# ROCA HONDA MINE
# Mine Operations and Reclamation Plan

Submitted to:
**New Mexico Mining and Minerals Division Energy, Minerals and Natural Resources Department**
**and**
**U.S. Forest Service (Cibola National Forest)**

Report Date: November 7, 2025

Prepared by:
**Stantec Consulting Inc.**
410 17th Street, Suite 1400
Denver, CO 80202-4427
Project No. 182925615

On behalf of:
**Roca Honda Resources, LLC**
225 Union Blvd., Suite 600
Lakewood, CO 80228

# Table of Contents

## List of Tables

## List of Figures

## List of Appendices

# List of Acronyms

| | |
|---|---|
| bdr | baseline data report |
| bgs | below ground surface |
| BMP | Best Management Practices |
| DF | drift-and-fill |
| EIS | Environmental Impact Statement |
| gpm | gallons per minute |
| LHD | load/haul/dump |
| MAT | most appropriate technology |
| MMD | Mining and Mineral Division |
| MORP | Mine Operations Reclamation Plan |
| NM | New Mexico |
| NMAC | New Mexico Administrative Code |
| NMDOT | New Mexico Department of Transportation |
| NMED | New Mexico Environmental Department |
| OSE | Office of State Engineer |
| PMLU | Post Mining Land Use |
| PoO | Plan of Operations |
| RHR | Roca Honda Resources, LLC |
| SLO | State Land Office |
| SPCC | Spill Prevention, Control, and Countermeasure |
| SRP | step room-and-pillar |
| SWPPP | Stormwater Pollution Prevention Plan |
| USEPA | United States Environmental Protection Agency |
| USFS | United States Forest Service |
| WTP | Water Treatment Plant |

# 1.0 EXECUTIVE SUMMARY

The Roca Honda Mine Project area encompasses five sections of land, Sections 9, 10, 16, 17, and a small portion of 8, as well as the disturbance area associated with the haul road, utility corridor, dewatering pads, and the mine water discharge pipeline leading into and out of the mine project area. Anticipated surface facilities include haul and utility roads, ore bays, retention (holding) ponds, diversion channels, wastewater treatment facilities, water treatment facilities, warehouse and storage areas for equipment, vehicles, chemicals and solutions, maintenance building, topdressing stockpiles, excavated materials stockpiles, parking areas, mine shafts, vent shafts and escape ways, hoist buildings and head frames, drill holes, dewatering wells and pipeline network, fences, power and water lines, surface water runoff control features, and a treated water discharge pipeline. The New Mexico Administrative Code (NMAC) requirements specify the various mine facilities that must be discussed. The Roca Honda mine will not have leach pads, heaps, pits, tailings disposal facilities, or mills. This section discusses those facilities that remain in the NMAC subject area.

# 2.0 INTRODUCTION

The Roca Honda Mine Project (Project) is wholly owned by Roca Honda Resources, LLC (RHR), a subsidiary of Energy Fuels Inc. (Energy Fuels). It is located approximately three miles northwest of the community of San Mateo, New Mexico, and 22 miles by road northeast of Grants, New Mexico, in McKinley County. Located specifically in portions of Sections 8, 9, 10, 16, and 17 of Township 13 North, Range 08 West, there is land and mineral ownership by the U.S. Forest Service (Sections 9 and 10), the State of New Mexico (Section 16), and RHR. The mineral claims are held by Energy Fuels Inc. for the project area, as shown in **Figure 1**.

The Project is planned as an underground operation using step room-and-pillar stoping (SRP) in the lower grade zones and drift-and-fill stoping (DF) in the higher-grade sections. **Figure 2** shows the pre-mine topography of the project area. The ore bodies identified for the project are shown on **Figure 3**. Processing of Roca Honda mineralized material will be conducted at Energy Fuels' White Mesa Mill, located approximately 272 miles northwest of the site near Blanding, Utah. The construction, operations, and reclamation of the mine are projected to last 18 years.

This Mining Operation and Reclamation Plan (MORP) fulfills the documentation requirement as detailed in the NMAC 19.10.6.602.D.15 for new non-coal mining operations. The MORP is organized in conformance with the regulatory requirements outlined in NMAC Section 19.10.6.602.D.15 (a) through (k) and 19.10.6.603.A. through H.

Selecting the optimum mine facility locations required the evolution of various practical geographic, technical, and regulatory considerations. While the general location of the mine is dictated by the location of the ore body, the locations of the surface facilities can be managed, to some extent, to maximize efficiencies and balance the geographic, technical, environmental, and regulatory constraints that the site presents. Following the submittal of the original MORP in 2009, Energy Fuels acquired the mineral rights to properties adjacent to the Roca Honda Project, on July 31, 2015, that contain known uranium resources and an existing mine shaft. The privately-owned properties, Sections 8 and 17, T13N, R08W, are part of the Lee Ranch. Both of these sections were extensively explored in the 1970's and early 1980's when more than 200 holes were drilled on Section 8 and over 500 holes were drilled on Section 17. The results of that drilling program led Kerr-McGee to sink a concrete-lined shaft to 1,469 feet below ground surface (bgs) in the early 1980s. The shaft is currently finished in the top of the Westwater Canyon Member of the Morrison Formation (the ore bearing horizon), but outside of ore, approximately 200 ft above its planned total depth. It is currently flooded to 750 ft bgs. No development into the ore body from the shaft was completed at that time. Surface facilities in Section 17 were constructed in support of the shaft sinking project, resulting in the disturbance of approximately 21 acres around the mine shaft and construction of a haul road to the shaft site from State Highway 605. The disturbed area has been used for ranching operations since abandonment of the shaft and was never reclaimed. Additional wide-spread surface disturbance throughout the section resulted from the extensive exploration drilling program as well as current ranching operations. Due to uneconomical conditions for uranium mining, development of the project was discontinued in 1982.

Potential facility locations were evaluated in relation to the desired mine shaft locations in Sections 16 and 17. The existing partially constructed shaft in Section 17 will be completed an additional 200 feet to the ore body. A portion of the surface facilities in Section 17 will be constructed within the previously disturbed area footprint, which minimizes new disturbances. These locations, selected for the mine facilities including the water treatment plant (WTP), are generally located on level ground to the extent possible and otherwise situated to maximize the natural topographic advantages available. Flood plains and steeply sloping ground were avoided, where possible. A variety of other factors were also considered in choosing the proposed locations for the facilities including minimizing impacts to archaeological and cultural resources, environmental impact potential, including those to wildlife, proximity to the neighboring rancher, and visibility/sightlines from State Highway 605. The following sections of this document reflect the planned general arrangement of the mine infrastructure and underground workings, as shown on **Figure 4, Figure 5, Figure 6, Figure 7, Figure 8, and Figure 9** after consideration of the factors listed above.

# 3.0 MINE OPERATIONS PLAN – 19.10.6.602.D.(15)

## 3.1 TYPE AND METHODS OF MINING - 19.10.6.602.D.(15)(a) AND (b)

*(a) A description of the type and method of mining and the engineering techniques proposed, and how the operation will meet the performance and reclamation standards and requirements of this Part.*

*(b) A map or maps at a scale approved by the Director and an approximate schedule or timetable indicating the mining operations including number of acres of land to be disturbed. A permittee will be required to follow the sequence described in the schedule or timetable, unless modified or revised. A permittee will not be required to meet specific dates for initiation or completion of mining according to the schedule or timetable.*

### 3.1.1 Material Definitions

A variety of materials will be discussed in subsequent sections. They are introduced here for consistency. These materials would be excavated during site preparation, construction and operations. They will be tested for radioactivity as they are being produced and will be handled in a manner protective of human health and the environment.

**Topdressing -** As with much of the Southwest, including New Mexico, soil horizons that exist in non-riparian zones of the state do not meet soils criteria for classification as "topsoil" (NMAC 19.10.6.602.D.(15)(c)(xi)). Therefore, the topsoil and subsoil layers of material to be stockpiled then placed for revegetation and reclamation are identified as "topdressing". Suitable materials that will be removed above the rock layer will be stockpiled together, identified as topdressing, and protected from erosion using Best Management Practices (BMPs) for use in concurrent and final reclamation of the site. Topdressing materials are non-mineralized therefore those stockpiles, disturbance areas and associated retention pond areas will not be lined.

**Sub-base rock -** After the topdressing has been removed from a disturbed area, further excavation will be performed by removing the sub-base rock to the required depth. Sub-base rock materials are considered non-mineralized therefore those stockpiles, disturbance areas and associated retention pond areas will not be lined.

**Non-ore development rock -** material excavated during development of shafts, stations and haulage levels or driving drift. Generally, non-ore development rock is excavated and brought to the surface but contains limited recoverable uranium. The non-ore development rock will be stockpiled then returned to the underground workings and shafts as backfill as mine development progresses. Should excess materials remain after backfilling is complete, it may be loaded into over the highway haul trucks and transported from the project area to be processed as ore at the White Mesa Mill. Non-ore development rock stockpiles may contain mineralized materials therefore pads and retention ponds associated with those stockpiles will be lined.

### 3.1.2 Site Preparation and Initial Construction Activities

Upon obtaining necessary permit approvals, RHR will mobilize a work force of company employees and contract personnel to begin site preparation and access development. Access road(s) will be constructed, and ingress and egress to the site will be via these roads, as shown on **Figure 10**. The surface facility areas will be graded using traditional earthmoving equipment to cut and fill, as necessary, and the site development construction activities will commence.

The three major areas for site preparation will be the surface facility footprints around the production shafts in Sections 16 and 17, the dewatering wells, and the water treatment plant (WTP) facilities, including the discharge pipeline. **Figure 4, Figure 5, Figure 6, Figure 7, and Figure 8** show the location of the initial surface facilities. A detailed discussion of the surface facilities is presented in **Section 3.2**. In addition, development drilling to further define the ore body will begin. **Figure 11, Figure 12, Figure 13, and Figure 14** show the approximate areas where development drilling will take place.

RHR recognizes the sensitivity and importance of the presence of cultural resources on the Roca Honda Mine project area. RHR conducted multiple archaeological surveys of the entire project area and designed its surface facilities to avoid eligible archaeological sites wherever possible. The surveys produced a detailed inventory of sites including those eligible for listing on the National Register of Historic Places on the State Register of Cultural Properties. RHR is working with the appropriate State and Federal authorities to confirm site classifications and verify that sites are protected and/or the required clearances have been granted. RHR, in concert with the U.S. Forest Service and State archaeologists, identified 11 sites (of the 193 sites found by the surveys) that required closer evaluation because of the proximity to proposed mining activities. These sites will be further investigated, and avoidance and mitigation plans will be devised to protect them during construction, operations, and reclamation. For example, some sites that could be disturbed by development activities may be excavated to recover data prior to construction. The surface facility layout has been and may be further modified to protect and avoid sites wherever possible.

Prior to initiating surface disturbance activities, proposed construction areas will be field verified by a qualified archaeological monitor against site archaeological survey results conducted previously. Mitigation measures to further protect cultural resources that may be required by the regulatory agencies will be implemented prior to beginning construction activities. An archaeologist will be present to monitor surface disturbance, as needed.

Sedimentation and run-off containment or diversion structures will be constructed as part of initial site preparation work. A Stormwater Pollution Prevention Plan (SWPPP) (not yet developed), in compliance with U.S. Environmental Protection Agency (USEPA) and State of New Mexico requirements, will be implemented.

RHR will clear and grub the surface facilities areas of the mine site and the WTP area to begin preparing them for construction. Topdressing and sub-base rock will be removed, as necessary, and stockpiled. RHR's Baseline Data Report (BDR) (RHR, 2020), Section 6.0 - Topsoil, contains a detailed characterization of the topsoil that exists on-site. The volumes of material that will be stockpiled and used in the proposed reclamation are further discussed in Section 3.2. Suitable materials that will be removed above the rock layer will be stockpiled together, identified as topdressing, and protected from erosion using BMPs for use in concurrent and final reclamation of the site.

### 3.1.3 Dewatering Wells

RHR was issued a Mine Dewatering Permit B-1706 Points of Diversion (PODs) 12 through 31 in March 2014 by the New Mexico Office of the State Engineer (NMOSE), for the proposed Roca Honda Mine following a protest of the application and hearing (HU No. 12-004) in November 2013. The permit authorizes temporary pumping of groundwater primarily from the Westwater Canyon Member of the Morrison Formation at a depth of 1,800-2,600 feet below ground surface (bgs) in order to develop an underground uranium mine. It also authorizes pumping of groundwater from the overlying (shallower) aquifers; the Dakota Sandstone and Gallup Sandstone. Under the conditions of permit approval, pumping will occur from wells located in Sections 16, 9 and 10, T. 13N R. 8W. The number and location of dewatering wells and mine shafts in each section were specified in the permit. As part of the settlement resulting from the permit hearing, the State Engineer, Acoma Pueblo, and RHR agreed to Stipulated Facts and Conclusions which set out the location to be dewatered, the time over which dewatering would occur, and the upper limits of the quantities to be dewatered from particular well locations. A three-dimensional groundwater flow model was constructed by INTERA at RHR's expense to support the application. This model was reviewed and after recommended modifications were made, was accepted by the NMOSE, the Acoma Pueblo consultant, and the USFS as an appropriate tool for calculating potential impacts on groundwater levels. It is important to note that the dewatering permit does not grant a water right as the aquifer withdrawal is for a temporary time period. The groundwater flow and drawdown model also indicates that two existing wells near the mine could be impacted so RHR was required by the NMOSE to agree to a plan of replacement for those two wells. The regional geology, geology of the project area, and a map of the geologic structures in the region can be found in **Figure 15, Figure 16, and Figure 17**, respectively.

In July 2015, RHR acquired the mineral rights to Section 17 T. 13N R. 8W, adjacent to Section 16- one of three sections included in the approved dewatering permit. RHR has revised its mining plan to incorporate Section 17 with its existing mine shaft, and to redistribute and reduce pumping in Sections 9, 10, and 16. The new mine plan will allow RHR to mine more efficiently and safely, while also minimizing the amount of new surface disturbance by utilizing preexisting disturbed areas within Section 17 for locating support facilities. Under the new mine plan the area subject to dewatering will be modified to include Section 17 with additional points of diversion in Sections 16 and 17 to be added> The total amount of groundwater pumped from the Westwater Canyon Member will be increased by an average of 200 gpm over what was permitted under B-1706 PODS 12 through 31, and dewatering will occur for an additional two years. The current Mine Dewatering Permit will be revised with the NMOSE to reflect the new mine plan, as required.

Dewatering portions of the mine will occur for approximately 12 years. Construction and operation of the mine will proceed in several phases. The timing and sequence of the dewatering/depressurizing and the aquifers dewatered will proceed in phases that reflect the underground progression of the mine workings. Phase 1 will involve the rehabilitation of the

Section 17 shaft and initial mine development, i.e. excavation of declines or drifts to access the ore zones. Phase 2 will commence concurrently with mine development activities in Section 17 and will consist of dewatering/depressurizing the area near the planned Section 16 shaft. Phase 3 will consist of extending the drift into Section 10. The locations of the approximately 21 anticipated dewatering wells required for the three phases are identified in **Figure 18**. These wells will be designed, permitted, and constructed in conformance with the NMOSE requirements, as outlined in NMAC 19.27.4.31. Prior to being cased and grouted, wells will be logged using geophysical instruments to determine screened intervals and construction requirements. Once constructed, the water produced at each well will be routed via surface pipe to the WTP for treatment prior to discharge. Operation of these wells will occur pursuant to conditions approved by the mine dewatering permit.

RHR's revised mine plan anticipates that during the first phase of mining, an existing mine shaft on Section 17 will be rehabilitated. In advance of shaft rehabilitation, up to four wells will be drilled around the perimeter of the shaft at a distance of 650-800 feet from the shaft, to a depth of approximately 1,600-1,800 feet bgs and screened in the Westwater Canyon Member. The shaft will be rehabilitated downward from land surface, and these wells will be pumped for up to 320 days at a total rate of up to 2,000 gpm ie., 500 gpm per well, prior to shaft rehabilitation reaching the top of the Westwater Canyon Member. The shaft currently extends from land surface down through the upper part of the Westwater Canyon Member, and because the shaft already passes through and seals off the geologic formations above the Westwater Canyon Member, no water will be produced from these formations during rehabilitation or mining. During shaft rehabilitation through the Westwater Canyon Member, the shaft will also become a point of diversion. The five wells and the shaft are identified as PODs 32 thru 36 in the existing mine dewatering permit. After completion of the shaft through the Westwater Canyon Member, the wells will continue to be pumped for as long as they aide in dewatering the mine. However, as Section 17 mine development begins, it is anticipated that the shaft will function as the main point of diversion of water produced from the Westwater Canyon Member for the mine. The wells around the shaft will produce less and less water as mine development proceeds and eventually will no longer contribute to mine dewatering. At that time pumping will be turned off but the wells will be retained for emergency purposes. At that point most of the water being produced from the Section 17 mine shaft area will be discharged through the shaft.

After rehabilitation of the Section 17 shaft, underground mining will be extended into Section 16, and three to five additional wells will be constructed as needed into the Westwater Canyon Member along the course of the underground decline in Section 16 and pumped to minimize inflow of groundwater into the mine workings in advance of decline construction. Pumping from the new points of diversion will commence during year 2 of mine operations, consistent with the mine dewatering permit.

During the life of the mine, the production shafts will become the major points of diversion as water produced from the workings is pumped to the surface through them. As the mine workings expand, the workings themselves will act as a gallery for gathering of the water within the mine. This water will be routed from the various working areas into a sump at the bottom of each shaft and pumped to the surface. The wells along the underground decline will be pumped for so long as they provide effective depressurization/dewatering mechanism. The RHR drawdown and flow model simulates that the total average annual discharge over the life of the entire mine (Sections 9, 10, 16 and 17) will be 4,700 gpm, with pumping rates varying from a total of 2,170 to 5,920 gpm from points of diversions and the shafts. These numbers are considered over-estimates of the actual amount of water the mine will produce because of conservative assumptions used for the groundwater model.

Each shaft dewatering well will have an approximate 250 foot by 250 foot surface area footprint (see **Figure 19**, though it should be noted that the surface disturbance of the wells installed during shaft construction will be within the overall mine surface facility disturbed area footprint. Water produced from the wells and shafts will be piped to the WTP for treatment prior to being discharged via the treated water pipeline. Once the shaft dewatering wells are no longer needed, they will be abandoned per NMOSE requirements, and the surface facility footprint reclaimed. However, a few wells will be kept in stand-by status for use as contingencies in emergency situations, such as in the event of a pump failure in the main shaft during mining. Determination of which wells will remain in stand-by status will occur on an individual basis according to progression of mining and operational requirements at the time they are eligible to be taken offline.

RHR submitted a report titled Assessment of Potential Impacts from Mine Dewatering at the Proposed Roca Honda Mine, McKinley County, NM (INTERA, 2011) to the NMOSE on November 7, 2011, in support of its Mine Dewatering Application. The report was also submitted to the United States Forest Service (USFS), the New Mexico Environmental Department (NMED) and the New Mexico Mining and Mineral Division (NMMMD) in support of its Mine Permit Application and Plan of Operations. The report provided analysis of potential impacts on existing water uses when groundwater is pumped at the rates and for the period of mining described above. Following questions that arose during the Environmental Impact Statement (EIS) process with the USFS, the report was revised and resubmitted in August 2012 (INTERA, 2012).

INTERA, RHR's groundwater modelling consultants at the time, constructed a numerical groundwater flow model of the San Juan Basin to evaluate the impact that the proposed dewatering activities might have on local and regional groundwater and surface water systems, including those for the nearby population centers of Grants, Gallup, Milan, Crownpoint, San Mateo, and the Acoma and Laguna Pueblos. Impacts are defined as changes in groundwater levels or flows at wells and springs. Specifically, INTERA constructed and calibrated a numerical model of groundwater flow to estimate predevelopment groundwater levels, i.e., groundwater levels prior to the year 1930 for conditions prior to the onset of large-scale mining in the Grants uranium belt. A transient numerical model of groundwater flow to estimate changes in groundwater levels from 1930 to 2012 caused by pumping from public water supply wells, mine dewatering, and recovery from historic mine dewatering was constructed and calibrated. The model, which was reviewed and accepted by the OSE and consultants preparing the EIS for the Cibola National Forest, simulates changes to the 2012 hydraulic groundwater levels during and after dewatering at the proposed Roca Honda Mine.

The groundwater flow and drawdown model provides a reliable prediction of the potential impacts of proposed mine dewatering at the Roca Honda Mine. Based on the available data and the model calibration, dewatering the Roca Honda Mine will not adversely impact the water resources of the Village of Milan, Acoma Pueblo, Laguna Pueblo, the City of Grants, the community of San Mateo, Crownpoint area, or the City of Gallup. Mine dewatering will not have adverse impacts on area springs. It was identified that mine dewatering would impact three domestic use wells near the mine site. The NMOSE approved Plans of Replacement for those three wells as part of the dewatering permit as noted earlier.

### 3.1.4 Shaft Construction

Site and mine development will begin in Section 17. The existing mine shaft in Section 17 will be incorporated into the Roca Honda Mine plan by using the shaft to produce ore and provide underground access to Section 16. The shaft is currently completed to a depth of 1,469 feet bgs. Kerr-McGee, the previous developer of the Section 17 project, anticipated completing the shaft to a total depth of 1,669 feet bgs. The WTP, discharge pipeline, retention ponds, and other necessary surface facilities would be constructed in Section 17 prior to beginning dewatering in Section 17. Once the WTP and initial dewatering pipeline construction are complete, the Section 17 shaft will be dewatered, rehabilitated as needed, and then sunk to total depth. Two mining levels will be used to access the ore body in Section 17. A drift (tunnel) from the upper mining level (1-4 level) will be advanced from the bottom of the shaft to the planned shaft location in Section 16.

Typical conventional shaft sinking involves vertical excavation from the ground surface downward. Little difficulty is anticipated in shaft sinking through solid rock. Excavation consists of a cycle of drilling, blasting, excavating or removing rubble (i.e., mucking and hoisting), installing or constructing a liner on the shaft walls in the excavated area and repeating the process until the ore horizon is reached. Up-reaming or raise boring shafts is also possible in competent rock formations and may be used for either ventilation or production shafts. The process involves drilling a pilot hole from the surface into an underground excavation, either a drift or stope (mine opening), where a large diameter drill bit can be attached and then pulled up to the surface. As the boring is advanced, drill cuttings fall into the mine workings where they are removed with underground mining equipment. When sinking the shaft from the surface through water-bearing strata, careful shoring and sealing of the shaft lining is necessary, and pumping facilities are needed. When raise boring, the shaft is lined from the surface by lowering the liner segments into the boring and grouting between the liner and surrounding rock as is done in conventional methods. Because the Section 17 shaft already exists to 1,469 ft bgs, the approximate 200-foot extension will be excavated using the conventional sinking technique with a final diameter of 18 feet.

In addition to dewatering/depressurizing as described in Section 3.1.3, grout will be used to further reduce the inflow of water into the shaft. Grout is a liquid material that when solidified, forms a seal that reduces or eliminates the flow of water in the area where it is applied. Using grout technology facilitates control of the inflow of water from the formation being grouted during the construction of the shaft, and importantly, during the operating life of the mine.

There are a number of ways grout can be introduced into the formation. Fundamentally, the approach is to drill a number of holes from the surface around the circumference of the shaft and pumping grout into the formation, forming a "curtain" in the formation in the geologic strata surrounding the shaft excavation. In the grouting process, liquid cement is forced into the water-bearing earth under very high pressure. On mixing with the water, the cement solidifies the adjacent area preventing groundwater inflow into the shaft.

The use of the conventional shaft sinking method allows the segregation of aquifers or water-bearing formations by facilitating the ability to seal such intervals prior to penetrating the formation. The Gallup and Dakota Sandstone formations are expected to be under hydraulic pressure and produce water in volumes that can be controlled by surface grouting. When shaft sinking reaches the top elevation for the interval to be sealed a probe hole will be drilled into the water-bearing formation. The hole will be equipped with special packers and gauges to measure water volumes and pressures. If volumes and pressures are within acceptable tolerance levels, shaft sinking will resume without grouting. If volumes and pressures are outside of these levels, grouting will be implemented prior to advancing the shaft sinking process. **Figures 20, Figure 21,** and **Figure 22** show the typical stratigraphy anticipated to be encountered at Roca Honda. **Figure 23** shows a typical grout curtain scenario in more detail.

It is anticipated that the production shaft in Section 16 will be constructed using the raise bore method initiated from the underground workings. For shafts constructed using raise boring or up-reaming methods, complete isolation of water bearing formations is not possible until the bore hole has been fully drilled, and the liner installed. However, dewatering wells installed prior to raise boring, as described previously for the surface sinking method, would limit the amount of water that could flow into the shaft during construction. Further, water flowing into the shaft would drain into the lowest point of the workings in the Westwater Canyon Member thereby preventing potential cross contamination of aquifers during the construction period. Water accumulating in the shaft would be pumped to the WTP for treatment prior to discharge. Shaft sinking activities will proceed using either of the methods described above through the water-bearing formations. After the liner has been installed the grout will remain in the surrounding formation providing a seal to minimize water inflow. Water that continues to flow into the shaft will be controlled by installing “water rings” to gather the water and direct it to temporary collection sumps at the shaft bottom. Water rings are heavy cast-iron segments, with flanges for connecting, and bolted together in place. Water collected in the sumps will be pumped to the surface where it will be treated at the WTP prior to discharge. As noted above, the excavated shaft material will be brought to the surface during shaft construction using conventional hoisting equipment. This material will be segregated as appropriate and placed in designated stockpile areas on the surface at the mine site. A permanent hoist house for operations will be installed before shaft construction is completed.

Upon completing shaft construction, a permanent pumping level station will be developed to accommodate mine dewatering during mine operations. **Figure 24** shows details of a typical pump station. Ultimately, the production shafts will be fitted with a permanent 85-foot-tall headframes and hoists for operations.

### 3.1.5 Ventilation Holes and Escape Shafts Construction

In year 1, Section 9/16 ventilation raise construction will begin and will be timed to reach the shaft station level simultaneously with dual decline development from Section 17. The approximately

11,800-ft long decline that connects the Section 17, 9/16, and 10 mineralized zones has been designed as a twinned heading. This is required for ventilation purposes, both during the driving of the decline, as the need for booster fans is eliminated, and for subsequent mining in the Section 10. When completed, one of the decline headings will serve as a dedicated fresh airway connecting the Section 10 and 9/16 workings to the Section 17 production shaft fresh air intake. The other decline heading will serve as a dedicated exhaust airway, connecting to the various exhaust boreholes in the Section 9/16 mining area, thus supplementing the exhaust capacity of the boreholes in the Section 10 area. Depressurizing of the water in the decline area will precede the initiation of the decline construction, and it will be maintained after completion.

Dewatering wells will be installed in advance of the drift and additional vent shafts constructed by up-reaming methods in the locations shown on **Figure 18**.

The deposit will be developed and mined based on single-pass ventilation using a series of separate and independent intake and exhaust networks. The exact number of ventilation shafts that will be installed in the project area will be determined as detailed engineering and mine development occur. The locations of vent shafts currently planned are shown in **Figure 4**. The size of each ventilation shaft will be approximately eight (8) feet in diameter. The first ventilation shafts will be installed in Section 17 using the raise boring method. **Figure 25** shows a typical raise bore drill rig and set up. Raise boring or up-reaming uses a drill rig set up on the surface to drill a pilot hole into an underground drift, tunnel or stope previously excavated by a mining crew. Once the pilot hole breaks into the opening underground, the mining crew assembles and attaches a large reamer bit (in this case approximately 8 feet) to the smaller diameter drill string. The reamer bit is then pulled to the surface while continuously rotating to cut the hole to final diameter. The cuttings from the drilling fall back down to the mining level where they are mucked out of the opening, hauled back to the shaft, and then hoisted to the surface and transported to the non-ore material stockpile shown on **Figure 4**. Water from the Gallup and Dakota Sandstone formations will flow into the hole and be collected in a sump underlying the vent hole. If excessive water inflow becomes an issue, seepage from the Gallup and Dakota Sandstone formations can be controlled by either grouting the formations from the surface as was described for shaft construction in Section 3.1.4 or by freezing. Freezing would be accomplished in a similar manner to grouting except that the water in the formation would be frozen.

Groundwater freezing is a widely used construction technique that typically uses small-diameter, closed-end freeze pipes that are inserted into vertical bore holes drilled along the edge of area to be shored or contained. A cooling agent, typically chilled brine ($CaCl_2$), is circulated through the pipes where heat is extracted from the formation causing the ground to freeze around the pipes. The warm brine is returned to the refrigeration plant where it is again cooled. Frozen earth forms around the freeze pipes in the shape of vertical, elliptical cylinders. As the cylinders gradually enlarge, they intersect to form a continuous wall. With heat extraction continued at a rate greater than the heat replenishment, the thickness of the frozen wall will expand with time.

Once groundwater inflows have been controlled by grouting or freezing and the hole has been reamed to final diameter, the vent hole will be lined with steel, concrete, or both. The liner will be designed to prevent inflow from the aquifers of concern. Water in the Westwater Canyon Member will not be a concern as that is where the pilot hole will break into the underground workings, and that area will already have been dewatered by dewatering wells or underground dewatering methods.

The ventilation holes will be designed to either introduce fresh air or exhaust air from mine workings at a rate of approximately 200,000 cubic feet per minute. As the underground mine workings expand, air flow directions in vents may need to be changed to balance fresh air intake and exhaust requirements. In this manner intake vents may become exhaust vents and vice versa. Air movement will be provided by an electric motor and fan assembly mounted horizontally on the surface on a concrete pad. This design will allow dual purpose use of some of the ventilation holes as emergency escape ways for mine personnel at the haulage level and mine working level elevations. As necessary or where noise studies indicate the need, ventilation fans may be shrouded to reduce noise impacts. The current mine plan anticipates using the production shafts in Section 17 and Section 16 as the main air intakes with the vents acting as exhausts.

The production shafts will be designed using downcast ventilation, in which fresh air is pulled down the shafts and is distributed throughout the mine. Fresh air will also be vented upward from the haulage level, which is below the ore level, to the mine working level (ore level) by means of raises or development drifts.

### 3.1.6 Proposed Development Drilling

The purpose of development drilling is to provide additional data for more detailed mine planning and certainty in resource estimations. RHR anticipates drilling approximately 200 development holes following issuance of the FEIS and approval of the MMD permit to mine. Development drilling activity will take place within areas that were heavily drilled 40-50 years ago. Abundant evidence of previous drilling includes old drill pads and two-track roads that were largely un-reclaimed. Wherever possible, RHR will use old drill pads and roads as to minimize new ground disturbance. Proposed drilling areas were included in the baseline biological and cultural resource study areas completed in recent years, allowing avoidance plans to be developed using existing information. Best management practices (BMPs) will be used to avoid or reduce environmental impacts. BMP’s will include:

1. Locating drill holes in previously disturbed areas or areas that will be disturbed by other development activities wherever possible;
2. Using common or overlapping drill pads where feasible;
3. Avoiding eligible archaeology sites to the extent possible;
4. Utilizing existing roads or two-track trails wherever possible;
5. Use of a common staging area for equipment and supplies within areas that will be affected by future mine development;
6. Avoiding significant drainage features;
7. Controlling fluids to prevent releases from the drill sites;
8. Avoiding drilling near active migratory bird or raptor nests; and,
9. Performing contemporaneous reclamation.

Using a realistic estimate of 0.3 acres disturbance per drill pad, the amount of temporary disturbance associated with planned drilling activities is approximately 60 acres, most of which would occur in Sections 9 and 10.

### 3.1.7 Mine Operations

Mine operations will begin once the production shaft in Section 17 and required ventilation shafts are completed, and a permanent sump is constructed at the lowest point of the mine shaft to provide a collection point for mine dewatering. Water produced from the mine as development advances and work areas are excavated, will be collected and held in the sump to remove sediment with the aid of decantation trenches. The collected water will be pumped through a series of pump stations to the surface, where it will be pumped to the WTP for treatment, as necessary to meet discharge standards. This will help mitigate groundwater effects on mine development, which is further detailed below.

#### 3.1.7.1 Haulage Level

The haulage level development will begin under the ore horizon as soon as practical after shaft construction has been completed. The haulage level of the mine serves several purposes. It provides a location from which to conduct longhole drilling underground that further defines the ore body. The longholes then provide a means of additional dewatering of the mining level by providing drainage from below. The haulage level also provides the clean air ventilation passageway and importantly, it provides the ore transport route from ore chutes to the hoisting transfer facilities.

**Figure 26** illustrates the concept of longhole drilling in underground mining. It is a dual-purpose technique used to define the mineable portion of the ore body and to help dewater the portion of the formation to be mined. Information obtained from the longhole drilling will be used to obtain a detailed understanding of the ore distribution within the mining zone and develop a corresponding extraction plan. Use of this technique reduces significantly the surface disturbances required for development drilling. Development drifts will be excavated following the longhole drilling to enable ore extraction.

As shown in **Figure 26**, the longhole drilling machine, located at the haulage and/or ore level, is capable of drilling at the working face (see front view) for distances into the rock of 200-300 feet ahead of the excavation in predetermined patterns. The top and side views show how the longhole drilling will be performed radiating out and up into the rock at various angles. The longholes will allow the water to drain from the rock in advance of excavation. The holes will also provide access into the rock with geophysical probes that will allow the ore to be more carefully defined.

During initial development of the haulage level, the excavated material will be hoisted to the surface and placed in stockpiles. As noted previously, the haulage level is located below the ore horizon therefore, the excavated material is not expected to contain constituents of concern. Nonetheless, this material will be stored in stockpiles on the surface of the mine site and handled in a manner protective of human health and the environment.

As development of the mine continues, it is anticipated increased amounts of non-ore development rock will be used as backfill in developed areas of the mine which will no longer be mined. This non-ore development rock will not be brought to the surface but rather be utilized for concurrent mine reclamation and minimizing surface stockpile footprints.

Ore will be removed by typical blasting techniques which entails drilling holes into the working face and inserting explosives. After blasting the material face, the rubblized (blasted) ore materials will be moved away from the face using load/haul/dump (LHD) equipment or a cable drag machine, known as a slusher, to a designated collection point. From the collection point, the ore will be loaded on an underground truck, transported to the bottom of the production shaft and then loaded into the hoist destined for surface deposition in ore bays.

#### 3.1.7.2 Ore Mining Method

Ore at the Roca Honda mine will be extracted using either a step room-and-pillar or drift-and-fill mining method depending on the characteristics of each ore zone. Both are common mining methods which are flexible and economically viable. **Figures 27** and **28** illustrate the layout in step room-and-pillar and drift-and-fill extraction methods, respectively.

In room-and-pillar mining, mined material is extracted across a horizontal plane while leaving "pillars" of material in place to support the rock above and resulting in open areas or "rooms" (stopes) underground. Step room-and-pillar mining is a variation in which the sill or bottom elevation of an inclined ore body is adapted for the use of rubber-tired equipment. Because every ore body is different, applications of step room-and-pillar mining cannot be fully generalized, however, this type of mining generally applies to ore deposits with thicknesses from 6 to 20 feet and dips ranging from 15 to 30 degrees.

This type of mine is normally developed on a grid creating a regular mining pattern that may be modified to reflect specific geologic conditions in the host rock. The percentage of material mined varies depending on many factors, including the material mined, width of the pillar required for roof support, and roof conditions.

Step room-and-pillar mining features a layout in which stopes and haulage-ways cross the dip of the ore body in a polar coordinate system. By orienting haulage-ways at certain angles across dip, stope floors assume an angle (<10°) that is easily traversed by rubber-tired equipment (see **Figure 27**). The main development of step room-and-pillar mining includes a network of parallel transport drifts on either side of the ore pod. These transport drifts provide one-way traffic for mine equipment and also provide fresh air ventilation into mine working areas. Stopes are advanced forward by drifting from the center haulage-way outwards to the parallel transport drifts. The next step is to excavate a similar drift or side slash one step updip or downdip and adjacent to the first drive. This procedure is repeated until the roof span becomes too wide to remain stable and an elongated strip is left as a "pillar." Pillars left in place to support the roof of the mine are typically either barren of ore or are of such low grade that they are left in place rather than removed. In some cases, the pillars contain sufficiently high mineralization that they can ultimately be removed using the drift-and-fill method discussed below.

At Roca Honda, a 10-foot-wide room will be excavated followed by leaving a 10-foot-wide pillar for support. Heights of rooms and pillars are not expected to exceed 12 feet. In cases where stope thickness exceeds 12 feet the stope will be mined in equal vertical lifts to the extent possible (i.e., a 20-foot-thick stope will be mined in two 10-foot intervals). The first 10-foot interval is mined and then backfilled so the second 10-foot interval can be mined. In this case the backfill becomes the floor for the second 10-foot interval that will be extracted. The length of a particular room or pillar is determined by the width of the ore pod being extracted. The width of pillars at the Roca Honda Mine is normally expected to be 10 feet. Room widths can vary with rock strength but are not expected to be smaller than 10 feet nor greater than 50 feet. Each ore pod will be separated into 200-foot stopes. Stopes will be separated by a sill (lowest elevation of ore) drift connecting each parallel transport drift on either side of the ore pod. This sill drift aids in ventilation and transportation of material.

As mining advances in an up-dip direction, rooms mined first will be filled with a cemented backfill and pillars will be partially mined. The purpose of cemented backfill is to provide a safe working environment for the miners. It will prevent the mine roof from collapsing or caving when the pillars are partially removed. Cemented backfill will also help in reduction of radon emanation from low grade pillars. As mining advances into the room, roof bolts will be placed in the ceiling to prevent collapse. Roof bolts are long steel rods that are inserted and tightened into holes drilled up into the ceiling of the rooms. The roof bolts will be further supplemented as necessary with the use of wire mesh draped on the ceiling and sidewalls and held in place with the roof bolt. The use of these techniques will further enhance the safety of the working environment. **Figure 29** shows a typical roof bolting operation.

In some areas of the mine, ore grade will be high enough to support drift-and-fill mining. Drift-and-fill mining allows for a higher extraction rate of ore, but operating costs associated with this type of mining are greater than costs associated with step room-and-pillar mining.

The drift-and-fill mining method is the same as the step room-and-pillar mining method except that in the drift-and-fill method, pillars created while mining are ultimately removed because of the high ore grade they contain. The higher ore grade can justify the additional cost of using additional engineered backfill to provide the stability needed to extract the pillars while maintaining a safe working environment. At Roca Honda those areas of the ore body that contain sufficiently high ore grade to justify use of the drift-and-fill method will first be mined using the step-room and pillar method. Backfill will then be used to replace the pillars while the drift-and-fill method is employed.

Over the mine life, an estimated 2.63 million tons of backfill will be needed with the high strength variety comprising 75% of the total. Of this total, approximately 400,000 tons of underground non-ore development rock will be directly placed into stopes. The non-ore development rock stockpiles will total approximately 700,000 tons, which includes hoisted non-ore development rock, surface excavations, main shaft, and other mine surface structure excavations. The remaining 1.53 million tons will be obtained from an existing surface quarry in the project vicinity. The primary source of high strength backfill material will be quarried and screened (to concrete aggregate specification quality) surface rock. There are quarries with suitable backfill materials within reasonable haul distance of the project that would be contracted to supply the necessary quantities of rock prior to beginning mine construction.

#### 3.1.7.3 Pillar Extraction

Rooms down dip from a pillar will be backfilled with non-ore development rock and/or aggregate imported into the mine from the surface. This material will be mixed with a pre-determined amount of cement to strengthen the backfill to a point which will prevent the room roof from collapsing. Prevention of roof collapse will be further supported by only partially removing pillars when necessary. **Figure 30** demonstrates the pillar extraction process.

To prepare an ore block for extraction, the pillars will be split for drilling and access. The size of the area to be extracted will be based on results of rock mechanic studies of the ground conducted during mining. The pillars will be monitored and if the geomechanics of the ground prove to be sufficiently stable, the pillars will be split again to facilitate more drilling and blasting.

When the pillars are blasted and extraction begins, a slusher may be used to remove the broken ore. Miners will not enter an active pillar extraction area with unstable ground conditions. The ore will be dragged out by the slusher and LHDs will load trucks or haul the ore to a chute to be transported to the production shaft. When the pillar extraction is complete, the area will be backfilled, and mining will progress in an up-dip direction until the stope is mined out.

#### 3.1.7.4 Backfill

Roof collapse or caving will be prevented at the Roca Honda Mine by backfilling previously mined rooms with non-ore development rock and/or aggregate from an existing source, imported into the mine from the surface. Early in the mine development and operation, excavated non-ore development rock from the mine will have to be hoisted to the surface and stockpiled as it is produced. This material cannot be stockpiled underground initially because of the limited space. As the underground workings are established and stope mining begins, this material will be reintroduced from the surface back into the mine as backfill.

As discussed in Section 3.1.7.4, one of the Westwater Canyon Member dewatering wells in Section 16 will be completed as a 36 inch diameter well and cased (lined) to serve as a “backfill raise” in the future once it is no longer needed as a dewatering well. Stockpiled non-ore development rock on the surface will be transported through this backfill raise into the mine, as needed, mixed with cement and placed in mined out rooms as stope mining progresses. Backfill provides in-ground support by reinforcing the roof, which in turn allows for complete or partial removal of adjacent pillars, depending on the extraction technique used.

Ore extraction from stopes will continue for some time after development access to ore pods has been completed. The surface stockpile of backfill material will continue to be depleted until stockpiled material has been reintroduced to the mine. When this occurs, material will be sourced from a local quarry to continue with backfill operations. This material will be a clean aggregate with sufficient geotechnical characteristics to be used as backfill and characterized prior to use to verify that it does not present a potential impact to groundwater.

#### 3.1.7.5 Mining Operations Schedule

Mine development and mining will proceed by the following general timeline:

- Construct the water treatment plant (WTP) and water reuse pipeline (main discharge line to Rio San Jose)
- Construct surface BMPs and necessary diversions in Section 17 and along pipeline corridor
- Drill surface dewatering wells and begin dewatering Section 17
- Begin the rehabilitation of the Section 17 Shaft, including:
  - Build and install head frame and hoist
  - Inspect and repair the existing shaft
  - Install Pumping stations and piping
  - Deepening of the shaft by approximately 297 ft (177 ft to shaft bottom and an additional 120 ft for sump and water storage
- Begin the construction of the Section 16 Shaft
- Begin the 11,788-ft long dual decline from Section 17 to Section 10
- Mining of the Section 17 mineralization
- Crosscut to Section 9 and Section 16 from the decline and begin mining Sections 9/16
- Terminate the decline at Section 10 and begin mining Section 10

**Table 1** provides a generalized schedule for construction, operation and reclamation of the Roca Honda Mine project in compliance with NMAC Section 19.10.6.602.D.(15)(b). Fundamentally, it is an approximate schedule of mining operations for a nominal 17-year period, however, the true life of the mine may be different as development drilling and underground development occur. regulations at NMAC Section 19.10.6.602.D.(15)(b), recognize that a mine life may vary by stating that a permittee "not be required to meet specific dates for initiation or completion of mining according to the schedule or timetable."

The schedule reflected in **Table 1** begins with day one after the day that permit approvals are received for the project. A permit approval date of November 11, 2027, is assumed in order to present the schedule in months and years as required by NMMMD. On day one, mobilization will occur to begin preparation of various site areas prior to the start of construction activities. The critical early activities include: the construction of the discharge pipeline from the WTP location to the discharge point at the Rio San Jose (**Figure 31**), construction of the water treatment facilities, and installation of the dewatering wells in Section 17. It is anticipated that these major site construction activities will be completed within the first 12 to 18 months.

Other early development activities will include additional drilling to better define the characteristics of the ore body and provide information needed to update an economic feasibility study. Development drilling will likely occur in phases, with the first phase completed in year one following permit approvals and a second phase the next year.

**Table 1 - Mine Schedule***

| Activity | Start Date | End Date |
|---|---|---|
| Feasibility and confirmation drilling | Nov 12, 2027 | Jan 28, 2029 |
| Mobilization to Sec 16 and 17 | Feb 1, 2029 | Feb 1, 2029 |

| | | |
|---|---|---|
| Site preparation/road construction in Sec 16 and 17 | Feb 2, 2029 | Nov 16, 2029 |
| Construct dewatering/reuse pipeline to Rio San Jose | Feb 2, 2029 | Feb 16,2030 |
| Facility construction in Sec 16 and 17 | Mar 1, 2029 | Nov 16, 2029 |
| Construct water treatment plant in Section 17 | May 19, 2029 | Nov 16, 2029 |
| Construct Sec 17 dewatering wells | May 19, 2029 | Nov 16, 2029 |
| Rehab Sec 17 existing shaft | Feb 15, 2030 | Jul 12, 2030 |
| Dewater Sec 17 shaft | Feb 15, 2030 | Dec 31, 2030 |
| Complete Sec 17 shaft to final depth | Aug 12, 2030 | Jan 11, 2031 |
| Dewater from Sec 17 shaft | Jan 31, 2031 | Jun 13, 2033 |
| Sec 17 mine development and dewater ore body | Jan 31, 2031 | Jun 27, 2031 |
| Dewater Sec 17 to Sec 16 drift | Jan 31, 2031 | Dec 16, 2031 |
| Drift to Sec 16 shaft location | Jan 31, 2031 | Jun 13, 2032 |
| Mining of Sec 17 ore | Jun 27, 2031 | Aug 10, 2035 |
| Dewater Sec 16 shaft | Nov 16, 2031 | Apr 30, 2033 |
| Upream Sec 16 shaft/Develop shaft stations | May 13, 2032 | May 13, 2033 |
| Mining of Sec 9 ore | Aug 10, 2034 | Aug 10, 2036 |
| SW/NE Sec 16 ore body mine development | Feb 10, 2037 | Feb 8, 2039 |
| Mobilization to Sec 10 | Aug 10, 2036 | Aug 10, 2036 |
| Additional site preparation/road construction | Aug 10, 2036 | Apr 10, 2037 |
| Construct dewatering wells on surface in Sec 10 | Aug 10, 2036 | Dec 8, 2037 |
| Sec 10 ore body mine development | Aug 10, 2036 | Aug 10, 2042 |
| Reclamation Sec 9, 10, 16 | Feb 11, 2039 | Jan 10, 2043 |
| Reclamation Sec 17 | Feb 6, 2044 | Aug 10, 2044 |

* From assumed permit approval date of Nov 11, 2027

It is assumed for the purpose of the **Table 1** schedule that treatment of water produced from the dewatering wells may be required. Ore production from Section 17 could begin quickly after the shaft is sunk to depth. The first ore is planned to be produced approximately 90 days following completion of the Section 17 production shaft. Initial development is scheduled to be completed within 4.5 years after commencement of the project at which time full production will begin. Mine development work in Section 16 would be ongoing as mining in Section 17 ramps up.

The main drift from Section 17 will continue to the location of the Section 16 production shaft (six months into the project). This timeframe assumes that the dewatering wells around the Section 16 shaft location have been operating. Additionally, the mining unit will be dewatered underground ahead of the miners. As such, the construction schedule of the shaft is dependent upon the dewatering activities. As described in more detail in Section 3.1.3, RHR has an approved mine dewatering permit.

The estimated life span of the Roca Honda project is approximately 18 years. Of that period of time ore will be produced for 12 years. The remaining time consists of construction and reclamation activities. Reclamation will begin on portions of Sections 17 and 16 after the end of production. Some Section 17 surface facilities, particularly the WTP, will remain operational throughout the life of the mine. Reclamation of the entire mine, including placement of non-ore development rock remaining on the surface back underground, will be completed approximately two years after mining has been completed.

As noted previously, the schedule presented in **Table 1** is for general planning purposes only. As provided for in the regulations, the actual schedule for the project will be dictated by many factors yet unknown, including the dates the permits are approved, the actual conditions encountered during construction, and the volume of ore ultimately available to be extracted. The remainder of this section is intended to provide the reviewer with a more detailed understanding of the work that will be undertaken to construct, operate, and reclaim the Roca Honda Mine in a manner that meets the performance and reclamation standards of the various state and Federal regulations that apply to the project.

## 3.2 MAPS AND PLANS FOR THE MINE FACILITY - 19.10.6.602.D.(15)(c)

*Maps and plans indicating the location, size and capacities for the mine facilities including:*
*(i) leach pads, heaps, ore dumps and stockpiles;*
*(ii) impoundments;*
*(iii) ponds;*
*(iv) diversions;*
*(v) disposal systems;*
*(vi) pits;*
*(vii) tailings disposal facilities;*
*(viii) mills;*
*(ix) water treatment facilities;*
*(x) storage areas for equipment, vehicles, chemicals and solutions;*
*(xi) topsoil and topdressing stockpiles;*
*(xii) waste rock dumps; and*
*(xiii) other facilities or structures.*

As described in Section 1.0, the Roca Honda mine project area encompasses four full sections of land, i.e., Sections 9, 10, 16, 17, and a small portion of 8, as well as the disturbance area associated with the haul road, utility corridor, dewatering pad, and the mine water discharge pipeline leading into and out of the mine project area. Anticipated surface facilities include haul and utility roads, ore bays, retention (holding) ponds, diversion channels, wastewater treatment facilities, water treatment plant facility, warehouse and storage areas for equipment, vehicles, chemicals and solutions, maintenance building, topdressing stockpiles, sub-base rock stockpiles, non-ore development rock stockpiles, parking areas, mine shafts, ventilation shafts and escape ways, hoist buildings and head frames, drill holes, dewatering wells and dewatering pipeline network, fences, power and municipal water lines, surface water runoff control features, and a treated water discharge pipeline. The NMAC requirements specify the various mine facilities that must be discussed. The Roca Honda mine will not have leach pads, heaps, pits, tailings disposal facilities, or mills. This section discusses those facilities that remain in the NMAC subject area.

