2/s. Appendix G.1 further describes the development of model input parameters and the results. The radon model will be updated using the updated cover thickness following completion of the highwall stability analysis, which will refine the volume of materials to be removed.

Erosional Stability and Soil Loss

The resulting factors of safety against soil erosion for the maximum length (1,025 feet) of an approximate 1.5 percent (100H:1.5V) cover slope included for the Pit 1 design are 6.0 for poor vegetation conditions and 19.0 for fair vegetation conditions which is considered to be acceptable. Using the RUSLE, an average annual soil loss of 0.3 tons/acre/year was calculated for the Pit 1 cover surface based on the proposed design. Appendix G.2 describes the methods used to develop the model input parameters and summarizes the results. Less than 2 tons/acre/year is considered tolerable for this environment without active erosion control management. Due to the gentle slopes and contouring on the Pit 1 cover, additional erosion control measures are not expected to be necessary as the vegetation is establishing.

Evapotranspiration

The combination of climate conditions and cover material properties is expected to restrict rainfall infiltration below the cover to small fluxes. These fluxes are expected to become negligible following revegetation of the cover. Variably saturated modeling of infiltration using historical climate data for the Site, and a range of hydraulic properties based on the particle-size distributions for the cover material, indicated that fluxes into the underlying material would be small under current conditions with little to no vegetative cover. Based on transpiration data for different vegetation communities found at nearby or similar New Mexico mine sites, transpiration from the revegetated cover will greatly increase loss from the vadose zone and significantly reduce the likelihood of recharge to pit groundwater.

6.6.3.2 Pit 2

The surface of Pit 2 will be sloped to drain out of the backfilled pit to the east-southeast at a slope of approximately 1.5 percent. Per Cedar Creek's recommendations, the thickness of the topmost cover layer, sourced from the West Borrow Area, will be 24 inches to create more favorable growth conditions for successful revegetation. This layer will be placed on a cover layer of clean material from the South Topsoil pile that will act as a barrier to attenuate radon emanation from the underlying compacted waste material. The full volume of available material in the South Topsoil pile will be excavated and placed on the surface of the compacted mine waste to provide radon emanation protection and establish surface drainage to the southeast and out of the pit, resulting in an estimated cover layer thickness of eight feet (96 inches). Stantec anticipates that the estimated thickness of material from the South Topsoil pile will be adjusted to be less, based on additional mine materials to be added to Pit 2 from the Old St. Anthony Mine and other site materials. Figure 6-4 shows the cover detail for the Pit 2 cover.

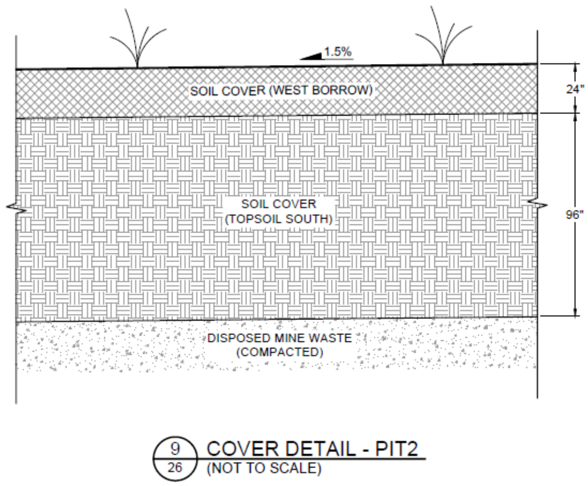

Figure 6-4. Pit 2 Cover Detail

Radon Emanation

Input values for the waste to be used as backfill in Pit 2 were estimated as the 75th percentile of the values measured during analytical testing for samples collected from the piles. The higher activity materials from the site surface materials and waste piles will be placed in Pit 2 and as a result Pit 2 likely will require a thicker cover. As with the Pit 1 cover, the NRC RADON model was used to calculate radon attenuation for the Pit 2 cover design. Appendix G.1 describes the development of model input parameters and the results. The proposed cover configuration resulted in a calculated rate of emanation of 11.4 pCi/m^2/s, which is below the threshold value of 20 pCi/m^2/s. The model will be updated to refine the thickness of material from the South Topsoil pile when the material balance is updated for the Final Design, based on changes to the final estimated waste material volume to be placed in Pit 2.

Erosional Stability and Soil Loss

The resulting factors of safety against erosion for the 1,440-foot-long 1.5 percent (100H:1.5V) cover slope included in the Pit 2 design is 4.8 for poor vegetation conditions and 14.5 for fair vegetation conditions which is considered acceptable. Using the RUSLE, an average annual soil loss of 0.3 tons/acre/year was calculated for the Pit 2 cover surface based on the proposed design. Appendix G.2 describes the methods used to develop the model input parameters and summarizes the results. Less than 2 tons/acre/year is considered tolerable for this environment without active erosion control management. Due to the gentle slopes and contouring on the Pit 2 cover, additional erosion control measures are not expected to be necessary as the vegetation is establishing.

6.6.3.3 Regraded In-Place Piles

A soil cover is required for radon attenuation and revegetation of the regraded in-place pile surfaces. Covers for Piles 1 and 2 (combined) and Pile 3 will comprise borrow material from the West Borrow area and will be placed directly over the regraded waste materials in each pile. A combination of borrow soil from the West Borrow and Lobo Tract borrow areas will be placed directly over the Pile 4 waste either as a single layer, a mixed layer of the two materials, or as separate lifts.

Radon Emanation

RADON calculations were performed for each pile cover assuming 2-ft cover thicknesses, which were the minimum recommended thicknesses required for revegetation. Based on the parameter inputs described in Appendix G.1 for the cover and waste materials at each pile, the corresponding radon fluxes for Piles 1 and 2 (combined), Pile 3 and Pile 4 were 6.2, 15.8, and 13.5 pCi/m^2/s, respectively. The results indicated that 2-ft cover thicknesses are sufficient to meet the threshold flux of 20 pCi/m^2/s.

Erosional Stability and Soil Loss

The resulting factors of safety against erosion for the critical slopes of the Pile 4 regrade design, a slope 400 feet-long at 4H:1V, is 1.9 for poor vegetation conditions and 6.5 for fair vegetation conditions. The resulting factors of safety against erosion for the critical slopes of the Piles 1, 2, and 3 regrade design, a slope 375 feet-long at 3H:1V, is 1.5 for poor vegetation conditions and 5.6 for fair vegetation conditions. Because the factor of safety is less than 2 for the poor vegetation conditions, active maintenance following large storm events may be required for repairs on the pile slopes until stable vegetation is established.

Using the RUSLE, an average annual soil loss of 12.6 tons/acre/year was calculated for the Piles 1 and 2 (combined) and Pile 3 cover surfaces based on the proposed designs. Soil loss of 8.9 tons/acre/year was calculated for the Pile 4 cover surface. Appendix G.2 describes methods used to develop the model input parameters and summarizes the results. Less than 2 tons/acre/year is considered tolerable for this environment without active erosion control management. Results from the RUSLE calculations for the piles indicate that additional erosion control measures will likely be necessary to reduce soil loss and maintain stability of the soil covers. Revegetation plans will include tilling and seeding along the contours, however additional breaks in the slopes may be required to reduce overall slope lengths. Active management of erosion and installation of post-construction erosion control measures on the slopes, such as rock check dams or straw bales to disperse concentrating flows, will be required prior to establishment of vegetation on the slopes. Site-specific erosion control measures will be evaluated during the final design. A summary of erosional stability calculation results for the regraded piles is included in Table 6-12.

Table 6-12. Erosional Stability Results for Regraded Piles

Pile	Design Configuration		Factors of Safety for Reclaimed Slopes	Erosional Soil Loss Estimates
	Maximum Slope	Maximum Slope Length	Vegetation Establishment (poor / good)	(tons/acre/year)
Piles 1 and 2	3H:1V	375	1.5 / 5.6	12.6
Pile 3	3H:1V	375	1.5 / 5.6	12.6
Pile 4	4.2H:1V	420	1.9 / 6.5	8.9

Reclaimed Grading Plan

Once the surface impacted materials are excavated and placed into Pit 2 or regraded and covered in-place, the ground surface will be graded to establish positive and stable drainage toward the arroyo. Drawings 8 through 20 show the proposed grading plan, including the proposed grading of the two pits and Pile 4. Shallow excavations in the vicinity of the existing piles will be shaped to allow positive drainage. Deeper excavations may require clean borrow to establish positive drainage following completion. Disturbed areas will be reseeded with the approved reclamation seed mix following verification surveys. Temporary erosion controls methods, such as rock check dams or biodegradable erosion control netting, may be installed to stabilize the disturbed areas where erosion is expected prior to establishment of vegetation.

6.7 ACCESS ROADS

The preliminary haul road layouts for material excavation are shown on Drawing 7. Both the North and South access roads into Pit 1 will be regraded to provide construction access and temporary stormwater management during construction. As part of the reclamation, the Pit 1 access roads will be surfaced with non-impacted soil and or rock. Following construction, select roads will remain for site access.

[text to be added for Final Design]

6.8 REVEGETATION

The Site Revegetation Plan was updated in 2022 by Cedar Creek Associates and was informed by previous vegetation sampling conducted in 2005; a growth media characterization effort and general Site survey conducted in 2018 (Appendix H); and local and regional experience successfully reclaiming uranium sites with similar conditions and challenges. In general, the plan applies to lands within the project area that are subject to revegetation, including the waste piles, soil borrow areas, and revegetated portions of backfilled pits. Revegetation protocols and performance criteria presented in the plan abide by the rules, regulations, and guidelines of the MMD. The revegetation design criteria are shown in Table 6-13.