### 3.2.1 Surface Facilities

Surface facilities were located to minimize potential environmental impact and cultural resource disturbance (NMAC 19.10.6.602 D.(15)(c)(i-xiii)). The surface facilities will be fenced with 8-foot cyclone fencing material topped with angled 3-strand barbed wire or equivalent. Table 2 lists the combined disturbance area per section.

**Table 2 - Disturbance Area Per Section**

| Section | Disturbance area (acre) |
|---|---|
| 9 | 9 |
| 10 | 63 |
| 11 | 0.0 (reestablish existing forest road) |
| 15 | 9 |
| 16 | 86 |
| 17 | 172.0 |
| **TOTAL** | **339** |

**Figure 5, Figure 6, Figure 7, and Figure 8** provide a more detailed view of the proposed surface facilities and associated surface disturbances in Sections 9, 10, 16, and 17, including the anticipated location of the production shafts and ventilation shafts. **Figures 10** and **31** show the additional disturbance for the haul roads, utility corridor dewatering pads and treated water discharge pipeline. Preliminary design drawings are included in **Appendix A**. The majority of the surface area disturbance will occur on Section 17 with the majority being from the stockpile areas, larger support facilities, and the water treatment facility's footprint. Most of the surface disturbance in Section 16 will be stockpile areas, production shaft support facilities, ventilation shafts, and dewatering well pads. It should be noted that the only disturbances anticipated in Section 9 are the construction of ventilation shafts, dewatering wells, associated mud pits, and access road/utility corridor. Similar disturbance is planned for Section 10. Disturbance of Section 15 consists of a road and utility corridor connecting Sections 10 and 16. It is also anticipated the mine will use an existing Forest Service Road which runs east/west through Section 11, connecting to the east side of Section 10 where dewatering well and ventilation shaft pads will be located.

Concurrent with the mine dewatering system (see Section 3.1.3) and shaft construction (see Section 3.1.4), will be the construction of other pertinent surface facilities. An archaeologist will be on-call to monitor surface disturbance activities, as discussed previously. Archaeological sites will be protected as necessary, topdressing will be removed and stockpiled, and the sites will be graded to their design elevations prior to construction of facilities. For archaeology sites that are eligible for listing on the NHRP that cannot be avoided, data recovery in accordance with an approved plan may be necessary prior to disturbance. Buildings will be constructed with exteriors of unobtrusive colors selected from an approved Federal or state land management agency list or as agreed upon with the regulatory agencies. Architectural drawings of the buildings and interior details will be developed, including the administration, rescue and emergency, warehouse, maintenance shop, assay building and guard house. The drawings will contain floor plans and elevations of the buildings in Section 17. Some of the same buildings are to be constructed in Section 16, as shown in **Figure 6**, but will be smaller than those in Section 17. The surface facilities in Section 16 are limited to head frame, hoist house, dewatering well pads and associated piping, ventilation shaft pads, non-ore development rock stockpiles, ore storage bays, sanitary septic system (as needed), and stormwater retention ponds.

Mined ore will be brought to the surface and staged on concrete pads (NMAC 19.10.6.602.D.(15)(c)(i)) in the ore bays in Sections 16 and 17 awaiting transport off-site for processing. The capacity of these bays in 16 and 17 is approximately 12,500 tons. These three-walled concrete bays will have sloped concrete floors, each with a drain to catch and allow captured water to be piped to a surge pond prior to entering the WTP. The bays will have a sump to collect solids before the water enters the surge pond. The solids will be cleaned out periodically, allowed to dry and transported off-site with the ore.

Ore will be segregated and loaded into over-the-road haul trucks for transport off-site for processing. Each truck will inspected to verify that the tailgate is tightly closed, the tarp is secure, there are no leaks, and the truck is safe and operational. Trucks will also be scanned with a radiation measuring device to verify that the outside of the truck is clean before leaving the site. Should the trucks need to be cleaned, water from the specially designed and designated truck wash station will also be collected in a retention pond, re-used/re-circulated and ultimately pumped to the WTP.

### 3.2.2 Stockpiles

Stockpiles (NMAC 19.10.6.602.D.(15)(c)(i)) will contain various types of materials segregated during site preparation activities and mining operations. Separate stockpiles will include topdressing, sub-base rock, and non-ore development rock. The stockpile for each type of material is discussed in more detail below. Estimated volumes of the materials generated over the anticipated life of the mine by type and origin are presented in **Table 3**.

**Table 3 - Material Volumes**

| Material Type (cubic yards) | Section 16 | Section 10 | Section 9 | Section 17 | Section 15 | Total |
|---|---|---|---|---|---|---|
| Production Shafts (50% swell) | 23,595 | -- | -- | 3,534 | -- | 27,129 |
| Typical Vent Shafts (50% swell) | 34,212 | 34,212 | 17,101 | 4,581 | -- | 90,106 |
| Non-Ore Development Rock (50% swell) | 221,000 | -- | -- | 477,000 | -- | 698,000 |
| Topdressing (15% swell) | 127,276 | 112,804 | 11,874 | 319,117 | 17,626 | 588,697 |
| Sub-Base Rock (50% swell) | 41,503 | 36,784 | 3,872 | 104,060 | 5,748 | 191,967 |

Topdressing is representative of the majority of soils that exist in the project area and in New Mexico in general. Vegetative communities that exist in the project area and New Mexico are adapted to these soil conditions. The topdressing stockpiles will be located within the operational facility footprint but out of the traffic patterns and will be placed in areas cleared of vegetation but not scraped of topdressing. Generally, stockpiles will be constructed with 3H:1V (horizontal (H): vertical (V)) slopes and at an estimated height of approximately 25 feet. The 3:1 slopes will accommodate ease of access to work on the piles and reduce erosion loss. The non-ore development rock stockpiles in Section 17, which will be of shorter duration than the Section 16 piles, will be constructed with 3H:1V side slopes to a maximum projected height of 55 feet.

After archaeological inspection/clearance, grading of the disturbed areas will begin with the removal of vegetation located in the footprint of facilities before the topdressing is collected during the site grading process. Prior to the salvaging of topdressing, areas of salvage will be staked to allow equipment operators to salvage the available good quality topdressing to the depth that it is available. Many locations within the planned disturbance area (i.e., the 339 acres) have material that meets good topdressing criteria to a depth of more than 24 inches. These areas will be identified and staked in the field and material removed from these areas to the depth of suitable material or until the required volume is achieved.

Topdressing material will be required for site reclamation to cover the total disturbance area of approximately 339 acres with 12 inches of topdressing. This volume is conservative, as some areas disturbed may be retained after completion of the project to benefit the Post Mining Land Use of grazing, such as some roadways, water catchments, and channels.

The topdressing material will be hauled and dumped on the stockpile area and then graded into layers and compacted with the weight of the equipment driving over it. When a stockpile is completed, it will be seeded with a seed mix (see **Table 8** in Section 5.7). The selected seed mix will perform well in the topdressing soils of the Roca Honda project area, based on precipitation at the time of seeding. The vegetation will reduce erosion while providing microhabitat for beneficial soil organisms.

Drainage swales will be constructed around the topdressing stockpiles where necessary to minimize stormwater run-on/runoff and erosion of the stockpiles. Wattles (fiber rolls) or other BMPs, including but not limited to earthen berms, will be installed below the stockpiles to minimize sediment mobilization during storm runoff events, in accordance with the SWPPP. Topdressing from areas not directly related to the mining facility, such as roads, ventilation/escape shaft pads, and the water treatment facility area, will be added to an existing stockpile or placed in localized areas if transport of the soil is impractical or small in quantity, such as may be the case with more remote ventilation shaft locations.

The excavated sub-base rock below the topdressing will be placed in a separate stockpile designated for sub-base rock in Sections 16 and 17. During initial construction activities, excavated rock will be used as fill or stockpiled for fill during reclamation. The topdressing will be removed and added to the topdressing stockpile before the sub-base rock is placed. The stockpile will be constructed with 3H:1V side slopes with a maximum height of 25 feet for topdressing piles and 55 feet for non-ore development rock stockpiles. The material will be placed in piles from haul trucks, and a dozer will push the material into flat layers. The movement of the dozer on top of the rock will crush and partially compact the material which improves the stability and reduces the volume. The dozer will slowly construct the side slopes and level the top. The stockpile surface may be sprayed with a soil stabilizer or water, if necessary, to control wind erosion. Drainage swales will be constructed around the stockpile to minimize stormwater run-on. Wattles or other BMPs will be installed below the stockpiles to minimize sediment mobilization during precipitation events, in accordance with the SWPPP.

Material generated during shaft construction will be placed in non-ore development rock stockpiles and returned to underground workings and shafts during reclamation. The material from the vent shafts will be hauled to the non-ore development rock stockpiles to decrease the disturbed area around the vents. The volume of production shafts and vent shafts material are separated in **Table 3**, but the shaft material stockpiles in Sections 16 and 17 contain the total volumes. The topdressing at the ventilation shaft areas will be removed and added to the topdressing stockpile. The non-ore development rock stockpiles will be located as near the production shafts as possible to reduce the haulage and keep the material accessible for return to the shafts during reclamation. The side slopes will be 3H:1V, and the height will be limited to 55 feet to minimize the visual impact.

The material will be placed in piles from the haul trucks and a dozer will push the material into flat layers. The movement of the dozer on top of the rock will crush and partially compact the material which improves the stability and reduces the volume. The dozer will slowly construct the side slopes and level the top. The stockpile surface will be sprayed with a soil stabilizer if necessary to control wind erosion. Drainage swales will be constructed around the stockpile where necessary to minimize stormwater run-on. The stormwater runoff from the stockpile will be captured in a retention basin.

The non-ore development rock from Sections 16 and 17 will initially be brought to the surface and placed in separate stockpiles. The designated stockpile areas will first be cleared of topdressing and lined to prevent seepage from the non-ore development rock into the ground surface. As the mine operations progress, material from the underground station and haulage levels of the mine (just below the shafts) will be added to the shaft material stockpile. This stockpile will have 3H:1V slopes and an estimated height of 55 feet. The material will be placed in piles from the haul trucks and a dozer will push the material into flat layers. The movement of the dozer on top of the rock will crush and partially compact the material which improves stability and reduces volume. The dozer will slowly construct the side slopes and level the top. The surface of the stockpile may be sprayed with a soil stabilizer or water, if necessary, to reduce wind erosion. Drainage swales will be constructed around the stockpile to prevent run-on erosion. Stormwater runoff from the stockpile will be diverted to a lined retention pond where sediment fines will be allowed to settle prior to being pumped to the WTP for treatment. As discussed in Sections 3.1.7.4 and 5.2, the non-ore development rock will be returned to the mine as backfill material. As such, the non-ore stockpile will be removed over time.

### 3.2.3 Stormwater Management

As part of the evaluation of continual development of baseline conditions, a surface water hydrology study was conducted to present the concepts, methodology and calculations associated with the stormwater management proposed for the project area and is included in **Appendix B**. The study results were used as a design tool to plan the location and size of the stormwater collection, conveyance, retention, and retention infrastructure, and erosion protection thereof.

Several water impoundments and ponds (NMAC 19.10.6.602.D.(15)(c)(ii)(iii)), i.e., retention ponds and a surge pond and off-spec pond associated with the WTP are planned within the project area to control stormwater runoff and assist in managing the potentially impacted water. Their design and function are described in more detail in Section 5.3.6. Treatment and holding ponds will be constructed as part of the WTP discussed below.

### 3.2.4 Water Treatment Plant

A WTP will be required to treat water generated during mine dewatering activities, collected runoff from ore and non-ore material stockpiles, and other contact water sources as described in Section 3.4.3. Mine dewatering wells, which are discussed in Section 3.1.3, are expected to be the primary consistent influent stream to the WTP during the initial dewatering phase, with other influent sources offering only minor, intermittent, and ephemeral contributions. After each initial mine dewatering phase, the mine dewatering wells will cease operation and ongoing groundwater intrusion will be conveyed in the mine workings and ultimately collected in the Section 17 and/or Section 16 mine shaft sumps and pumped to the WTP.

A preliminary concept-level design for the WTP is predicated largely upon (1) influent water quality from on-site and nearby well data for the aquifers of interest, (2) effluent water quality requirements for discharge as established by 40CFR Part440, Subpart C and relevant NM water quality standards, and (3) a volumetric throughput capacity of 6,000 gpm. Historic data indicates radon, radium, uranium, and molybdenum may be present at levels above applicable standards in the extracted groundwater with arsenic and selenium expected to be present in lower concentrations. These represent the primary constituents of concern (COC) requiring treatment prior to discharge. A general layout of the WTP is presented in **Figure 32**. The envisioned treatment sequence is depicted in **Figure 33**.

It begins with influent water reporting to an air stripping tower to liberate entrained radon, whereafter the water will report to a surge pond designed with a 24-hour hydraulic retention time. From this surge pond, the water will then be conducted to a ferric coprecipitation and lime softening treatment sequence, along with an additional process step to adjust the sodium absorption ratio (SAR). According to this sequence, sulfuric acid would be dosed to the influent water to lower the pH to a range of approximately 4 to 5 [S.U.]. This water would then report to a series of two reactor vessels (reactor set one) where ferric iron would be added as a coagulant to coprecipitate molybdenum and arsenic to anticipated effluent discharge standards, along with a small percentage of the influent selenium and uranium. Following the reactions that take place in the first reactor set, the water would be routed to a multimedia filtration (MMF) unit to remove suspended solids. In the detailed design phase, RHR may consider an alternative to the first MMF unit using a compact sand-ballasted clarifier unit for liquid/solids separation. Water exiting the MMF unit would then be pumped to the second reactor set in a series configuration where calcium salt, ferric and lime are added to induce precipitation of calcium carbonate and magnesium hydroxide in a lime softening process. Radium and uranium are well known to coprecipitate in lime softening processes. Following the reactions that take place in the second reactor set, the water would then report to a clarifier for liquid/solids separation followed by a second MMF unit to further remove suspended solids. Preliminary sampling data indicates the potential need for water exiting the second MMF unit to flow to a buried selenium biological reactor which is designed to have the ability to reduce selenate (which has an oxidation state of +6) to forms of selenium with lower oxidation states, primarily elemental selenium (0). In the detailed design phase this need will be further investigated. Furthermore, RHR may consider an alternative selenium treatment step using ion exchange specifically targeting selenium, e.g., Selen-IX™ process. Water exiting the buried selenium biological reactor would then report to a SAR unit to adjust the ion ratios of the water prior to being discharged.

Sludges generated from the precipitation treatment process, as well as wastes from backwashes, and other accumulated residual streams necessary to service and maintain the treatment sequence are designed to be routed to onsite Geotubes or contained in double-lined cells that will be designed to capture filtrates. The filtrate will be pumped back to the WTP for treatment. Once Geotube capacity has been reached, they will be relocated to a repository area that will be designed and permitted specifically for that purpose, according to regulatory guidance.

It is anticipated that uranium, thorium, radium, as well as trace amounts of other radioactive materials in the U-238 decay series, will be present in the materials recovered from the treatment process. In accordance with the provisions of this MORP, these materials will be collected and shipped offsite to an appropriately licensed facility for proper disposal.

As part of a similar, but alternative process to this sequence, RHR is also considering the use of ion exchange (IX) technology to remove uranium and radium as depicted in **Figure 34**.

As these radionuclides occur naturally in different ionic states, two different IX processes would be required to remove them from the influent streams. This alternative treatment step would involve the use of two sets of IX resin beds, whereby the uranium and radium in the passing water would sorb to the resin via their respective charge affinities: anionic IX resin for uranium, cationic IX resin for radium. Should RHR move forward with this alternative, under normal circumstances the IX resin loaded with radium would be disposed of as radioactive waste, however, RHR may elect to regenerate the uranium-loaded IX resin for repeated use. Regeneration of IX resin is a simple process that involves a wash in diluted acid to strip the uranium from the resin as is routinely done at Energy Fuels' White Mesa Mill in compliance with current NRC licensure and regulations. While this process would be performed at either the mill or licensed offsite facility, it would nonetheless render the regenerated IX resin as by-product material as defined in Section 11, Paragraph e.(2) of the Atomic Energy Act of 1954 et seq. Regardless, upon review of the IX resin sorption performance specifications from multiple vendors, it is assumed that transportation of the fully loaded resin would be considered a Low Specific Activity (LSA) shipment in accordance with the requirements of 49 CFR 173 at all theoretical concentrations and total activities of these radionuclides, and therefore would not warrant additional precautions other than those already in place for shipment of LSA material.

The preliminary treated water pipeline design specifies a 20-inch diameter PVC or HDPE pipe buried below ground in the right of way (ROW). New Mexico Department of Transportation personnel confirmed that the pipeline may be legally and practically placed in the existing, disturbed right-of-way (ROW) parallel to State Highway Route 605. Under unrestricted gravity flow, velocities in the pipe would average 5 to 7 feet per second, and upwards of 10 feet per second in steeper areas near the mine site. As necessary and depending on final WTP facility configurations and elevations, flow control valves may be installed in order to reduce velocities, avoid supercritical flow conditions, and induce full pipe conditions at all locations within the pipe. Based on the pipeline route chosen, the total length of the pipeline varies from 20 to 26 miles. The proposed discharge point would be in a recently re-engineered and widened stretch of the Rio San Jose streambed that runs through the Village of Milan (see BDR Supplement dated July 24, 2018).

RHR's mine permit application and Groundwater Discharge Permit application submitted to NMMMD and NMED, respectively, in 2009 proposed discharge of the treated effluent to San Mateo Creek. In response to agency concerns and comments on the Draft EIS, RHR developed an alternative discharge location to allay those concerns. The discharge will be into the Rio San Jose west of the Village of Milan. Downstream of the discharge point, the water will become available for a variety of users and create a year-round flow in the Rio San Jose, which could increase habitat and potentially benefit wildlife during the period of discharge.

At this time, RHR anticipates that it will operate the pipeline although it is possible that a separate utility company or association of water users may assume the operational responsibilities at some point in the future. Under the New Mexico Mine Dewatering Act (72-12A-1 to 72-12A-13 NMSA 1978), the water removed from the Mine is considered "produced water" and is not considered an appropriation of water; therefore, it does not convey a water right to the party withdrawing it, however, there is nothing in the Mine Dewatering Act that limits the use or uses of the produced water.

Sanitary wastewater treatment facilities will be constructed in Section 17 to treat wastewater from toilets, sinks, showers, and laundry facilities. The wastewater will be routed to buried septic systems designed to treat approximately 10,000 gallons per day.

Surface water at Roca Honda Mine will be managed by infrastructure designed to accommodate the 100-year, 24-hour storm event precipitation total of 2.43 inches. Calculations and design criteria are detailed in the surface water management plan provided in **Appendix B**. Diversion structures (i.e., berms and channels) have been designed for locations in Sections 16 and 17 where stormwater flows could potentially impact the proposed surface facilities (NMAC 19.10.6.602.D.(15)(c)(iv)) or where required to separate contact (i.e., water originating from disturbed areas) and non-contact stormwater. The majority of runoff in Section 17 is currently diverted around the western side of the existing shaft site pad, however, hydraulic modeling of existing conditions for the 100-year 24-storm show that the existing pad would be inundated. Detailed results of the existing conditions flood model are provided in **Appendix B**. To avoid potential flooding of the site an engineered diversion channel would be constructed to intercept runoff from the natural channel to the north, route it along the western perimeter of the pad, and return it to the existing channel downstream of the pad. The proposed road network connecting the various work areas on site crosses natural, ephemeral washes at several locations. Culverts would be installed at each crossing to maintain access to site locations during inclement weather.

Design criteria for less critical crossings (i.e., road crossings away from critical infrastructure and disturbed areas) may be refined in future studies. Retention basins are included for the topdressing stockpile, sub-base rock stockpile, and non-ore development rock stockpile to collect and manage contact water generated on site during the 100-year 24-hour storm. The disturbed surface facilities would be the only areas draining to each of these lined stormwater retention ponds. Portions of the diversion structures (channels and berms) and pond intakes may require stabilization measures such as rock armoring or erosion control mats to prevent erosion and verify zero discharge of contact water.

Warehouse storage areas for chemicals, fuels, explosives and supplies, parking areas for equipment and vehicles, the maintenance facility for vehicles, and electrical substations will be sited appropriately for the designated activities (NMAC 19.10.6.602 D.(15)(c)(x)), and power and water conveyance lines will be constructed to support mine operations. Note that an existing powerline already exists to the Section 17 shaft site. The planned locations of other conveyance lines are indicated on **Figure 4, Figure 5, Figure 6, Figure 7, and Figure 8**.

Construction of the mine shafts is described in detail in Section 3.1.4. Ventilation shafts will be constructed as described in Section 3.1.5 for the required air ventilation and egress in the event of an emergency. The estimated disturbed area for vent shaft pads is approximately 8.9 acres in total, with an additional 4.6 acres for roads to these sites. This disturbed area figure includes the vent shaft material stockpile and drilling recirculation mud pit associated with each shaft. Each vent shaft disturbed area will include an approximate 100 x 250 feet mud pit for the shaft material, and a 100–foot radius drill pad. Wattles or other BMPs will be installed around these areas to minimize sediment release from stormwater on the drill area. Additionally, the areas around the ventilation holes and escape shafts will be graded and bermed to prevent stormwater run-on.

Roads and fences will be constructed to provide access to and security for surface facilities and associated utilities (NMAC 19.10.6.602.D.(15)(c)(xiii)). These features are indicated in **Figure 4, Figure 5, Figure 6, Figure 7, and Figure 8**. Roads are discussed in more detail in Sections 3.4.2 and 4.1.8. Total road surface disturbance within the project area is estimated to be approximately 47.2 acres. This includes haul roads and roads to the vent shafts, dewatering wells, and drill holes. Separate exclusionary fences will be constructed around explosives facilities, electrical substations, and shafts. Fencing specifications are discussed in Section 3.2 and 4.1.10.

The existing meteorological and air quality monitoring stations in Section 16 will be relocated prior to construction activities in the area where it is currently located. Additional stations (largely air monitoring stations) will be installed as necessary in and around the facility at locations to be determined in the future.

RHR has installed three monitoring wells around several of the impoundments in Section 16. One well was completed into the Gallup formation. Two wells were completed in the Dilco formation. Three monitoring wells in Section 17 consist of two wells in the Gallup formation and one in the existing shaft. These wells will be incorporated in a revised NMED Groundwater Discharge Permit Application. An additional three alluvial wells will be installed at locations specified in the approved Discharge Permit.

To confirm and refine the advancement of mining activities, RHR will need to conduct additional development or in-fill drilling. This activity will begin immediately upon approval of the mine permit application and likely occur in phases over the first two years following permit approvals. The development drilling will provide additional data for layout of underground mine workings. Surface disturbance associated with development drilling is temporary in nature as drill sites will be reclaimed on an ongoing basis, typically within weeks or months of plugging the drill holes. Drill sites will typically disturb about 0.3 acres per site including areas that may be compacted by equipment traffic but not bladed or stripped of vegetation. In order to minimize new disturbance, RHR has developed a drill plan that features overlapping drill pads and will drill multiple holes from individual pads wherever possible. Very little new road construction will be required as most sites can be accessed via existing two-track roads or overland travel. Also, most of the access will be in conjunction with other planned surface disturbance. **Figure 4, Figure 5, Figure 6, Figure 7, and Figure 8** show the number of proposed drill holes within each drill area boundary. Drilling will be performed pursuant to approvals obtained from the NMMD as part of the mine permitting process and hole plugging and abandonment will be done in accordance with OSE regulations.

## 3.3 WILDLIFE IMPACTS CONTINGENCY PLAN – 19.10.6.602.D.(15)(d)

*(d) A contingency plan to mitigate impacts to wildlife when there has been an emergency or accidental discharge of toxic substances that may impact wildlife.*

RHR considers it highly unlikely that there will be emergencies or accidental discharge of toxic substances from the Roca Honda Mine and its related surface facilities. With the exception of the storage and use of diesel fuel and/or gasoline, other materials and supplies used onsite will be in small quantities.

Chemical supplies for use at the WTP will be stored in small tanks or other appropriate containers equipped with secondary containment and sumps to prevent accidental release, as necessary. Hydraulic oils, lubricants, antifreeze, and similar fluids will be stored in relatively small quantities that are unlikely to pose a significant environmental or safety risk in the event of an accidental release. Such materials will be stored in compliance with State and Federal requirements.

The mine facilities will include above ground storage tanks for diesel and gasoline. In accordance with NMAC 20.5.109.904, these tanks will be equipped with secondary containment systems. Each containment area will be designed to hold at least 110% of the volume of the largest tank within that area. Additionally, the containment capacity will account for the displacement volume of other tanks located within the same containment area.

Roca Honda Mine will maintain a Spill Prevention, Control, and Countermeasure (SPCC) Plan as part of its operating protocols. This SPCC Plan will address mitigation of potential impacts to wildlife from emergency or accidental releases of toxic substances.

## 3.4 SEDIMENT CONTROL – 19.10.6.602.D.(15)(e)

*(e) A description of measures which will be undertaken to reduce sedimentation from the Project area and a plan for the monitoring of non-point source sediment pollution from the disturbed area.*

Development of the mine surface facilities and associated infrastructure support, as well as the actual mining activities, will disturb portions of the project area making them more vulnerable to erosion. Therefore, surface runoff control measures will be implemented within the RHR project area to contain non-point sources of suspended solids and other potential pollutants.

BMPs will be used to stabilize the site and prevent activities within the project area from contributing suspended solids or other potential pollutants to off-site areas in excess of regulatory standards. As previously mentioned, a SWPPP will be developed and implemented for the facility. The following types of BMPs will be designed, constructed and maintained at the Roca Honda Mine in accordance with the requirements of the New Mexico Department of Transportation (NMDOT, 2009) and the U.S. Environmental Protection Agency (USEPA, 2009). Typical erosion control devices may include, but not be limited to, the following:

- Runoff control devices (swales, ditches, wattles)
- Energy dissipaters (check dams, riprap, etc.)
- Slope drains
- Excavated sediment traps
- Retention ponds
- Diversion channels (overland flow and stream)
- Retention basins
- Stockpile slope construction
- Stockpile soil cover and vegetation

Controls will be inspected and maintained as designed, as described in Section 5.1.2.

### 3.4.1 Surface Facilities

The proposed site grading is shown in **Figure 4, Figure 5, Figure 6, Figure 7, and Figure 8**, while drainage plans for the mine facilities are shown in the stormwater management report provided in **Appendix B**. The installation of site drainage and erosion control BMPs for these facilities will generally proceed according to the following sequence.

Prior to starting preparation of areas for surface facilities' construction, coverage of the area by previous archaeological surveys will be confirmed against the site archaeological survey by a qualified archaeologist and inspected in the field. When the location is "cleared" for cultural resource parameters, the topdressing will be removed and stockpiled. Note that most of the facility area in Section 17 has already been stripped of topdressing and leveled by previous operators and current ranching activity, so very little material is available for salvage.

Stockpile locations are indicated on **Figure 4, Figure 5, Figure 6, Figure 7, and Figure 8**. Separate stockpiles will be constructed for:

- Topdressing
- Sub-base rock
- Non-ore development rock

Stockpile slopes will be constructed at a slope ratio of 3H:1V. Diversion ditches will be constructed around the base of the stockpiles and terminated at excavated sediment traps with rock filter per NMDOT Standard 603-01-5/7 (NMDOT 2009). Wattles or other similar erosion control BMPs will be installed below the stockpiles to minimize material movement. Stormwater runoff from stockpiles disturbance areas will be captured in lined retention ponds constructed with sediment settling structures that will be cleaned as needed.

Topdressing and sub-base rock materials are non-mineralized therefore those stockpiles, disturbance areas and associated retention pond areas will not be lined. Non-ore development rock stockpiles may contain toxic materials therefore retention ponds associated with those stockpiles will be lined. Lined retention ponds will be constructed with liner systems and may include the liner bedding, leak detection systems, synthetic liners, anchor trenches, and berms. Disposal of this water will be accomplished by pumping to the WTP.

To further minimize mass movement of sediments from the site, the stockpiles will be compacted in layers as they are constructed. The stockpile surfaces will be sprayed with a soil stabilizer, if necessary, to control wind erosion.

Following installation of runoff control measures, construction of buildings and other site structures will commence. After construction is complete the disturbed areas not needed for on-going operations will be seeded or treated with tackifiers to reduce erosion by rain and wind.

### 3.4.2 Roadways, Drill Pads, Vent Shafts and Utility Transmission Corridors

As with the previously described installation of BMPs, prior to constructing new roadways, drill pads, vent shafts, and utility corridors, or improving existing roadways, RHR will verify that there are no impacts to archaeological sites eligible for listing on the NRHP. Isolated objects or other culturally significant items discovered during construction will be evaluated for recovery potential by the on-site archaeology monitor. Where appropriate, topdressing will be removed and stockpiled for future use and reclamation.

Access roadways, drill pads, and utility corridors will be constructed at or near existing grade, where possible. Some cut and/or fill for roads and vent shafts may be necessary. Drill pads will conform to existing topography and require minimal preparation for drilling. Typically, existing two track roads or trails will be used to access drill sites while improved roads will by necessary for some vent shaft locations as shown in **Figure 4, Figure 5, Figure 6, Figure 7, and Figure 8**. Detailed plan and profile drawings for the roads will be included in the final mine design drawings. Multiple culvert crossings will be constructed in the project area for access and haul roads. The locations and sizes of the culverts are presented in the Surface Water Management Plan (**Appendix B**).

Culvert design typically accommodates the 10-year, 24-hour storm event and anticipates larger events to overtop the road surface for short durations. Diversion structures, including two culverts adjacent to the mine portal pad where stormwater allowed to overtop the road could inundate the pad and enter the portal, are designed to safely convey a 100-year, 24-hour precipitation event. As more advanced mine design takes place, the surface water management strategy will be refined to accommodate the more detailed information available. Sediment traps will be used immediately upstream of locations where roadside swales discharge to existing drainage channels. Swales and sediment traps will be checked and maintained following runoff events. Maintenance will include restoring roadside swale damage to their original constructed condition and repairing slope erosion damage. In some cases, it may be necessary to install water bars or similar features across roads to decrease erosion potential.

### 3.4.3 Water Treatment Plant

The WTP will be located in Section 17. Site drainage and erosion control BMPs will generally be installed at the site of construction of the WTP in the following sequence, after archaeological clearance has been confirmed:

- Install the perimeter runoff control swales.
- Strip topdressing and store in the designated location. Topdressing slopes will be at a ratio of 3H:1V. Install diversion ditch around base of the stockpile and terminate at an excavated sediment trap with rock filter per NMDOT Standard 603-01-5/7 (NMDOT 2009). Install wattles below the stockpile. Divert runoff to nearest arroyo.
- Grade site to finish grade. Cut slopes will be 2H:1V and fill slopes will be 3H:1V. Place topdressing in the topdressing stockpile and excavated rock in the sub-base rock stockpile, both located in Section 17. These stockpiles will have 3H:1V side slopes.
- Install runoff control swale and excavated sediment trap at toe of cut slopes.
- Following installation of runoff control measures, begin construction of the WTP, associated ponds and pipeline. The ponds will be designed and constructed with appropriate freeboard.

### 3.4.4 Non-Point Source Sediment Monitoring Plan

The Roca Honda Mine project area is drained by ephemeral arroyos that eventually drain to San Mateo Creek, as discussed in more detail in Section 8, Surface Water, of the BDR (RHR, 2020). The drainage basins associated with the project area are described in **Appendix B**. Stormwater discharges from the project area will enter the ephemeral drainages and flow southward to San Mateo Creek, potentially reaching areas of ephemeral or intermittent flow. Stormwater in the process areas will be contained in retention ponds and will not leave the site. Stormwater runoff not captured in the retention ponds will be monitored where there is potential for it to be impacted by industrial activities. The primary regulatory requirements for monitoring the receiving drainages potentially affected by the Roca Honda Mine operations discharges are identified in NMAC 20.6.4, which establishes water quality standards for surface waters of the state and includes an anti-degradation policy.

The general requirements for monitoring the quality of the receiving drainage, including ephemeral, intermittent, and perennial water bodies, are established in NMAC 20.6.4.13 and include limits on the following constituents:

- Suspended or settleable solids
- Floating solids
- Oil and grease
- Color
- Odor and taste of water
- Concentrations of plant nutrients
- Toxic pollutants
- Radioactivity
- Pathogens
- Temperature
- Turbidity
- Total Dissolved Solids

  Dissolved gases (nitrogen, oxygen and ammonia)

Potential non-point source sediment from stormwater runoff from the project area as a result of storm events will be monitored during and/or following storm events, to the extent practicable. Locations to be monitored will include, but not be limited to, the outlets from the planned retention basins and at the receiving drainage in Sections 16 and 17.

The retention basins will be designed to temporarily hold or slow surface runoff from specified drainage basins within the project area to the receiving drainage(s) in order to minimize erosion of existing drainage features. The evaluation of surface water hydrology in **Appendix B** contains preliminary designs for the quantity of stormwater for runoff control structures in Sections 16 and 17. The planned locations of these retention basins are indicated on **Figure 4, Figure 5, Figure 6, Figure 7, and Figure 8**.

During operations the retention basins will be sampled at the outlets after a storm event, when practical, to provide background sediment and water quality data. Grab samples will be analyzed for major cations and anions, suspended solids, and other water quality parameters indicative of ambient runoff water quality.

### 3.4.5 Mine Excavated Materials Management

Management of the excavated material generated during Roca Honda mining operations will generally be addressed in the following ways. Shaft material will be stockpiled separately in a designated area. Non-mineralized material is excavated outside of the mineralized zone to gain access to the ore. These excavations include haulage ways, drifts, raises and other mine development passages that are designed and located to minimize the possibility of containing mineralization. Some of these materials will be hoisted to the surface and stockpiled, particularly in the early development of the mine as discussed in Section 3.1.4. As the mine develops and matures, this type of material produced in the underground excavations will be managed so that it will be excavated and immediately placed underground as mine backfill as described in Section 3.1.7.4. As a result, these materials will not reach the surface of the mine site. When mining has been completed, RHR anticipates that the stockpiled material temporarily stored on the surface will have been re-deposited in the mine and the shafts as part of the final reclamation, pending the results of materials characterization. Some barren rock may be used in achieving design topographic elevations or grades during final reclamation.

The majority of the excavated materials, i.e., the ore brought to the surface of the mine, will be transported off-site for processing. Some sub-grade mineralized material, approximately 221,000 cubic yards in Section 16 and 477,000 cubic yards in Section 17, will be temporarily stockpiled at the mine surface in non-ore development rock stockpiles. Most of this material will be returned to the mine as backfill (see Section 3.1.7.4) though some may be transported to the mill. Production of this material will be minimized to the extent possible as handling this material results in increased mining costs.

## 3.5 POST-MINING LAND USE – 19.10.6.602.D.(15)(f)

*(f) If a post-mining land use is proposed, a detailed description of how the disturbed area will be reclaimed to achieve that use and written approval of the surface owner for the proposed use.*

RHR proposes to reclaim the surface areas of the mine project area that are disturbed by the mining operation to the approved post-mining land use of grazing. Sections 9 and 10 of the project area are owned by the federal government and administered by the USFS; RHR holds the mining claims in these two sections. The Cibola National Forest Land and Resource Management Plan (USFS, 1985) provides for multiple land uses of the forest, including grazing. **Appendix C** contains a letter from Ms. Nancy Rose, former Forest Supervisor of the Cibola National Forest and National Grasslands, approving RHR's proposed grazing post-mining land use for these sections.

Section 16 is owned by the state of New Mexico and administered by the State Land Office (SLO). RHR holds a general mining lease for the section while the Fernandez Company, owned by Lee Ranch, holds the grazing lease. **Appendix D** includes a letter from the New Mexico SLO approving RHR's grazing proposed post-mining land use for Section 16.

The Post Mining Land Use (PMLU) of grazing will be achieved through the successful revegetation of the areas disturbed by the RHR mining operation as described in more detail herein. The reclaimed area will be managed until a viable vegetative community is established which will support livestock grazing. At the request of the landowner(s) some roads and structures may be left to facilitate post-mining land management goals.

# 4.0 PROPOSED RECLAMATION PLAN – 19.10.6.602.D.(15)(g)

The proposed Reclamation Plan has been developed consistent with the requirements of Title 19, Natural Resources and Wildlife, Chapter 10, Non-Coal Mining, Part 6, New Mining Operations and relevant sections of MMD Guidelines. Those guidelines include *Guidance Document for Part 6 New Mining Operations (NM-EMNRD 2010)* and *Joint Guidance for Meeting Radiation Criteria Levels and Reclamation at New Uranium Mining Operations (NM-EMNRD 2016).* Sections 4.0 through 6.0 are organized to address regulations developed under Part 6, with each requirement listed and addressed here. The proposed surface facilities of the mine have been located to avoid eligible archaeological sites wherever possible. The proposed Reclamation Plan has also been developed with the goal of minimizing potential impacts to such cultural resources.

The following sections address NMAC requirements of 19.10.6.602.D.(15)(h) through (k), 19.10.6.603.A through H, and NMAC 19.10.6.605.F.

## 4.1 DESCRIPTION OF THE PROPOSED RECLAMATION PLAN NMAC 19.10.6.602.D.(15)(g) AND NM MINING ACT 69-36-7(H)(4)

*A description of the proposed reclamation plan, including a detailed description of how the disturbed area will be reclaimed to meet the requirements of Section 69-36-7(H)4 and the performance and reclamation standards and requirements of this Part.*

The proposed Reclamation Plan provides a detailed description of the processes to be followed to reclaim areas disturbed by the Roca Honda Mine to meet the requirements of the above cited regulations and Mining Act Section, and the performance and reclamation standards required by this Part. The proposed Reclamation Plan includes performance of a post mining radiological survey of the facilities footprint in compliance with 19.10.6.603.C.(1)(f), and the joint guidance document referenced in Section 4.0 to identify and clean up potential radiological contamination. **Appendix E,** Post Mine Radiological Surveys Plan (Survey Plan), contains the details of the surveys conducted in 2013. Many aspects of the 2013 Survey Plan are consistent with the guidelines established in the 2016 joint guidance document. However, several of the suggested cleanup criteria in the guidance document pertain to licensed facilities such as ore milling operations, uranium mill tailings, etc., which will not be a part of the planned facilities at the mine. RHR is committed to mitigating mine site radiation levels to the State of New Mexico Radiation Cleanup Criteria, where applicable.

Section 3.0 provides a detailed description and design drawings for the construction of the mine surface facilities and the stockpile areas for the excavated soils and rock. To meet the requirements of the NMAC and NM Mining Act Closeout Plan Guidelines for Existing Mines (NMMA, 1996), RHR will recontour disturbed areas utilizing geomorphic design principles to reestablish the general landforms of the area, and to provide for stable configurations that will minimize erosion and provide for successful reclamation. The Preliminary Reclamation Cost

Estimate is included in **Appendix H**. The proposed Reclamation Plan outlines procedures for preparing subgrade materials, applying and conditioning topdressing for seeding, and implementing seeding and mulching activities. The revegetation strategy includes the use of plant species specifically selected for their compatibility with local soils, the regional climate conditions of the project area and the intended post-mining grazing use. As with much of the Southwest and New Mexico, soil horizons that exist in non-riparian zones of the state do not meet soils criteria for classification as "topsoil." Therefore, the final layer of soil material to be placed for revegetation and reclamation is identified as "topdressing."

Section 5.7 describes the revegetation plans in detail. The seed mix shown in that section is a mixture of cool and warm season species of grasses, forbs, and shrubs that have demonstrated the ability to re-establish in mine reclamation soils and support livestock grazing. Each species is known for its palatability to livestock and wildlife, its high nutritive value for herbivores, and its differing optimal growth period (e.g. warm season versus cool season), which makes the mix supportive of the post-mining land use of grazing on a year-round basis. After seeding, the areas will be managed to control access to allow for re-establishment of the vegetative community that will support livestock grazing on a sustainable basis.

The following sub-sections summarize the major reclamation activities planned for the project area following completion of mining activities. These activities are discussed generally in the order they will occur.

### 4.1.1 Disposition of Non-Ore Development Rock Material

Production of non-ore development rock is described in more detail in Section 3.0. Generally, non-ore development rock is excavated and brought to the surface but contains limited recoverable uranium. Reclamation considerations of this material are dependent upon its ultimate disposition. The non-ore will either be stockpiled and hauled offsite for processing or returned to the mine for use as backfill.

Shaft excavation material refers to the material removed during shaft construction, extending from the surface of the ground to the shaft's final depth. This material will either be temporarily stockpiled on the surface within the project area and returned to the mine for use as backfill or hauled off site for processing. RHR has committed to the NMED to perform the analysis of the excavated shaft material as a condition of an approved Discharge Plan to demonstrate that the material can be returned to the mine without impact to groundwater.

The non-ore development rock stockpile areas will be underlain with a liner material to prevent infiltration of water from the material. These temporary stockpile areas will be reclaimed by first excavating down below the original surface grade about 12 inches and that material will either be removed offsite or returned to the mine. The areas will then be ripped to a depth of 12 to 18 inches, topdressing placed in a single lift, and the topdressing lightly ripped or disked to prepare the seedbed. The areas will then be seeded as described in Section 4.1.9.

### 4.1.2 Underground Equipment

An assessment of equipment and materials will be made to determine whether it is salvageable. Salvageable equipment in the mine will be dismantled and transferred to the surface via the production shaft hoisting system. Salvageable equipment and materials will be removed offsite for disposition.

Unsalvageable equipment and materials will be left in the mine. No hazardous materials or toxic substances will be left underground. Prior to equipment being left underground, batteries, fuel, lubricants, hydraulic fluids and other fluids will be drained from the equipment, the equipment will be steam cleaned, and cleaning water collected. These fluids and materials will be removed from the mine and recycled or disposed of in an approved facility.

### 4.1.3 Plugging Shafts, Wells and Drill Holes

Wells and drill holes will be plugged or abandoned in accordance with the OSE requirements per NMAC 19.27.4.31. Hole abandonment and reclamation procedures will begin immediately following geophysical logging of each drill hole. Surface casing (where used) would be removed and the drill rig used to seal holes with a column of high-density bentonite clay material designed specifically for abandonment. The abandonment mud will fill the hole from total depth to ten feet bgs as required by MMD and NMOSE regulations. A cement plug will then be placed from the top of the mud column to a point two feet bgs. The top two feet of the hole will then be backfilled with topdressing to the original ground surface. Drill cuttings in the fenced mud pit will be allowed to dry until they can be covered in place and mounded to compensate for settlement over time. Compacted areas will be scarified or ripped and topdressing material salvaged during drill pad preparation will be spread over the most heavily compacted areas.

Disturbed areas at the drill site will then be reclaimed by broadcasting an approved seed mixture over the areas and harrowing or mulching to cover the seed during the first favorable season. Large shrubs or trees removed during pad preparation will be cut into small pieces and scattered over the reclaimed drill site. Unless on-going access to the site or location is needed, the two-track trail or road to the site will also be reclaimed as described in Section 4.1.8.

Shafts will be plugged by installing an engineered concrete plug at a location below the ground surface. The plug will be approximately four feet in thickness poured, with reinforcing rebar, at a depth of approximately 10 feet below the shaft collar. After curing, the area above the plug will be backfilled with rock and soil material to within one foot of the surface. Another concrete plug will be poured at the surface, again with reinforcing rebar. Once cured, this surface plug will be covered with a 12-inch lift of subgrade soil material, and each lift wetted with water and wheel rolled for compaction.

### 4.1.4 Decommissioning of Retention Ponds

If water exists in the retention ponds (**Figure 4, Figure 5, Figure 6, Figure 7, and Figure 8**) when the ponds are scheduled for closure, the water will be transported via pipeline or truck to the WTP for treatment and release. Accumulated pond sediment will be sampled and analyzed to determine the mineralogy and radionuclide content of the material to determine the appropriate method of management and disposal. Synthetic liners will be removed and disposed of in mine workings, if available, or at a licensed landfill. Sub-liner materials that may be impacted by leaks will be handled in the same manner as accumulated pond sediment. Earthen perimeter berms established as a part of pond construction will be regraded and used for backfilling voids left by pond excavation. Pond backfill will be placed in compacted lifts to promote structural stability, shaped to encourage positive drainage, and contoured to integrate seamlessly with the natural geomorphology of the surrounding landscape. While the regraded site may not exactly match the erosional and depositional characters of the surrounding terrain, the grading will be conducted to blend the reclaimed area so that it is representative of the geomorphological character of the area in general and will meet the geomorphic objective of a stable landform that is resistant to excessive erosion.

The graded elevation will be approximately one foot lower than the final desired elevation to allow for placement of topdressing material. The area will be lightly ripped or disked to a depth of six to 12 inches, and the topdressing applied on this prepared slope. The topdressing will then be prepared for seeding using a disc or harrowing with typical farm equipment, and the area seeded with the approved seed mix.

### 4.1.5 Decommissioning of the Water Treatment Plant

The WTP (**Figure 32**) will not be needed after the mine dewatering has ended and the retention ponds are dry. Once remaining water, including that in the treatment ponds, has been treated and discharged, the bottom sediment will be sampled and analysed to determine its composition and to identify the appropriate management and disposal methods. Sediment will be removed from the ponds using hydro-vac equipment or similar minimize damage to the liner. Material suitable for plant growth medium will be salvaged and blended with top dressing material for use in final reclamation. Sediment deemed unsuitable for plant growth but below regulatory thresholds for contaminant concentrations, as determined through results from laboratory analysis, may be buried in mine workings, if room is available at the time. Alternatively, this material may be loaded into covered highway trucks and transported to an approved landfill. The liners will then be cut into manageable pieces, folded, and disposed of in an approved landfill or buried on site in the mine workings, depending on results from laboratory analysis.

The treatment units will be cleaned, rinsed, and disassembled for sale and reuse at another facility. If the units are not reusable, they will be cleaned, rinsed, and disassembled for disposal in an approved facility. Remaining treatment chemicals may be removed and reused at another site and storage tanks will be recycled or disposed of at an approved landfill. The empty building will be demolished using heavy equipment, with structural components cut or broken into pieces small enough for transport unless written agreement from the landowner specifies leaving the structure to support post mining grazing use. Debris will be loaded into trucks and hauled to an approved landfill. The remaining concrete slab will be broken up and placed in designated pond areas as structural fill, then covered with a minimum of 24 inches of backfill prior to topdressing and final reclamation.

At decommissioning of the WTP, when water treatment has ceased, the discharge water pipeline and mine dewatering pipelines will be removed and the pipeline corridor reclaimed as necessary to meet the geomorphic character of the surrounding areas. Material such as concrete structures and culverts used for arroyo crossings will be removed and the arroyos regraded to approximate pre-crossing conditions although channel armoring materials will be left as erosion control structures. Disturbed areas will be reseeded. The plastic pipeline will be sawed into manageable lengths, loaded on flatbed trailers, and transported for offsite disposal.

### 4.1.6 Disposition of Salvageable Material and Demolition Debris

Salvageable materials will be segregated for recycling. Demolition debris will be staged for transportation and disposal at approved facilities.

Buildings and structures not designated for post-ming use pursuant to written agreements with landowners will be decommissioned in a systematic manner, beginning with the de-energizing of electrical systems and the shutdown of other utilities. Remaining materials, including process reagents, oils, lubricants, and batteries, will be removed and either recycled or disposed of at licensed and approved facilities in accordance with regulatory requirements. Salvageable materials such as metal and copper piping and wiring, corrugated metal siding and roofing, metal beams, windows, doors, interior cabinetry and shelving, lighting, etc. will be recovered and shipped offsite for re-use and/or recycling.

### 4.1.7 Regrading

After the reclamation steps discussed above have been completed, the disturbed areas of the surface facilities will be contoured and graded to meet the geomorphology and topography of the surrounding area to provide controlled drainage and to prepare those areas for revegetation.

The approximate final reclamation contours are shown in **Figures 35, Figure 36, and Figure 37**. Constructed areas that require cut-and-fill to level the surface and control stormwater run-on will require the return of fill to a cut area. Recontouring will involve the removal of constructed drainages and berms, followed by reshaping the surface to align with the natural geomorphology of the surrounding landscape. This process is designed to direct surface runoff toward permanent drainage arroyos in a stable configuration, thereby minimizing the potential for excessive erosion and supporting long-term landform stability. The areas to be recontoured will be protected during construction by erosion control BMPs such as straw bales, wattles, and silt fencing to reduce the loss of soil from stormwater. Prior to reclamation, the cut slopes in rock will be evaluated to determine their potential for long-term stability. The evaluation will include a review of observed movements from initial construction through the mining period of operation. Obvious rock debris, visible displacements of rock structure, and other physical evidence will be considered for final placement. Potentially unstable slopes will be backfilled to a final slope no greater than 3H:1V.

Recontouring will be performed by utilizing bulldozers, excavators, and road graders. Bulldozers and excavators will be used for shaping areas to meet geomorphological objectives of making the reclaimed areas consistent with pre-existing and surrounding geomorphology of the area. The graders will be used to blend the recontoured surface into adjacent undisturbed areas.

A smooth transition to adjacent undisturbed ground will be achieved by blading to meet geomorphic objectives and maintain desired slope gradient. Topdressing will be placed and ripped or disked to a depth of six to 12 inches.