Revegetation planning considers: 1) local vegetation communities (see Section 3.6); 2) post-mining (or post-disturbance) land use (PMLU); 3) specific considerations pursuant to desired post-disturbance management of private lands; and 4) industry-standard methods and techniques related to revegetation, soil amendments, seedbed preparation, seeding, mulching, and general reclamation science. In addition, quality assurance and quality control procedures in the form of monitoring surveys will be undertaken to confirm that revegetation efforts are implemented correctly and that the results of the process meet design criteria. This process of monitoring and evaluation will also allow for an adaptive management approach to reclamation, further assuring a positive project outcome at the St. Anthony Mine Site.

Table 6-6-13. Revegetation Design Criteria

Design Element	Design Criteria	Design Guidance
Revegetation	• Revegetation monitoring period of 12 years with monitoring every 3 years • Meet success criteria defined in MMD framework of 70% ground cover and 60% woody plant density	MARP Closeout Plan Guidelines and Attachment #2 (NMMMD, 2006) Self-Sustaining Ecosystem Guidelines (NMMMD, 2022) Soil and Cover Material Handling and Suitability (NMMMD, 2022) Revegetation Guidelines (NMMMD, 2022)

6.8.1 Self-Sustaining Vegetation Ecosystem

Stantec contracted Cedar Creek in 2022 to update the site Revegetation Plan in support of this closeout plan for UNC's St. Anthony Mine. The updated Revegetation Plan is informed by previous vegetation sampling conducted in 2005 (Cedar Creek, 2006); a growth media characterization effort and general Site survey conducted in 2018; and Stantec's experience successfully reclaiming uranium sites with similar conditions and challenges. The revegetation plan specifies the use of suitable growth media which supports native seeded communities expected to occupy all niches in the reclaimed areas which are also found in the life zone of the project. When seeding native species of reclaimed areas, early to mid-seral species typically inhabit the site and set the stage for a successional trajectory to occur. Initiating succession on reclaimed areas generates a self-sustaining ecosystem. Appendix H includes the Cedar Creek growth media characterization report and the Site revegetation plan. Drawing 21 shows the areas of the Site that will be revegetated following soil excavation and regrading.

6.8.2 Engineering Controls

Access to the St. Anthony Mine is gained via lands owned by Lupo Lands, LLC. A locked gate currently stands at the entrance to the Site to prevent public access. Fences that are currently onsite will remain in place and will be repaired and photographically documented.

Temporary range fence is proposed to protect the revegetation areas from cattle grazing or traffic while the vegetation is establishing. Temporary fencing will be added around the perimeter of the mine Site to fill gaps in the existing fence and prevent cattle access. A temporary gate and fence will be added across the road up to the underground area to prevent grazing access in that area. The temporary fences will be removed following establishment of the Site revegetation and approval by MMD. Permanent engineering controls (e.g., fencing, or other methods) are being considered to prevent access to Pit 1 and to provide a safety barrier on the top of the highwall. For example, controls will be established at the top of each access ramp into Pit 1 to prevent cattle grazers from accessing the truck ramps into the pit. Additional controls will be instituted at key points along the top of the highwall to restrict access to the fall hazard by cattle or people. Safety warning signage will be included on the permanent engineering controls in select locations. Drawing 22 shows the proposed fencing, permanent and temporary, for the reclaimed Site. The specific nature and location of the Pit 1 engineering controls will be refined in the final design.

6.8.3 Temporary Erosion Protections

[text to be added for Final Design]

7.0 SCHEDULE AND PERMITS

7.1 SCHEDULE

The following is an anticipated list of project items to be completed for implementation of the St. Anthony Mine reclamation and the estimated durations, following approval of the final Stage 2 and 100% CCOP. Each item is subject to change.

Table 7-1. Proposed Implementation Schedule Durations

Schedule Item	Estimated Duration (days)
MMD and NMED issue approval of final Stage 2 and 100% CCOP documents	-
UNC prepares updated surety cost estimate for financial assurance and Issued for Construction (IFC) drawings and specifications	120
Pre-bid meeting and Contractor bid preparation	90
Contract procurement	90
Construction duration, assumes no winter shutdowns; some tasks concurrent	1,095 (3 years)
-Mobilization	15
-Pit 1 Stabilization	75
-Mine-impacted soils excavation, move to Pit 2	375
-Pile regrading	200
-Borrow soil hauling and cover construction	275
-Stormwater channel construction	175
-Reclaim borrow areas, site revegetation and erosion controls	45
-Demobilization	15
Monitoring (engineering inspections) and Maintenance, beginning post-construction	Twice in year 1 following construction, then annual for 3 years, and then once every 5 years until MMD approval of revegetation.
Revegetation monitoring, beginning post-construction until MMD approves vegetation establishment	Years 1, 3, 6, 9, 11, and 12 following construction; up to 12 years
Groundwater monitoring, per the Stage 2 Abatement Plan Modification	Water levels quarterly, water quality samples annually; until completion of Abatement