Control of surface water run-on and runoff of the reclaimed areas will be accomplished as part of the recontouring and final grading, and as a part of the overall geomorphological objectives for the site. Existing natural drainage arroyos will be preserved to the extent feasible.

Prior to construction, stormwater runoff in the project area flowed naturally across the surface and drained into a nearby arroyo, following the existing topography. The design of the reclaimed area contours, following geomorphologic objectives, will maintain natural drainage patterns by directing surface runoff into the same arroyos as occurred prior to operations. Drainage channel stabilization materials or structures implemented during site construction may be retained to minimize post-mining erosion. The pre-existing drainages that were diverted away from the mine operation will be recreated to the extent possible. These drainages will follow natural surface gradients so that control structures and energy dissipaters will not be required.

### 4.1.8 Reclamation of Roads

The proposed disposition of haul roads and access roads will be reviewed by the landowners. Prior to final reclamation, the State, USFS, and landowner will determine which roads will be left intact, which will be left but returned to pre-mining condition, and which will be removed and reclaimed pursuant to written agreements with the respective landowners. If the roads retained include constructed crossings such as culverts, these structures will be removed, if requested by the landowners, and drivable low water crossings will be constructed as part of reclamation.

During road reclamation the roadbed will be ripped to a depth of 12 to 18 inches to loosen the subgrade. Road segments that were lower than the surrounding topography will be filled to match the surrounding grade, consistent with geomorphic objectives. Drainage crossings will be removed except as noted above, and the natural drainages will be graded to match the upstream and downstream inverts. After grading meets the geomorphic objective for a specific area and is consistent with the undisturbed terrain, the subgrade surface will be prepared for placement of topdressing by ripping or disking to a depth of six to 12 inches. The topdressing will then be placed on the prepared subgrade to an approximate depth of 12 inches and scarified to a depth of three to six inches, and the area reseeded with the approved permanent seed mix. Topdressing for these roads will be sourced from the closest topdressing stockpile.

A weed-free straw mulch will be applied to the reclaimed roadways at the approximate rate of two tons per acre. As with other locations on the reclamation site, the straw applied will be a long-stemmed straw mulch crimped into the soil with tracked equipment or tractor pulled disc.

Access roads to the ventilation/escape shafts that are not to be retained will be graded to match the original topography. If road surfaces were improved with crushed rock or concrete, this material would be removed prior to regrading, and the material used on another area of the roadways to be retained or hauled offsite.

The utility corridor is a two-track access road and a surface pipeline to carry water from Section 10 dewatering, across Section 15, to the WTP in Section 17. The corridor will be reclaimed by removing the pipeline for disposal, ripping the two-track road, removing the culverts, grading to match the original topography, applying the specified seed mix, then mulching and crimping.

The treated water transport pipeline will be 20 to 30 inch-diameter high density polyethylene (HDPE) or polyvinyl chloride (PVC) and will be buried in accordance with NM DOT specifications. The corridor will be reclaimed by excavating the pipeline, cutting the plastic into manageable sections for disposal in a landfill, refilling the trench, grading to match the original topography, applying the specified seed mix, then mulching and crimping. The concrete encasements, concrete manholes, drainage crossing support structures, and the arroyo discharge structure will be removed, crushed, and hauled to a licensed or approved disposal site.

### 4.1.9 Placement of Topdressing, Seeding and Mulching

Topdressing will be placed as the final layer of material over the areas to be reclaimed. Because topdressing stockpiles are typically constructed to maintain stability and prevent erosion, materials stored at depths greater than two feet have been largely deprived of oxygen and moisture. This lack of exposure can reduce the biological activity essential for supporting plant growth. To address this, these deeper topdressing materials will be amended with Mycorrhizal Inoculum prior to placement at the time of seeding at a rate of 3.6 million propagules per acre (as specified by the supplier) in order to facilitate root establishment and growth.

To further amend the stockpiled topdressing, organic fertilizer will be applied at a rate of 75 pounds of nitrogen per acre. Current organic fertilizer utilized for this type of amendment include Biosol 6-1-3, Fertil-Fibers 6-4-1 and Suståne 5-2-4.

After topdressing is placed, it will be lightly ripped or disked to a depth of three to six inches to prepare a loose and optimum seedbed. Achieving good seed-to-soil contact and ensuring that seeds are adequately covered with soil are critical factors for successful plant establishment in reclaimed areas.

Revegetation of the disturbed area will be designed to create a stable, self-sustaining plant community and will conform with the post-mining land use of grazing. Greater detail on revegetation is presented in Section 5.7. The disturbed project area will be reseeded; using methods best suited to an area's topography. Most topography will be gentle slopes conducive to broadcast or drill seeding. In select areas where slopes are too steep to permit use of drill seeding equipment, the area may be hand broadcast or hydroseeded.

The plant species included in the proposed reclamation seed mix have a proven record of success in this region of New Mexico. The seed mix has been previously approved by the New Mexico Mining Division for use at the nearby Lee Ranch Coal Mine, many other smaller exploration areas, and some former uranium mines in the project vicinity. The plant species, and varieties in the seed mix, are adapted to the soils, climate, and geomorphic character of the McKinley/Cibola County region. Local experience has demonstrated that these plant species are capable of reestablishing stable, self-sustaining plant communities that support livestock grazing without the need for soil amendments or intensive care. Successful revegetation has been achieved with the proposed see mix through proper topdressing management and placement, followed by seeding and the application of weed-free straw mulch.

Mulch will be applied at a rate of 2 tons per acre, and will consist of a long-stemmed, weed-free straw. The straw will typically be applied from 1 ton round bales and distributed with a mulch blower that unrolls the bales and spreads the straw. This results in longer stemmed straw segments which can then be effectively crimped into the soil to anchor it and provide its beneficial properties to the re-establishment of vegetation on the area. This practice has also been shown to be effective at the nearby Lee Ranch Coal operations.

On slopes that may be too steep to apply mulch with this method, straw may be hand spread or spread with a smaller straw blower and anchored using a tackifying agent. Lastly, the areas may be hydro-seeded and hydro-mulched if no other technique is feasible. Additional erosion control BMPs will be placed around the reclaimed areas, in close proximity and remain until vegetation has been established. Monitoring of the areas will be conducted on a periodic basis as required by the Permit to Mine by a qualified botanist, vegetation specialist, or similarly educated professional. The progress of the reclaimed areas will be compared to the reference plot as discussed in Section 5.7.

### 4.1.10 Remove Reclamation Areas Fencing

During operations, areas will be fenced to control access. The fences will remain during reclamation until the recontouring and grading begins. The 8-foot fences surrounding the mine operations areas will be removed and sent off site for disposal or recycling, to allow access and ease of movement for the heavy equipment for regrading and reclamation operations. After the areas have been seeded, they will be fenced with livestock fencing, constructed in accordance with specifications for minimizing injury to big game animals as described in the New Mexico Department of Game and Fish *Habitat Guidelines for Mine Operations and Reclamation* (NMDGF, 2004), until vegetation is established. If the landowners desire, the fencing will be removed after reclamation approval.

## 4.2 RECLAMATION MAPS AND SCHEDULE – 19.10.6.602.D.(15)(h)

*(h) A map or maps at a scale approved by the Director and an approximate schedule indicating the reclamation activities to take place on disturbed areas of the mine site including the number of acres to be reclaimed. A permittee will be required to follow the sequence described unless modified or revised.*

**Figure 4, Figure 5**, **Figure 6, Figure 7, and Figure 8** indicate the surface facilities to be constructed for the proposed mine operation. These facilities will be removed and the surface reclaimed during the timelines presented in Section 4.2. It is estimated that approximately 339 acres required for surface facilities, including access roads, haul roads, utility corridors and pipeline corridors, will require reclamation. The mine operation is estimated to last 15 years.

Reclamation will begin after the mining ceases in Sections 9, 10, and 16, and continue for approximately four years. Reclamation in Section 17 will begin approximately five years after reclamation activities begin. Section 17 reclamation activities are anticipated to take place over a six-month period. The schedule is relative to when activities start and end, as the exact year and month that reclamation will be initiated cannot be accurately predicted at this time. The schedule for the reclamation activities is presented in **Table 4** and **Table 5**. The schedule is divided into the four-section project area. Overall reclamation operations are currently planned to extend for approximately 5.5 years.

**Table 4 – Reclamation Schedule: Sections 9,10, and 16**

| Reclamation Schedule: Sections 9, 10, and 16<br>February 2039 - January 2043 |
|---|
| **Reclamation Activities:** |
| Access Roads |
| Buildings |
| Development Drilling Pads |
| Dewatering Pads |
| Dewatering wells |
| Drillholes |
| Fencing |
| Graded Pads |
| Haul Roads |
| Ore Bay |
| Production Shaft |
| Retention Ponds |
| Shaft Pads |

| |
|---|
| Stockpiles |
| Vent Shafts |

**Table 5 – Reclamation Schedule: Section 17**

| Reclamation Schedule: Section 17<br>February - August, 2044 |
|---|
| **Reclamation Activities:** |
| Access Roads |
| Buildings |
| Dewatering Pad |
| Dewatering Wells |
| Diversion Channels |
| Drillholes |
| Fencing |
| Graded Pads |
| Haul Road |
| Ore Bay |
| Parking Areas |
| Pipelines |
| Production Shafts |
| Retention Ponds |
| Shaft Pads |
| Stockpiles |
| Vent Shafts |
| Water Treatment Pond |

## 4.3 RECLAMATION TOPOGRAPHIC MAP(S) – 19.10.6.602.D.(15)(i)

*(i) A topographic map of the anticipated surface configuration of the permit area upon the completion of reclamation operations.*

Topographic maps of the anticipated surface configuration of the project area upon the completion of reclamation operations are provided in **Figures 35, Figure 36,** and **Figure 37**. The objective of the final site contours of the project area is for the reclaimed areas to be stable from mass-movement and erosional conditions and to be compatible with the geomorphic character of the general area. In support of the post-mining land use objective of livestock grazing, flatter slopes are preferred in the reclaimed landscape. Flatter terrain allows precipitation to infiltrate more effectively into the surface soil profile, making moisture more readily available to plant root systems. This promotes the development of more robust, stable, and productive vegetation communities. In contrast, steeper slopes tend to shed water more quickly, are more prone to erosion, and typically support less biomass due to reduced moisture retention and more challenging growing conditions. Designing reclaimed slopes with gentler gradients not only enhances vegetation success but also contributes to long-term landform stability and sustainable land use.

## 4.4 TOXIC DRAINAGE AFTER RECLAMATION – 19.10.6.602.D.(15)(j)

*(j) A description of the potential for the generation of acid or other toxic drainage from overburden and waste materials following reclamation and a design that incorporates measures to reduce, to the extent practicable, the formation of acid or other toxic drainage that may otherwise occur following reclamation to prevent releases that cause federal or state standards to be exceeded.*

### 4.4.1 Waste Characterization

As discussed in Section 7.4 of the BDR (RHR, 2020), historically, acid mine drainage has not been a problem in the Grants Mineral Belt. While some sulfides are known to exist in some rock formations beneath the planned mining area, acid neutralization potential exceeds acid generation potential.

There is little or no potential for geochemical alteration of overburden, the ore body, or other material. The material excavated during shaft construction and operations will primarily be overburden from rocks overlying the Westwater Canyon Member and material from the Westwater Canyon Member i.e., the ore zone. The only materials overlying the Westwater Canyon Member in the project area that have potential to contribute to acid drainage are the thin coal beds in the Dilco Coal and the Gibson Coal Members of the Crevasse Canyon Formation.

The Dilco Coal Member is present only deep below ground surface in the project area. Section 7.3.1 of the BDR (RHR, 2020) indicates that the Dilco is approximately 600 feet below the surface in Section 16 and 900 feet below the surface in Section 10. The Dilco has an average thickness of 120 feet and a maximum thickness of 128 feet in the project area. The Gibson Coal Member crops out at the surface side slopes of the mesas in Sections 9 and 10 of the project area. At the location of the shafts, the Gibson is typically 100 to 300 feet below the surface. The Gibson has a maximum thickness of 240 feet in the project area.

The individual thickness of the coal seams in the Dilco and the Gibson Members is in the order of five feet thick or less. The Gibson has a reported sulfur content of 0.6 percent sulfur due to trace amounts of pyrite (Kirschbaum and Biewick, 2000). While this could theoretically lead to the production of acid drainage, laboratory studies show that shale/coal with sulfur content less than one percent rarely produces significant acid drainage (Morrison, 1985).

Moreover, RHR's activities in the Dilco and Gibson are limited to transecting the formations during construction of the production and ventilation shafts. As such, the potential for acid and other toxic drainage is inconsequential.

The shaft in Section 17 is currently finished in the top of the Westwater Canyon Member of the Morrison Formation (the ore bearing horizon), but outside of ore, approximately 200 ft above its planned total depth. It is currently flooded to about 750 ft bgs. No development into the ore body from the shaft was ever completed.

In the Westwater Canyon Member, clay minerals are the primary iron-bearing phase (Riese, 1980). The Westwater Sandstone contains areas where the dominant iron mineral is hematite, and areas where the dominant iron mineral is limonite (Saucier, 1980). However, since both limonite and hematite chemically alter pyrite (a potential acid-producing constituent), the new compound formed from pyrite no longer has the potential to generate acid solutions.

### 4.4.2 Material Handling Plan

As previously noted, RHR has committed to characterization of excavated materials as a condition of the NMED approved Discharge Plan. The excavated material will be analyzed to determine the potential for acid generation or other constituents of concern. Material excavated during construction of the mine shafts and vent holes will be temporarily stored in designed lined and unlined stockpiles, as determined by its composition, to prevent mass movement and protect it from stormwater run-on. If the material is chemically inert, it will be returned to the mine and used to backfill areas for stability during mining. If the analytical results indicate the presence of potential acid generating or toxic constituents, the material will be managed in accordance with regulatory requirements.

Runoff from these stockpiles will be collected in lined stormwater retention ponds. Water that does not evaporate will be pumped to the WTP and treated before it is discharged. The sediment from the ponds will be analyzed and managed in accordance with regulatory requirements.

## 4.5 CONTEMPORANEOUS RECLAMATION – 19.10.6.602.D.(15)(k)

*(k) A detailed description of how waste, waste management units, pits, heaps, pads and other storage piles will be designed, sited and constructed in a manner that facilitates, to the maximum extent practicable, contemporaneous reclamation and are consistent with the approved reclamation plan.*

The underground nature of the Roca Honda Mine precludes much opportunity for contemporaneous reclamation activities other than concurrent backfilling of mined out stopes or other mine workings. Areas disturbed will be minimized to the extent possible, and an area that is disturbed during construction and operations will remain disturbed and utilized for the life of the project. The exception are development drill sites that will be reclaimed immediately after geophysical logging and vent shaft pads that will be partially reclaimed following construction.

Section 3.2 outlines the procedures for material handling to support contemporaneous reclamation wherever feasible. Early reclamation activities will include salvaging topdressing and placing it in protected stockpiles for future use, promptly closing dewatering wells once they are no longer required, and reclaiming drill sites as soon as drilling operations are completed. During shaft construction, excavated rock generated from the sinking of the production and ventilation shafts will be brought to the surface and may be temporarily stored in designated stockpile areas until it can be used or properly managed. The design, siting, and construction of these temporary stockpiles are discussed in Section 3.2. The material will be either transported offsite for disposal or returned to the mine as engineered fill. As part of contemporaneous reclamation, as soon as the material to be removed offsite is transported from a temporary stockpile, that stockpile area will be reclaimed as discussed in Section 4.1.

The non-ore development rock produced from initial mine development will be brought to the surface and stockpiled separately. It may be used in backfilling mine workings or hauled to the mill if sufficient uranium to justify processing is present. As the mine develops and ore begins to be removed from the mine, non-ore development rock will remain underground to be used as backfill. This comprises contemporaneous reclamation as it avoids leaving waste rock piles on the surface that would otherwise require reclaiming at the end of the mine life.

# 5.0 PERFORMANCE AND RECLAMATION STANDARDS AND REQUIREMENTS – 19.10.6.603

*The permit area will be reclaimed to achieve a self-sustaining ecosystem appropriate for the life zone of the surrounding areas following closure unless conflicting with the approved post-mining land use. Each reclamation plan must be developed to meet the site-specific characteristics of the mining operation and the site.*

The project area will be reclaimed to support the post-mining land use of livestock grazing following closure. The proposed Reclamation Plan has been specifically tailored to reflect the unique characteristics of both the site and the mining operation. This approach allows reclamation activities to effectively restore the land to a condition suitable for grazing, aligning with long-term land use goals and regulatory requirements.

## 5.1 MOST APPROPRIATE TECHNOLOGY AND BEST MANAGEMENT PRACTICES – 19.10.6.603.A

*The mining operation and the reclamation plan shall be designed and operated using the most appropriate technology and the best management practices.*
"Most appropriate technology" (MAT) means the most suitable technology for a given application, in this case, reclamation activities. In practice, it means selecting and using the appropriate level of technology that can effectively achieve the intended purpose while disturbing the environment as little as possible. BMPs are effective, practical, structural or nonstructural methods that prevent or reduce the impact of a particular activity on the environment. They include currently accepted, tested methods and materials.

The reclamation methods described in the following sections include the most appropriate technologies and best management practices. These methods are developed to achieve a balance between performance of the reclamation activities and protection of the immediate and surrounding environment as an integral component of the proposed Reclamation Plan.

### 5.1.1 Stormwater Quality

Potential effects to stormwater quality during construction, operations and reclamation come primarily from the earth moving activities associated with excavation, transportation, and distribution of materials from roads, sub-base rock and topdressing. Should precipitation occur during this time, the potential for downgradient effects from the transport of sediment, and to a lesser extent, fuels and lubricants from equipment are the greatest. To minimize the potential effects from precipitation during reclamation operations, sediment control BMPs will be established downgradient of reclamation areas to localize effects of rain during operations. A list of potential pollutants that could affect stormwater quality is listed in **Table 6** and **Table 7**.

### 5.1.2 Stormwater Management Controls

The proposed temporary reclamation BMPs are designed to stabilize soils in active work areas and implement structural controls that manage surface water. These measures will divert run-on and runoff, reduce erosion, capture sediment, and mitigate potential stormwater pollutants from sources such as vehicle tracking and wind erosion. To maximize effectiveness, reclamation activities will be coordinated with the implementation of BMPs, ensuring timely and integrated stormwater protection throughout the project area.

The following temporary and permanent BMPs may be implemented, as appropriate, during reclamation activities (see typical designs in **Figure 38**):

*Existing vegetation.* Disturbance of existing vegetation with equipment or vehicles will be minimized to the maximum extent possible in the work areas to reduce or eliminate erosion in those areas.

*Straw bales.* Two or three string bales of weed free straw, measuring approximately three to four feet long and 18 inches square are effective materials for the control of overland water flow, and act to filter, reduce velocity and divert surface flow. Straw bales have more weight and mass than wattles and can often be left in place to naturally degrade over time and add organic matter to the area. Straw bales are secured with two wooden stakes driven through the bales about ten inches from each end.

*Wattles.* Wattles are tubes of rice, straw, fiber, or composted material used for erosion control, sediment control, and stormwater runoff control. They help to stabilize slopes by slowing, spreading, and filtering overland water flow, which in turn helps to prevent sheet erosion and rill and gully development. As necessary, wattles will be placed along the perimeter downgradient of the areas to be graded or recontoured before reclamation takes place during periods when precipitation is likely. They may also be placed along washes and arroyos, down-slope of exposed soil areas. Once in place, they will be staked at approximately three-foot intervals to anchor them in place.

*Wind erosion control.* Wind erosion control consists of applying water and/or other dust palliatives as necessary to prevent or reduce erosion by the forces of wind. Water spray may be applied to small, temporary soil piles during reclamation activities.

**Table 6 - Potential Pollutant Sources - Equipment[2]**

| Material | Chemical/Physical Description | Use | Potential Pollutant[1] |
|---|---|---|---|
| Antifreeze | Colorless or colored oily liquid | Antifreeze coolant for equipment | Ethylene glycol |
| Cleaning solvents | Colorless, blue, or yellow-green liquid | Cleaning equipment | Perchloroethylene, methylene chloride, trichloroethylene, petroleum distillate |
| Diesel fuel | Clear, blue-green, or yellow liquid | Fuel for generators, trucks, heavy equipment | Petroleum distillates, oil and grease, naphthalene, xylene |
| Gasoline | Colorless, pale brown or pink liquid | Fuel for trucks | Petroleum hydrocarbon, benzene, ethyl benzene, toluene, xylene, methyl tertiary-butyl ether |
| Grease, petroleum based | Reddish color, semi-solid gel | Lubricant | Petroleum hydrocarbon |
| Hydraulic fluid | Brown oily petroleum hydrocarbon | Hydraulic devices | Mineral oil |
| Oil | Brown or dark brown oily liquid | Lubricant | Petroleum hydrocarbon |

1Data from Safety Data Sheets, if available

2 These fluids will generally only be used in designated, enclosed shop/equipment maintenance areas equipped with sumps to contain possible fluid spills. Most mining equipment will be fueled and maintained in designated underground service areas.

**Table 7 - Potential Pollutant Sources - Non-Equipment Related**

| Drainage Area | Potential Contributors | Source of Potential Pollutants |
|---|---|---|
| Cleared and graded areas | Soil and sediments | Erosion from cleared and graded areas |
| Demolition and reclamation sites | Soil; sediments; hydraulic fluid, oil, gasoline, and diesel from heavy equipment | Erosion from cleared and graded areas<br>Leaking equipment and support vehicles<br>Spills during fueling and maintenance of equipment and vehicles |
| Site entrance(s) and exit(s), and access roads | Soil, sediments, gasoline, diesel, oil, and hydraulic fluid | Leaking equipment and vehicles<br>Spills during fueling and maintenance of equipment and vehicles<br>Tracking of soil to and from work areas |

### 5.1.3 Practices to Minimize Effects to Stormwater

Specific management practices can be applied to reclamation activities to help minimize potential effects to stormwater in the project area. These practices typically involve good housekeeping and spill control practices, as discussed below.

*Trash and debris.* Trash and debris from the site will be collected and deposited in securely lidded metal dumpsters, which will be emptied as needed by offsite licensed contractors.

No trash or debris will be buried onsite. Personnel will be instructed regarding the correct procedure for waste disposal during reclamation activities.

*Sanitary waste.* The sanitary wastewater treatment units will remain until late in the reclamation process. Portable units will be placed around the final areas after the treatment system has been dismantled.

*Project site access.* The entrance and exit points to the project area will be stabilized to reduce the amount of mud and dirt tracked onto public roads by vehicles and heavy equipment. Stabilization will be accomplished by:

- Limiting the points of entrance/exit to the project site;
- Limiting the speed of vehicles to control dust;
- Properly grading each entrance/exit point to direct runoff away from the entrance/exit; and
- Placement of larger diameter rock (4 to 8 inches) in a 12-inch layer for 50 feet from the pavement to dislodge soil from vehicle tires leaving the project area.

*Vehicle and equipment fueling*. Vehicles that are taken offsite at the end of a work shift will be refueled offsite whenever possible (i.e., in town). Equipment and vehicles refueled onsite will follow the practices outlined below:

- Mobile fueling of equipment throughout the site will be minimized. Whenever practical, equipment will be transported to the designated fueling area(s);
- Absorbent spill clean-up materials and spill kits will be available in the fueling area and on fueling trucks used to refuel equipment outside the designated fueling area, and will be disposed of properly after use;
- Drip pans or absorbent pads will be used as necessary during vehicle and equipment fueling;
- Fueling will be performed on level-grade areas;
- Nozzles used in vehicle and equipment fueling will be equipped with an automatic shut-off to control drips. Fueling operations will not be left unattended;
- Fuel tanks will not be "topped off." Attendant will be present during fueling operations; and
- If fueling is required away from the central fueling area, the fueling area will be located at least 100 feet from downstream drainages and waterways.

*Vehicle and equipment maintenance*. Vehicle and equipment maintenance procedures and practices will be designed to minimize or eliminate the discharge of fuel spills and leaks to site waterways.

- Site vehicles will be monitored daily for leaks and will receive regular preventive maintenance to reduce the potential for leaks. Vehicles with leaks will be repaired immediately or removed from the site if further maintenance is required. A daily checklist will be maintained by operators for their equipment;

- Drip pans or absorbent pads will be used during vehicle and equipment maintenance work;

- Maintenance areas will have spill kits and/or use other spill protection devices;

- If maintenance is required away from the central maintenance shop, maintenance areas will be located at least 100 feet from downstream drainage facilities and waterways; and

- Absorbent spill clean-up materials will be available in maintenance areas and will be disposed of properly after use.

### 5.1.4 Coordination of BMPs with Reclamation Operations

Structural BMPs will be coordinated with reclamation activities, so the BMPs will be in place before reclamation begins. The BMPs placed prior to reclamation activities will be placed away from and downgradient enough to allow an operating perimeter so that equipment can operate safely and efficiently without damage to the BMPs. After the reclamation operations are complete for an area, the BMPs will be relocated to the edge of the newly reclaimed areas. The following BMP coordination with reclamation activities will occur:

- The temporary downgradient perimeter controls (i.e., wattles, straw bales, etc.) will be installed before grading and recontouring begin;
- Once reclamation activities cease permanently in an area, that area will be stabilized (i.e., permanent seed and mulch, soil amendments, revegetation); and
- The temporary perimeter controls will not be removed until reclamation activities are complete, and soils have been stabilized.

## 5.2 CONTEMPORANEOUS RECLAMATION – 19.10.6.603.B

*Contemporaneous reclamation is required to the maximum extent practicable and in a manner that is consistent with the approved reclamation plan.*

Contemporaneous reclamation will be implemented by RHR to the maximum extent practicable, as described in Section 4.5. However, in an underground mining operation, such as the Roca Honda Project, opportunities for contemporaneous reclamation are limited relative to a surface mining operation. Many areas disturbed early in the life of the Project will remain disturbed until mine closure and reclamation. Since the majority of activity will take place below the surface, a relatively small percentage of project operation affects surface resources.

Surface disturbances will consist of the administrative and support facilities, WTP, and ponds, excavation material stockpiles, roads, utility corridors, surface water flow channels and retention basins, retention ponds, and other facilities as described in more detail in Section 3.2. Most of these areas must remain as constructed until mining operations cease and final site reclamation begins.

The approach to contemporaneous reclamation is to avoid and minimize site disturbance where possible. Contemporaneous reclamation will be initiated with topdressing salvage and continue through mine operations with protection and maintenance of excavation material stockpiles, closure and reclamation of dewatering wells when they are no longer needed, and reclamation of drill sites as soon as possible after drilling. This early reclamation reduces erosion, isolates and protects material for later use, provides mitigation of potential effects, and reduces the final reclamation work and costs. The protection and maintenance of material stockpiles are discussed in the following paragraphs.

### 5.2.1 Topsoil (Topdressing)

As with much of the Southwest and New Mexico, soil horizons that exist in non-riparian zones of the state do not meet soils criteria for classification as “topsoil”. Therefore, the final layer of soil material to be placed for revegetation and reclamation is identified as “topdressing.” This material is representative of most soils that exist in the project area and in New Mexico. Vegetative communities that exist in the project area and New Mexico are adapted to these soil conditions. The selected seed mix will perform well in the topdressing soils of the project area, based on precipitation at the time of seeding.

Topdressing will be salvaged as detailed in Section 3.2 to the extent it exists in each area. A total of approximately 588,697 cubic yards of topdressing material will be required to cover the total disturbance area of 339 acres with 12 inches of topdressing. This volume is conservative, as some disturbed areas, such as roadways, water catchments, and channels, may be retained after completion of the project to benefit the post-mining land use of grazing.

Clearing disturbed areas will begin with the removal of existing vegetation within designated facility footprints. This will be followed by the collection of suitable topdressing during site grading activities. Suitable topdressing has been identified in the project area.

Prior to topdressing salvage, designated salvage areas will be clearly staked in the field to guide equipment operators. The goal is to recover up to 588,697 cubic yards of high-quality topdressing material. Many locations within the planned 339-acre disturbance area contain suitable topdressing to depths exceeding 24 inches. These areas will be identified and marked, and material will be salvaged to the full depth of suitability to maximize recovery and support the availability of quality material for reclamation.

Salvaged topdressing will be segregated and stored in a stockpile designated and labeled for topdressing only. Topdressing from roads, ventilation/escape shaft pads, and the WTP area will be added to an existing stockpile or placed in localized areas if transport of the topdressing is impractical. The stockpiles will be stabilized with grass cover until ready for use. **Table 8** displays the seed mix to be used for temporary soil stockpile cover. The final cover will consist of grass species that are well adapted to the regional climate and soil conditions and are known for their ability to establish quickly on disturbed soils. The vegetation will reduce erosion while providing microhabitat for beneficial soil organisms. Diversion ditches will be constructed around the stockpiles, where necessary, to minimize stormwater run-on and run-off erosion.

### 5.2.2 Sub-Base Rock

After the topdressing has been removed from a disturbed area, further excavation will be performed by removing the sub-base rock to the required depth. A predetermined cut and fill grading plan will be used for the large operational facilities, WTP, smaller vent fan pads, and roads, per Section 3.2. Sub-base rock not used as fill to obtain the desired grade during facility construction will be stockpiled and labeled. Diversion ditches around the stockpiles will be constructed where necessary to minimize stormwater run-on erosion and contain runoff from the stockpile. The volume of sub-base rock is anticipated to be minimal based on the depth to bedrock provided in Section 6.0 of the BDR (RHR, 2020). Some of this material may be used as rip rap and/or crushed and used for road base.

### 5.2.3 Non-Ore Development Rock

The production shafts and the ventilation/escape shafts will be excavated as described in Sections 3.1.4 and 3.1.5. Shaft excavation material brought to the surface will be stockpiled separately in non-ore development rock stockpiles. Once the underground development has progressed to a point when backfill material is needed, this material may be used for stability in mined-out areas. Alternatively, the material may be loaded into over the highway haul trucks and transported from the project area to be processed as ore at the White Mesa Mill. The temporary stockpile areas will be reclaimed consistently with the procedures and materials described in previous sections of the proposed Plan.

The non-ore development rock material produced during the mining operations is discussed in Section 3.2. It will be stockpiled onsite until mine development has progressed to the point of needing backfill. Some non-ore development rock will remain underground to help backfill mined-out areas.

Over the mine life, an estimated total of 2.24 million tons of backfill will be needed with the high strength variety comprising 75% of the total. Of this total, 387,000 tons of underground development waste will be directly placed into stopes. The surface development waste stockpile will contribute 516,000 tons, which includes hoisted waste, surface excavations, production shafts, and other mine surface structure excavations. The remaining 1.34 million tons will be generated from a surface quarry.

### 5.2.4 Contemporaneous Reclamation Schedule

The final reclamation schedule will begin after the completion of mining operations (approximately 15 years after operations begin). Since the operation will establish temporary stockpiles during construction, and facilities and infrastructure will be utilized throughout mining operations, there will be little opportunity for contemporaneous reclamation to take place other than concurrent backfilling of mine workings as previously described. However, RHR will continually seek opportunities and conditions to conduct contemporaneous reclamation operations.

## 5.3 ASSURE PROTECTION – 19.10.6.603.C

*The mining operation and completed reclamation shall meet the following requirements established to assure protection of human health and safety, the environment, wildlife and domestic animals.*

### 5.3.1 Signs, Markers and Safeguarding – 19.10.6.603.C.(1) (a)-(f)

*Signs, Markers and Safeguarding Measures will be taken to safeguard the public from unauthorized entry into shafts, adits, and tunnels and to prevent falls from highwalls or pit edges. Depending on site-specific characteristics, the following measures shall be required:*

*(a) closing shafts, adits or tunnels to prevent entry;*
*(b) posting warning signs in locations near hazardous areas;*
*(c) restricting access to hazardous areas;*
*(d) marking the permit area boundaries;*
*(e) posting a sign at the main entrances giving a telephone number of a person to call in the event of emergencies related to the mine; or*
*(f) other measures as needed to protect human safety.*

To protect the public from potential hazards associated with mining operations, a comprehensive system of signs, markers, and safeguarding measures will be implemented starting with limiting access to the mine to employees and vendors. These measures are designed to prevent unauthorized access to hazardous areas such as shafts, adits, tunnels, and to verify that personnel and visitors are protected from site-specific risks.

Access to the project area will be controlled from initial construction activities through mining and reclamation operations to maintain public safety. This is necessary due to potential hazards such as heavy equipment operation, truck traffic, and other site activities that pose risks to untrained individuals. Personnel entering the site will be required to check in and complete site-specific safety training. No individual will be permitted unescorted access to the project area until they have received adequate training, orientation, and formal company approval. Access will be limited to designated areas and tasks specific to each individual’s role and level of authorization.

During reclamation operations, after the site buildings are removed, a temporary field office will be used as a control point for workers and visitors. If a visitor requires entrance beyond the office, the reclamation personnel will accompany them. The access points not being used during reclamation will remain locked. Warning signs will remain in place throughout reclamation and will only be removed once the associated hazards, such as open shafts, have been fully mitigated or removed. These signs will be updated as necessary to reflect changing site conditions. Fencing and other physical barriers will be used to restrict access to hazardous areas and will be adjusted during reclamation work to maintain safety.

Production and ventilation shafts will be permanently closed using engineering methods that prevent unauthorized entry and support long-term safety. These closures will be implemented in accordance with standard engineering practices and are detailed in Section 4.1.3.

Project boundaries will be marked with signs and prominent markers, especially where fencing is not installed. At the main entrance to the site, signage will include the project name, operator information, and a telephone number for emergency contact. These signs will be maintained in good condition and updated as needed to sustain visibility and accuracy.

Additional safeguarding measures, such as radiological surveys, will be conducted in accordance with the Post Mine Radiological Surveys Plan in **Appendix E** to confirm that no residual hazards remain.

### 5.3.2 Wildlife Protection – 19.10.6.603.C.(2) (a)-(c)

*Wildlife Protection Measures shall be taken to minimize adverse impacts on wildlife and important habitat. Based on site-specific characteristics, the following measures will be required:*

*(a) restricting access of wildlife and domestic animals to toxic chemicals or otherwise harmful materials;*

*(b) minimizing harm to wildlife habitat during mining; and*

*(c) reclaiming areas of wildlife habitat if not in conflict with the approved post-mining land use.*

The wildlife protection measures outlined in Section 3.3 will remain in place during reclamation. During closure, products and materials used during operations that have potential to affect wildlife or habitat will be removed from the site and disposed of in an approved and licensed facility. Overhead electric supply lines may remain onsite, decided upon by the utility company and landowners.

Potential harm to wildlife habitat during mining is addressed in Section 3.3. The proposed reclamation plan incorporates best practices that will be maintained throughout reclamation activities. These include minimizing land disturbance and ensuring that reclaimed areas are revegetated with plant species that support both livestock grazing and wildlife habitat through enhanced plant diversity, cover, and productivity.

No open water ponds will remain following reclamation, except for pre-existing stock ponds, which may be reconstructed to their original, pre-mining conditions. By incorporating geomorphic design principles and strategically planting trees and shrubs in clumps, islands, and rows, the reclamation will create transitional zones that enhance habitat diversity. These features provide valuable benefits to both wildlife and livestock by offering windbreaks, shade, and varied habitat structure.

The Habitat Guidelines for Mine Operations and Reclamation (NMDGF, 2004) describes measures that minimize potential adverse effects to wildlife and their habitat. Specific mitigation strategies include creating topographic variability during grading, rather than traditional smooth slopes, to reflect the natural geomorphic character of the area. Where feasible, features such as undulating profiles, niches or ledges on slope faces, brush piles, and rock piles will be incorporated.

Plant species selected to succeed in this environment will be used in reclamation, and seed and mulch will be certified weed-free. Weed control measures will be implemented to prevent the introduction and spread of noxious weeds, particularly those harmful to livestock and wildlife. A Weed Control Plan for the project is included as **Appendix F**.

### 5.3.3 Cultural Resources – 19.10.6.603.C.(3)

*Cultural resources listed on or eligible for listing on the National Register of Historic Places or the State Register of Cultural Properties, and cemeteries or burial grounds shall be protected until clearance has been granted by the State Historic Preservation Office or other appropriate authority.*

RHR recognizes the sensitivity and importance of the presence of cultural properties on the Roca Honda project area. RHR conducted multiple archaeological surveys of the entire project area and designed its surface facilities to avoid archaeological sites wherever possible. The surveys produced a list of sites eligible for listing on the National Register of Historic Places on the state Register of Cultural Properties. RHR is working with the appropriate State and Federal authorities to confirm these sites are protected and/or the required clearances have been granted. RHR in concert with the USFS and State archaeologists identified eleven sites (of the 193 sites found by the surveys) that required closer evaluation because of the proximity to proposed mining activities. These sites will be further investigated, and avoidance and mitigation plans will be devised to protect the sites during construction, operations, and reclamation. For example, some sites may be excavated to recover data prior to construction. Data recovery efforts will be done by knowledgeable archaeologists in accordance with a plan or plans approved by the NM SHPO. The surface facility layouts have been adjusted and may be further modified to protect and avoid sites.

### 5.3.4 Hydrologic Balance – 19.10.6.603.C.(4) (a)-(d)

*Operations shall be planned and conducted to minimize change to the hydrologic balance in both the Project and potentially affected areas. If not in conflict with the approved post-mining land use, reclamation shall result in a hydrologic balance similar to pre-mining conditions unless non-mining impacts have substantially changed the hydrologic balance.*

*(a) Operations shall be designed so that non-point source surface releases of acid or other toxic substances shall be contained within the permit area, and that all other surface flows from the disturbed area are treated to meet all applicable state and federal regulations.*

*(b) The disturbed areas shall not contribute suspended solids above background levels, or where applicable the Water Quality Control Commission's standards, to intermittent and perennial streams.*

*(c) To provide data to determine background levels for surface water entering the permit area, appropriate monitoring shall be conducted on drainages leading into the permit area.*

*(d) All diversions of overland flow shall be designed, constructed and maintained to minimize adverse impacts to the hydrologic balance and to assure the safety of the public.*

- *(i) No diversion shall be located so as to increase the potential for landslides.*
- *(ii) Unless site-specific characteristics require a different standard which is included in the approved permit, diversions which have watersheds larger than 10 acres shall be designed, constructed and maintained to safely pass the peak runoff from a 10-year, 24- hour precipitation event.*
- *(iii) All diversion designs which have watersheds larger than 10 acres shall be certified by a professional engineer registered in New Mexico as having been designed in accordance with 19.10 NMAC. Diversion designs shall be kept on-site or otherwise be made available, upon request, to the Director for inspection.*
- *(iv) When no longer needed, temporary diversions shall be removed and the disturbed area reclaimed.*

Mine operations surface facilities were designed and located to avoid disturbance of and minimize potential effects to surface hydrologic resources. This includes minimizing alteration of arroyos, springs, and stock ponds, as described in Section 3.2. To the extent possible, surface water will be routed around disturbed areas via constructed diversion channels. Surface water entering the project area that does not contact disturbed ground will continue to flow through and exit the project area in its natural channels during operations. Water that encounters disturbed ground or potentially contaminating material will be captured as previously discussed. Some retention basins will also be added to control the flow rate through the watercourses, per Section 3.4. If desired and approved by the landowners, these basins may be retained post-mining to enhance hydrologic stability and support wildlife use.

After operations have ceased, mine water will no longer be discharged. Natural drainage patterns will be restored, and disturbed areas will be returned to grazing land use.

Non-point surface releases will be contained within the project area in retention ponds, and only clean stormwater or treated surface water will leave the area. Materials excavated as part of mine operations will be retained within the project area in constructed stockpiles and reclaimed as part of the contemporaneous reclamation operations. Stormwater that falls on disturbed areas during reclamation will be directed to lined ponds. If necessary, the water will be pumped to the WTP. These facilities will be among the last facilities to be reclaimed.

A SWPPP will be developed to guide stormwater management during construction, operations, and reclamation. BMPs will be used to control suspended solids and prevent erosion. These include regrading, runoff control swales, retention basins, seeding and mulching, erosion control wattles, chemical soil stabilization, and sediment traps. Operational BMPs will remain in place during reclamation until areas are stabilized, and new BMPs will be installed as needed to prevent rill and gully formation until vegetation is established.

Surface water monitoring will continue during reclamation to track the quality and quantity of water entering and leaving the project area, consistent with operational monitoring protocols.

Diversions of overland flow have been designed and constructed to minimize adverse impacts to the hydrologic balance and support public safety. In Sections 17 and 16 of the project area, diversion channels and retention basins have been constructed to redirect overland flow away from disturbed areas and into existing arroyos. These features will remain in place during reclamation until final affected areas are stabilized, after which they will be filled and regraded to match final site contours. The regraded areas will be protected with erosion control measures such as straw bales, wattles, or other BMPs until the vegetation is established.

Diversions have been located to avoid increasing potential for landslides. They have been designed to safely pass the peak runoff from a 10-year or 100-year, 24-hour precipitation event, depending on the temporary or permanent nature of each diversion. Once no longer needed, temporary diversions will be removed, regraded, and reclaimed to match the geomorphic character of the surrounding area.

### 5.3.5 Stream Diversions – 19.10.6.603.C.(5) (a)-(c)

*When streams are to be diverted, the stream channel diversion shall be designed, constructed, and removed in accordance with the following:*

*(a) unless site-specific characteristics require different measures to meet the performance standard and are included in the approved permit, the combination of channel, bank and flood plain configurations shall be adequate to safely pass the peak run-off of a 10-year, 24-hour precipitation event for temporary diversions, a 100-year, 24-hour precipitation event for permanent diversions;*

*(b) the design and construction of all intermittent and perennial stream channel diversions shall be certified as meeting 19.10 NMAC by a professional engineer registered in New Mexico. As-built drawings shall be completed promptly after construction and be retained on site or otherwise made available upon request to the Director; and*

*(c) when no longer needed, temporary stream channel diversions shall be removed and the disturbed area reclaimed.*

No perennial stream channels exist within the Roca Honda project area. However, several ephemeral arroyos are located near the planned disturbed areas. Aerial topography and ground surveys were used to identify the existing conditions of these arroyos.

As part of reclamation, arroyo reconstruction will take place where the system was affected by mine disturbance. The existing bank elevations of the arroyos will remain, and the interior side slopes will be reconstructed to 3H:1V. The bottom inverts will match the original contours. The reconstructed arroyo will meet the geomorphic character of the surrounding area and will end at the location at which it turns into sheet flow. An energy dissipater similar to the one shown in **Figure 39** will be added to the point where the arroyo ends to enhance the transfer to sheet flow. The remainder of the improved channel will be filled and regraded to match the surrounding topography.

Temporary diversions will be designed and constructed to safely pass the peak runoff from a 10-year, 24-hour precipitation event, unless site-specific conditions require a different standard.

Although there are no intermittent or perennial streams within the project area, stream channel diversions will be constructed in accordance with 19.10 NMAC and certified by a professional engineer registered in New Mexico. As-built drawings will be completed promptly after construction and be retained onsite.

When no longer needed, temporary surface water diversions will be removed. The disturbed areas will be regraded and reclaimed to match the geomorphological character of the region.

### 5.3.6 Impoundments – 19.10.6.603.C.(6) (a)-(b)

*If impoundments are required, they shall be designed, constructed and maintained to minimize adverse impacts to the hydrologic balance and adjoining property and to assure the safety of the public.*

*(a) Unless site-specific characteristics require different measures to meet the performance standard and are included in the approved permit, impoundments having earthen embankments but not subject to the jurisdiction of the Mine Safety and Health Administration or the State Engineer shall:*

- *(i) have a minimum elevation at the top of the settled embankment of 1.0 foot above the water surface in the pond with the spillway flowing at the design depth;*
- *(ii) have a top width of the embankment not less than 6 feet;*
- *(iii) have combined upstream and downstream side slopes of the settled embankment not less than 5 horizontal: 1 vertical with neither slope steeper than 2 horizontal: 1 vertical. Slopes shall be vegetated or otherwise stabilized to control erosion;*
- *(iv) have the embankment foundation cleared of all vegetative matter, all surfaces sloped to no steeper than 1 horizontal: 1 vertical and the entire foundation area scarified;*
- *(v) have fill material free of vegetative matter and frozen soil;*
- *(vi) have spillways provided to safely discharge the peak runoff of a 25-year, 24-hour precipitation event, or an event with a 90-percent chance of not being exceeded for the design life of the structure; or*
- *(vii) have other site-specific design criteria for embankments as long as they result in a minimum static safety factor of 1.3 with water impounded to the design level;*
- *(viii) be designed and certified by a professional engineer registered in New Mexico as having been designed and constructed in accordance with 19.10 NMAC. As-built drawings shall be completed promptly after construction and be retained on site or otherwise made available upon request to the Director; and*
- *(ix) if necessary for sediment control be, in place before any other disturbance to the watershed for the impoundment.*

*(b) When no longer required, impoundments shall be graded to achieve positive drainage unless:*

- *(i) the surface estate owner has requested in writing that they be retained;*
- *(ii) they are consistent with the approved reclamation plan; and*
- *(iii) they are appropriate for the post-mining land use or the self-sustaining ecosystem.*

Impoundments will be designed, constructed, and maintained to minimize potential adverse effects to the hydrologic balance and adjoining property and to assure the safety of the public. These design considerations are addressed in Section 3.2.

The landowners will be consulted to determine whether impoundments should be retained as enhancements to the post-mining land use of livestock grazing and wildlife habitat. If retained, the impoundments will remain consistent with the proposed Reclamation Plan and will support post-mining land use. If the landowners do not wish to retain the impoundments, treatment ponds, retention ponds, and retention basins, they will be filled and graded to match the geomorphic character of the surrounding landscape.

Material used to fill the impoundments will be sourced from the impoundment embankments and from stockpiles of inert materials developed and maintained during mine development and operation. These materials will consist of non-mineralized rock and soil. Fill will be placed in lifts of 24 inches or less, moistened, and compacted using wheel-rolling equipment for stability. This process will continue until the impoundments are filled to approximately four feet of the surrounding land surface. Topdressing or sub-base rock will then be placed from stockpiles to a depth of approximately three feet. A minimum of 12 inches of topdressing will be added and graded to match the geomorphic character of the surrounding topography. The areas will then be lightly ripped or disked, seeded with the approved seed mix at prescribed rates, mulched with weed-free mulch, and the mulch will be crimped into the soil or stabilized with a tackifier.

Retention ponds and the WTP ponds will be lined during their construction. If, at the time of closure, the retention ponds contain water, the water will be characterized and treated as necessary by pumping it to the treatment facility prior to discharge. The retention pond bottom solids and liners will be removed and disposed of in approved offsite landfills. The ponds will be reclaimed as discussed in the previous paragraph.

When the WTP is no longer needed, its associated ponds will be closed. Pond sediment and liners will be removed and disposed of in approved and licensed offsite landfills. The ponds will be reclaimed as described above.

Retention basins will not be lined, as they are intended to collect only stormwater that has not contacted potentially contaminated areas. This water will slowly dissipate naturally into the ground, as it does in the arroyos. The primary purpose for the retention basins is to control runoff.

At reclamation, the retention basins will be drained, the overflow structures removed, and the basins filled and regraded as discussed above. These basins may be retained for use as livestock or wildlife water sources if desired by the landowners. Otherwise, they will be reclaimed and recontoured as described above.

### 5.3.7 Minimization of Mass Movement – 19.10.6.603.C.(7)

*Man-made piles such as waste dumps, topsoil stockpiles and ore piles shall be constructed and maintained to minimize mass movement.*

As described in Section 3.2, man-made slopes and stockpiles will be constructed to prevent mass movement. To minimize mass movement of reclaimed slopes or fill areas is minimized, the fill areas will be constructed in 24 inches or less lift, with the addition of water, and each lift wheel rolled to achieve compaction. Since the areas will not be required to support structures or weight other than overlying material, these procedures will be adequate to prevent mass movement.

The soil and rock stockpiles will be used as part of the final reclamation for fill and vegetation growth. No stockpiles will remain on the surface in the project area after final reclamation.

### 5.3.8 Riparian and Wetland Areas – 19.10.6.603.C.(8)

*Disturbance to riparian and wetland areas shall be minimized during mining. Adverse effects to riparian and wetland areas shall be mitigated during reclamation unless the mitigation conflicts with the approved post-mining land use.*

During baseline data investigations within the mine project area, no riparian and wetland areas, as defined by the Clean Water Act Section 404, were identified within the project area.

The proposed water reuse pipeline route to the Rio San Jose would cross numerous ephemeral waterways, and at least two intermittent waterways. In late 2014, a detailed review of each waterway was conducted in the project area. In the spring of 2015 Marron and Associates, Inc., (Marron) completed wetland determinations and delineations within those waterways where wetland characteristics were present. These determinations were completed using the format and data forms presented in the U.S. Army Corps of Engineers (USACE) *Arid West Region Wetland Delineation Manual*. BDR Addendum 1 - Appendix A-3 *Wetland Determination and Delineation, Proposed Pipeline Corridor*, submitted July 24, 2018, presents the findings of those determinations and delineations.

### 5.3.9 Roads – 19.10.6.603.C.(9) (a)-(c)

*Roads shall be constructed and maintained to control erosion.*

*(a) Drainage control structures shall be used as necessary to control runoff and to minimize erosion, sedimentation and flooding. Drainage facilities shall be installed as road construction progresses and shall be capable of safely passing a 10-year, 24-hour precipitation event unless site-specific characteristics indicate a different standard is appropriate and is included in the approved permit. Culverts and drainage pipes shall be constructed and maintained to avoid plugging, collapsing, or erosion.*

*(b) Roads to be constructed in or across intermittent or perennial streams require site-specific designs to be submitted with the permit application.*

*(c) Roads to be made permanent must be approved by the surface owner and be consistent with the approved post-mining land use.*

Section 3.4.2 describes how roads will be constructed and maintained to control erosion, and to meet the applicable regulatory requirements.

Some roads constructed for the mine will support the management of lands for livestock grazing operations and are therefore consistent with the approved post-mining land use. The landowners will be contacted by RHR to determine whether roads should be made permanent after mining operations conclude. If the landowners request that certain roads be made permanent, RHR will submit a formal request to the NMMMD for approval.

### 5.3.10 Subsidence Control – 19.10.6.603.C.(10)(a)-(b)

*Underground and in situ solution mining activities shall be planned and conducted, to the extent technologically and economically feasible, to prevent subsidence which may cause material damage to structures or property not owned by the operator.*

*(a) Underground and in situ solution mining activities near any aquifer that serves as a significant source of water supply to a public water system shall be conducted to avoid disruption of the aquifer and consequent exchange of ground water between the aquifer and other strata.*

*(b) Underground and in situ solution mining activities conducted beneath or adjacent to any perennial stream must be performed in a manner so that subsidence is not likely to cause material damage to streams, water bodies and associated structures.*

Underground mining activities at Roca Honda will be planned and constructed in a manner to prevent subsidence and damage to structures and/or property not owned by RHR.

The target ore zone of the Roca Honda mine is contained within sandstones of the Westwater Canyon Member of the Morrison Formation at a depth of approximately 1,650 to 2,600 feet bgs at the mine site. Between the Westwater Canyon Member and land surface are approximately 2,000 feet of primarily shale with thinner sandstone layers. Mining will occur only within sandstones of the Westwater Canyon Member, and lateral drifts will be restricted to that geologic unit. The vertical depth to the mining area from the surface makes it highly unlikely that mining activities will cause surface subsidence to occur.

The Roca Honda mining activities will be conducted to avoid disruption of aquifers above the ore body and exchange of groundwater between the formation being mined and overlying aquifers. The Roca Honda mine shaft, ventilation holes, and dewatering wells will pass through three saturated geologic units which function as aquifers in parts of the San Juan Basin. From highest to lowest in the geologic section, these units are the Gallup Sandstone, the Dakota Sandstone, and the Westwater Canyon Member of the Morrison Formation. Groundwater within all three of these units is expected to occur under artesian conditions.

As described in more detail in Section 3.1.3, RHR will depressurize the Gallup Sandstone, Dakota Sandstone, and Westwater Canyon Member. This activity will result in groundwater level drawdown in the vicinity of the mine. Extensive evaluation of groundwater occurrences within the project area and modeling of drawdown effects from mining has been completed under the direction of a technical advisory group consisting of representatives from the OSE, NMED, MMD and the USFS. The initial model was updated after RHR acquired the minerals under Section 17 and described in a Technical Memorandum entitled Assessment of Potential Impacts from Dewatering at the Roca Honda Mine, INTERA Inc. April 20, 2017. That memorandum was included as Appendix E-1 of the 2018 BDR Supplement submitted to the MMD. The updated model concluded that mine dewatering "will have (1) negligible impacts on groundwater levels at the public water supplies for Crownpoint and Gallup or at the pueblos of Laguna and Acoma, (2) essentially no impact on springs- including Horace Springs, and (3) negligible impact of groundwater flow to rivers with perennial reaches, including the San Juan River, Rio San Jose, Puerco River, and Rio Puerco".

Development drill holes will be plugged and abandoned in accordance with NMOSE requirements which are intended to prevent potential cross contamination of aquifers.

The Roca Honda Mine is not located beneath or adjacent to a perennial stream or water body. The closest intermittent stream, San Mateo Creek, is located two miles to the south of the mine area. The sources of the creek waters are runoff from precipitation on Mt. Taylor.

No impact to the ground surface or aquifers is expected due to subsidence, as a result of mining activities.

### 5.3.11 Explosives Blasting – 19.10.6.603.C.(11)

*Blasting shall be conducted to prevent injury to persons or damage to property not owned by the operator. Fly rock shall be confined to the Project area. The Director may require a detailed blasting plan, pre-blast surveys or specify blast design limits to control possible adverse effects to structures.*

The use of explosives for construction and mining is discussed in Section 3.1. No explosives use is anticipated for reclamation.

## 5.4 SITE STABILIZATION AND CONFIGURATION – 19.10.6.603.D

*The permit area shall be stabilized, to the extent practicable, to minimize future impact to the environment and protect air and water resources. The final surface configuration of the disturbed* *area shall be suitable for achieving a self-sustaining ecosystem or approved post-mining land use.*

The proposed Reclamation Plan describes in detail how the project area will be stabilized to minimize the potential for future effects on the environment and to protect air and water resources. The final surface configuration of disturbed areas will meet the geomorphological character of the region and surrounding areas and will be suitable for achieving the approved post-mining land use of livestock grazing and wildlife habitat.

### 5.4.1 Final Slopes and Drainage Configuration – 19.10.6.603.D.(1)

*Final slopes and drainage configurations must be compatible with a self-sustaining ecosystem or approved post-mining land use.*

Final slopes and drainage configurations will be constructed to conform with the geomorphic character of the region and surrounding area and will be compatible with the approved post-mining land use of livestock grazing and wildlife habitat.

### 5.4.2 Backfilling – 19.10.6.603.D.(2)

*Backfilling or partial backfilling shall be required only when necessary to achieve reclamation objectives that cannot be accomplished through other mitigation measures.*

Underground mine workings, shafts, impoundments, roads and other depressions will be backfilled, as described in the proposed Reclamation Plan to meet stability requirements and the geomorphic character of the region and surrounding areas.

### 5.4.3 Minimizing Mass Movement – 19.10.6.603.D.(3)

*Reconstructed slopes, embankments and roads shall be designed, constructed and maintained to minimize mass movement.*

Prevention of mass movement of reclaimed slopes, embankments, roads or other fill areas will be achieved through the construction of fill areas in lifts of 24 inches or less, moistened, and wheel-rolled to achieve compaction. Since the areas will not support structures or weight other than overlying material, these procedures will be adequate to prevent mass movement.

The soil and rock stockpiles will be used as part of the final reclamation for fill and vegetation growth. No stockpiles will remain on the surface in the project area after final reclamation.

### 5.4.4 Toxic Drainage Formation – 19.10.6.603.D.(4)

*Measures must be taken to reduce, to the extent practicable, the formation of acid and other toxic drainage that may otherwise occur following closure to prevent releases that cause federal or state standards to be exceeded.*

As discussed in Section 7.0 of the BDR (RHR, 2020) and Section 4.4, historically, acid mine drainage has not been a problem in the Grants Mineral Belt. While some sulfides are known to exist in the rock formations of the project area, acid neutralization potential exceeds acid generation potential.

During operations, RHR will characterize excavated materials as a condition of an approved NMED *Groundwater Discharge Permit*. The excavated material will be analyzed to determine the potential for acid generation or toxic constituents. Material excavated during construction of the mine shafts and vent holes will be temporarily stored in designed stockpiles to prevent mass movement and protected from stormwater run-on. If the material is inert, it will be returned to the mine and used to backfill areas for stability during mining. If the analytical results indicate that acid-generating or other toxic constituents could be leached, the material may be placed back in the mine workings, capped in place, or alternatively taken offsite for disposal. Runoff from these stockpiles will be collected in stormwater retention ponds. Water that does not evaporate will be treated in the on-site WTP for treatment before it is discharged. The bottom sediment from the ponds will be analyzed for constituent makeup and disposed of appropriately in an offsite facility. Alternatively, if sediment is inert, it may be used as soil amendment, if not placed in underground mine workings Consequently, material with the potential to release acid and other toxic drainage will not be onsite after reclamation.

### 5.4.5 Non-Point Source Releases – 19.10.6.603.D.(5)

*Non-point source surface releases for acid or other toxic substances shall be contained within the permit area.*

As previously discussed, materials excavated from the underground development will be temporarily stored on constructed stockpile areas that will contain stormwater runoff from the stockpiled material and direct it to lined retention ponds. There will be no releases from the project area.

## 5.5 TOPSOIL (TOPDRESSING OR COVER MATERIAL) – 19.10.6.603.E (1)-(6)

*Where sufficient topsoil is present, the operator shall take measures to preserve it from erosion or contamination and verify that it is in a usable condition for sustaining vegetation when needed.*

*The following requirements shall be met unless site-specific characteristics mandate different requirements and those requirements are included in the approved permit.*

*(1) Topsoil and topdressing shall be sampled and analyzed for vegetation establishment suitability:*

*(a) sample spacing and interval shall be based on site-specific materials; and*

*(b) suitability will be identified by analysis based on site-specific materials.*

*(2) If revegetation is a component of the reclamation plan and if sufficient topsoil is present in the disturbed or borrow areas, it shall be collected and preserved to the extent practicable. Sufficient topsoil means that it is of sufficient quality to conform to the definition of topsoil. Any necessary topdressing may be obtained from areas to be disturbed or borrow areas and shall be salvaged separately from other materials as needed to ensure its availability for distribution when needed for reclamation.*

*(3) Where direct distribution of topsoil or topdressing is not possible, it shall be stockpiled separately and in a manner to prevent loss of the resource.*

*(4) Topsoil and topdressing shall be distributed in a manner to establish and maintain vegetation, consistent with the approved permit.*

*(5) After distribution, topsoiled and topdressed areas shall be stabilized to protect loss of the resource.*

*(6) Where topsoil has been stockpiled for more than one year, the permittee may be required to conduct analyses to determine if amendments are necessary.*

Topdressing suitability has been evaluated as detailed in Section 6.0 of the *BDR (RHR, 2020)*. Topdressing has been sampled and analyzed for its ability to support vegetation establishment. Ample material has been identified to utilize as topdressing for re-establishing a vegetative community that will support the approved post-mining land use of livestock grazing and wildlife habitat.

The subject of topdressing is discussed in detail, in Section 5.2.1. Where sufficient topdressing is present in the borrow areas, it will be collected and preserved to the extent practicable. Topdressing may also be obtained from areas to be disturbed or from borrow areas and will be salvaged separately from other materials for reclamation purposes.

Where direct distribution of topdressing is not possible, it will be stockpiled separately and in a manner to prevent loss of the resource. Stockpiling and management of stockpile topdressing is addressed in Section 4.1.9.

Topdressing will be distributed in a manner that supports the establishment and maintenance of vegetation. The distribution and application of topdressing on reclaimed areas is further discussed in Section 5.2.1.

After distribution, areas where topdressing was applied will be stabilized to protect against loss of the resource. The materials will be lightly ripped or disked to prepare a suitable seedbed, and seed will be applied by drilling or broadcast seeding. The seeded areas will then be mulched and stabilized.

Topdressing that has been stockpiled for more than one year will be analyzed prior to use to determine if soil amendments are necessary to support successful reclamation of disturbed areas.

## 5.6 EROSION CONTROL – 19.10.6.603.F (1-7)

*Reclamation of disturbed lands must result in a condition that controls erosion. Revegetated lands must not contribute suspended solids above background levels, or where applicable the Water Quality Control Commission's standards, to streamflow of intermittent and perennial streams. Acceptable practices to control erosion include but are not limited to the following:*

*(1) stabilizing disturbed areas through land shaping, berming, or grading to final contour;*
*(2) minimizing reconstructed slope lengths and gradients;*
*(3) diverting runoff;*
*(4) establishing vegetation;*
*(5) regulating channel velocity of water;*
*(6) lining drainage channels with rock, vegetation or other geotechnical materials; and*
*(7) mulching.*

As part of reclamation operations, disturbed areas will be stabilized through grading to conform to the geomorphic character of the region and surrounding area. This includes shaping, berming, and grading to final contour to reduce erosion potential. Reclamation of slopes will incorporate the practice of minimizing slope lengths and gradients, construction of water bars or other methods to further reduce the risk of excessive erosion.

Runoff and run-on will be diverted from reclaimed areas to prevent erosion. Establishment of vegetation is a primary objective of the mine's reclamation operations and is described in detail in Section 5.7. Vegetation will play a key role in stabilizing soils and reducing sediment transport.

To manage surface water flows and reduce erosion, systems will be constructed to regulate channel velocity. These systems, described in Section 3.4, include surface water diversions and stabilization BMPs such as riprap, energy dissipation structures, straw bales, and wattles.

Weed-free mulch will be applied to reseeded areas at a rate of two tons per acre to protect soil surfaces, retain moisture, and support seed germination. This mulching practice will further enhance erosion control and contribute to successful revegetation.

## 5.7 REVEGETATION – 19.10.6.603.G

Revegetation of areas disturbed by mining operations will be achieved following the practices and procedures outlined in the proposed reclamation plan. Affected areas will be backfilled, regraded and shaped to conform with the geomorphic character of the area before mining operations and of areas surrounding the disturbed areas. Salvaged topdressing will be redistributed over regraded areas and seeded in support of the post-mining land use of livestock grazing.

The proposed seed mix shown in **Table 8** is utilized at the Lee Ranch Coal Mine, which is located in the same region as the Roca Honda Mine and in similar topography, soils and climatic regime. This seed mix has been developed and shown to be effective over the past 30+ years. The seed mix includes a combination of cool and warm-season grasses, forbs, and shrubs that have proven successful in re-establishing vegetation in reclaimed mining facilities. These species are well-suited for wildlife and livestock grazing due to their high palatability and nutritional value. Their varied seasonal growth patterns ensure year-round forage availability, supporting the post-mining land use of grazing by both domestic livestock and wildlife.

**Table 8 - Proposed Reclamation Seed Mix for the Roca Honda Mine**

| Common Name | Scientific Name | Variety/Source | Application Rate – PLS lbs/acre (Broadcast) |
|---|---|---|---|
| Cool Season Grasses | | | |
| Thickspike Wheatgrass | *Agropyron dasystacyum* | Critana | 2.0 |
| Indian Ricegrass | *Achnatherum hymenoides* | Nezpar or Paloma | 1.0 |
| Western Wheatgrass | *Agropyron smithii* | Arriba | 3.0 |
| Warm Season Grasses | | | |
| Blue Grama | *Bouteloua gracilis* | Hachita or Alma | 2.0 |
| Sideoats Grama | *Bouteloua curtipendula* | Niner or Vaughn | 2.0 |
| Galleta | *Hilaria jamesii* | Viva | 3.0 |
| Alkali sacaton | *Sporobolus airoides* | Native | 0.1 |
| Forbs | | | |
| Munro Globemallow | *Sphaeralcea munroana* | Native | 0.4 |
| Blue Flax | *Linum lewisii* | Appar | 0.5 |
| Shrubs | | | |
| 4-Wing Saltbush | *Atriplex canescens* | Native | 3.0 |
| Winterfat | *Ceratoides lanata* | Native | 1.0 |
| Shadscale | *Atriplex confertifolia* | Native | 1.0 |

### 5.7.1 NMAC 19.10.6.603.G.(1)-(3)

*To obtain the release of financial assurance revegetated lands must meet the following standards:*

*(1) Revegetation success for a self-sustaining ecosystem shall be determined through comparison of ground cover, productivity and diversity and shall be made on the basis of the following approved reference areas; through the use of technical guidance procedures published by the U. S. Department of Agriculture; other reasonably attainable standards methods and techniques on reference areas and reclaimed areas.*

*(a) foliage or basal cover and productivity of living perennial plants of the revegetated area shall be established equal to 90 percent of the reference area or equal to the approved revegetation standard to within a 90-percent statistical confidence;*

*(b) diversity of plant life forms (woody plants, grasses, forbs) shall consider what is reasonable based on the physical environment of the reclaimed area; and*

*(c) woody plant species shall be established to the approved density with an 80 percent statistical confidence.*

*(2) For areas for which the approved post-mining land use is for wildlife habitat or forest land, success of vegetation shall be determined on the basis of tree or shrub stocking (density) and ground cover.*

*(a) The ground cover of living perennial plants shall be equal to 90 percent of the native ground cover of the reference area or the approved standard to within a 90 percent statistical confidence and shall be adequate to control erosion.*

*(b) Tree stocking for forest land shall have stocking rates of plant species equal to 90 percent of the approved reference area or other approved standard with an 80 percent statistical confidence and shall be adequate to control erosion.*

*(c) If wildlife habitat is to be the post-mining land use, the operator shall select and use plant species on reclaimed areas based on the following criteria:*

*(i) their proven nutritional value for fish and wildlife;*

*(ii) their uses as cover and security for wildlife;*

*(iii) their ability to support and enhance fish and wildlife habitat; and*

*(iv) distribute plant life forms to maximize benefits of edge effect, cover and other benefits for fish and wildlife.*

*(3) Revegetation for other post-mining land shall be consistent with the approved post-mining land use. Site-specific standards may include standards for foliar or basal cover, production and diversity and will be included in the approved permit.*

Revegetation success for a self-sustaining ecosystem will be determined through comparison of ground cover, productivity, and diversity and will be made on the basis of a reference area located in Section 16, see **Appendix G** for the Proposed Reference Area Report. The revegetation success will also be determined using technical guidance procedures described in MMD's Guidance Document for Part 6 New Mining Operations. Data collection will be performed using the same methods and techniques on reference areas and reclaimed areas. More specifically, the goal of revegetation will be to meet:

- Foliage or basal cover and productivity of plants of the revegetated area to 90% of the reference area or within a 90% statistical confidence
- Diversity of plant forms (woody plants, grasses, forbs) relative to the physical environment of the area to be reclaimed
- Establishment of woody plants to obtain the approved density with an 80% statistical confidence.

The approved post-mining land use for the project area is livestock grazing. Therefore, revegetation design, species and methods proposed will result in the area being supportive of livestock grazing on a sustainable basis.

As such, the reclamation objectives will target a higher percentage of grasses and forbs than woody plants. However, woody species such as four-wing saltbush *(Atriplex canescens)* and winterfat *(Ceratoides lanata)*, offer good livestock and wildlife forage as well as providing habitat diversity.

## 5.8 PERPETUAL CARE – 19.10.6.603.H

*The operation will be designed to meet without perpetual care all applicable environmental requirements of the Act, 19.10 NMAC and other laws following closure.*

RHR reclamation was designed to meet, without perpetual care, applicable environmental requirements of the Act, 19.10.6 NMAC and other laws following closure.

# 6.0 COMPLIANCE WITH OTHER APPLICABLE LAWS - 19.10.6.604.A-C

(A) *Enforcement of other state or federal laws, regulations or standards shall be conducted by the agency charged with the responsibility under the applicable state or federal law, regulation or standard.*

(B) *Enforcement of non-point source surface releases of acids or other toxic substances shall be performed by the Environment Department.*

(C) *During the term of a permit issued pursuant to 19.10 NMAC, the permittee must maintain environmental permits required for the permit area. Revocation or termination of such a permit or the forfeiture of financial assurance related to the permit area by another governmental agency is adequate ground for the Director to issue a cessation order pursuant to 19.10.11 NMAC.*

RHR is committed to complying with other applicable laws in the construction, operation, closure and reclamation of the Roca Honda Mine. **Table 9** contains a list of other regulatory agency approvals that will be needed for the mine.

**Table 9 - List of Federal and State Permits**

| Permit Approval | Granting Agency |
|---|---|
| Federal | |
| NPDES Discharge Permit | U.S. Environmental Protection Agency (EPA) |
| U.S. COE 404 Permit | If needed, U.S. Army Corps of Engineers |
| NPDES Construction Stormwater Permits | EPA |
| NPDES Stormwater Discharge Permit | EPA |
| Approved Plan of Operations for Mine | US Forest Service |
| ROW for water pipeline; depending on direction; possible special use permit | Possibly USFS |
| ROW for electrical power line; depending on existing ROW; possible special use permit | Possibly USFS |
| Radioactive material license for ion exchange | Possibly NRC for mine water treatment if > 0.05 % uranium by weight |
| Mine Registration | Mine Safety and Health Administration |
| State | |
| Mine registration (Form 1) | New Mexico Energy, Minerals and Natural Resources Dept., Mining and Minerals Division |
| Construction and Operations Permits (Air) | New Mexico Environment Dept., Environmental Protection Division, Air Quality Bureau |
| Petroleum Storage Tanks Registration Form | New Mexico Environment Dept., Environmental Protection Division, Air Quality Bureau, Petroleum Storage Tank Bureau |

| | |
|---|---|
| Permit to Appropriate Underground Waters of the State of NM | Office of the State Engineer, Water Resource Allocation Program |
| Mine Dewatering Permit | Office of the State Engineer, Water Resource Allocation Program |
| Mine Discharge Permit | New Mexico Environment Department, Ground Water Quality Bureau |
| Closure Plan for retention ponds | New Mexico Environment Department, Ground Water Quality Bureau |
| Liquid (Septic) Waste Permit or Registration | New Mexico Environment Dept., Environmental Protection Division, Solid Waste Bureau |
| Building Permit | New Mexico Regulation and Licensing Dept., Construction Industries Division |
| Non-Subdivision Road Work Request | New Mexico Dept. of Transportation through McKinley County office |
| State Highway Access Permit | New Mexico State Highway and Transportation Dept |
| Radioactive material license RCB Form 016 (possibly for source used for onsite analysis) | New Mexico Environment Dept., Field Operations Division, Radiation Control Bureau |

# 7.0 REFERENCES

INTERA, 2011, 2012. Assessment of Potential Impacts from Mine Dewatering at the Proposed Roca Honda Mine, McKinley County, NM.

Kirschbaum, M.A., and L.R.H. Biewick, 2000. “A Summary of the Coal Deposits in the Colorado Plateau: Arizona, Colorado, New Mexico, and Utah,” in Geologic Assessment of Coal in the Colorado Plateau: Arizona, Colorado, New Mexico, and Utah, U.S. Geological Survey Professional Paper 1625-B.

Morrison, J.L., 1985. Pre-Mining Prediction of Acid Mine Drainage in the Allegheny Plateau of Western Pennsylvania, Geological Society of America, Abstracts with Programs, v. 17, issue 98, p. 669.

NMDGF (New Mexico Department of Game and Fish), 2004. Conservation Habitat Handbook, “Habitat Guidelines for Mine Operations and Reclamation.”

NMDOT (New Mexico Department of Transportation), 2009. Standards and Specifications Unit, Division 603, Temporary Erosion and Sediment Control.

NMMA (New Mexico Mining Act), Reclamation Program, 1996. Section 69-37-7(H), Closeout Plan Guidelines for Existing Mines.

Riese, W. C., Brookins, D. G., and Della Valle, R. S., 1980. Scanning-electron-microscope Investigation of Paragenesis of Uranium Deposits, Mt. Taylor and Elsewhere, Grants Mineral Belt: in Rautman, Geology and Mineral Technology of the Grants Uranium Region, 1979, NM Bureau of Mines and Mineral Resources, Memoir 38, NM Institute of Mining and Technology, Socorro, NM.

RHR (Roca Honda Resources LLC), 2020. Baseline Data Report for the Roca Honda Mine Revision 1.

Saucier, A.E., 1980. Tertiary Oxidation in Westwater Canyon Member of Morrison Formation: in Rautman, C. A. (ed), Geology and Mineral Technology of the Grants Uranium Region 1979, NM Bureau of Mines and Mineral Resources, Memoir 38, NM Institute of Mining and Technology, Socorro, NM.

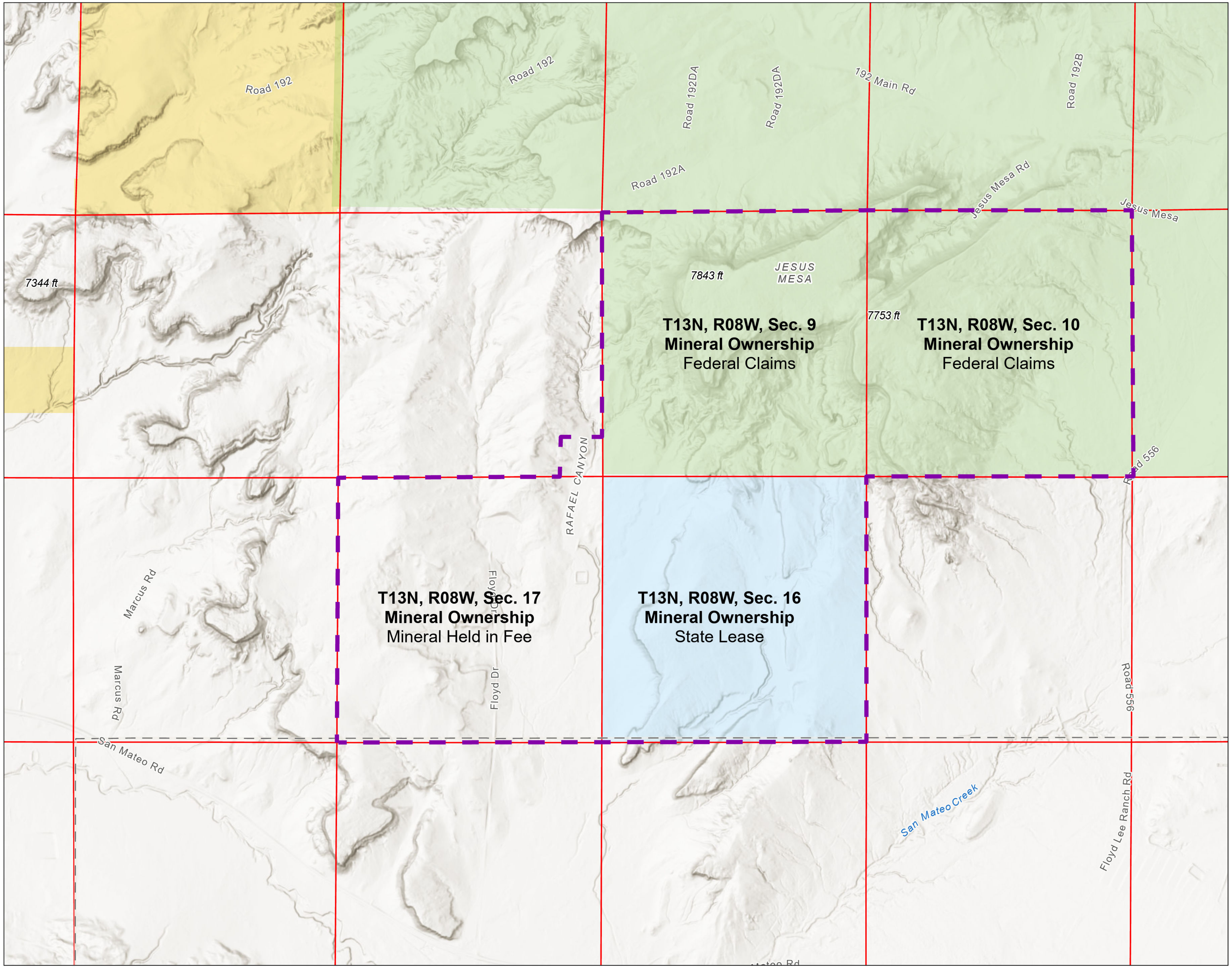
State of New Mexico NM-EMNRD, Mining and Minerals Division and NMED. Joint Guidance for the Cleanup and Reclamation of Existing Uranium Mining Operations in New Mexico, March 2016.

State of New Mexico NM-EMNRD, Mining and Minerals Division and NMED. Guidance Document for Part 6 New Mining Operation Permitting Under the New Mexico Mining Act, August 2010.

U.S. Department of Agriculture, Forest Service, SW Region, Cibola National Forest Land and Resource Management Plan, July 1985.

U.S. Environmental Protection Agency, 2009. National Pollutant Discharge Elimination System, Stormwater, Stormwater Pollution Prevention Plans for Construction Activities.

# Figures




Stantec

## Legend

- Roca Honda Project Area
- Section Line
- Private
- State
- U.S. Forest Service
- Bureau of Land Management

***Notes***

**1.** Coordinate System: NAD 1983 2011 StatePlane New Mexico West FIPS 3003 Ft US

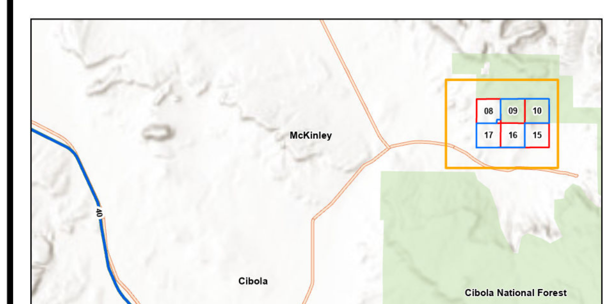
**2.** Data Sources: 1. Roca Honda Resources, LLC 2. BLM Surface Management Agency Layer, Rasterized by Esri from feature May 2025.

**3.** Background: Esri, Esri, NASA, NGA, USGS, FEMA, Esri, CGIAR, USGS, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

N

0 2,000 4,000 Feet

(At original document size of 11x17)
1:24,000




*Project Location*
McKinley County, New Mexico

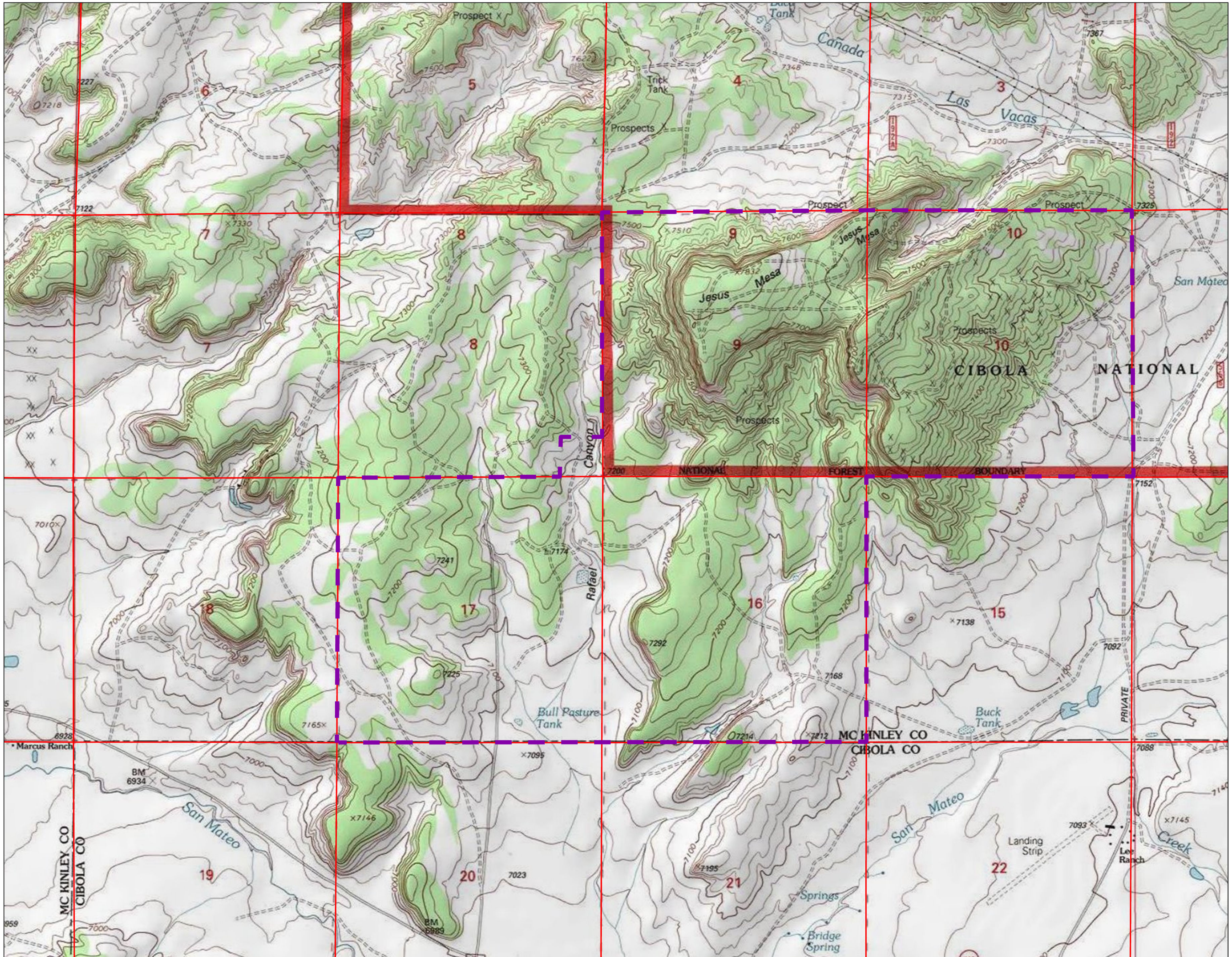
Prepared by SK on 8/5/2025
TR by EZ on 8/5/2025
IR by AR on 8/5/2025

*Client/Project* 182925615
Client: Roca Honda Resources, LLC
Project: Roca Honda Mine
Report: MORP

*Figure No.*
**01**

*Title*
**Project Area Boundary Map**

U:\1829\182925615_ArcPro\Roca Honda\Roca Honda_August 5.aprx Project Plan Boundary Map_11x17 Revised: 2025-08-05 By: skashani




Stantec

## Legend

Roca Honda Project Area

Section Line

**Notes**

**1.** Coordinate System: NAD 1983 2011 StatePlane New Mexico West FIPS 3003 Ft US

**2.** Data Sources: 1. Roca Honda Resources, LLC 2. BLM Surface Management Agency Layer, Rasterized by Esri from feature May 2025.

**3.** Background: Esri, CGIAR, USGS, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community, Copyright:© 2013 National Geographic Society, i-cubed

0 2,000 4,000 Feet

(At original document size of 11x17)
1:24,000


*Project Location*
McKinley County, New Mexico

Prepared by SK on 8/5/2025
TR by EZ on 8/5/2025
IR by AR on 8/5/2025

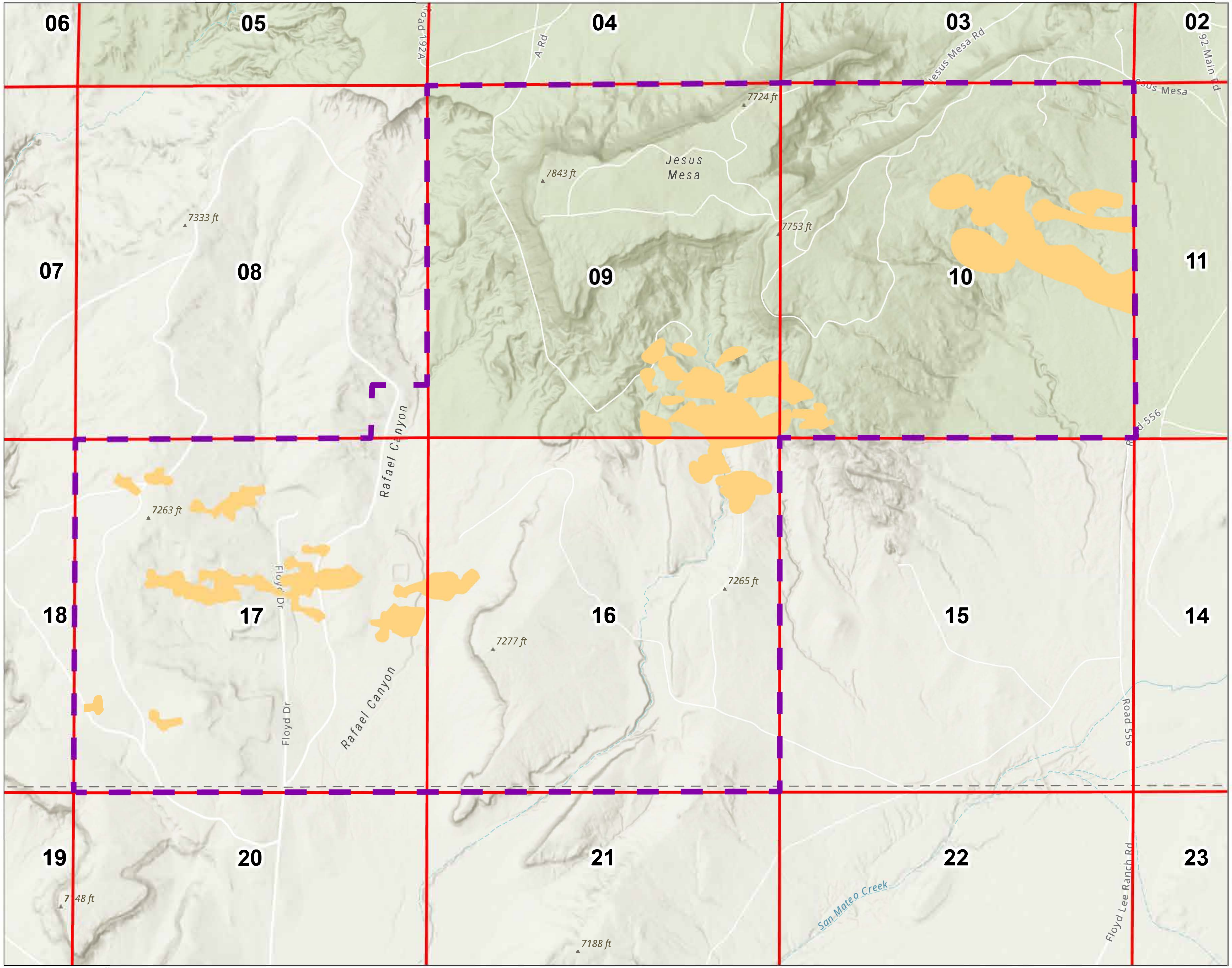
*Client/Project*
182925615

Client: Roca Honda Resources, LLC
Project: Roca Honda Mine
Report: MORP

*Figure No.*
**02**

*Title*
**Pre-Mine Topographic Map**

U:\182925615_ArcPro\Roca Honda\Roca Honda_August 5.aprx Pre-Mine Topographic Map_11x17 Revised: 2025-08-05 By: skashani




Stantec

**Legend**

- Project Boundary
- Ore Bodies
- Section Line

***Notes***

**1.** Coordinate System: NAD 1983 2011 StatePlane New Mexico West FIPS 3003 Ft US
**2.** Data Sources: Roca Honda Resources, LLC
**3.** Background: Esri, NASA, NGA, USGS, FEMA, Esri, CGIAR, USGS, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community

N

0 1,500 3,000 Feet

(At original document size of 11x17)
1:18,000


*Project Location*
McKinley County, New Mexico

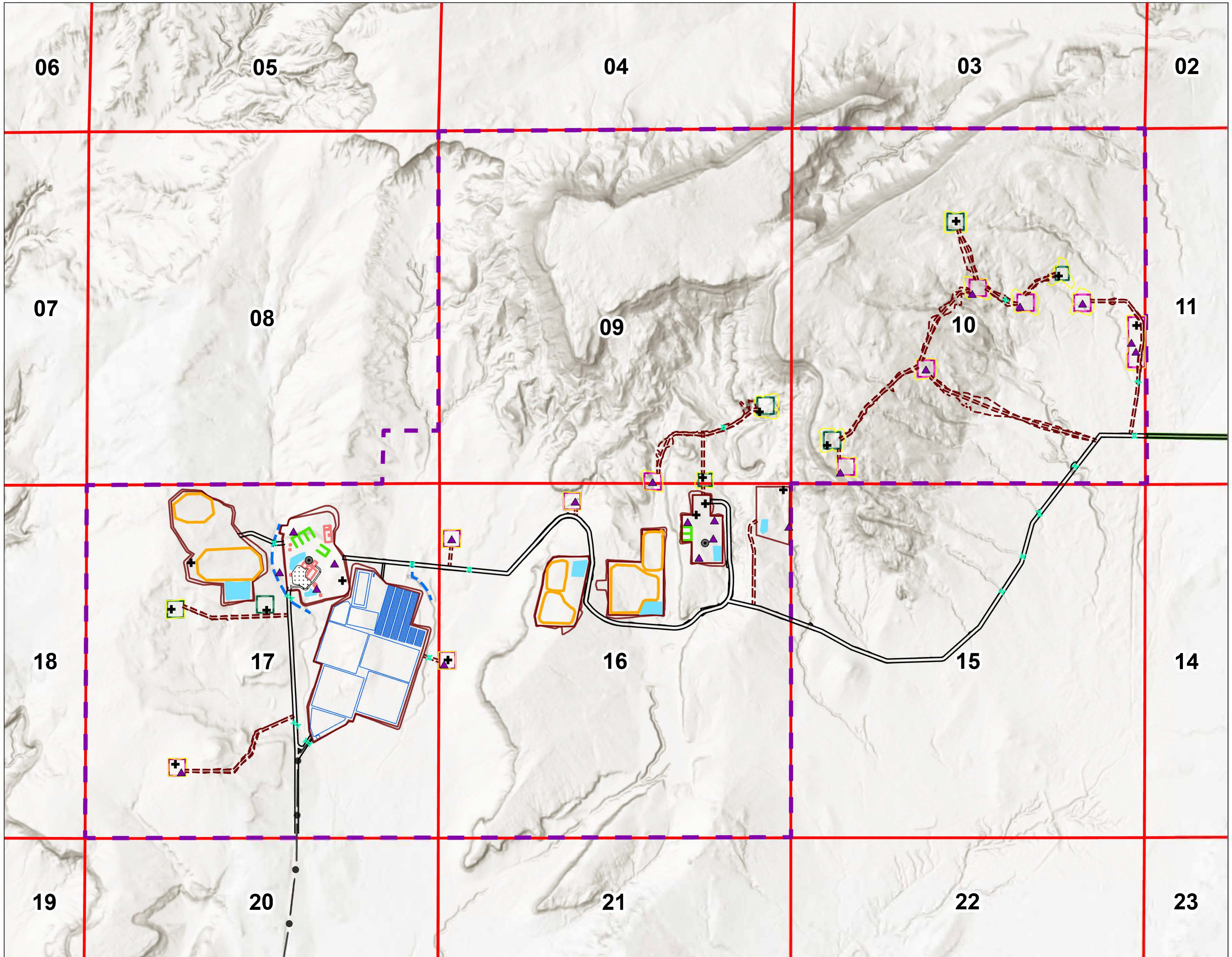
Prepared by SK on 8/27/2025
TR by EZ on 8/27/2025
IR by AR on 8/27/2025

*Client/Project*
182925615

Client: Roca Honda Resources, LLC
Project: Roca Honda Mine
Report: MORP

*Figure No.*
**03**

*Title*
**Location of Ore Bodies**




Stantec

## Legend

- Dewatering Well
- Culvert Location
- Production Shaft
- Vent Shaft
- Access Road
- Diversion Channel
- Discharge Pipeline
- Forest Service Road
- Haul Road
- Project Boundary
- Stockpile
- Building
- Dewatering Pad
- Fence
- Graded Pad
- Graded Pad Extent
- Ore Bay
- Parking
- Retention Pond
- Shaft Pad
- Section Line
- Water Treatment Plant

***Notes***

1. Coordinate System: NAD 1983 2011 StatePlane New Mexico West FIPS 3003 Ft US
2. Data Sources: Roca Honda Resources, LLC
3. Background: Esri, NASA, NGA, USGS, FEMA, Esri, CGIAR, USGS, BLM Admin State

N

0 900 1,800 Feet

(At original document size of 11x17)
1:18,000

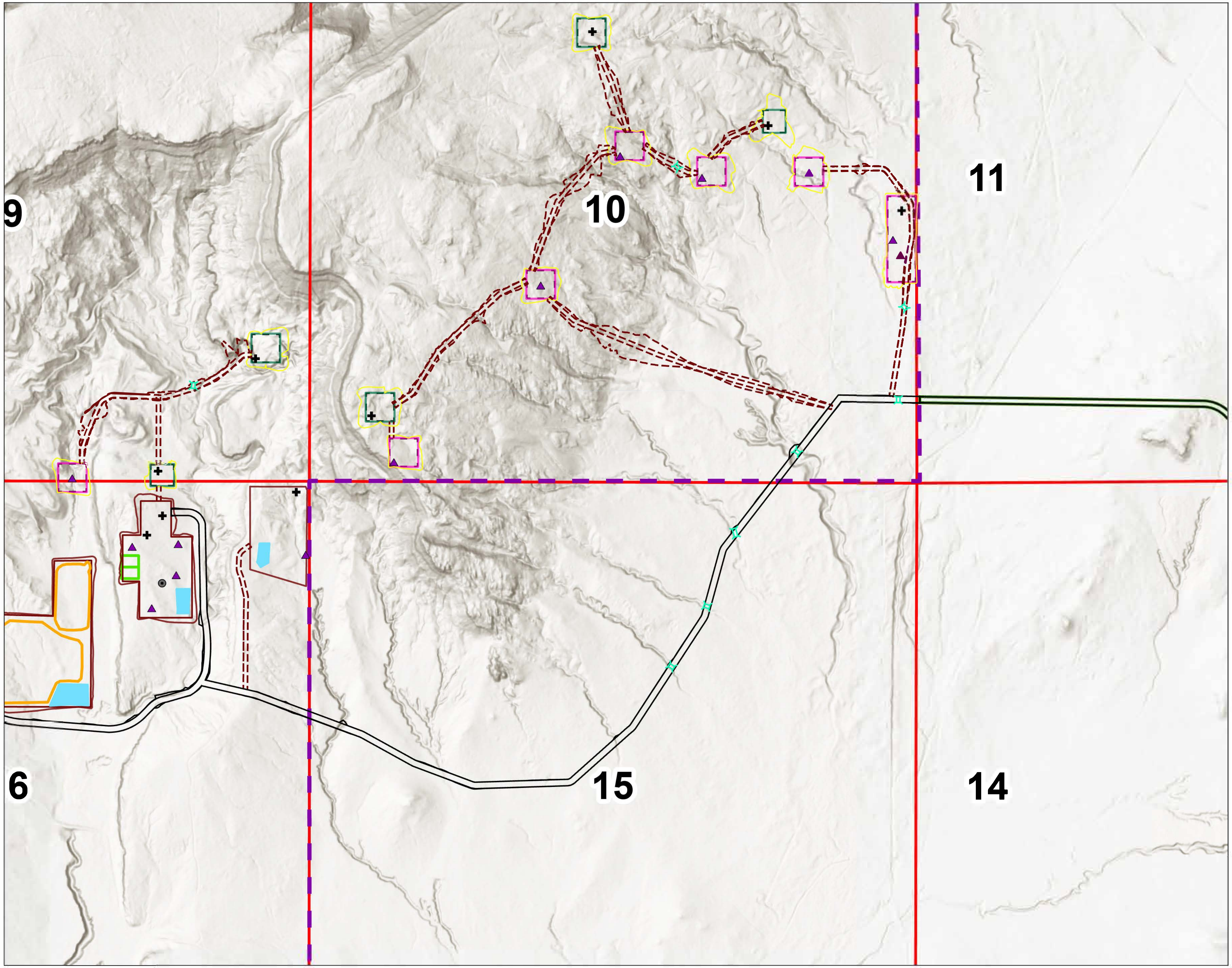

*Project Location*
McKinley County, New Mexico

Prepared by SK on 10/28/2025
TR by EZ on 10/28/2025
IR by AR on 10/28/2025

*Client/Project* 182925615
Client: Roca Honda Resources. LLC
Project: Roca Honda Mine
Report: MORP

*Figure No.*
**04**

*Title*
**Roca Honda Mine Surface Facilities and Project Area**




Stantec

**Legend**

| | |
|---|---|
| Dewatering Well | Stockpile |
| Culvert Location | Dewatering Pad |
| Production Shaft | Fence |
| Vent Shaft | Graded Pad |
| Access Road | Graded Pad Extent |
| Diversion Channel | Ore Bay |
| Discharge Pipeline | Retention Pond |
| Forest Service Road | Shaft Pad |
| Haul Road | Section Line |
| Project Boundary | Water Treatment Plant |

***Notes***

1. Coordinate System: NAD 1983 2011 StatePlane New Mexico West FIPS 3003 Ft US
2. Data Sources: Roca Honda Resources, LLC
3. Background: Esri, NASA, NGA, USGS, FEMA, Esri, CGIAR, USGS, BLM Admin State