7.2 FUTURE CONSIDERATIONS

The final CCOP will be implemented following approval by MMD and NMED. Stantec will prepare an updated surety estimate once MMD and NMED provide feedback on the final CCOP and indicate that the plan is approvable. Upon MMD approval of both the final CCOP and the surety cost estimate, UNC will prepare construction permit applications and select a construction contractor.

Prior to preparing the updated surety estimate and construction planning, several design items will be optimized. For the final design, Stantec plans to complete the following additional details:

- Identify a quarry capable of supplying the channel armoring materials (roller compacted concrete, riprap, granular filter material) outlined for use in the design drawings.
- Detailed design of roller-compacted concrete (RCC) grade control structures to minimize the excavation and material volumes necessary to provide adequate protection along the arroyo. This may include adjustment to the size or location of individual structures.
- Present designs for channel filters to be installed beneath riprap revetments. The channel filter system may utilize granular filters (as depicted in the design drawings) or manufactured geotextiles specifically designed for surface water drainage applications.

7.3 CONSTRUCTION PERMITS

If required, a NPDES construction permit for storm water discharge will be obtained prior to implementation of the final CCOP. A SWPPP will be prepared prior to construction. The SWPPP will present erosion control measures that will be implemented, inspected, and maintained for the duration of construction. Dust will be controlled by periodically watering haul roads and other dust generating areas, as necessary. Permitting criteria for construction are summarized on Table 7-2.

Table 7-2 Project Permitting Criteria

Design Element	Design Criteria	Design Guidance
Permitting	1. Evaluate Air Quality Standards, if applicable 2. SWPPP updated to incorporate reclamation work	- 20.2.72.200 NMAC - Section 402 (NPDES) of Clean Water Act

7.4 POST-CLOSURE REQUIREMENTS

[text to be added for Final Design]

7.4.1 Water Quality Monitoring and Reporting

Groundwater quality and/or water level monitoring will be ongoing through completion of the Site reclamation activities. Annual reports will be provided which will summarize the results. A post-closure monitoring program will be proposed based on the results of the abatement monitoring.

7.4.2 Reclamation Monitoring and Maintenance

Appropriate reference areas to determine revegetation success will be selected in accordance with New Mexico Mining and Minerals Division guidelines. Each reference area will be selected from ecological communities in the life zone of the project and represent logical targets for revegetation communities expected to inhabit the reclaimed facilities, including vegetation communities on the regraded piles, the pit covers, and other reclaimed areas of the site. Should a Pit Waiver be requested for Pit 1, revegetation success, as appropriate, will be addressed in the Pit Waiver.

7.4.3 Inspections

Engineering inspections will be conducted following completion of construction to evaluate ongoing performance of the Site improvements. Stantec anticipates that two inspections (spring and fall) will be conducted during the first year following completion of construction and inspections will be conducted thereafter on an annual basis until bond release.

Revegetation inspections will be conducted in the Fall a minimum of once every 3 years beginning in the first year after revegetation, with an inspection each in years 11 and 12. Revegetation inspections will continue until bond release, or up to 12 years.

[text to be added for Final Design]

7.5 REPORTING

Stantec will prepare a construction completion report to document the construction onsite.

Stantec will prepare annual inspection reports until bond release.

[text to be added for Final Design]

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APPENDICES

Appendix A PREVIOUS CULTURAL, WILDLIFE, AND VEGETATION REPORTS

A.1 2006 VEGETATION AND WILDLIFE

A.2 2006 CULTURAL RESOURCES

Appendix B RADIOLOGICAL CHARACTERIZATION REPORTS

B.1 2007 MATERIAL CHARACTERIZATION

B.2 2018 SUPPLEMENTAL MATERIALS CHARACTERIZATION

B.3 2019 PIT 1 PILE CHARACTERIZATION

Appendix C AVM VERIFICATION PLAN

C.1 EXCAVATION CONTROL PLAN

C.2 VERIFICATION SURVEY PLAN

C.3 STANDARD OPERATING PROCEDURES (SOPS)

Appendix D GEOTECHNICAL INVESTIGATION MEMO

Appendix E MATERIAL BALANCE CALCULATIONS

Appendix F SURFACE WATER ANALYSIS

Appendix G COVER DESIGN CALCULATIONS

Appendix H AGRONOMIC DATA AND REVEGETAION PLAN