N

0 525 1,050 Feet

(At original document size of 11x17)
1:10,500


*Project Location*
McKinley County, New Mexico

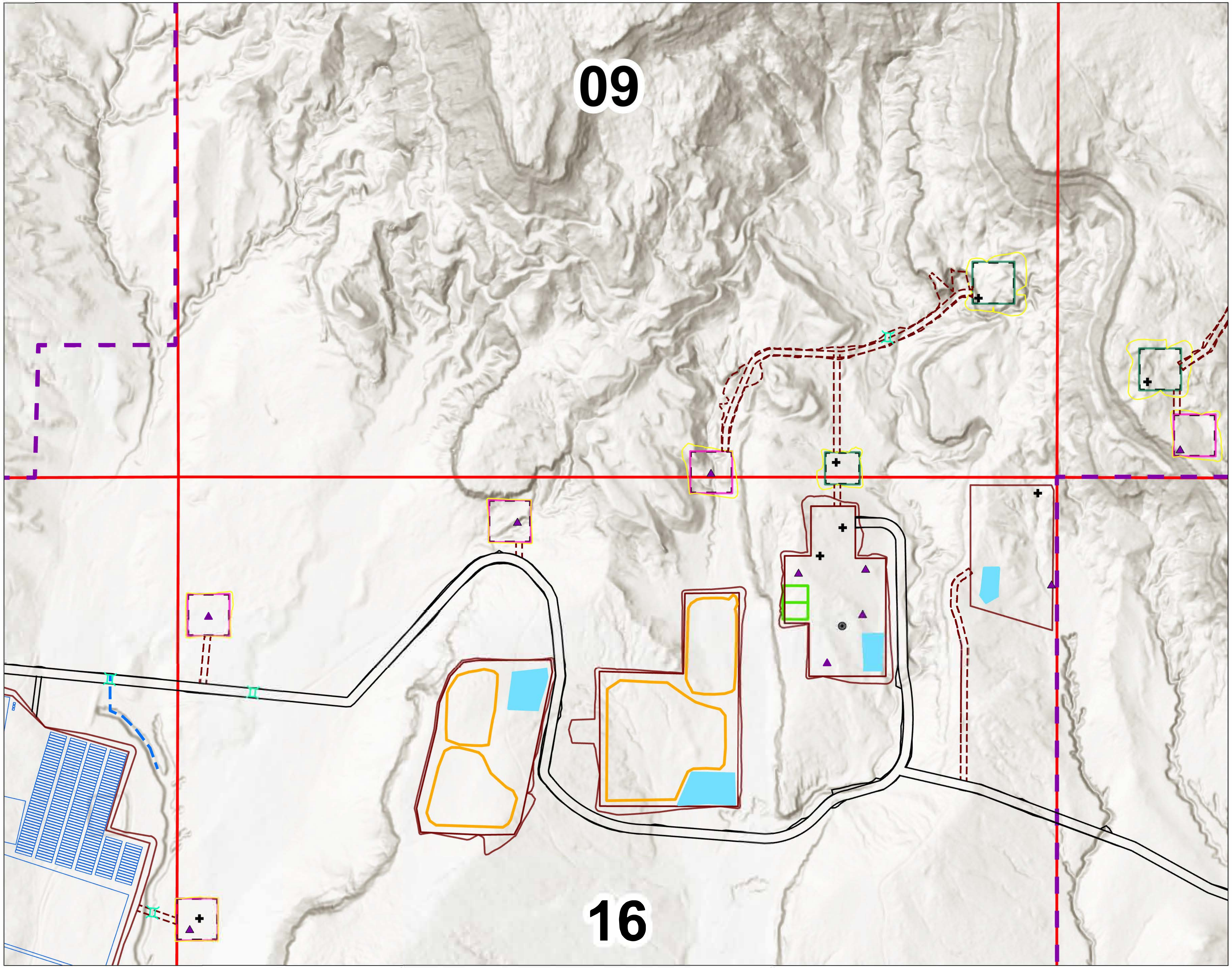
Prepared by SK on 10/28/2025
TR by EZ on 10/28/2025
IR by AR on 10/28/2025

*Client/Project*
182925615
Client: Roca Honda Resources. LLC
Project: Roca Honda Mine
Report: MORP

*Figure No.*
**05**

*Title*
**Section 10 & 15 Surface Facility Layout**

U:\182925615_ArcPro\Roca Honda\Roca Honda\Roca Honda_August 5.aprx Roca Honda Mine Surface Facilities and Permit Area_11x17 Revised: 2025-10-28 By: skashani




Stantec

## Legend

- Dewatering Well
- Culvert Location
- Production Shaft
- Vent Shaft
- Access Road
- Diversion Channel
- Discharge Pipeline
- Forest Service Road
- Haul Road
- Project Boundary
- Stockpile
- Dewatering Pad
- Fence
- Graded Pad
- Graded Pad Extent
- Ore Bay
- Retention Pond
- Shaft Pad
- Section Line
- Water Treatment Plant

***Notes***

1. Coordinate System: NAD 1983 2011 StatePlane New Mexico West FIPS 3003 Ft US
2. Data Sources: Roca Honda Resources, LLC
3. Background: Esri, NASA, NGA, USGS, FEMA, Esri, CGIAR, USGS, BLM Admin State

N

0 360 720 Feet

(At original document size of 11x17)
1:7,200


*Project Location*
McKinley County, New Mexico

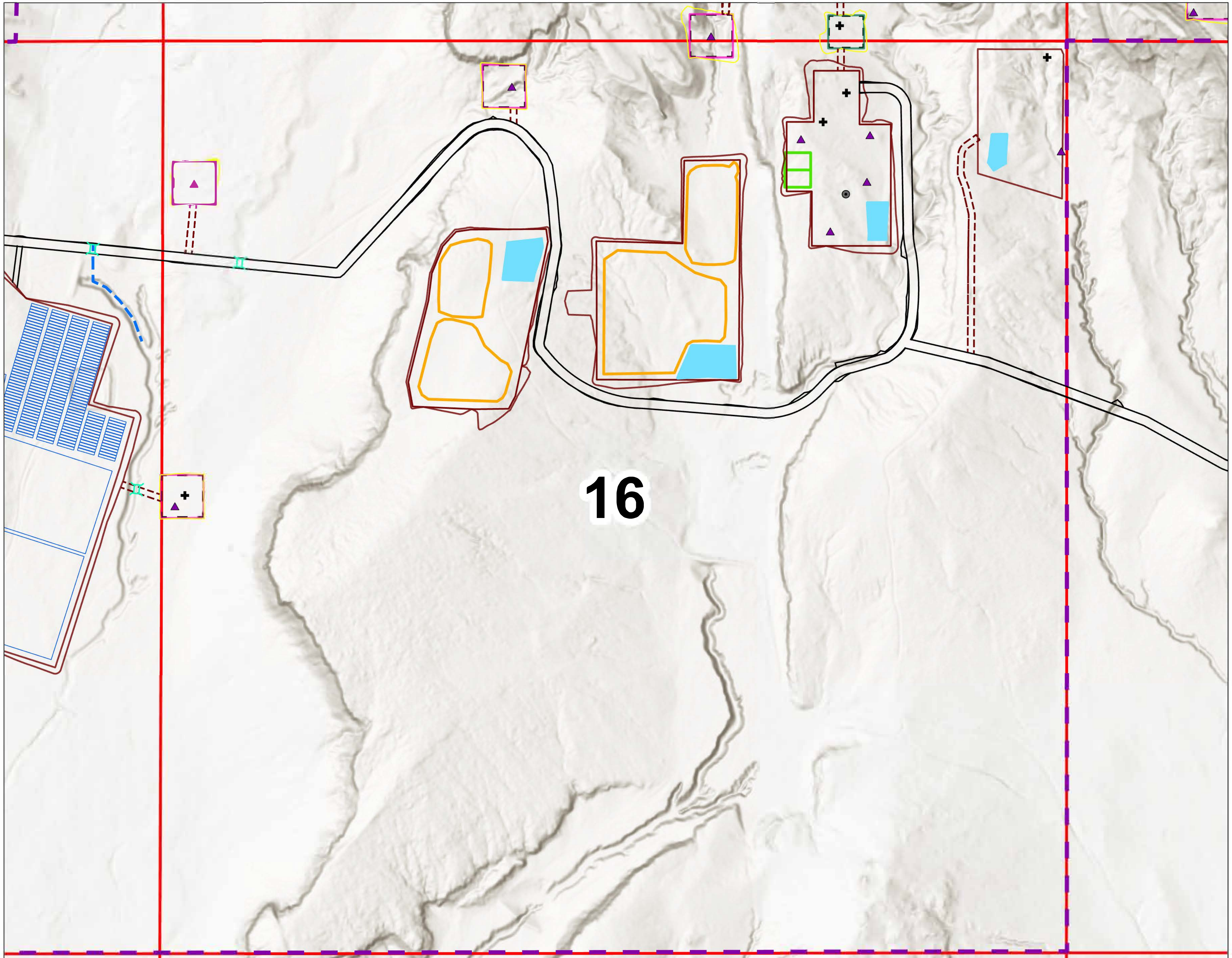
Prepared by SK on 10/28/2025
TR by EZ on 10/28/2025
IR by AR on 10/28/2025

*Client/Project*
182925615
Client: Roca Honda Resources. LLC
Project: Roca Honda Mine
Report: MORP

*Figure No.*
**06**

*Title*
**Section 9 & 16 Surface Facility Layout**

U:\1829\182925615_ArcPro\Roca Honda\Roca Honda_August 5.aprx Roca Honda Mine Surface Facilities and Permit Area_11x17 Revised: 2025-10-28 By: skashani




Stantec

## Legend

- Dewatering Well
- Culvert Location
- Production Shaft
- Vent Shaft
- Access Road
- Diversion Channel
- Discharge Pipeline
- Forest Service Road
- Haul Road
- Project Boundary
- Stockpile
- Dewatering Pad
- Fence
- Graded Pad
- Graded Pad Extent
- Ore Bay
- Retention Pond
- Shaft Pad
- Section Line
- Water Treatment Plant

***Notes***

**1.** Coordinate System: NAD 1983 2011 StatePlane New Mexico West FIPS 3003 Ft US
**2.** Data Sources: Roca Honda Resources, LLC
**3.** Background: Esri, NASA, NGA, USGS, FEMA, Esri, CGIAR, USGS, BLM Admin State

N

0 350 700 Feet

(At original document size of 11x17)
1:7,000


*Project Location*
McKinley County, New Mexico

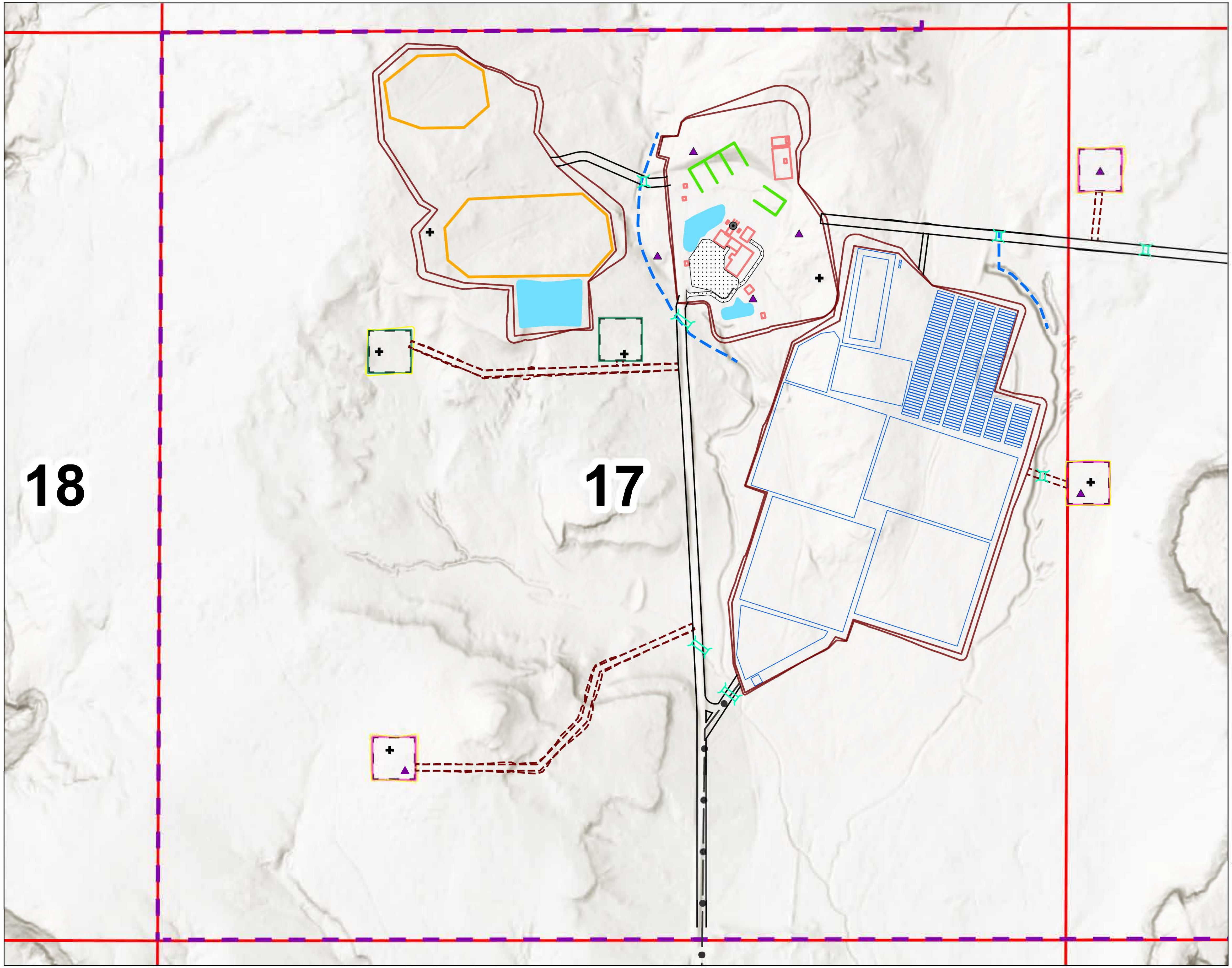
Prepared by SK on 10/28/2025
TR by EZ on 10/28/2025
IR by AR on 10/28/2025

*Client/Project* 182925615
Client: Roca Honda Resources. LLC
Project: Roca Honda Mine
Report: MORP

*Figure No.*
**07**

*Title*
**Section 16 Surface Facility Layout**

U:\182925615_ArcPro\Roca Honda\Roca Honda_August 5.aprx Roca Honda Mine Surface Facilities and Permit Area_11x17 Revised: 2025-10-28 By: skashani




Stantec

## Legend

- Dewatering Well
- Culvert Location
- Production Shaft
- Vent Shaft
- Access Road
- Diversion Channel
- Discharge Pipeline
- Forest Service Road
- Haul Road
- Project Boundary
- Stockpile
- Building
- Dewatering Pad
- Fence
- Graded Pad
- Graded Pad Extent
- Ore Bay
- Parking
- Retention Pond
- Shaft Pad
- Section Line
- Water Treatment Plant

***Notes***

**1.** Coordinate System: NAD 1983 2011 StatePlane New Mexico West FIPS 3003 Ft US
**2.** Data Sources: Roca Honda Resources, LLC
**3.** Background: Esri, NASA, NGA, USGS, FEMA, Esri, CGIAR, USGS, BLM Admin State

N

0 350 700 Feet

(At original document size of 11x17)
1:7,000


*Project Location*
McKinley County, New Mexico

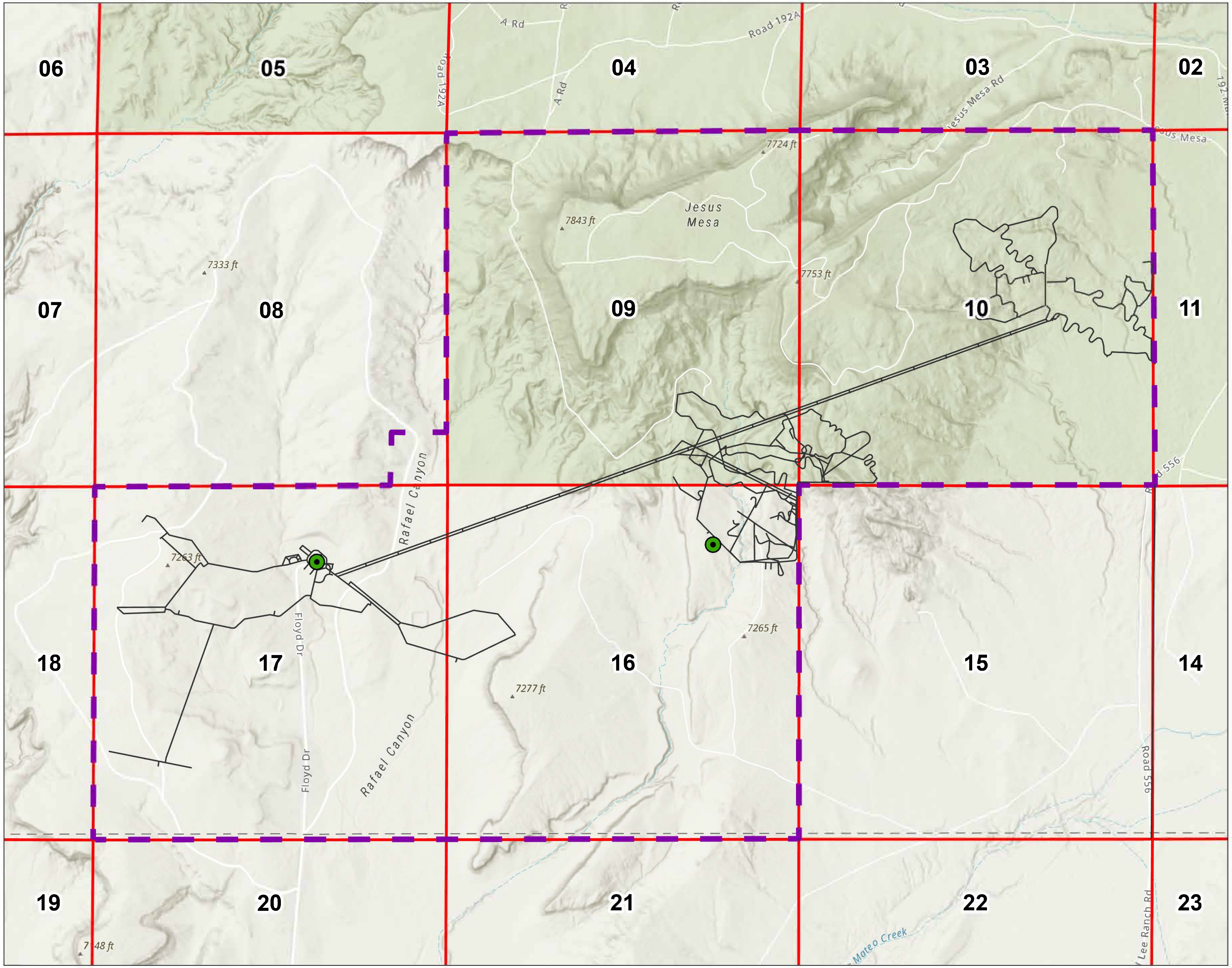
Prepared by SK on 10/28/2025
TR by EZ on 10/28/2025
IR by AR on 10/28/2025

*Client/Project*
182925615
Client: Roca Honda Resources. LLC
Project: Roca Honda Mine
Report: MORP

*Figure No.*
**08**

*Title*
**Section 17 Surface Facility Layout**

U:\182925615_ArcPro\Roca Honda\Roca Honda_August 5.aprx Roca Honda Mine Surface Facilities and Permit Area_11x17 Revised: 2025-10-28 By: skashani




Stantec

**Legend**

- Production Shaft
- Proposed Underground Working
- Project Boundary
- Section Line

***Notes***

**1.** Coordinate System: NAD 1983 2011 StatePlane New Mexico West FIPS 3003 Ft US

**2.** Data Sources: Roca Honda Resources, LLC

**3.** Background: Esri, NASA, NGA, USGS, FEMA, Esri, CGIAR, USGS, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community

N

0 1,500 3,000 Feet

(At original document size of 11x17)
1:18,000


*Project Location*
McKinley County, New Mexico

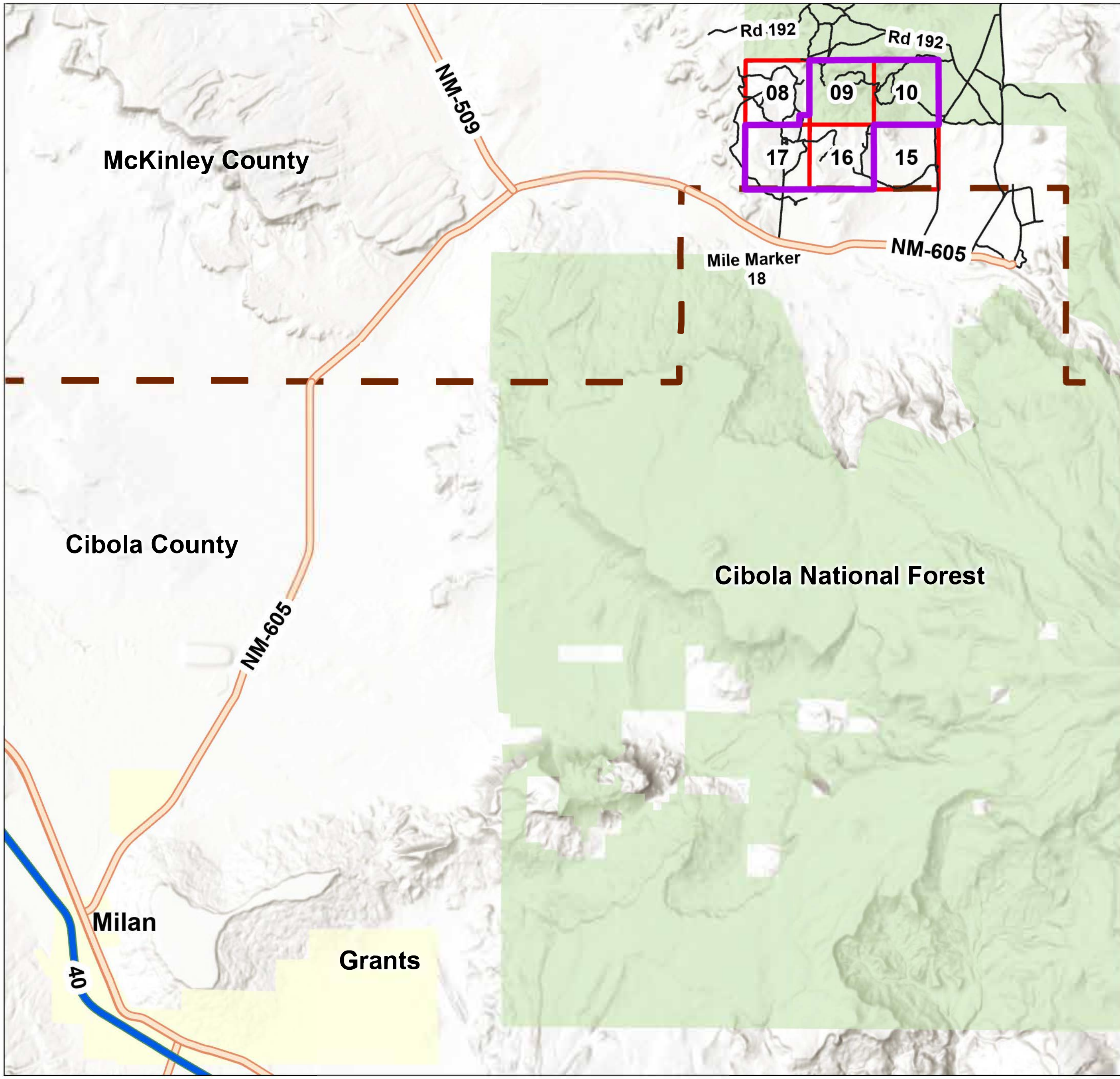
Prepared by SK on 9/3/2025
TR by EZ on 9/3/2025
IR by AR on 9/3/2025

*Client/Project* 182925615
Client: Roca Honda Resources, LLC
Project: Roca Honda Mine
Report: MORP

*Figure No.*
**09**

*Title*
**Underground Mine General Layout**

U:\182925615_ArcPro\Roca Honda\Roca Honda_August 5.aprx Underground Mine General Layout_11x17 Revised: 2025-09-03 By: skashani




Stantec

**Legend**

- Roca Honda Project Area
- Primary Road
- Secondary Road
- Unnamed Road
- Cibola National Forest
- County Boundary
- Grant Milan City Area
- Section Line

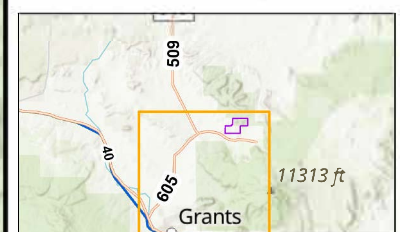
*Notes*

1. Coordinate System: NAD 1983 2011 StatePlane New Mexico West FIPS 3003 Ft US
2. Data Sources: Roca Honda Resources, LLC
3. Background: Esri, NASA, NGA, USGS, Esri, CGIAR, USGS, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community

N

0 5,000 10,000 Feet

(At original document size of 8.5x11)
1:50,000




*Project Location*
McKinley County, New Mexico

Prepared by SK on 7/29/2025
TR by EZ on 7/29/2025
IR by AR on 7/29/2025

*Client/Project*
Client: Roca Honda Resources, LLC
Project: Roca Honda Mine
Report: MORP

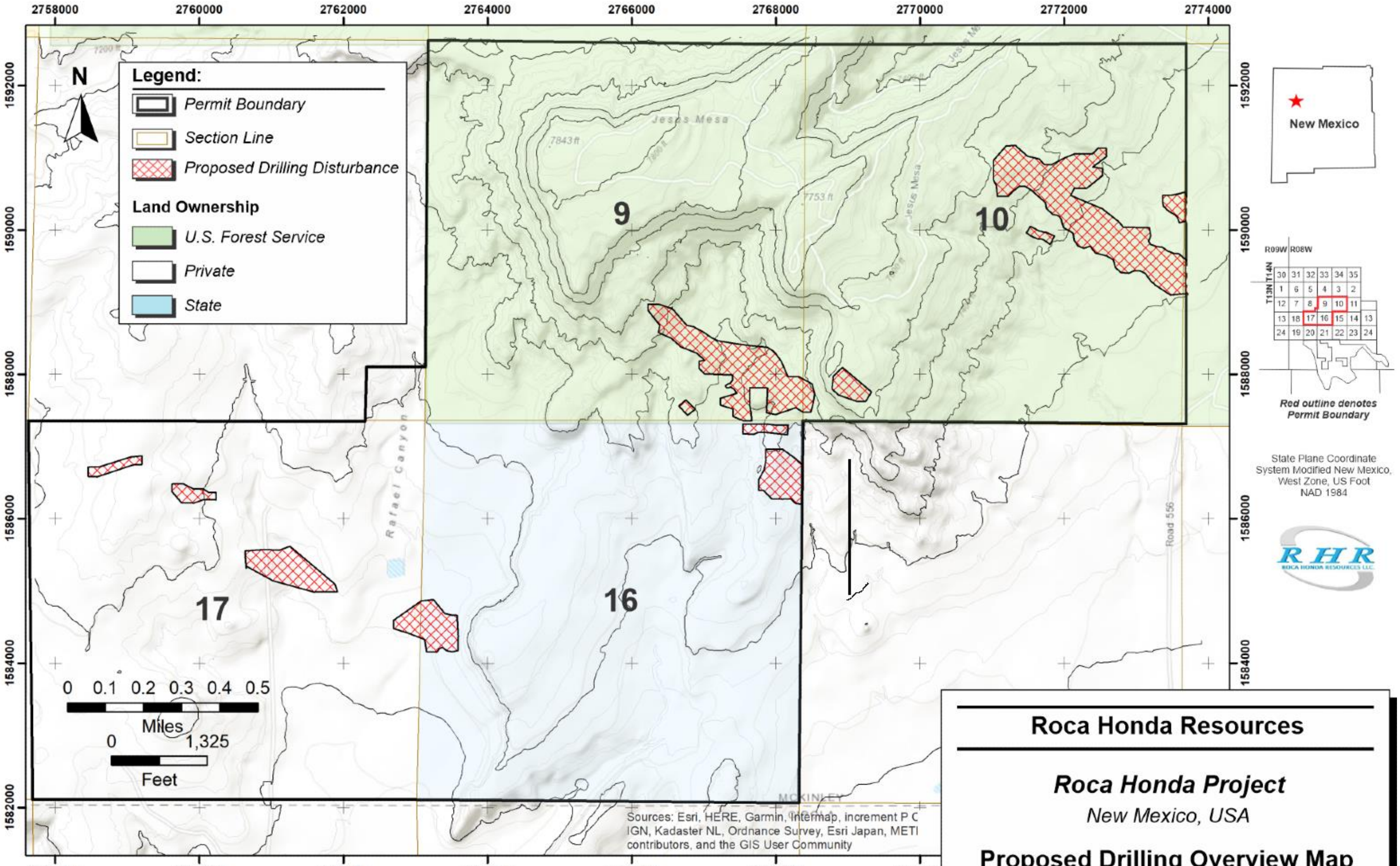
182925615

*Figure No.*
**10**

*Title*
**Location of and Access to the Roca Honda Mine**

U:\1829\182925615_ArcPro\Roca Honda\Roca Honda_July29.aprx Location of and Access to the Roca Honda Mine_8.5x11 Revised: 2025-07-29 By: skashani

Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.




**Roca Honda Resources**

***Roca Honda Project***

*New Mexico, USA*

**Proposed Drilling Overview Map**

***Source: RHR, 2024.***

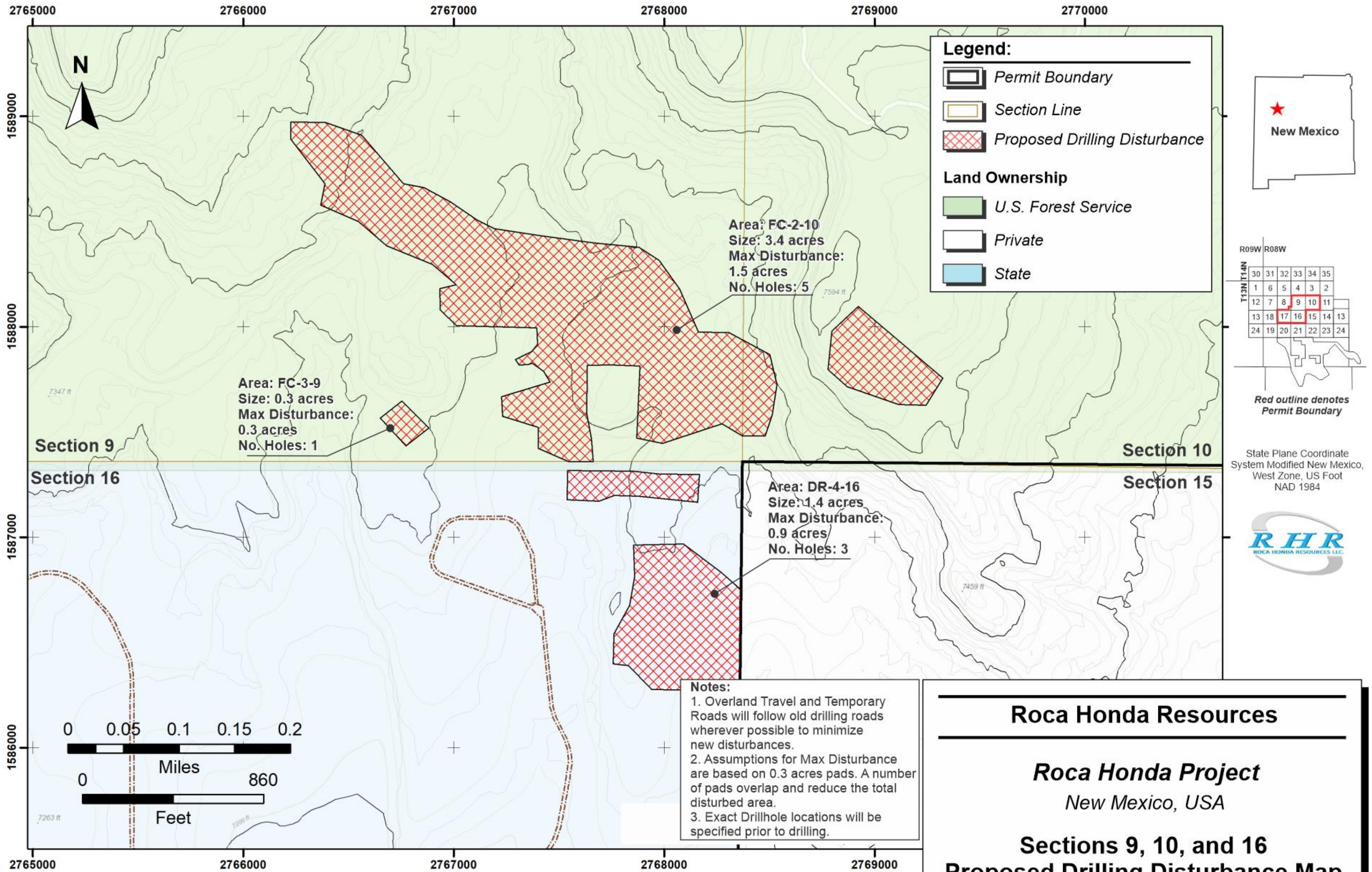
Stantec

McKinley County, New Mexico
*Project Location*

Roca Honda Resources, LLC
*Client/Project*

11
*Figure No.*

Proposed Drilling Overview Map
*Title*




**Roca Honda Resources**

***Roca Honda Project***

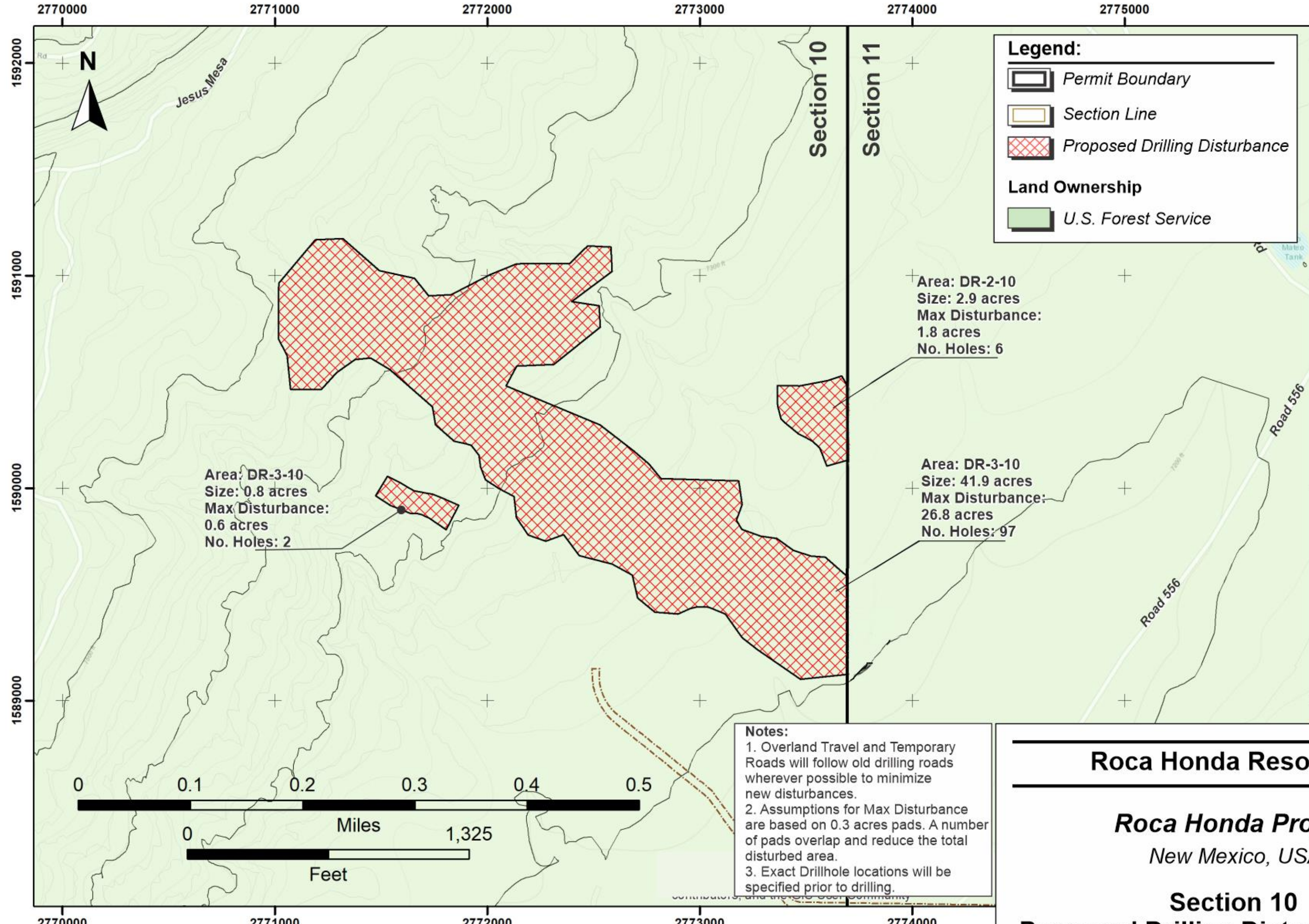
*New Mexico, USA*

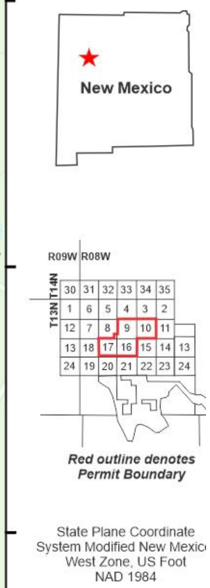
**Sections 9, 10, and 16**
**Proposed Drilling Disturbance Map**

***Source: RHR, 2024.***

Stantec

McKinley County, New Mexico
***Project Location***
Roca Honda Resources, LLC
*Client/Project*
12
*Figure No.*
Sect. 9, 10, 16 Proposed Drilling Disturbance Map
*Title*




Source: RHR, 2024.

**Roca Honda Resources**

***Roca Honda Project***

*New Mexico, USA*

**Section 10**
**Proposed Drilling Disturbance Map**

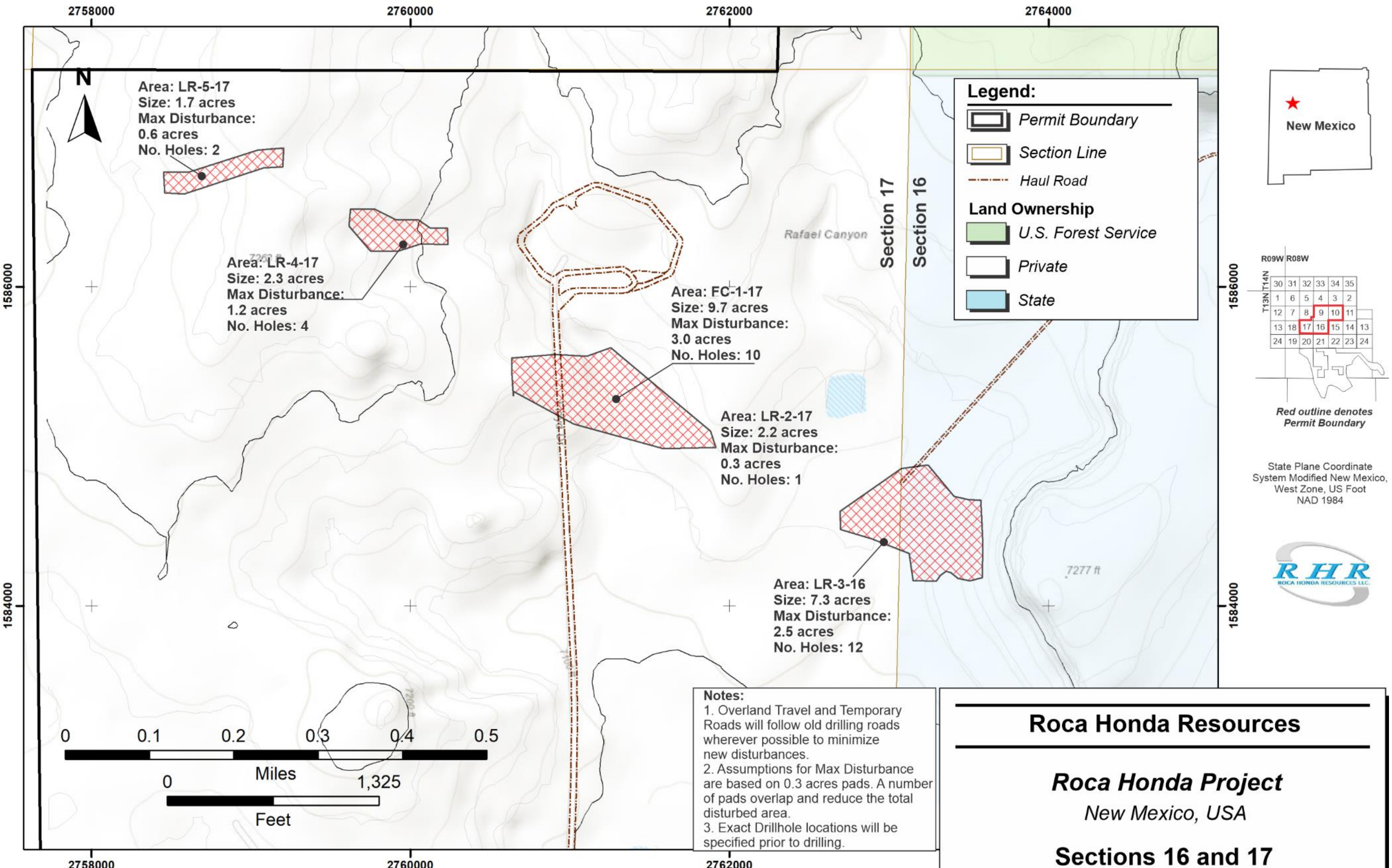
Stantec

McKinley County, New Mexico
*Project Location*

Roca Honda Resources, LLC
*Client/Project*

13
*Figure No.*

Sect. 10 Proposed Drilling Disturbance Map
*Title*




**Notes:**
1. Overland Travel and Temporary Roads will follow old drilling roads wherever possible to minimize new disturbances.
2. Assumptions for Max Disturbance are based on 0.3 acres pads. A number of pads overlap and reduce the total disturbed area.
3. Exact Drillhole locations will be specified prior to drilling.

**Roca Honda Resources**

***Roca Honda Project***

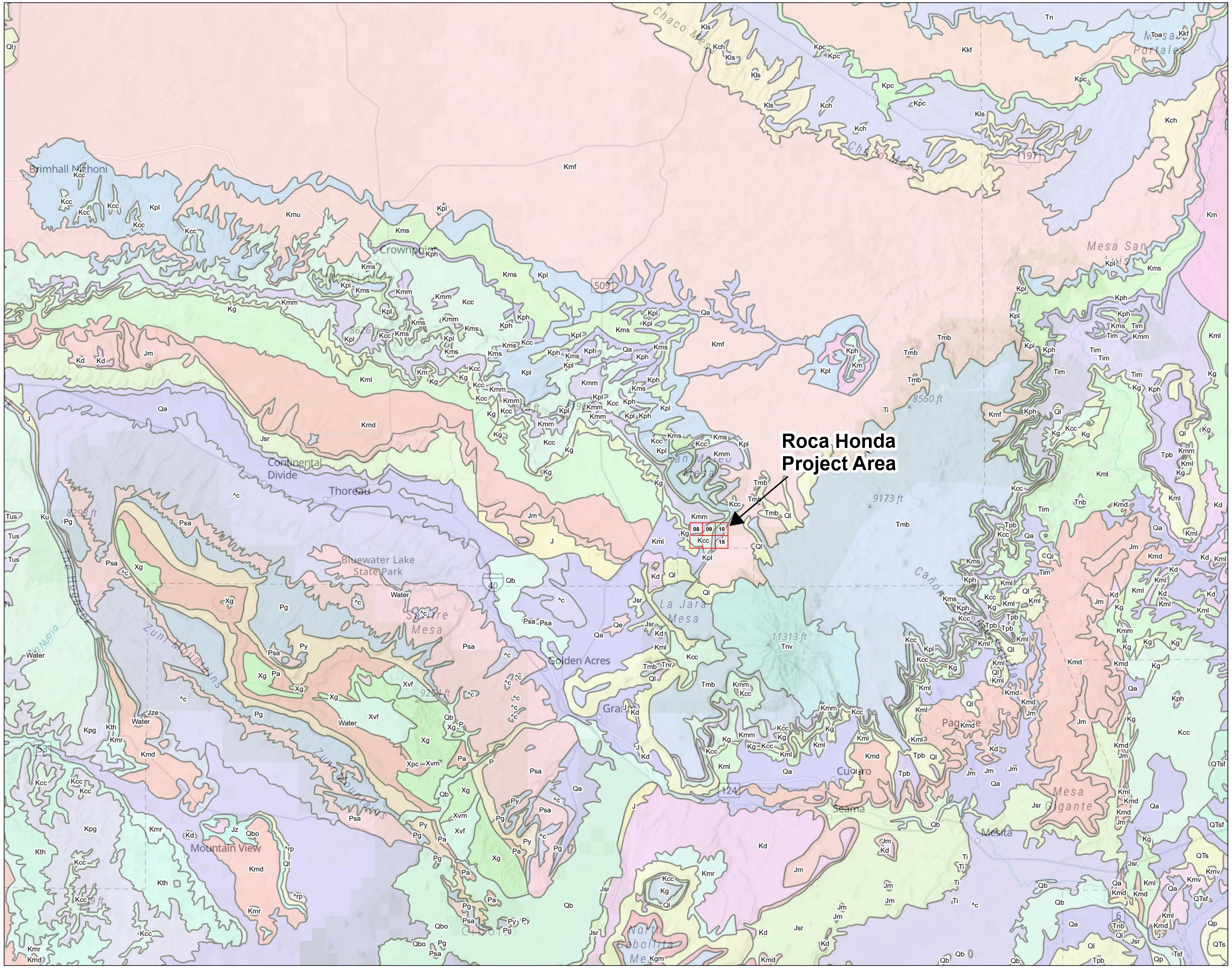
*New Mexico, USA*

**Sections 16 and 17**
**Proposed Drilling Disturbance Map**

*Source: RHR, 2024.*

Stantec

McKinley County, New Mexico
*Project Location*
Roca Honda Resources, LLC
*Client/Project*
14
*Figure No.*
Sect. 16, 17 Proposed Drilling Disturbance Map
*Title*




# Stantec

**Legend**

Section Line

Geologic Unit ID

| | | |
|---|---|---|
| J | Kmu | Qp |
| Jm | Kmv | Ti |
| Jsr | Kpc | Tim |
| Jz | Kpg | Tmb |
| Jze | Kph | Tn |
| Kcc | Kpl | Tnb |
| Kch | Kth | Tnr |
| Kd | Ku | Tnv |
| Kg | P | Toa |
| Kgm | Pa | Tpb |
| Kkf | Pg | Tsf |
| Kls | Psa | Tus |
| Km | Py | Water |
| Kmd | QTs | Xg |
| Kmf | QTsf | Xpc |
| Kml | Qa | Xvf |
| Kmm | Qb | Xvm |
| Kmr | Qbo | Yg |
| Kms | Qe | c |
| | Ql | rp |

***Notes***

1. Coordinate System: NAD 1983 2011 StatePlane New Mexico West FIPS 3003 Ft US
2. Data Sources: 1. Roca Honda Resources, LLC, 2. National Geologic Map Database (NGMDB)
3. Background: Esri, CGIAR, USGS, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community

N

0 40,000 80,000 Feet

(At original document size of 11x17)
1:500,000


*Project Location*
McKinley County, New Mexico

Prepared by SK on 7/29/2025
TR by EZ on 7/29/2025
IR by AR on 7/29/2025

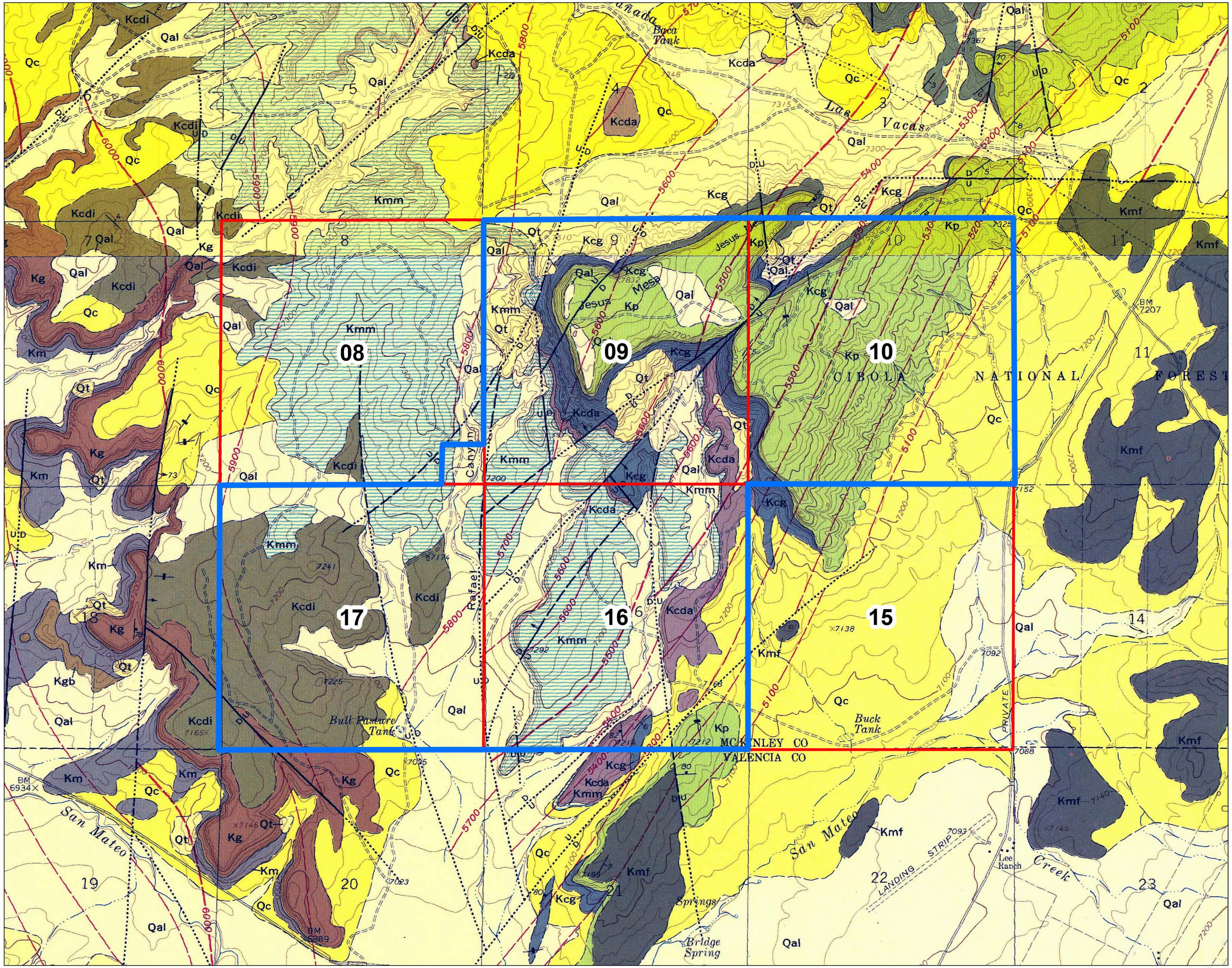
*Client/Project*
182925615

Client: Roca Honda Resources, LLC
Project: Roca Honda Mine
Report: MORP

*Figure No.*
**15**

*Title*
**Regional Geologic Map**

Regional Geologic Map_11x17 Revised: 2025-07-29 By: skashani




Stantec

## Legend

- Roca Honda Project Area
- Section Line

### Explanation

**Pleistocene and Recent**

**Qt** - Talus and landslide blocks
**Qal** - Alluvial and eolian deposits
**Qc** - Saprolite

**Miocene and Pliocene**

**Tbc** - Cinder cone; unconsolidated volcanic ash, lapilli, and bombs
**Trc** - Silicic tuffs and flows
**Tb** - Basaltie flows
**Ta** - Porphyritic andesite (includes some latite flows and tuff)

**Upper Cretaceous**

**Kmf** - Menefee Formation; pale yellowish-brown siltstone interbedded with pale yellowish-brown and light gray fine- to medium-grained sandstone

**Upper Cretaceous - Mancos Shale**

**Kp** - Point Lookout Sandstone; light gray and reddish-brown medium- to fine- grained sandstone. Divisible into two parts where Satan Tongue of Mancos Shale is present
**Kcg** - Crevasse Canyon Formation; Gibson Coal Member; interbedded sandstone, siltstone, shale, and coal beds
**Kcda** - Crevasse Canyon Formation; Dalton Sandstone Member; light gray medium- and fine-grained sandstone
**Kcs** - Crevasse Canyon Formation; stray sandstone of local usage; gray fine-, medium-, and coarse-grained fossiliferous sandstone, and conglomerate
**Kcdi** - Crevasse Canyon Formation; Dilco Coal Member; interbedded sandstone, siltstone, shale, and coal beds
**Kmm** - Mulatto Tongue; pale yellowish-brown sandy shale, dark gray shale, and massive pale yellowish-brown fine-grained silty sandstone. Occurs between Kcda and Kcs or, where Kcs is missing, between Kcda and Kcdi of Crevasse Canyon Formation
**Kg** - Gallup Sandstone; main body of Gallup Sandstone; pale reddish-brown and light gray fine- and medium-grained sandstone.
**Kgb** - Gallup Sandstone; gray fossiliferous fineand very coarse-grained sandstone.
**Km** - Main body of Mancos Shale; dark gray friable silty shale with minor thin light brown sandstone and gray fissile shale. Occurs below Kg and below Kgb and Kga of Gallup Sandstone
**Kmc, Kma** - Lower part of Mancos Shale; Kmc, Kma, gray shale, overlain by pale yellowish brown to pale yellowish-gray fine-and medium-grained sandstone

**Lower Cretaceous**

**Kd** - Dakota Sandstone; pale yellowish-brown, orange, and white fine- and medium-grained sandstone

**Upper Jurassic**

**Jmb** - Morrison Formation; Brushy Basin Member; mainly grayish green mudstone, with minor Lenticular light gray and yellowish-gray fine-and medium-grained sandstone
**Jmw** - Morrison Formation; Westwater Canyon Member; mainly light gray, yellowish, and reddish-gray fine-and medium-grained sandstone. Minor light greenish gray Lenticular mudstone

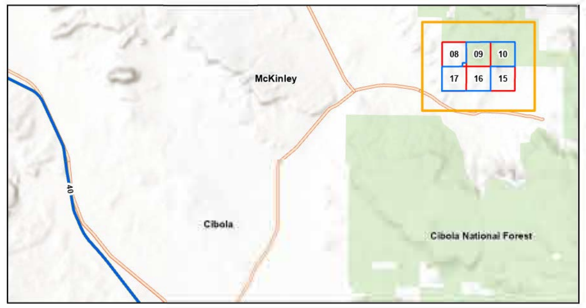
***Notes***

1. Coordinate System: NAD 1983 2011 StatePlane New Mexico West FIPS 3003 Ft US
2. Data Sources: 1. Roca Honda Resources, LLC, 2. Geology of Tertiary modified from unpublished photogeologic map by Arthur S. Knox, 1963-64
3. Background: Esri, CGIAR, USGS

N

0 2,000 4,000 Feet

(At original document size of 11x17)
1:24,000



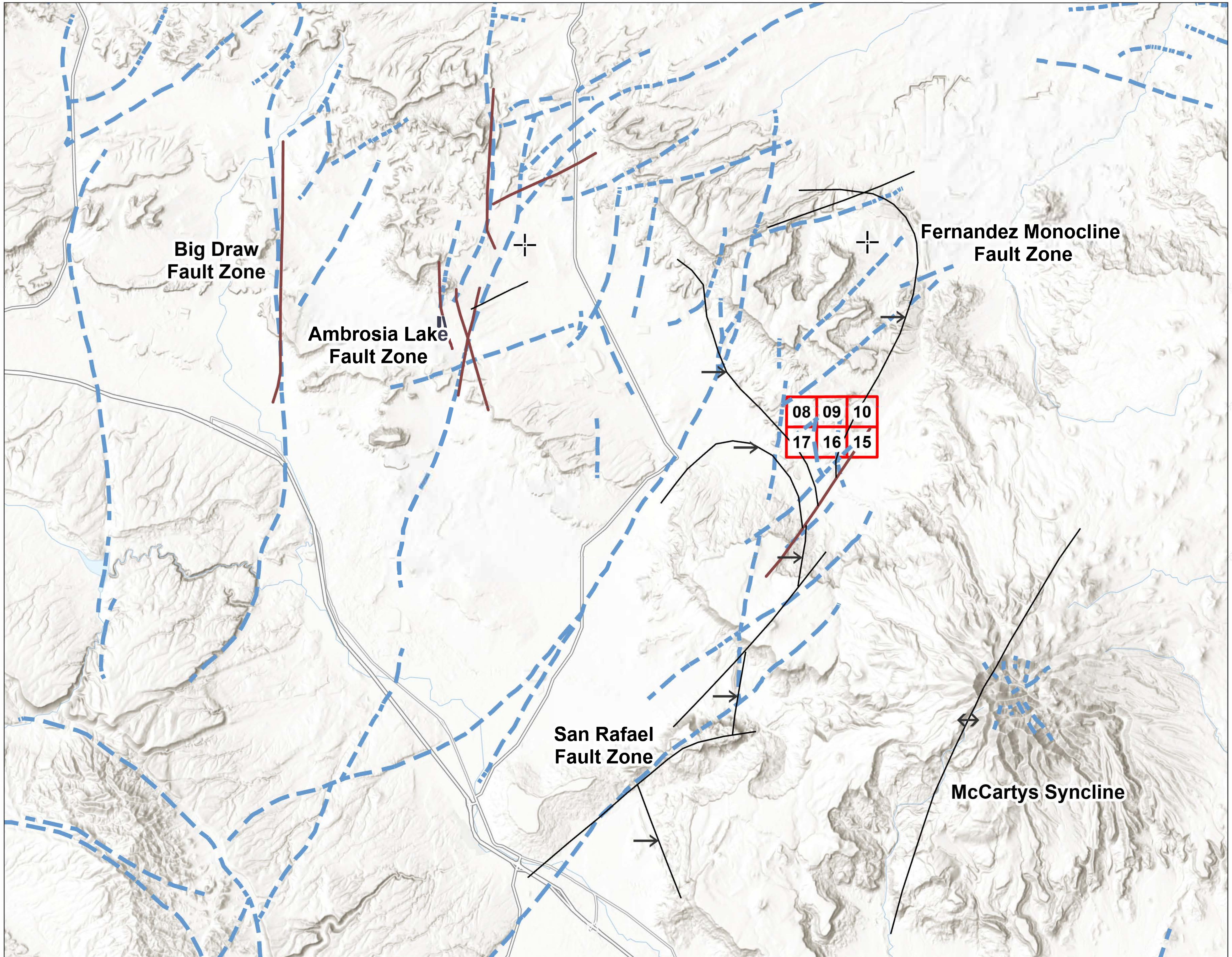

*Project Location*
McKinley County, New Mexico

Prepared by SK on 7/29/2025
TR by EZ on 7/29/2025
IR by AR on 7/29/2025

*Client/Project* 182925615
Client: Roca Honda Resources, LLC
Project: Roca Honda Mine
Report: MORP

*Figure No.*
**16**

*Title*
**Geologic Map of Project Area**




Stantec

**Legend**

- Normal Fault
- Strike-Slip
- NGMDB Fault
- Section Line
- Dome
- Monocline
- Syncline

***Notes***

**1.** Coordinate System: NAD 1983 2011 StatePlane New Mexico West FIPS 3003 Ft US

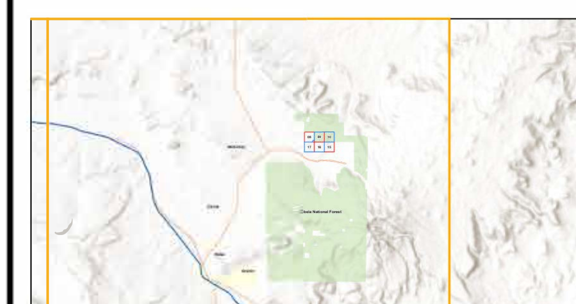
**2.** Data Sources: 1. Roca Honda Resources, LLC, 2. National Geologic Map Database (NGMDB)

**3.** Background: Esri, CGIAR, USGS, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

N

0 17,500 35,000 Feet

(At original document size of 11x17)
1:210,000



*Project Location*
McKinley County, New Mexico

Prepared by SK on 7/29/2025
TR by EZ on 7/29/2025
IR by AR on 7/29/2025

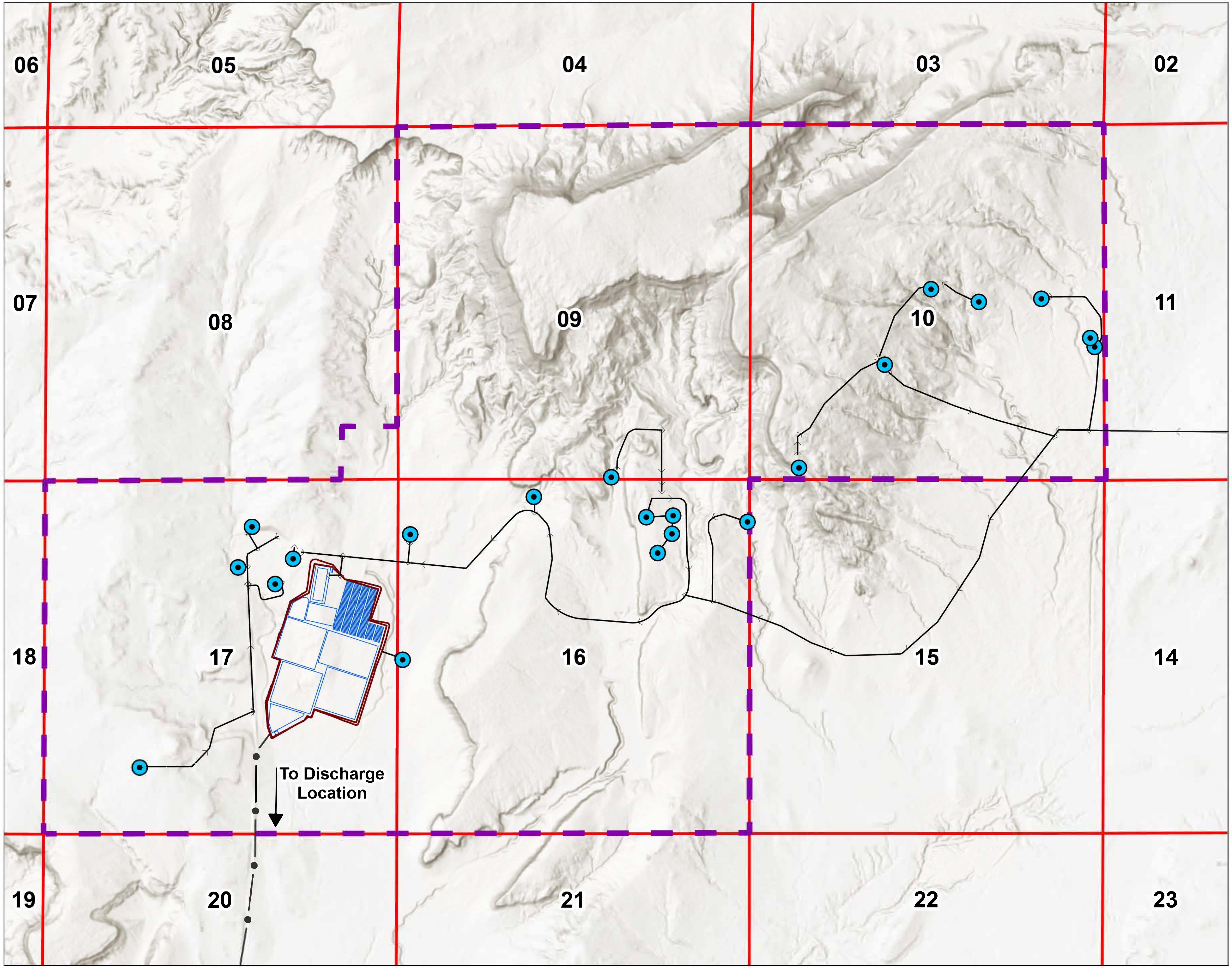
*Client/Project* 182925615

Client: Roca Honda Resources, LLC
Project: Roca Honda Mine
Report: MORP

*Figure No.*
**17**

*Title*
**Regional Structural Features Map**

U:\182925615_ArcPro\Roca Honda\Roca Honda_July29.aprx Regional Strctural Map_11x17 Revised: 2025-07-29 By: skashani




Stantec

## Legend

- Dewatering Well
- Dewatering Pipeline
- Discharge Pipeline
- Project Boundary
- Graded Pad
- Section Line
- Water Treatment Plant

***Notes***

1. Coordinate System: NAD 1983 2011 StatePlane New Mexico West FIPS 3003 Ft US
2. Data Sources: Roca Honda Resources, LLC
3. Background: Esri, NASA, NGA, USGS, FEMA, Esri, CGIAR, USGS, BLM Admin State

N

0 1,500 3,000 Feet

(At original document size of 11x17)
1:18,000

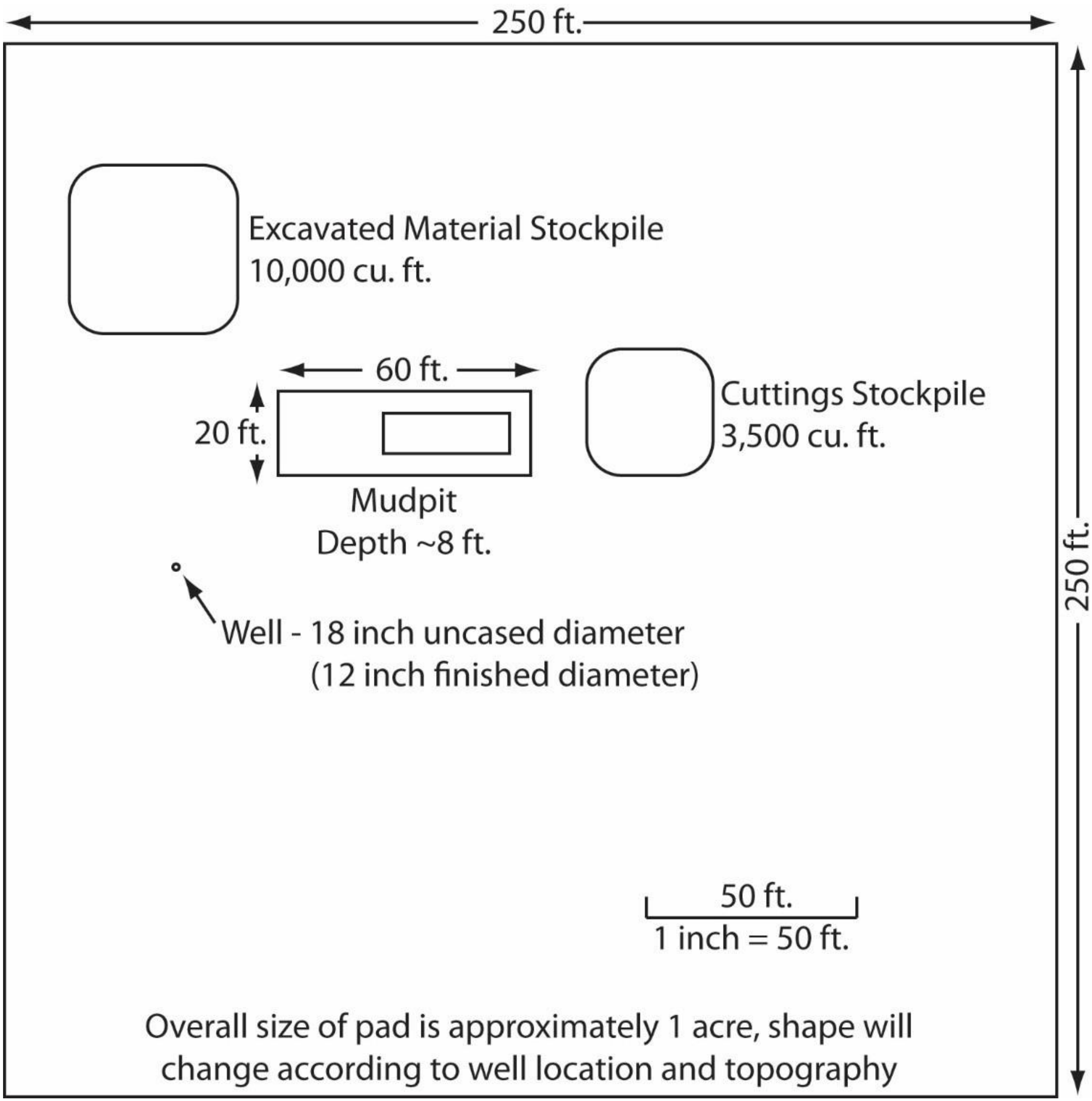

*Project Location*
McKinley County, New Mexico

Prepared by SK on 10/28/2025
TR by EZ on 10/28/2025
IR by AR on 10/28/2025

*Client/Project* 182925615
Client: Roca Honda Resources. LLC
Project: Roca Honda Mine
Report: MORP

*Figure No.*
**18**

*Title*
**Generalized Mine Dewatering Layout**




Stantec

McKinley County, New Mexico

***Project Location***

Roca Honda Resources, LLC

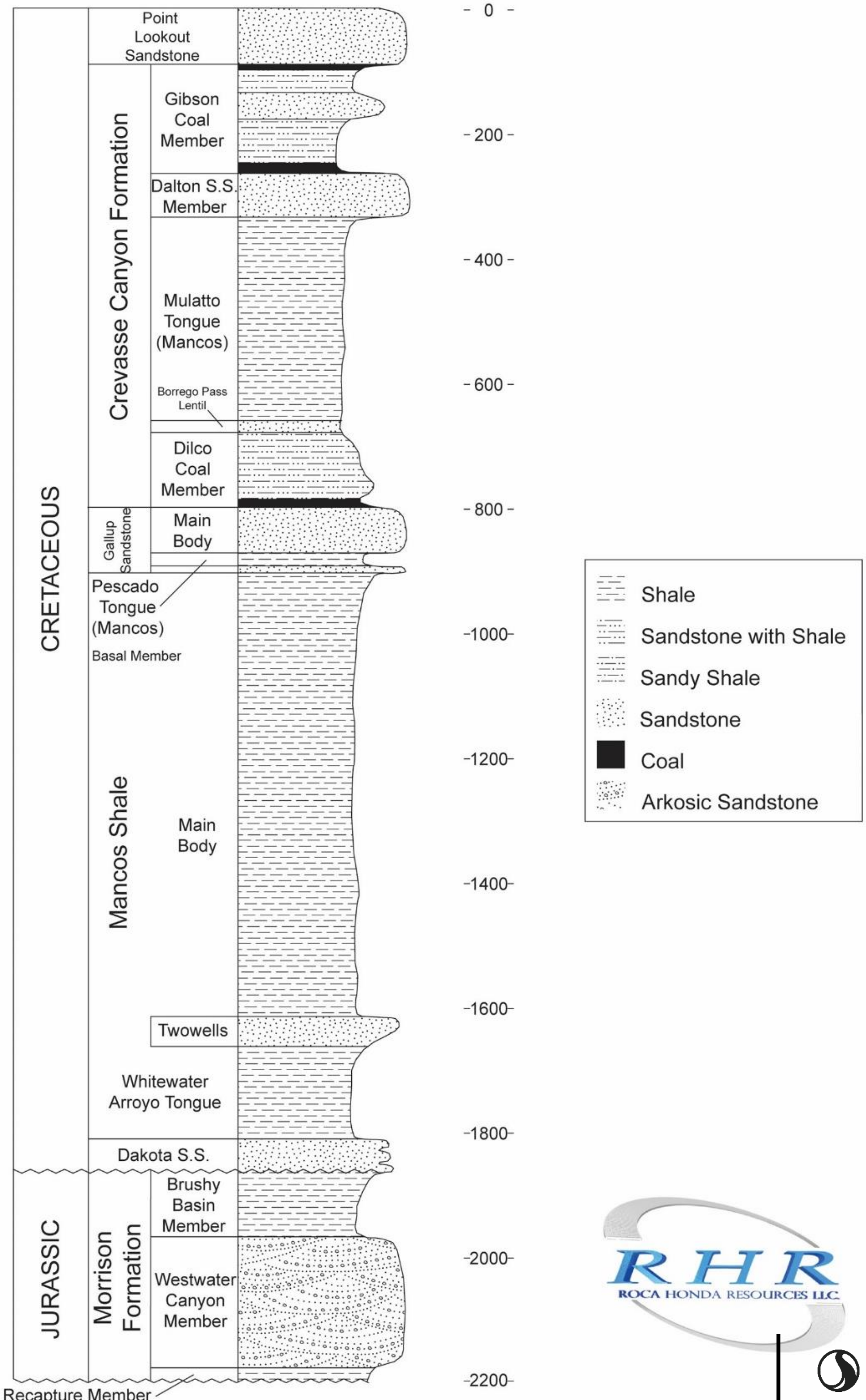
*Client/Project*

**19**

*Figure No.*

Typical Drill Pad Layout for Dewatering Wells

*Title*

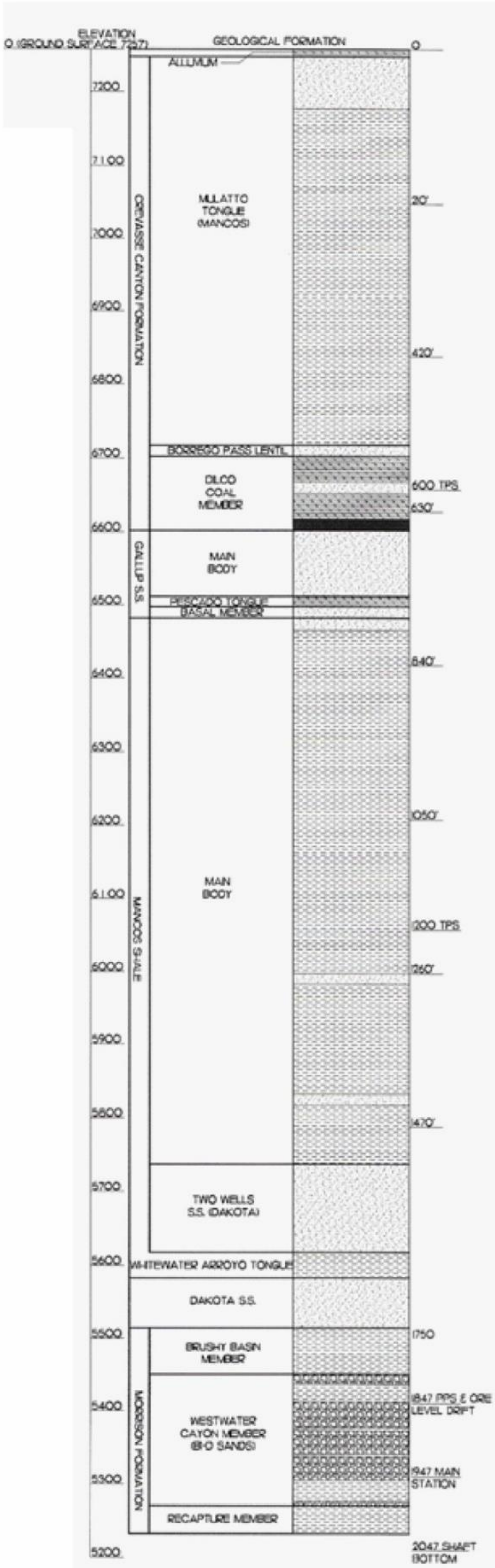



McKinley County, New Mexico
***Project Location***

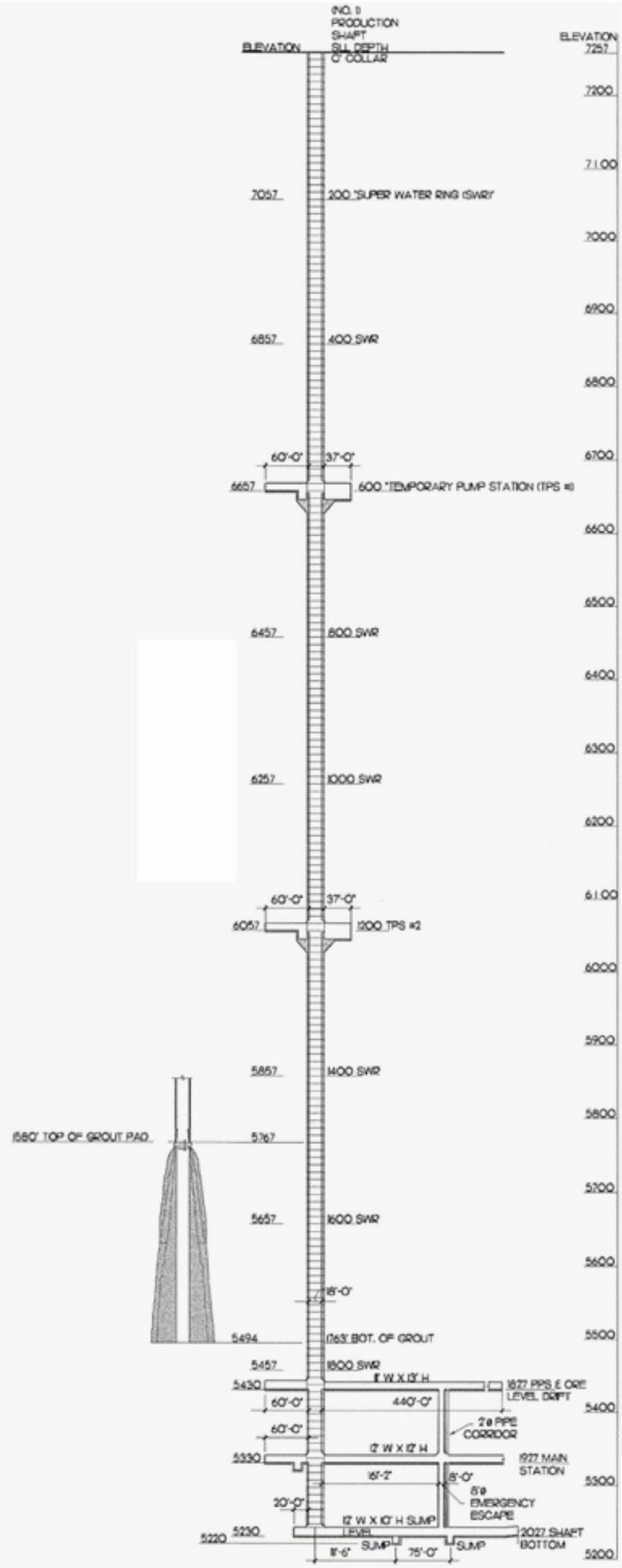
Roca Honda Resources, LLC
*Client/Project*

20
*Figure No.*

Typical Stratigraphic Section of RH Permit Area
*Title*




Projected Stratigraphy




Shaft Cross-Section

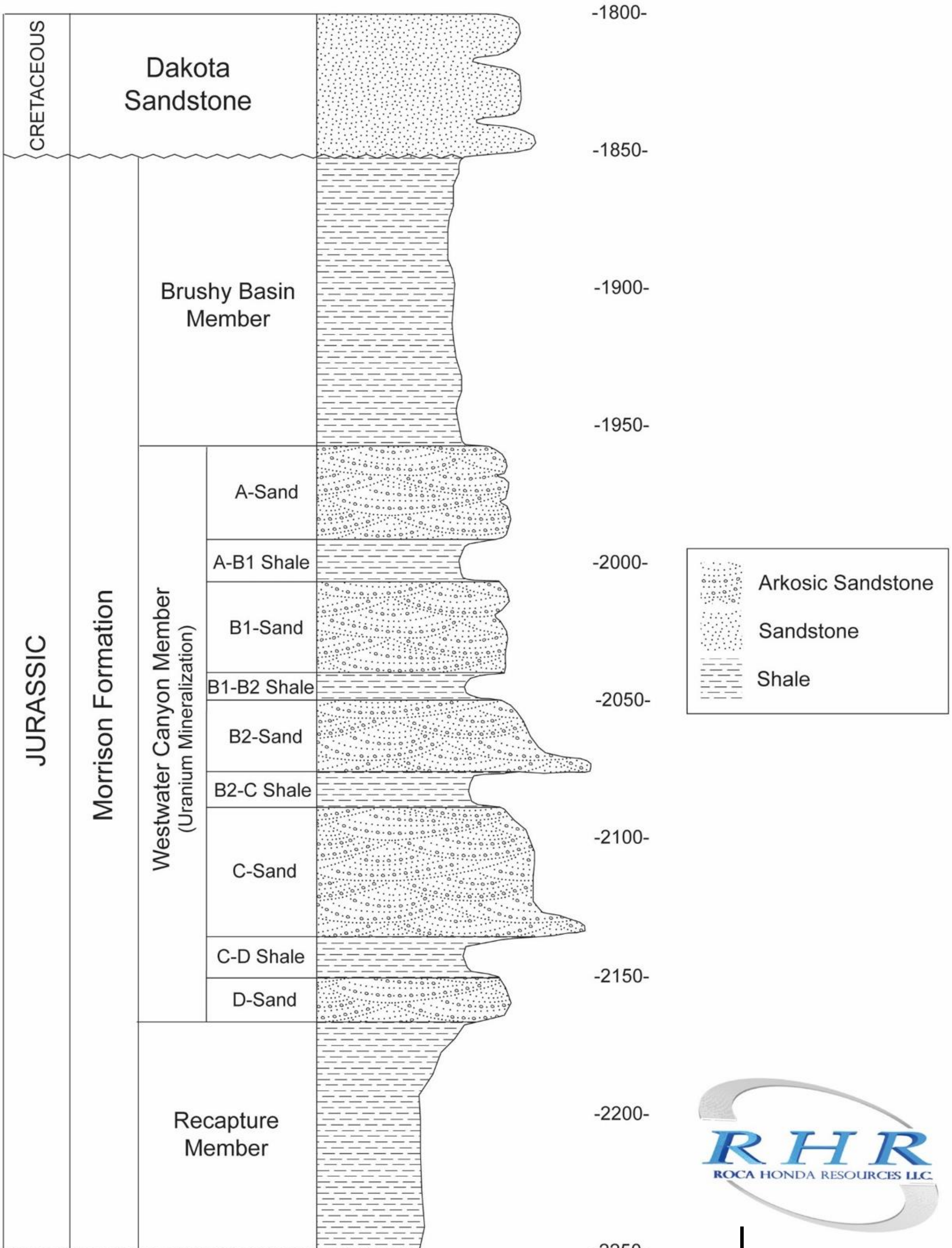
Stantec

McKinley County, New Mexico
***Project Location***

Roca Honda Resources, LLC
*Client/Project*

**21**
*Figure No.*

Typical Stratigraphic Section at RH Shaft Location
*Title*




RHR
ROCA HONDA RESOURCES LLC

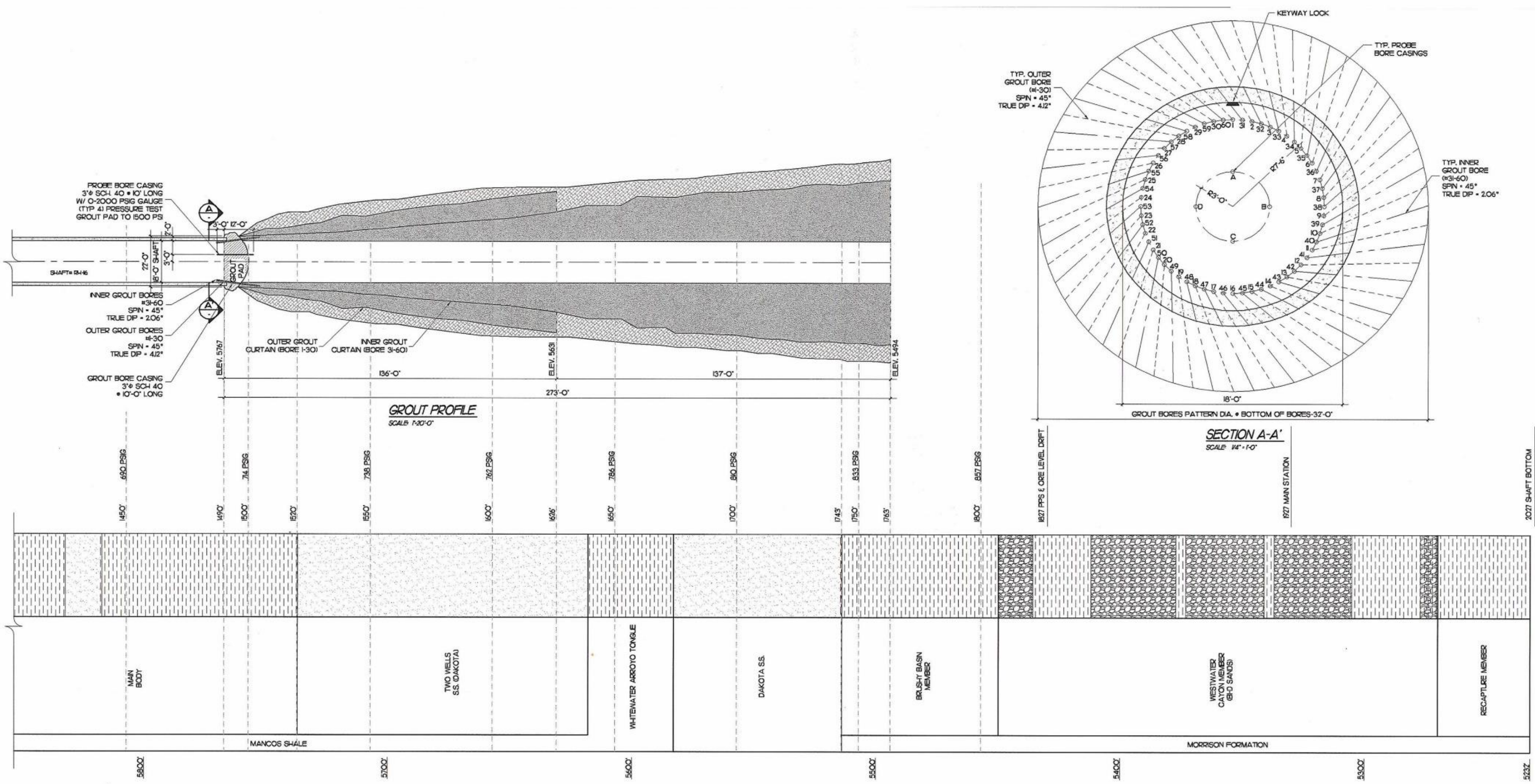
Stantec

McKinley County, New Mexico
*Project Location*

Roca Honda Resources, LLC
*Client/Project*

22
*Figure No.*

Typical Stratigraphic Section of Morrison Formation
*Title*



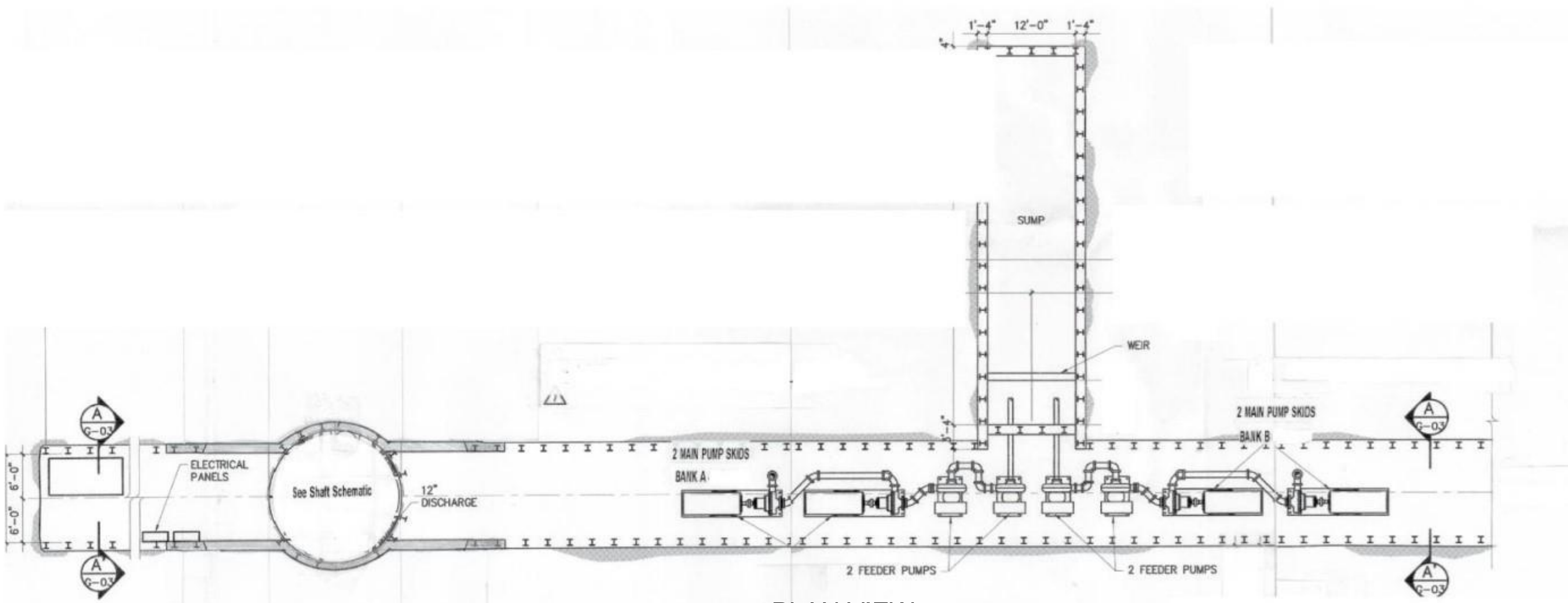

Stantec

McKinley County, New Mexico
*Project Location*

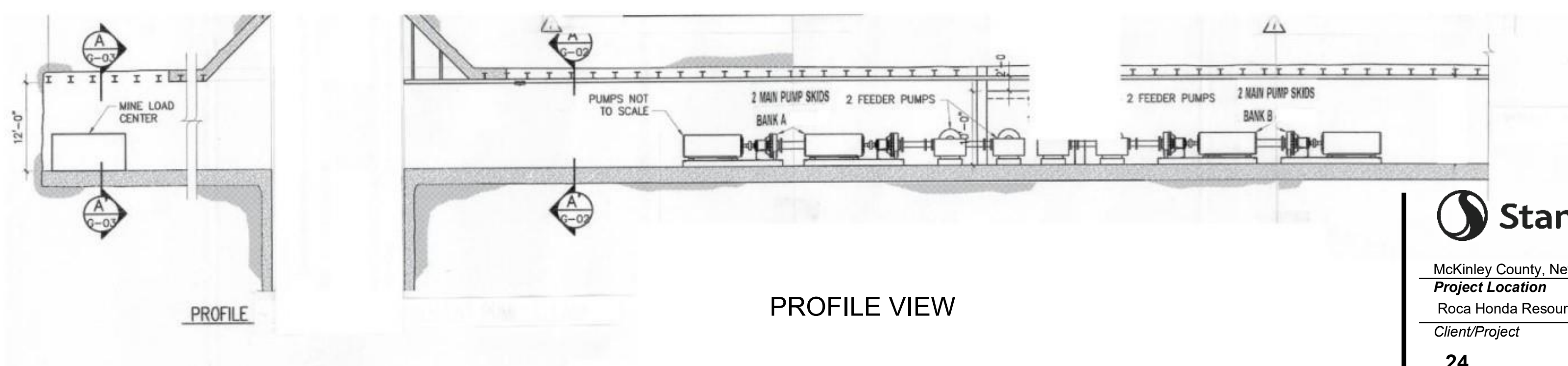
Roca Honda Resources, LLC
*Client/Project*

23
*Figure No.*

Typical Grouting Technique for Shaft Construction
*Title*




PLAN VIEW




PROFILE VIEW

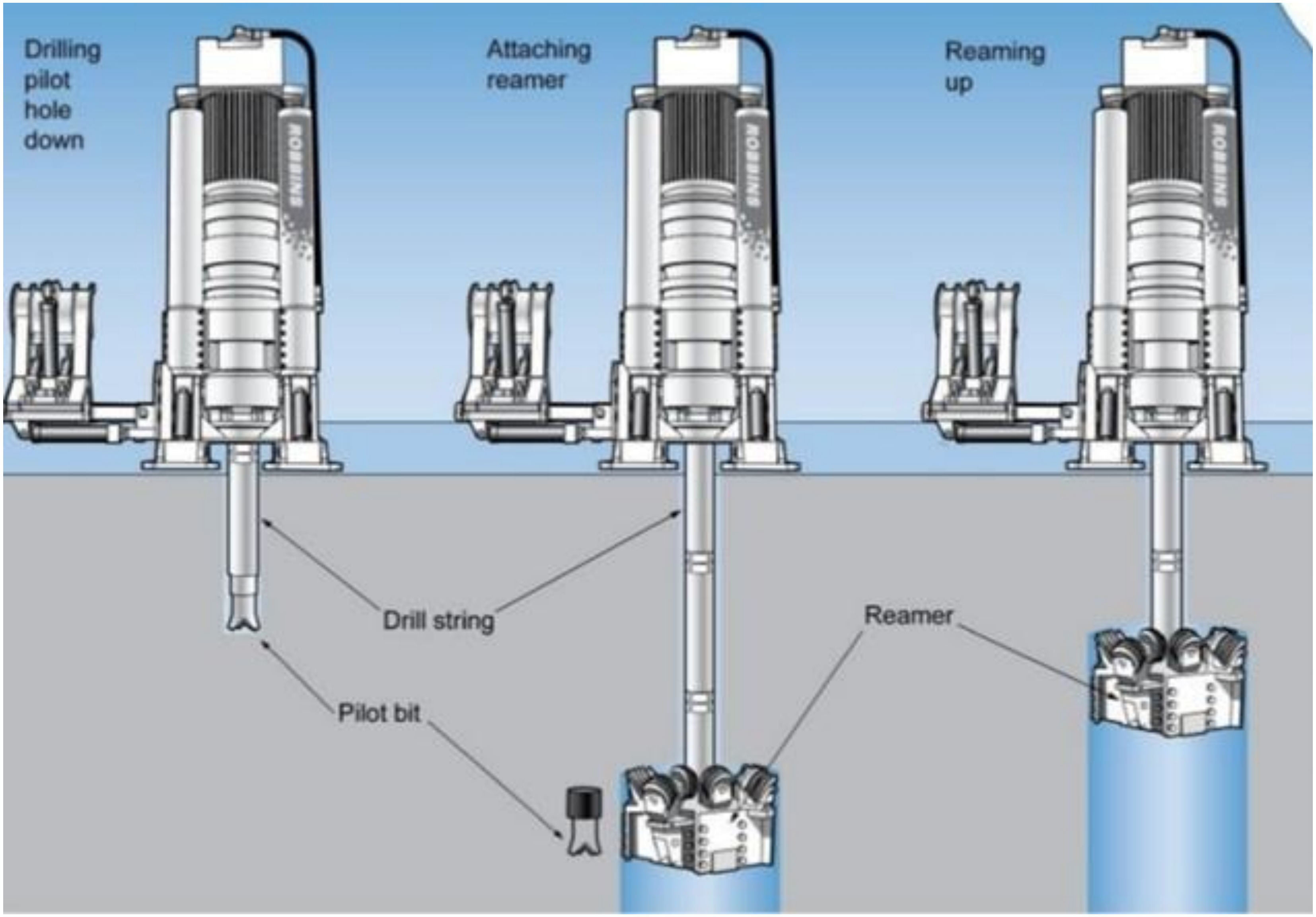
Stantec

McKinley County, New Mexico
*Project Location*

Roca Honda Resources, LLC
*Client/Project*

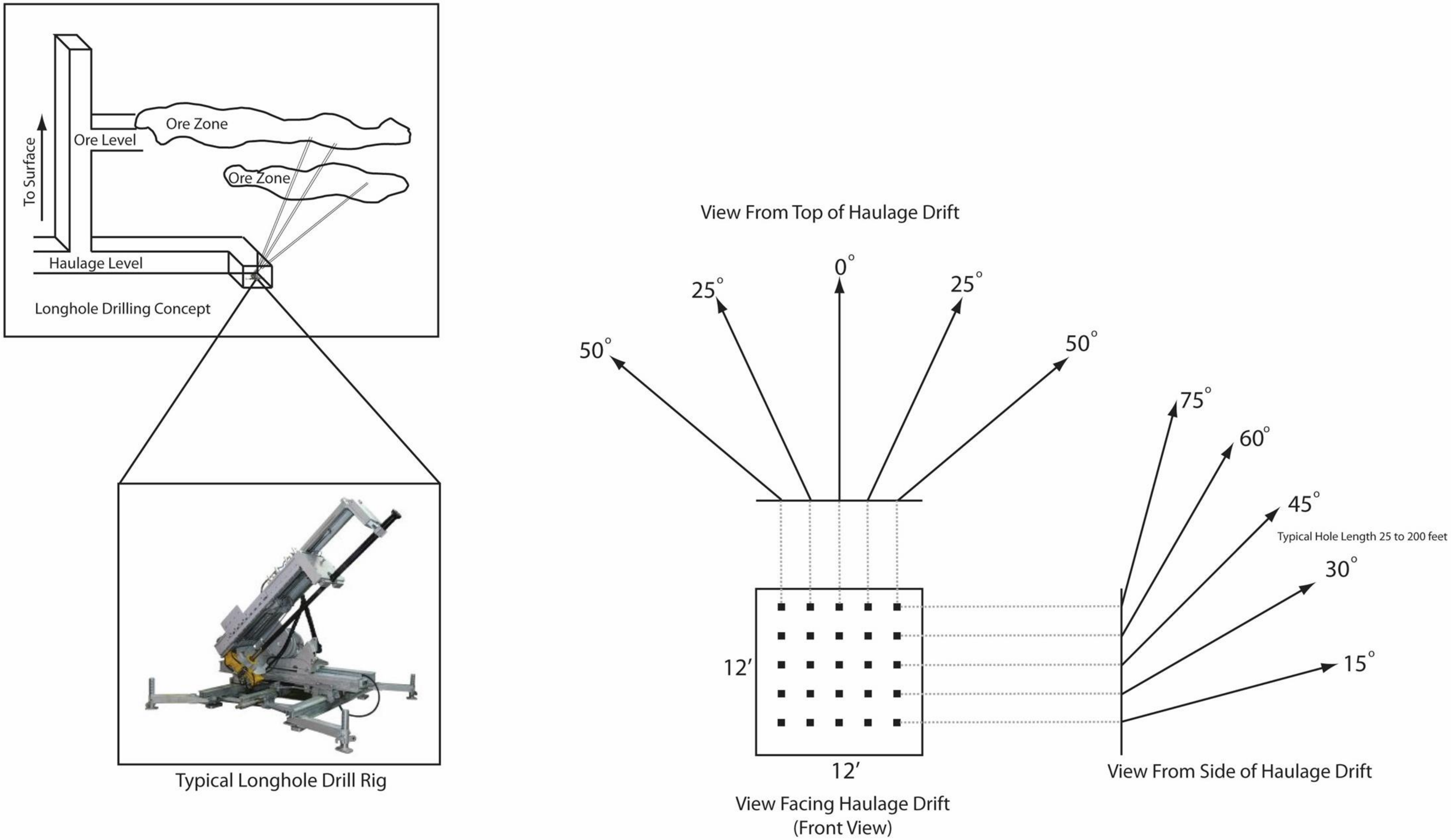
**24**
*Figure No.*

Typical Pumping Level Station
*Title*




Stantec

McKinley County, New Mexico
***Project Location***
Roca Honda Resources, LLC
*Client/Project*
**25**
*Figure No.*
Typical Raise Boring Equipment Setup
*Title*



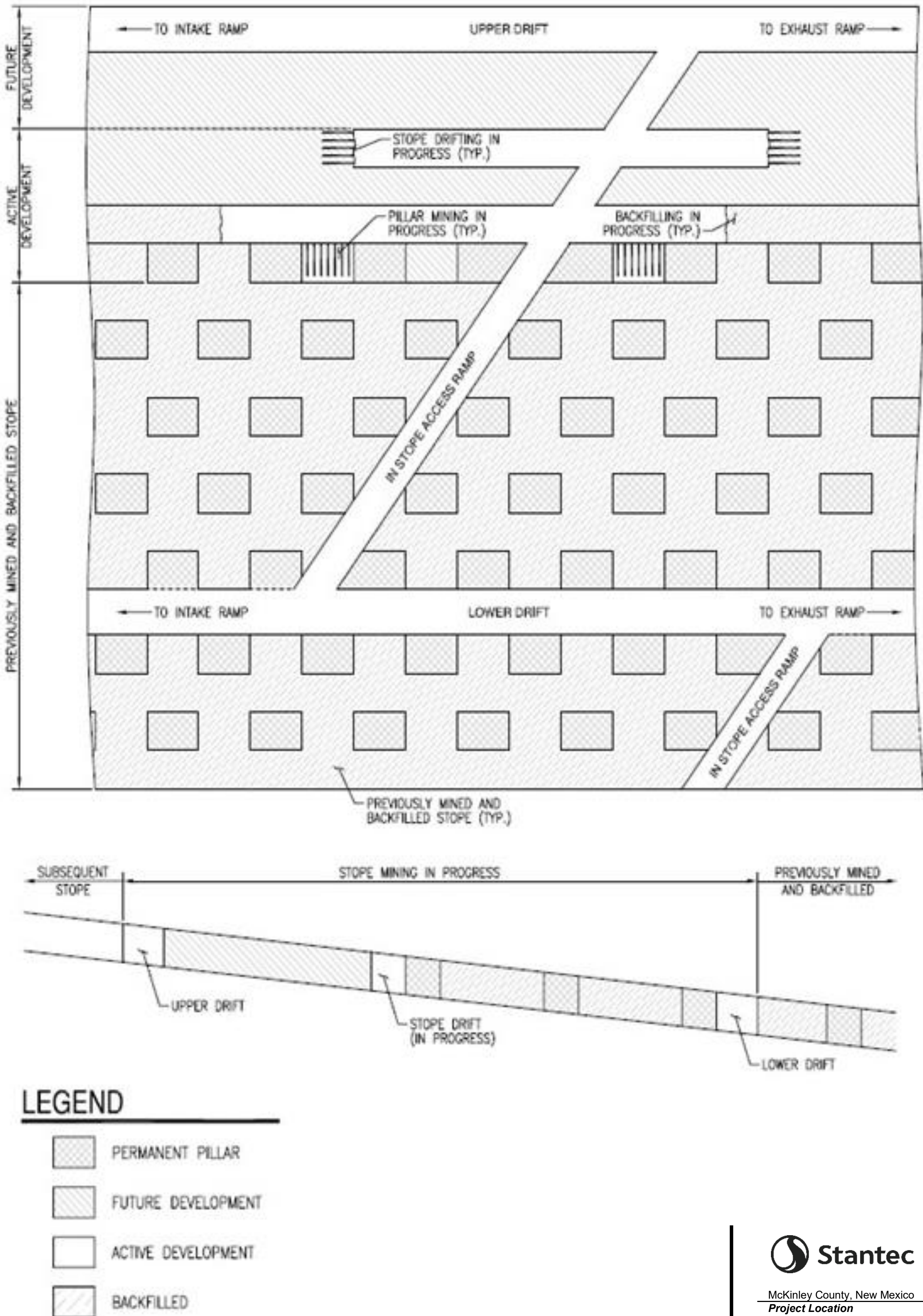

Stantec

McKinley County, New Mexico
***Project Location***

Roca Honda Resources, LLC
*Client/Project*

**26**
*Figure No.*

Typical Long-hole Drilling Technique
*Title*



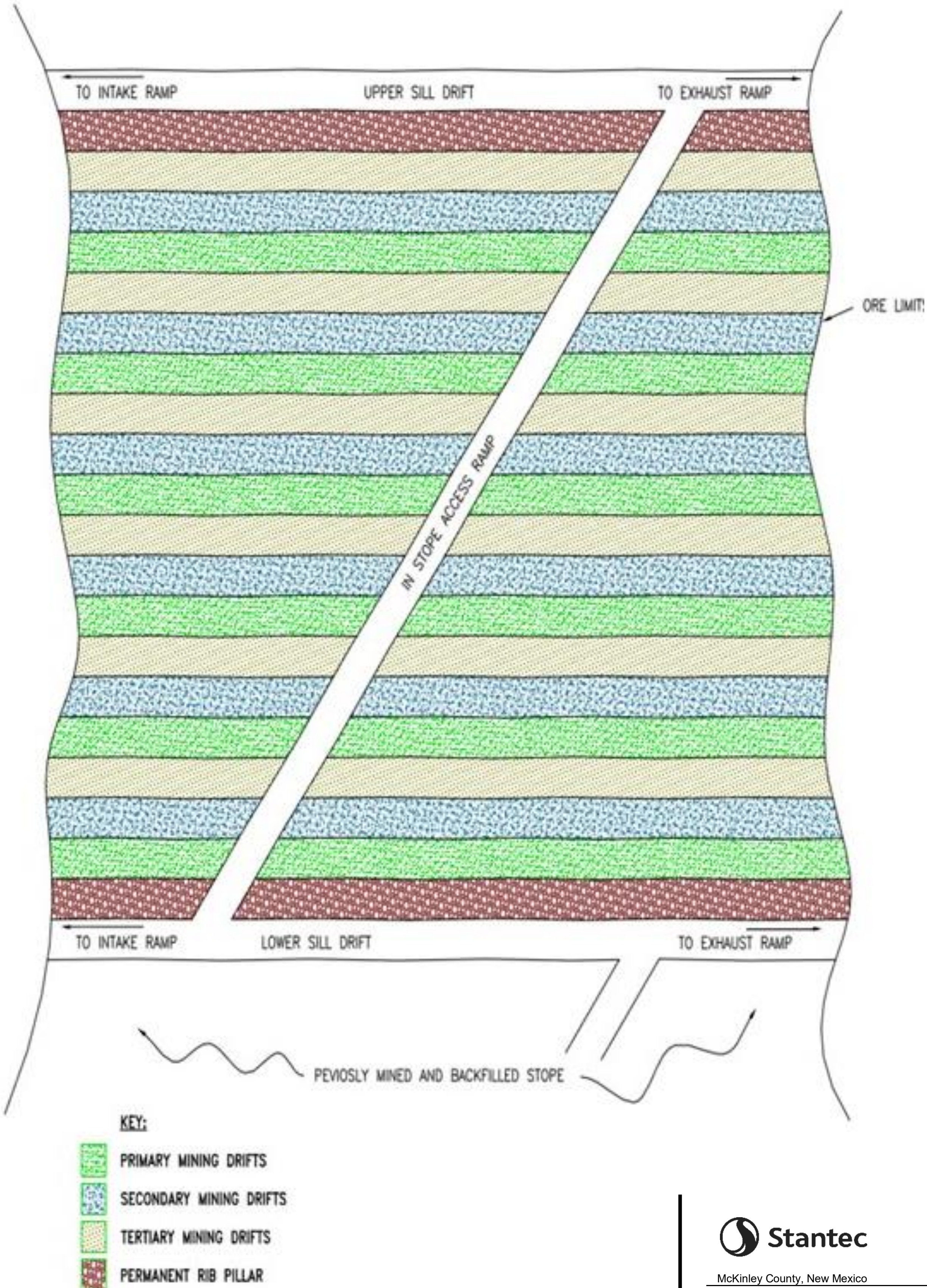

Stantec

McKinley County, New Mexico
*Project Location*

Roca Honda Resources, LLC
*Client/Project*

**27**
*Figure No.*

Typical Step Room and Pillar Mine Design
*Title*



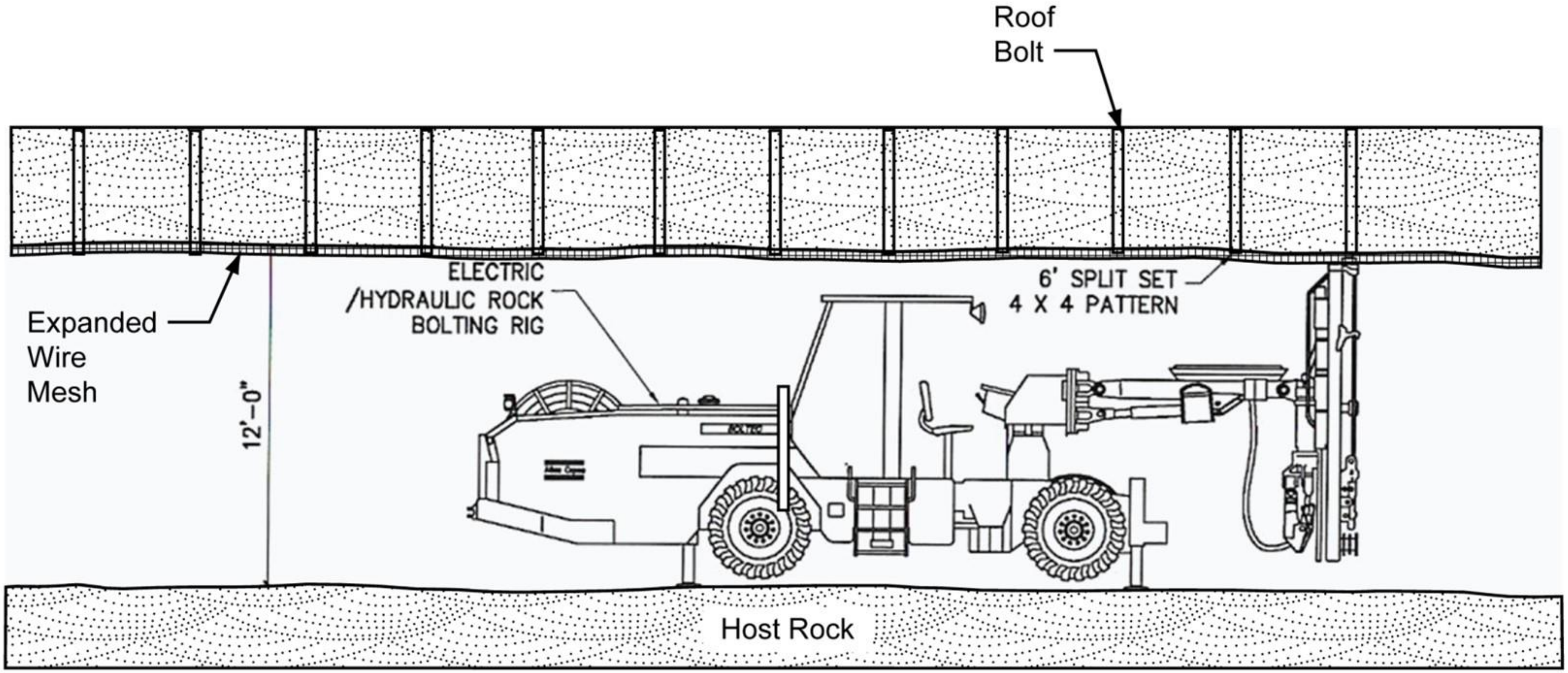

Stantec

McKinley County, New Mexico
*Project Location*

Roca Honda Resources, LLC
*Client/Project*

**28**
*Figure No.*

Typical Drift and Fill Mine Design - Plan View
*Title*




Typical Roof Bolting

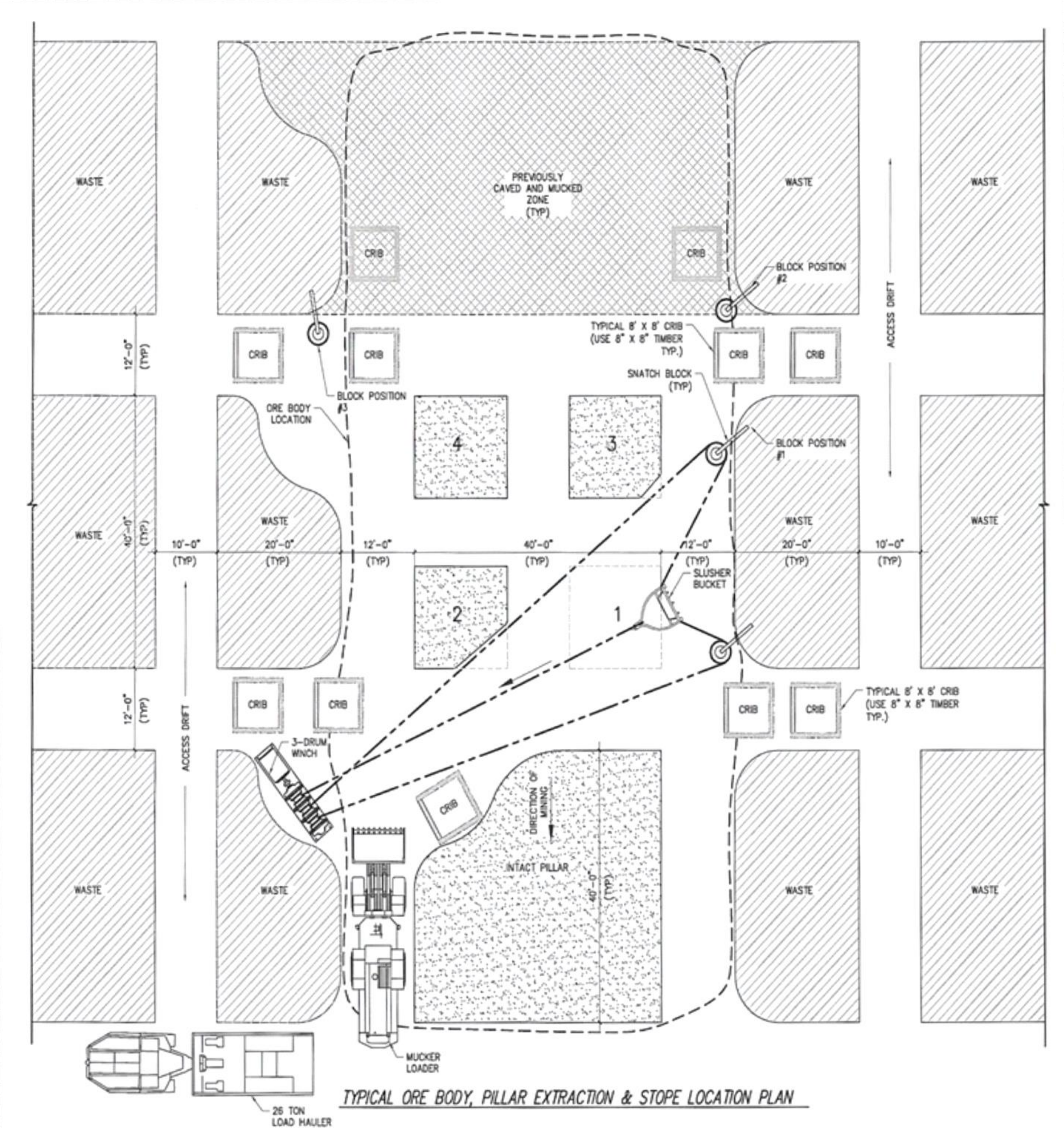
Stantec

McKinley County, New Mexico
*Project Location*

Roca Honda Resources, LLC
*Client/Project*

29
*Figure No.*

Typical Roof Bolting Method for Room and Pillar Mining
*Title*




Stantec

McKinley County, New Mexico

***Project Location***

Roca Honda Resources, LLC

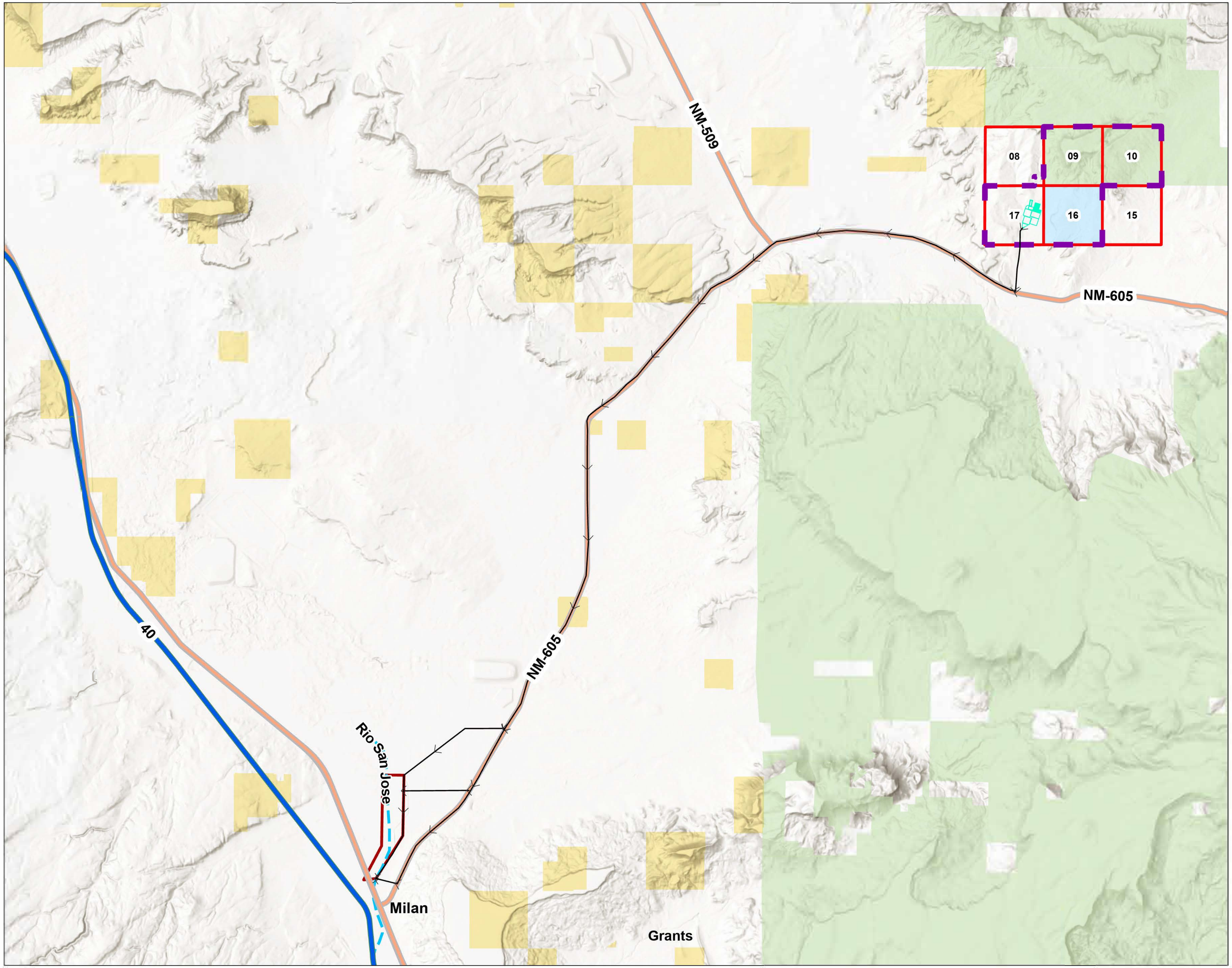
*Client/Project*

**30**

*Figure No.*

Typical Ore Body Pillar Extraction and Stope Location Plan

*Title*




Stantec

## Legend

- Discharge Pipeline Route
- Primary Road
- Project Boundary
- Roca Honda Discharge Permit Area
- Secondary Road
- Rio San Jose River
- Section Line
- Bureau of Land Management
- State
- U.S. Forest Service
- Water Treatment Plant

***Notes***

1. Coordinate System: NAD 1983 2011 StatePlane New Mexico West FIPS 3003 Ft US
2. Data Sources: Roca Honda Resources, LLC
3. Background: Esri, Esri, NASA, NGA, USGS, FEMA, Esri, CGIAR, USGS

N

0 9,000 18,000 Feet

(At original document size of 11x17)
1:108,000


*Project Location*
McKinley County, New Mexico

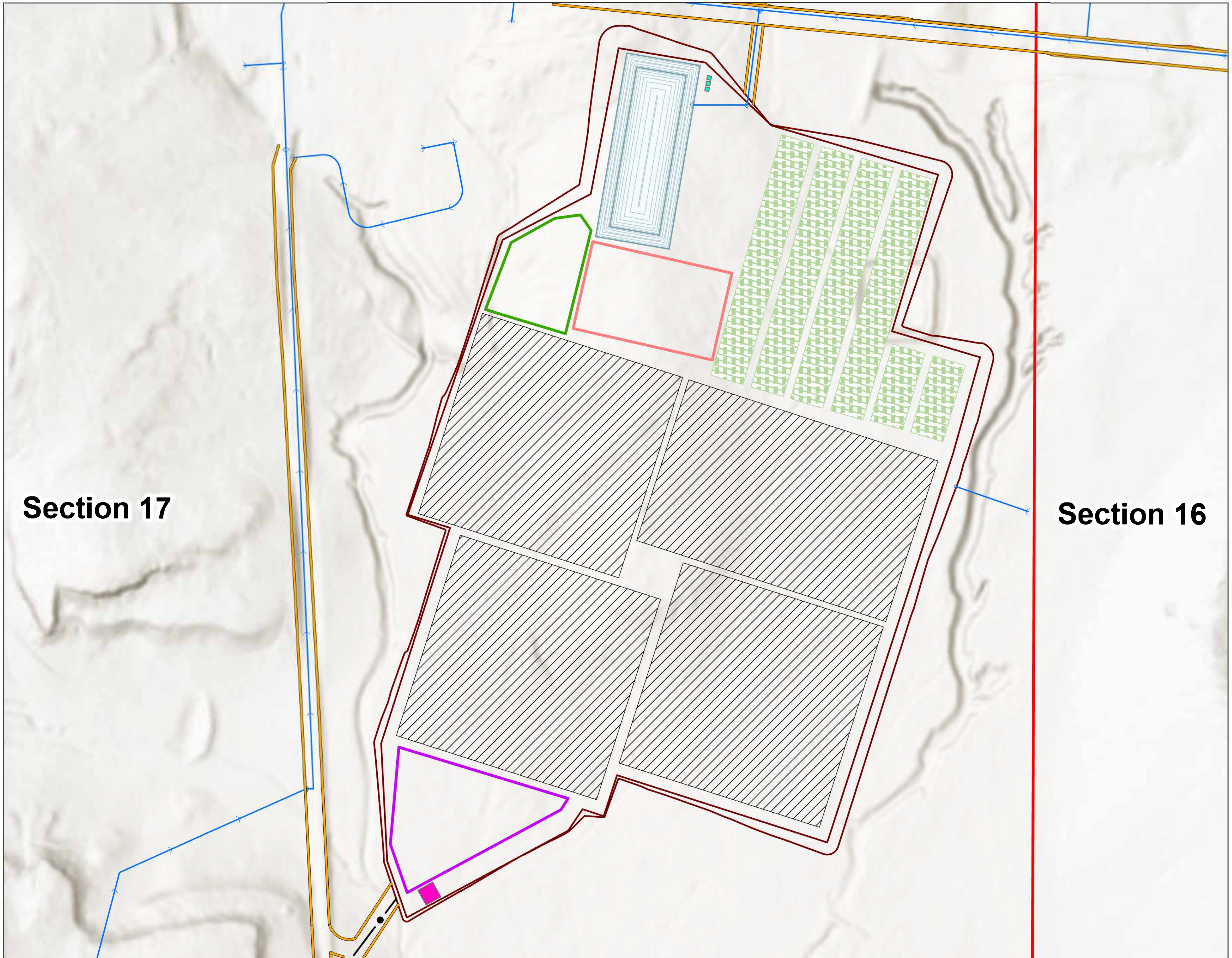
Prepared by SK on 8/8/2025
TR by EZ on 8/8/2025
IR by AR on 8/8/2025

*Client/Project* 182925615
Client: Roca Honda Resources. LLC
Project: Roca Honda Mine
Report: MORP

*Figure No.*
**31**

*Title*
**Discharge Pipeline Layout**

U:\182925615_ArcPro\Roca Honda\Roca Honda_August 5.aprx Discharge Pipeline_11x17 Revised: 2025-08-08 By: skashani




Stantec

## Legend

- Dewatering Pipeline
- Discharge Pipeline
- Haul Road
- Graded Pad
- Section Line

### Water Treatment Plant

- Buried Biological Reactor Group
- Finishing Pond
- Geotube Sludge Dewatering and Storage Basin
- Off-Spec Pond
- Packed Tower Air Strippers
- SAR Treatment Area
- Surge Pond
- Water Treatment Facility

***Notes***

1. Coordinate System: NAD 1983 2011 StatePlane New Mexico West FIPS 3003 Ft US
2. Data Sources: Roca Honda Resources, LLC
3. Background: Esri, CGIAR, USGS, Sources: Esri, Maxar, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap, and the GIS user community, BLM Admin State

N

0 300 600 Feet

(At original document size of 11x17)
1:3,600

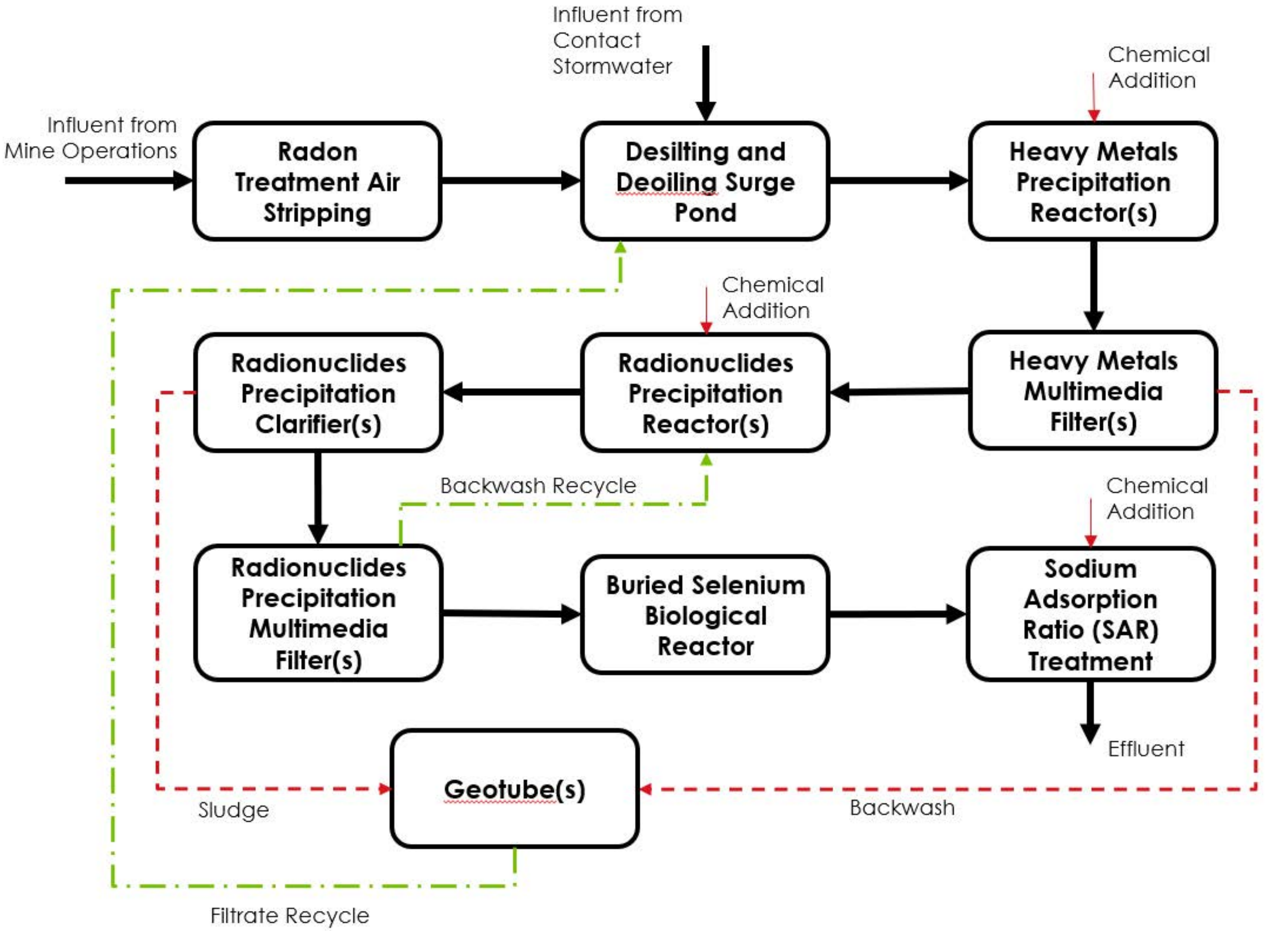

*Project Location*
McKinley County, New Mexico

Prepared by SK on 10/24/2025
TR by EZ on 10/24/2025
IR by AR on 10/24/2025

*Client/Project* 182925615
Client: Roca Honda Resources. LLC
Project: Roca Honda Mine
Report: MORP

*Figure No.*
**32**

*Title*
**Water Treatment Plant General Layout**



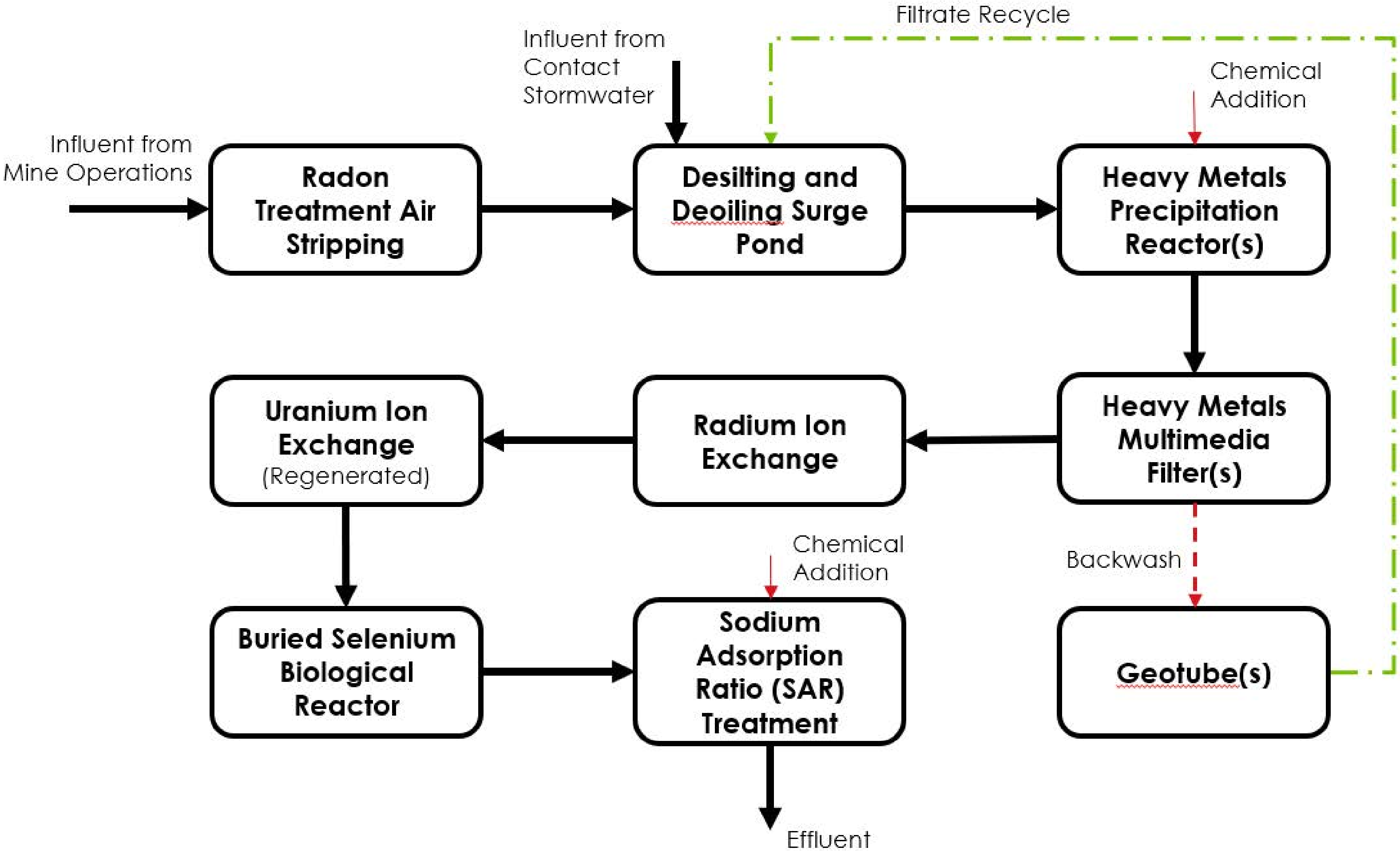

Stantec

McKinley County, New Mexico
*Project Location*

Roca Honda Resources, LLC
*Client/Project*

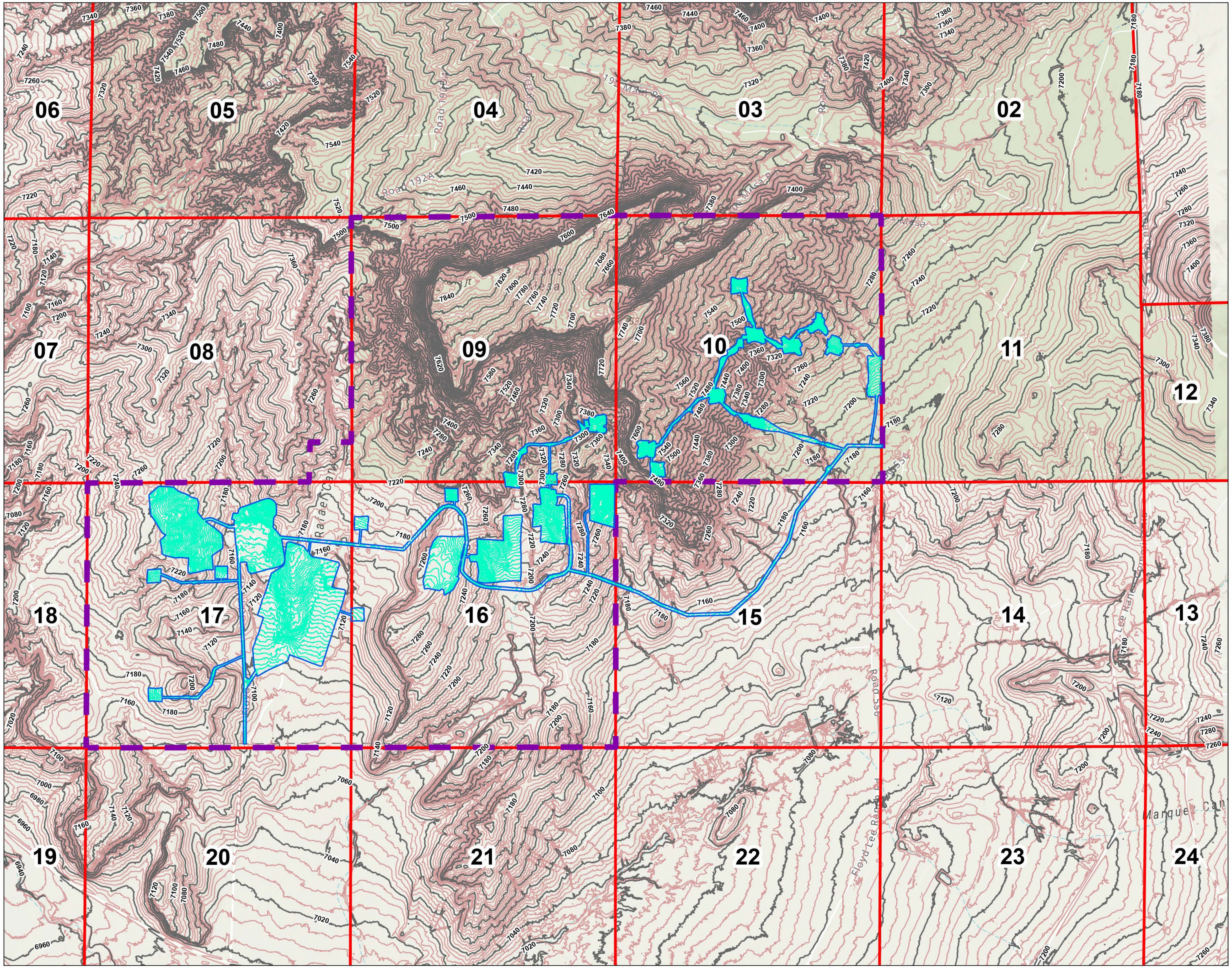
**33**
*Figure No.*

Preliminary Concept WTP PFD
*Title*




Stantec

McKinley County, New Mexico
*Project Location*
Roca Honda Resources, LLC
*Client/Project*
**34**
*Figure No.*
WTP with Ion Exchange (IX) Technology PFD
*Title*




Stantec

**Legend**

- Existing Contour (5ft)
- Existing Contour (20ft)
- Project Boundary
- Reclamation Contours
- Section Line
- Disturbance Boundary

***Notes***

**1.** Coordinate System: NAD 1983 2011 StatePlane New Mexico West FIPS 3003 Ft US
**2.** Data Sources: Roca Honda Resources, LLC
**3.** Background: Esri, NASA, NGA, USGS, FEMA, Esri, CGIAR, USGS, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, BLM Admin State

N

0 2,000 4,000 Feet

(At original document size of 11x17)
1:24,000


*Project Location*
McKinley County, New Mexico

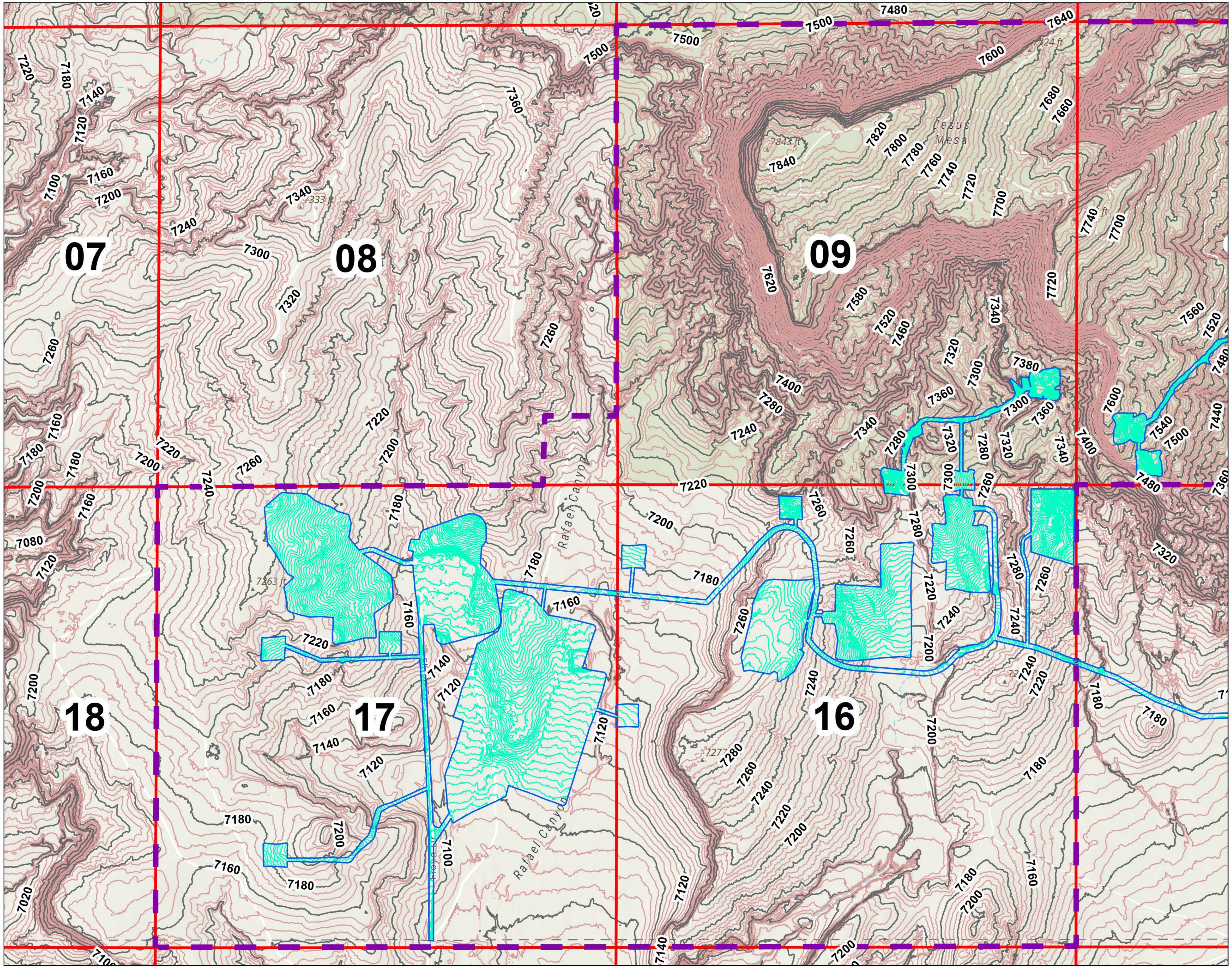
Prepared by SK on 10/24/2025
TR by EZ on 10/24/2025
IR by AR on 10/24/2025

*Client/Project*
182925615
Client: Roca Honda Resources, LLC
Project: Roca Honda Mine
Report: MORP

*Figure No.*
**35**

*Title*
**Reclamation Contour Index Map**

U:\182925615_ArcPro\Roca Honda\Roca Honda_August 5.aprx Reclamation Contour Index Map_11x17 Revised: 2025-10-24 By: skashani




Stantec

**Legend**

- Existing Contour (5ft)
- Existing Contour (20ft)
- Project Boundary
- Reclamation Contours
- Section Line
- Disturbance Boundary

***Notes***

**1.** Coordinate System: NAD 1983 2011 StatePlane New Mexico West FIPS 3003 Ft US
**2.** Data Sources: Roca Honda Resources, LLC
**3.** Background: Esri, NASA, NGA, USGS, FEMA, Esri, CGIAR, USGS, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, BLM Admin State

N

0 1,150 2,300 Feet
(At original document size of 11x17)
1:13,800

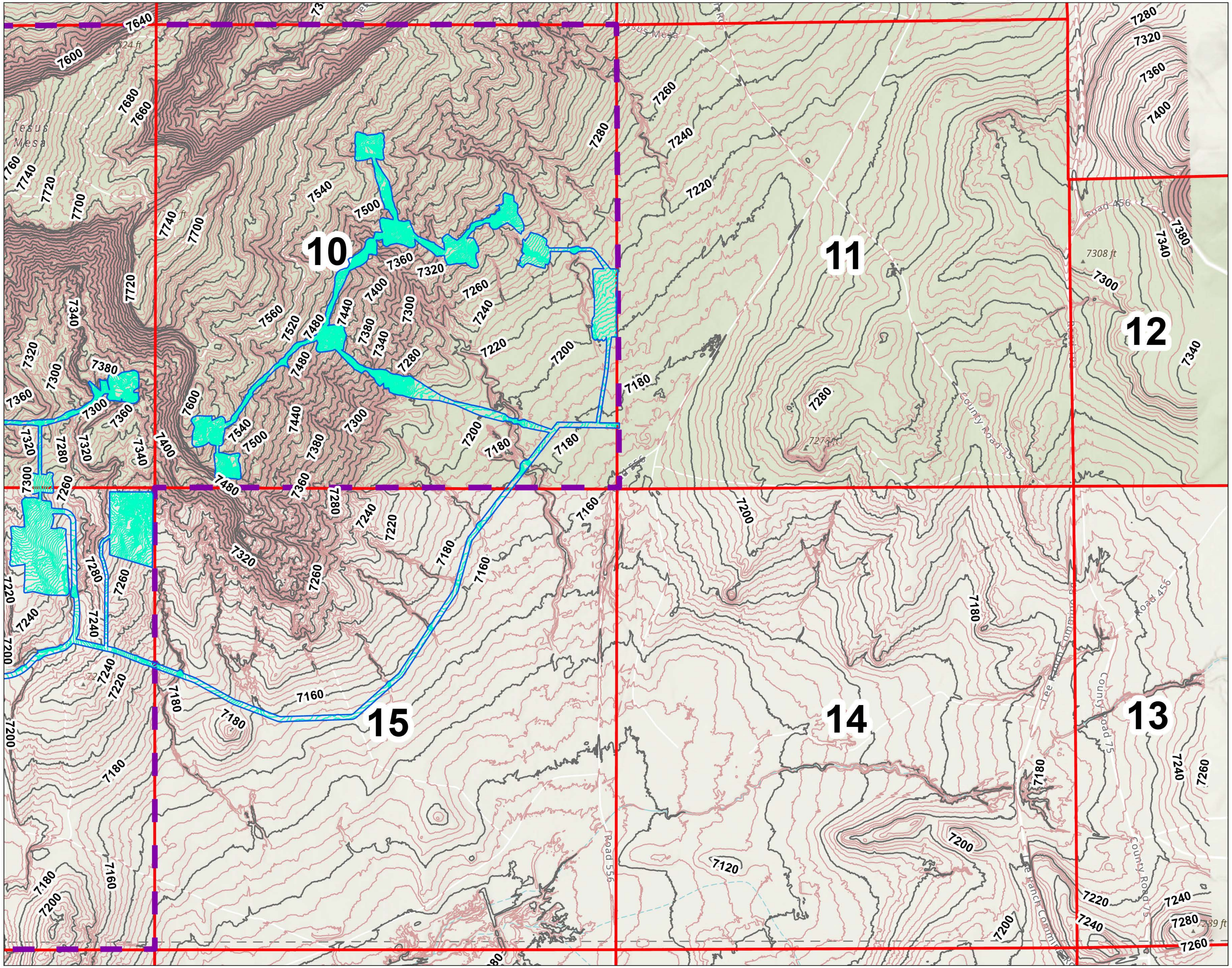

*Project Location*
McKinley County, New Mexico

Prepared by SK on 10/24/2025
TR by EZ on 10/24/2025
IR by AR on 10/24/2025

*Client/Project* 182925615
Client: Roca Honda Resources, LLC
Project: Roca Honda Mine
Report: MORP

*Figure No.*
**36**

*Title*
**Reclamation Contour Map (Sections 8, 9, 16, & 17)**




Stantec

## Legend

- Existing Contour (5ft)
- Existing Contour (20ft)
- Project Boundary
- Reclamation Contours
- Section Line
- Disturbance Boundary

***Notes***

1. Coordinate System: NAD 1983 2011 StatePlane New Mexico West FIPS 3003 Ft US
2. Data Sources: Roca Honda Resources, LLC
3. Background: Esri, NASA, NGA, USGS, FEMA, Esri, CGIAR, USGS, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, BLM Admin State

N

0 1,150 2,300 Feet

(At original document size of 11x17)
1:13,800


*Project Location*
McKinley County, New Mexico

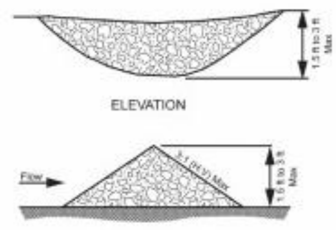
Prepared by SK on 10/24/2025
TR by EZ on 10/24/2025
IR by AR on 10/24/2025

*Client/Project*
182925615
Client: Roca Honda Resources, LLC
Project: Roca Honda Mine
Report: MORP

*Figure No.*
37

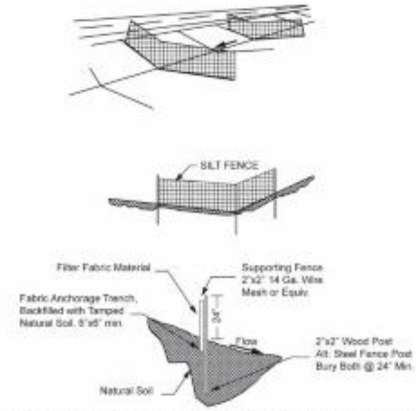
*Title*
**Reclamation Contour Map (Sections 10, 11, 14, & 15)**

U:\182925615_ArcPro\Roca Honda\Roca Honda_August 5.aprx Reclamation Contour Index Map_11x17 Revised: 2025-10-24 By: skashani

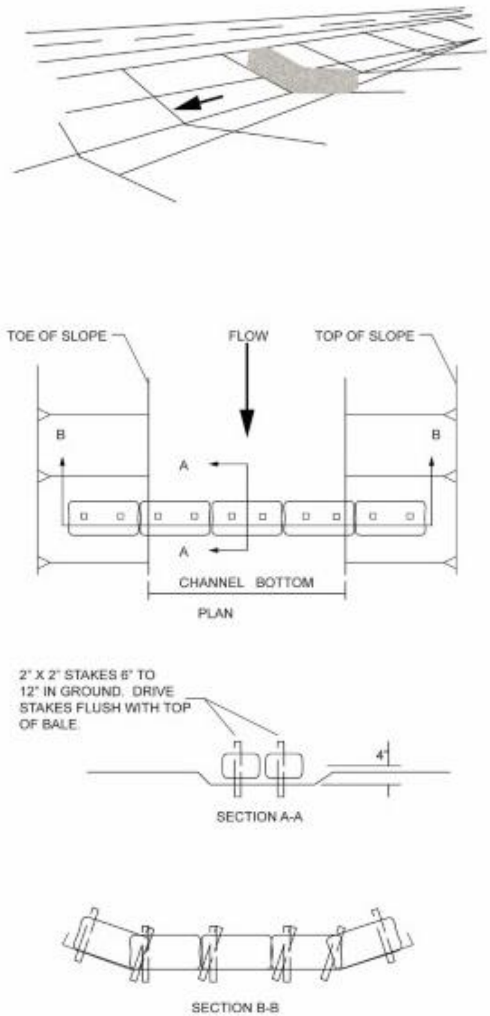



ROCK CHECK DAM
NOT TO SCALE

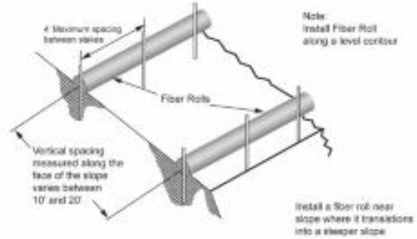
## TYPICAL ROCK CHECK DAM SECTION



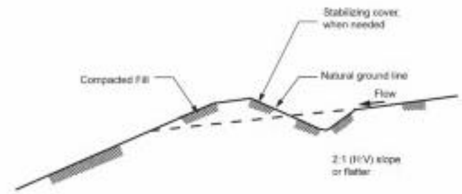

## TYPICAL SILT FENCE INSTALLATION




## TYPICAL STRAW BALE INSTALLATION

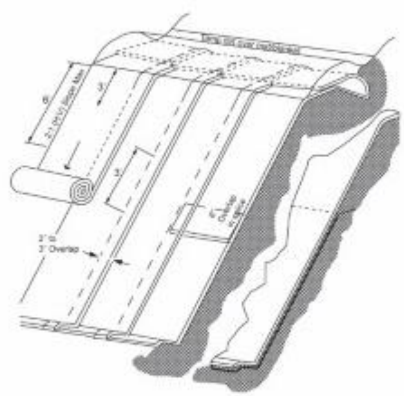



## TYPICAL FIBER ROLL INSTALLATION

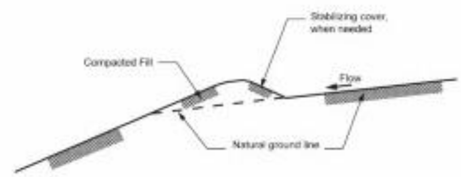



## TYPICAL DRAINAGE SWALE
NOT TO SCALE

NOTES:
1. Stabilize inlet, outlests, and slopes
2. Properly compact the subgrade



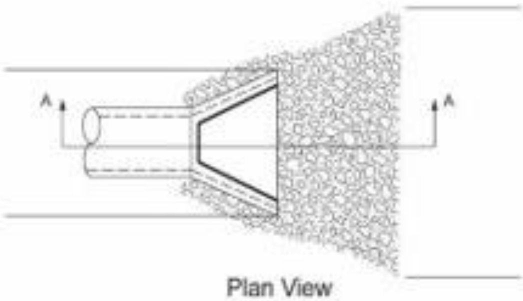

## TYPICAL SLOPE SOIL STABILIZATION



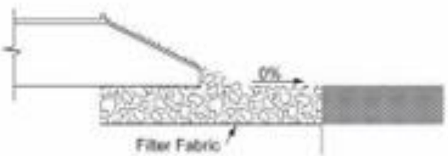

## TYPICAL EARTH DIKE
NOT TO SCALE

Stantec

McKinley County, New Mexico
*Project Location*
Roca Honda Resources, LLC
*Client/Project*
38
*Figure No.*
Best Management Practices
*Title*

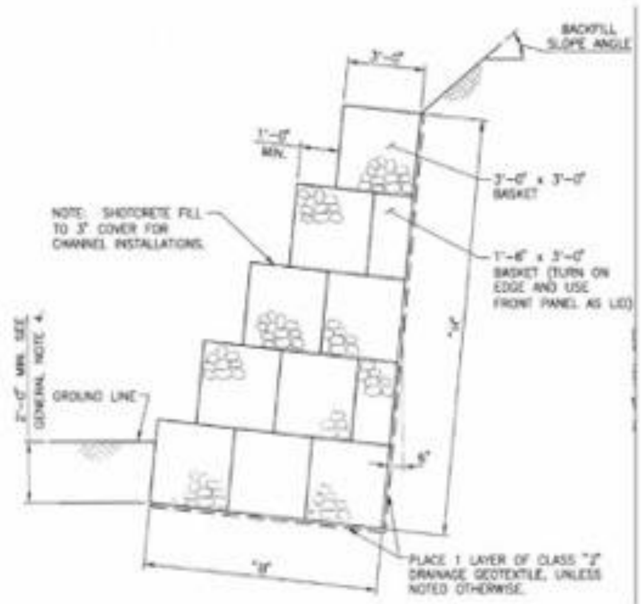



Plan View

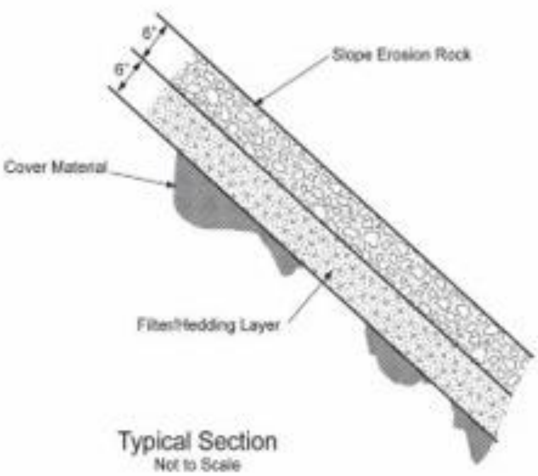



Section A-A

**Typical Velocity Dissipation Device**

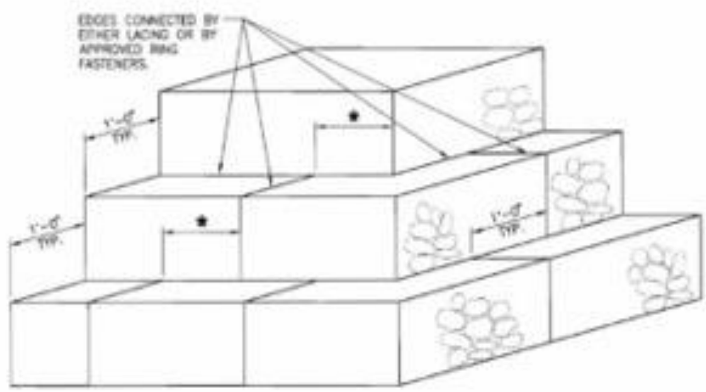



Typical Cross Section for
Type "A" Standard Retaining Wall




Typical Section
Not to Scale

**Typical Riprap Installation**



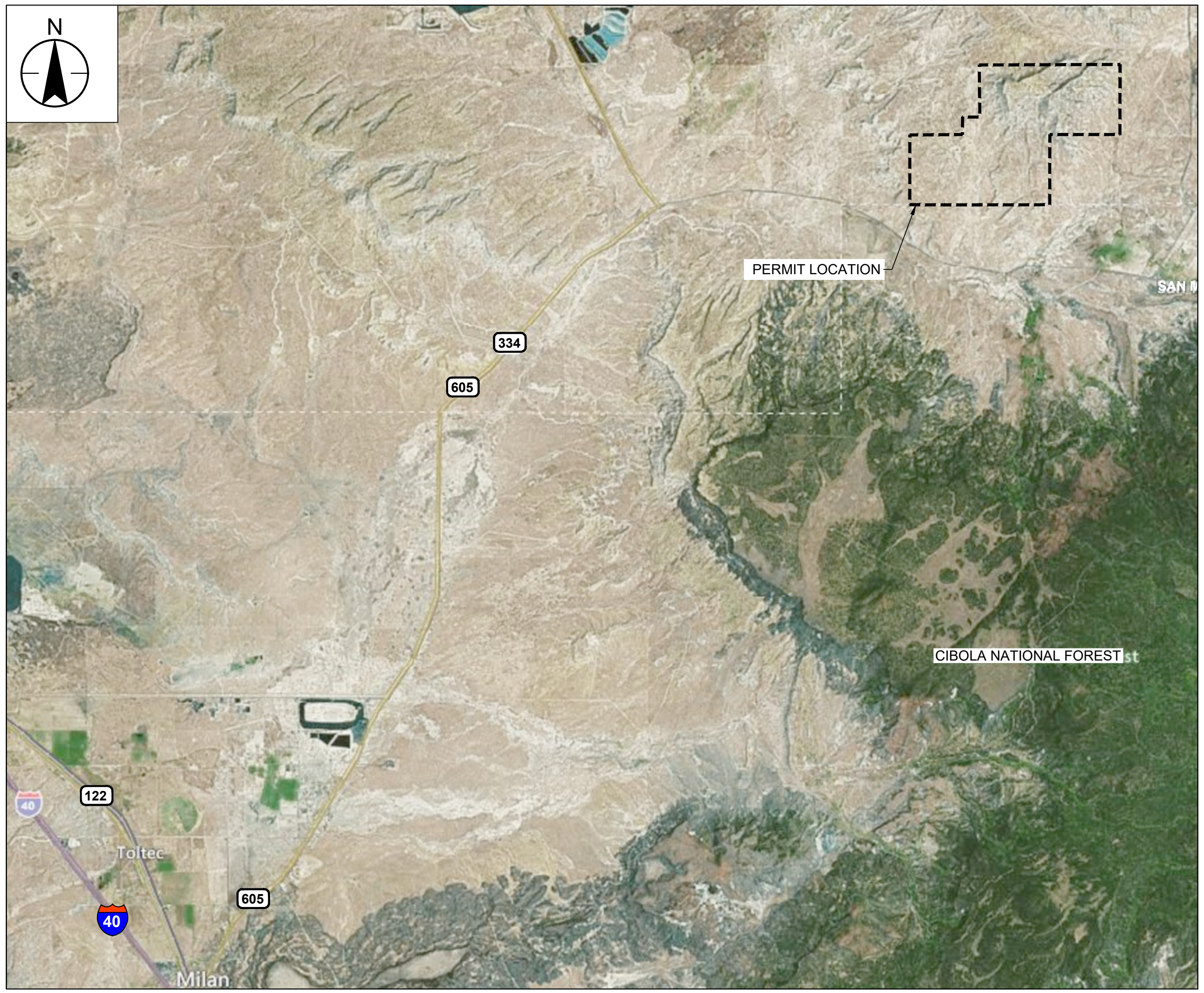

**Typical Gabion Retaining Wall**
**NMDOT 602.01 4/6**

Stantec

McKinley County, New Mexico
***Project Location***
Roca Honda Resources, LLC
*Client/Project*
*39*
*Figure No.*
Stream Channel Reclamation Typical Details
*Title*

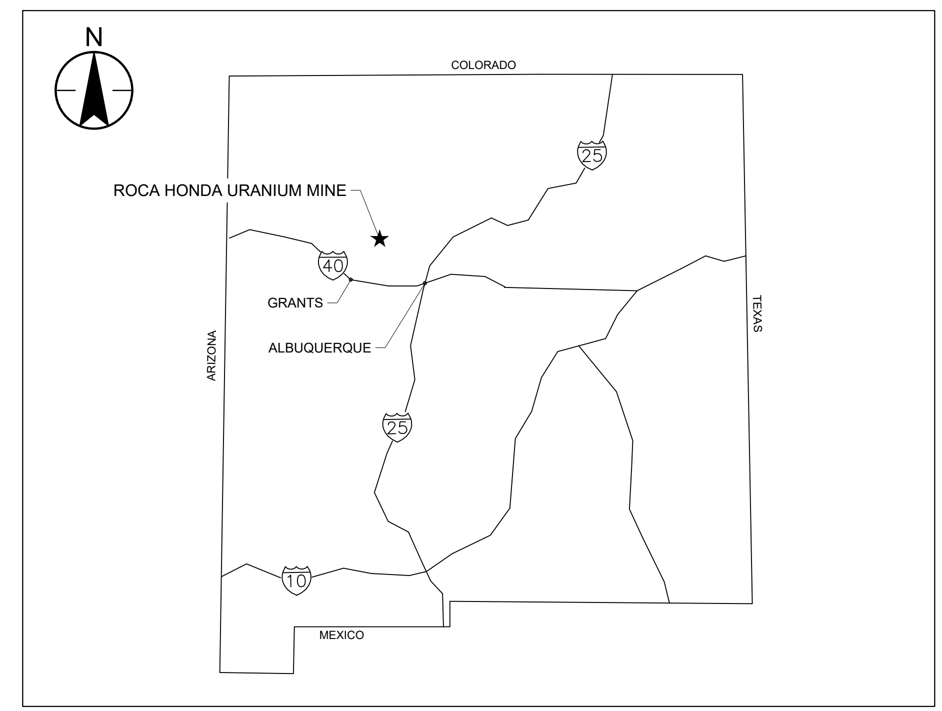
# Appendix A Preliminary Design Drawings

# ROCA HONDA RESOURCES, L.L.C
# PRELIMINARY DESIGN DRAWINGS
## ROCA HONDA URANIUM MINE




LOCATION MAP
N.T.S.

| INDEX OF DRAWINGS | | |
|---|---|---|
| DRAWING NUMBER | DESCRIPTION | REVISION |
| 1 | COVER AND INDEX SHEET | A |
| 2 | GENERAL ARRANGEMENT | A |
| 3 | GENERAL ARRANGEMENT SECTION 17 PLAN VIEW | A |
| 4 | SECTION 17 CROSS SECTIONS | A |
| 5 | GENERAL ARRANGEMENT SECTION 16 PLAN VIEW | A |
| 6 | SECTION 16 CROSS SECTIONS | A |
| 7 | WEST HAUL ROAD PLAN AND PROFILE | A |
| 8 | EAST HAUL ROAD PLAN AND PROFILE | A |
| 9 | TYPICAL DETAILS | A |




VICINITY MAP
N.T.S.

FOR REVIEW ONLY
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| A | ISSUED FOR REVIEW | 2025-10-23 | CF | NS | NS | |

Permit-Seal

Stantec

3133 West Frye Road Suite 300
Chandler AZ 85226-5110
www.stantec.com

The Contractor shall verify and be responsible for all dimensions. DO NOT scale the drawing - any errors or omissions shall be reported to Stantec without delay.


Client/Project
ENERGY FUELS RESOURCES, NEW MEXICO
ROCA HONDA MINE

RHR
ROCA HONDA RESOURCES LLC.

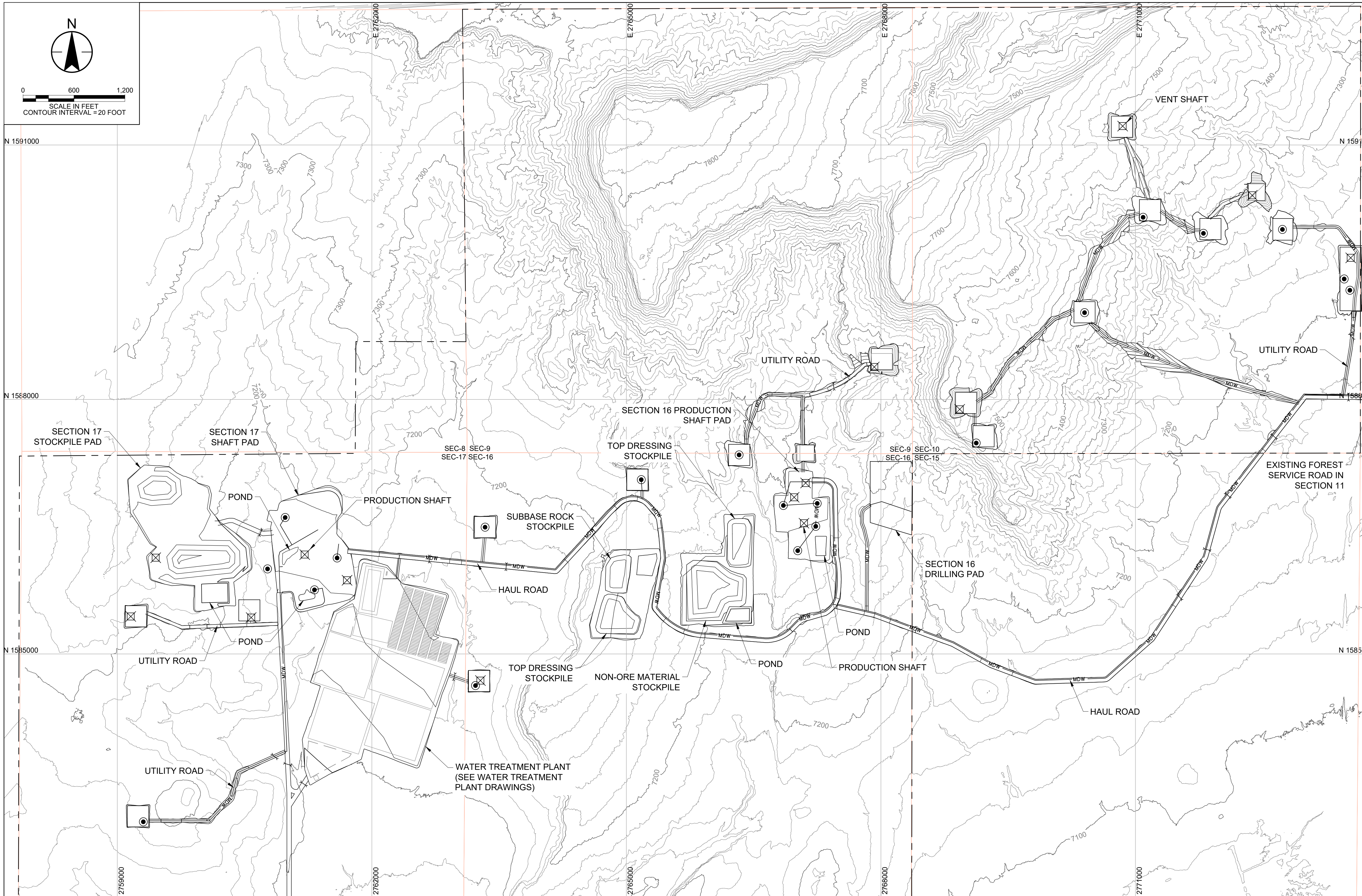
| File Name: SHT-1 COVER.dwg | CF | NS | NS | 25.10.29 |
|---|---|---|---|---|
| | Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title
COVER AND INDEX SHEET

Project No. 182925615
Scale N.T.S.
Drawing No. 1
Revision A

C:\ProjectWise-Drive\Stantec\182925615\6.0 Design\sheet Set\SHT-1 COVER.dwg
2025/10/29 1:24 PM By: Fowler, Camille

ORIGINAL SHEET - ANSI D




## LEGEND

| | |
|---|---|
| 7400 | EXISTING GROUND CONTOURS, FT |
| 7400 | DESIGN GROUND CONTOURS, FT |
| | SECTION LINES |
| | EXISTING ROAD |
| | PERMIT BOUNDARY |
| MDW | DEWATERING PIPELINE |
| | CULVERT |
| | DEWATERING WELL |
| | VENT SHAFT |

## NOTES:

1. COORDINATE SYSTEM REFERENCE: NAD 83 (NSRS 2011) NEW MEXICO STATE PLANE, WEST ZONE, US FOOT.

FOR REVIEW ONLY
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

C:\ProjectWise-Drive\Stantec\182925615\6.0 Design\sheet set\SHEET1.dwg
2025/10/29 1:25 PM By: Fowler, Camille

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| A | ISSUED FOR REVIEW | 2025-10-23 | CF | NS | NS | |

Permit-Seal

Stantec

3133 West Frye Road Suite 300
Chandler AZ 85226-5110
www.stantec.com

The Contractor shall verify and be responsible for all dimensions. DO NOT scale the drawing - any errors or omissions shall be reported to Stantec without delay.
The Copyrights to all designs and drawings are the property of Stantec. Reproduction or use for any purpose other than that authorized by Stantec is forbidden.

Client/Project
ENERGY FUELS RESOURCES, NEW MEXICO
ROCA HONDA MINE

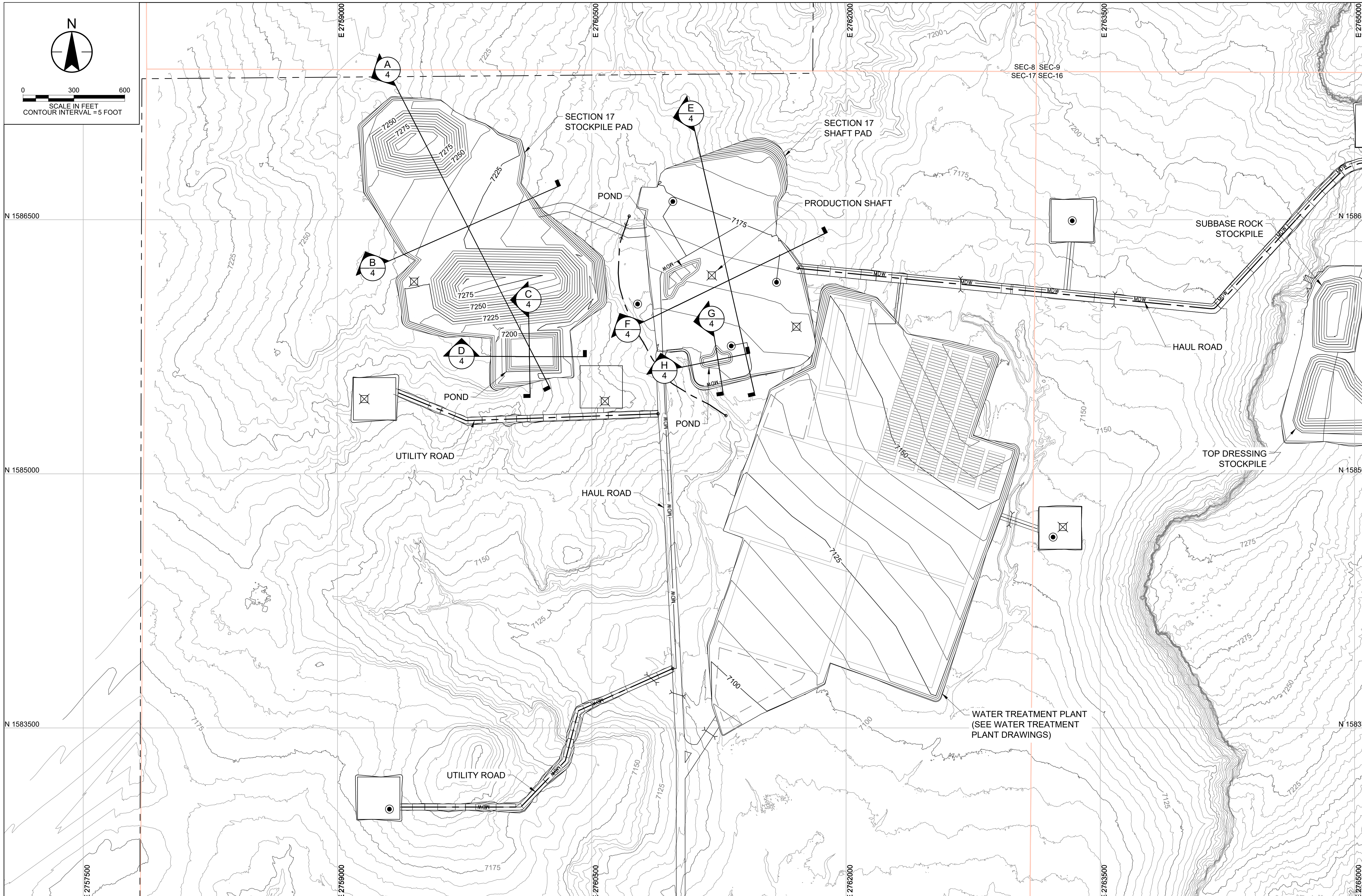
RHR
ROCA HONDA RESOURCES LLC.

| File Name: SHEET1.dwg | CF | NS | NS | 25.10.29 |
|---|---|---|---|---|
| | Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title
GENERAL ARRANGEMENT

Project No. 182925615
Scale 1" = 600'
Drawing No. 2
Revision A

ORIGINAL SHEET - ANSI D




## LEGEND

| | |
|---|---|
| 7400 | EXISTING GROUND CONTOURS, FT |
| 7400 | DESIGN GROUND CONTOURS, FT |
| | SECTION LINES |
| | EXISTING ROAD |
| | PERMIT BOUNDARY |
| MDW | DEWATERING PIPELINE |
| | CULVERT |
| | DEWATERING WELL |
| | VENT SHAFT |

## NOTES:

1. COORDINATE SYSTEM REFERENCE: NAD 83 (NSRS 2011) NEW MEXICO STATE PLANE, WEST ZONE, US FOOT.

FOR REVIEW ONLY

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

C:\ProjectWise-Drive\Stantec\182925615\6.0 Design\sheet set\SHEET2_PLAN AND SECTIONS.dwg
2025/10/29 1:25 PM By: Fowler, Camille

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| A | ISSUED FOR REVIEW | 2025-10-23 | CF | NS | NS | |

Permit-Seal

Stantec

3133 West Frye Road Suite 300
Chandler AZ 85226-5110
www.stantec.com

The Contractor shall verify and be responsible for all dimensions. DO NOT scale the drawing - any errors or omissions shall be reported to Stantec without delay.


Client/Project

ENERGY FUELS RESOURCES, NEW MEXICO
ROCA HONDA MINE

RHR ROCA HONDA RESOURCES LLC.

| File Name: | Dwn. | Chkd. | Dsgn. | YY.MM.DD |
|---|---|---|---|---|
| SHEET2_PLAN AND SECTIONS.dwg | CF | NS | NS | 25.10.29 |

Title

GENERAL ARRANGEMENT
SECTION 17 PLAN VIEW

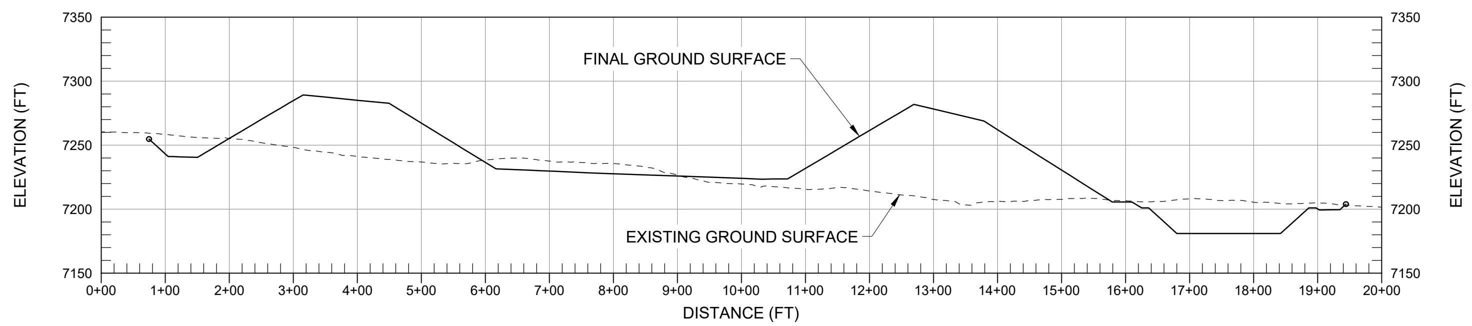
Project No. 182925615

Scale 1" = 300'

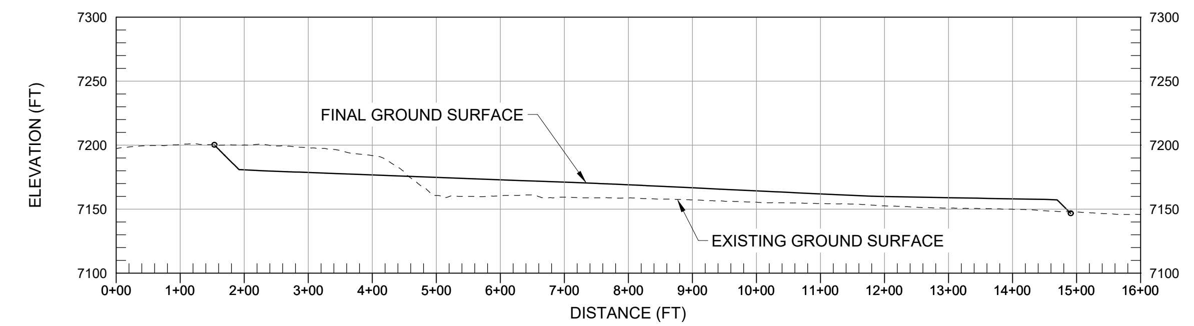
Drawing No. 3

Revision A

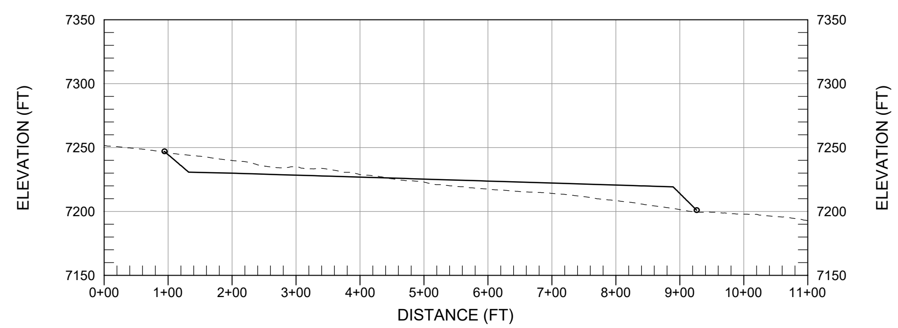
ORIGINAL SHEET - ANSI D



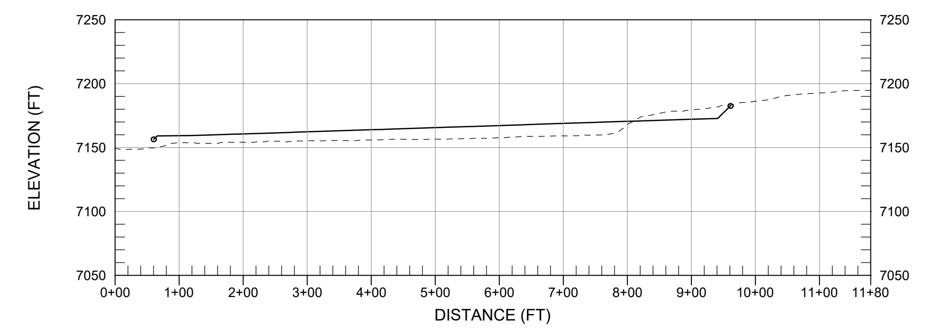

A 4 SECTION A



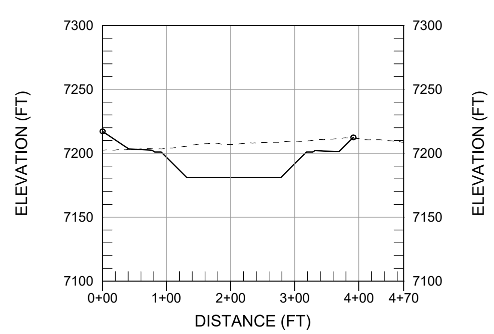

E 4 SECTION E



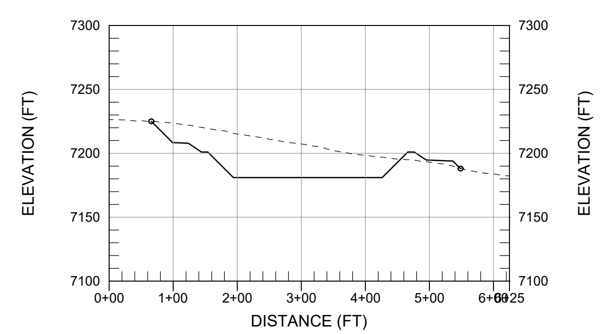

B 4 SECTION B



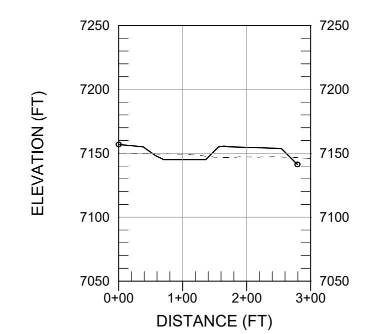

F 4 SECTION F



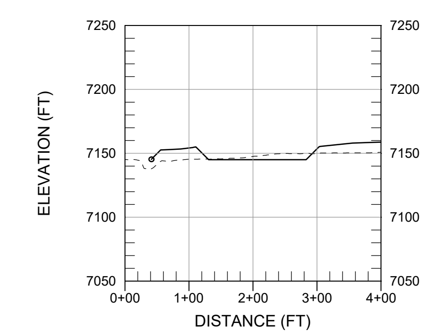

C 4 SECTION C




D 4 SECTION D




G 4 SECTION G




H 4 SECTION H

HORZ 0 150 300
VERT 0 75 150
SCALE IN FEET

FOR REVIEW ONLY
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| A | ISSUED FOR REVIEW | 2025-10-23 | CF | MS | MS | |

Permit-Seal

Stantec

3133 West Frye Road Suite 300
Chandler AZ 85226-5110
www.stantec.com



Client/Project
ENERGY FUELS RESOURCES, NEW MEXICO
ROCA HONDA MINE

RHR ROCA HONDA RESOURCES LLC.

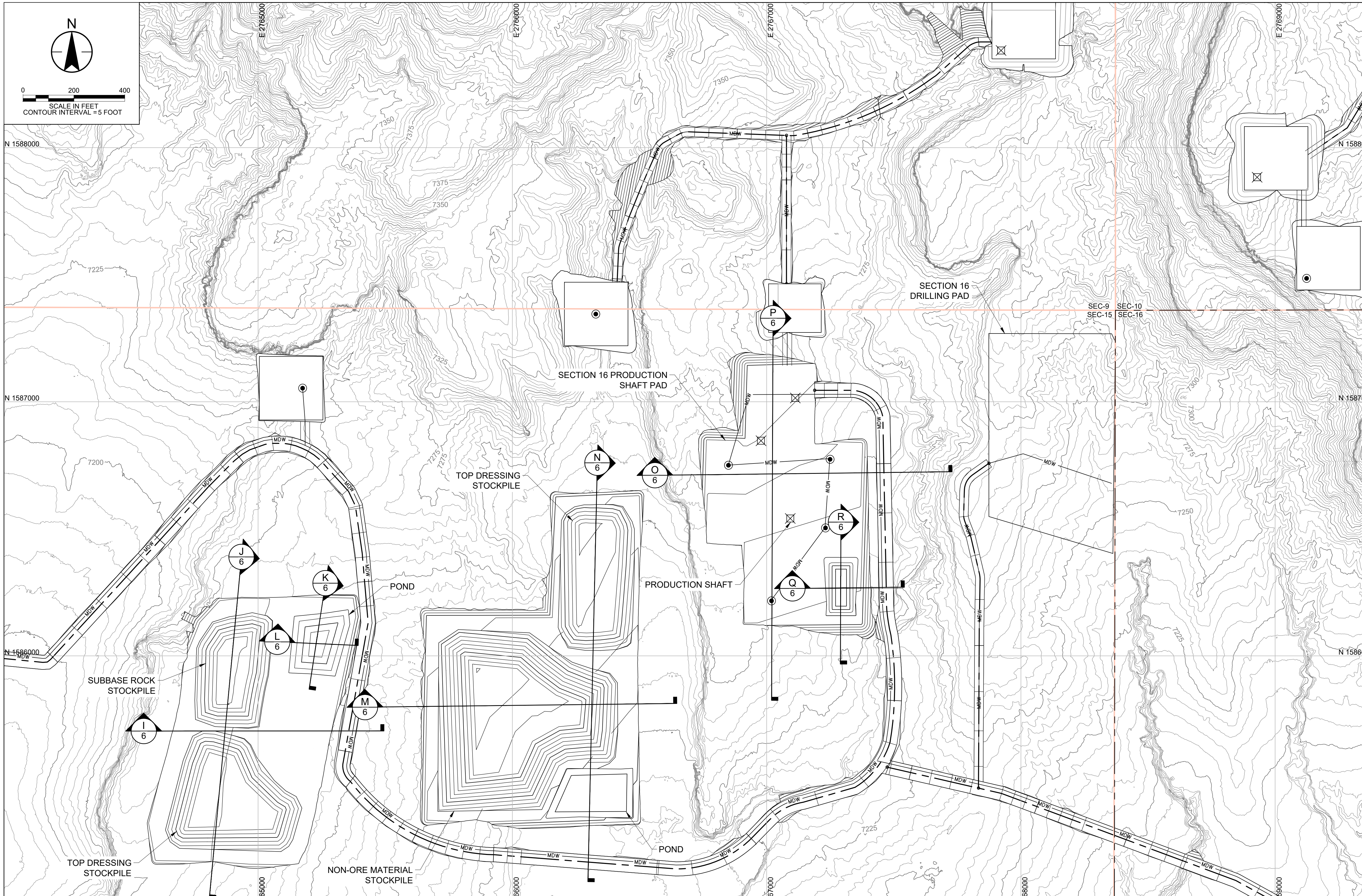
| File Name: | Dwn. | Chkd. | Dsgn. | YY.MM.DD |
|---|---|---|---|---|
| SHEET2_PLAN AND SECTIONS.dwg | CF | MS | MS | 25.10.29 |

Title
SECTION 17 CROSS SECTIONS

Project No. 182925615
Scale AS SHOWN
Drawing No. 4
Revision A

C:\ProjectWise-Drive\Stantec\182925615\6.0 Design\sheet Set\SHEET2_PLAN AND SECTIONS.dwg
2025/10/29 1:27 PM By: Fowler, Camille

ORIGINAL SHEET - ANSI D




## LEGEND

| | |
|---|---|
| 7400 | EXISTING GROUND CONTOURS, FT |
| 7400 | DESIGN GROUND CONTOURS, FT |
| | SECTION LINES |
| | EXISTING ROAD |
| | PERMIT BOUNDARY |
| MDW | DEWATERING PIPELINE |
| | CULVERT |
| | DEWATERING WELL |
| | VENT SHAFT |

## NOTES:

1. COORDINATE SYSTEM REFERENCE: NAD 83 (NSRS 2011) NEW MEXICO STATE PLANE, WEST ZONE, US FOOT.

FOR REVIEW ONLY
**PRELIMINARY**
NOT TO BE USED FOR CONSTRUCTION

C:\ProjectWise-Drive\Stantec\182925615\6.0 Design\sheet Set\SHEET3_PLAN AND SECTIONS.dwg
2025/10/29 1:25 PM By: Fowler, Camille

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| A | ISSUED FOR REVIEW | 2025-10-23 | CF | NS | NS | |

Permit-Seal

Stantec

3133 West Frye Road Suite 300
Chandler AZ 85226-5110
www.stantec.com

The Contractor shall verify and be responsible for all dimensions. DO NOT scale the drawing - any errors or omissions shall be reported to Stantec without delay.


Client/Project
ENERGY FUELS RESOURCES, NEW MEXICO
ROCA HONDA MINE

RHR ROCA HONDA RESOURCES LLC.

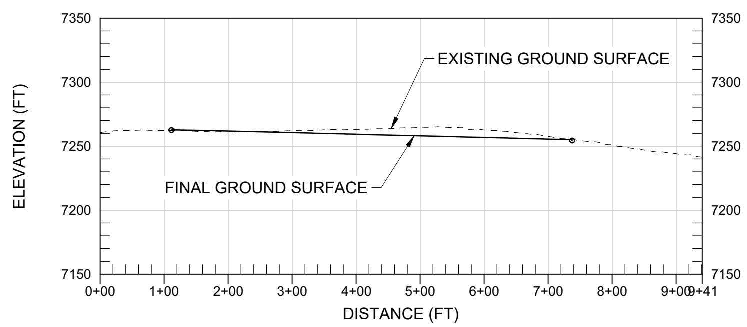
| File Name: SHEET3_PLAN AND SECTIONS.dwg | CF | NS | NS | 25.10.29 |
|---|---|---|---|---|
| | Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title
GENERAL ARRANGEMENT
SECTION 16 PLAN VIEW

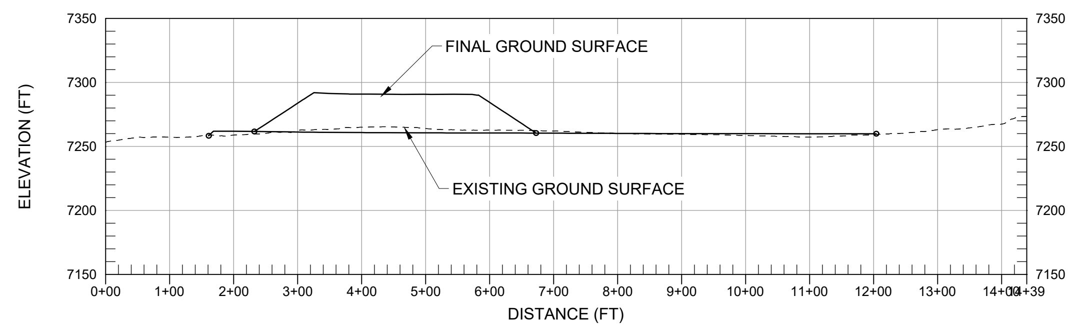
| Project No. | Scale |
|---|---|
| 182925615 | 1" = 200' |

| Drawing No. | Revision |
|---|---|
| 5 | A |

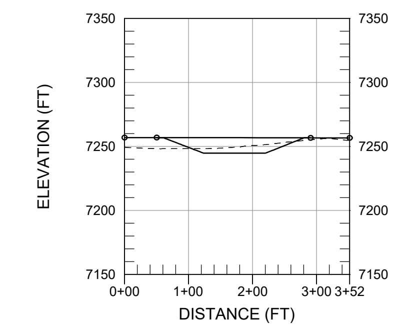
ORIGINAL SHEET - ANSI D



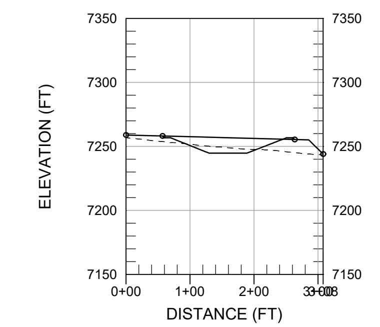

I
6
SECTION I



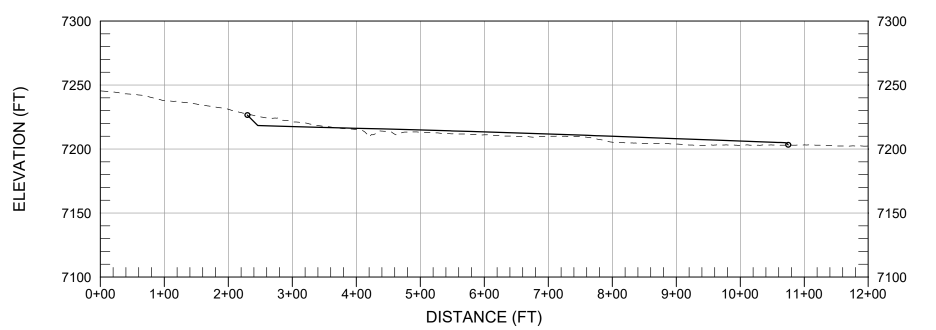

J
6
SECTION J



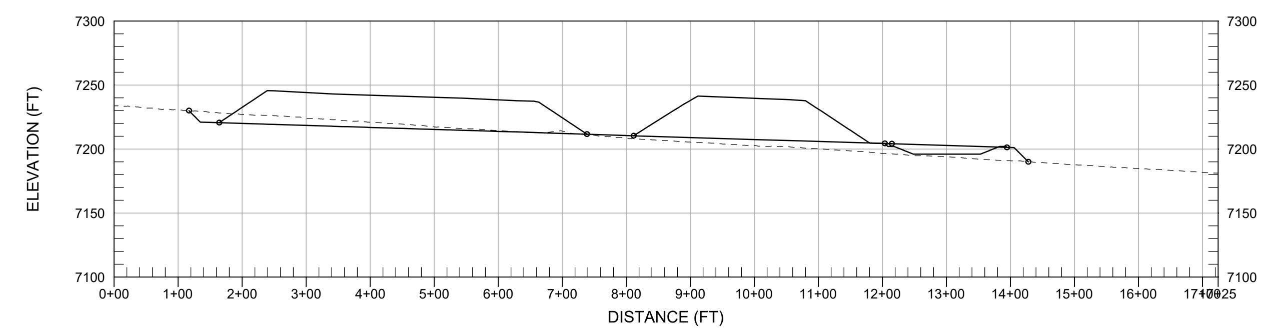

K
6
SECTION K



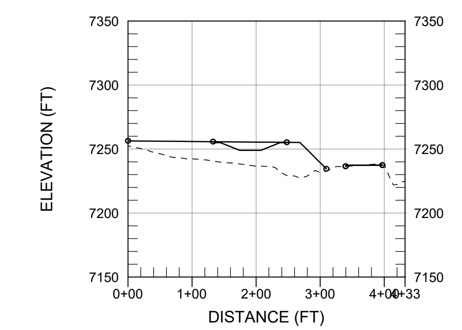

L
6
SECTION L



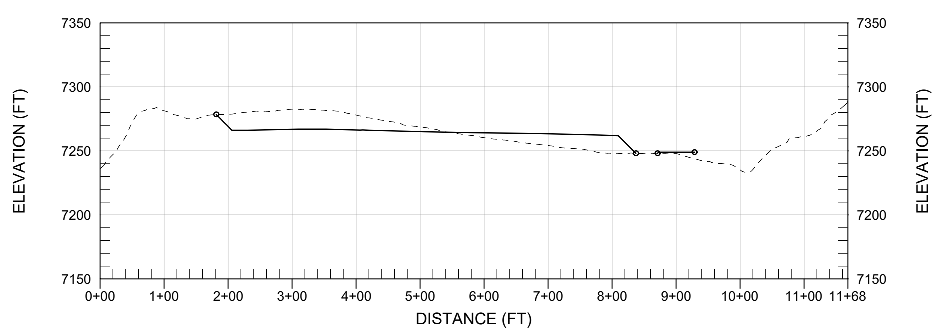

M
6
SECTION M



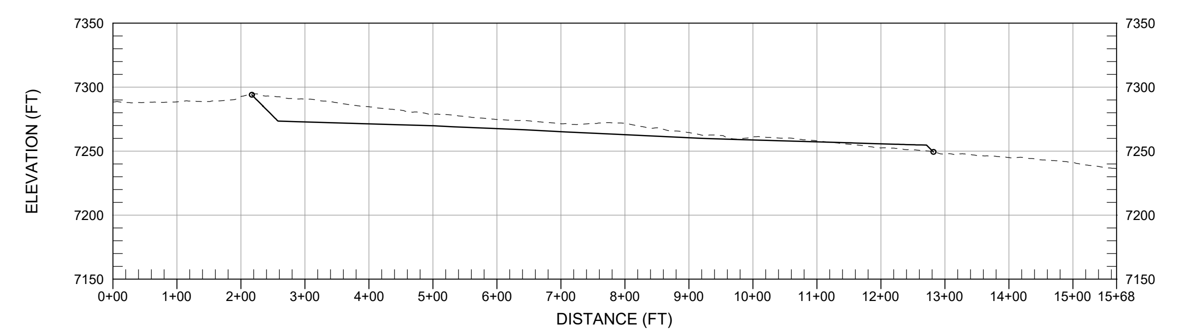

N
6
SECTION N



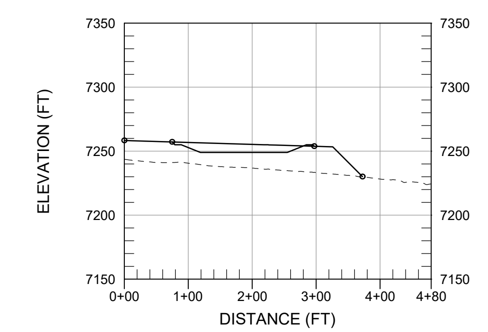

Q
6
SECTION Q




O
6
SECTION O




P
6
SECTION P




R
6
SECTION R

HORZ 0 150 300
VERT 0 75 150
SCALE IN FEET

FOR REVIEW ONLY
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| A | ISSUED FOR REVIEW | 2025-10-23 | CF | NS | NS | |

Permit-Seal

Stantec

3133 West Frye Road Suite 300
Chandler AZ 85226-5110
www.stantec.com

The Contractor shall verify and be responsible for all dimensions. DO NOT scale the drawing - any errors or omissions shall be reported to Stantec without delay.
The Copyrights to all designs and drawings are the property of Stantec. Reproduction or use for any purpose other than that authorized by Stantec is forbidden.

Client/Project
ENERGY FUELS RESOURCES, NEW MEXICO
ROCA HONDA MINE

RHR
ROCA HONDA RESOURCES LLC.

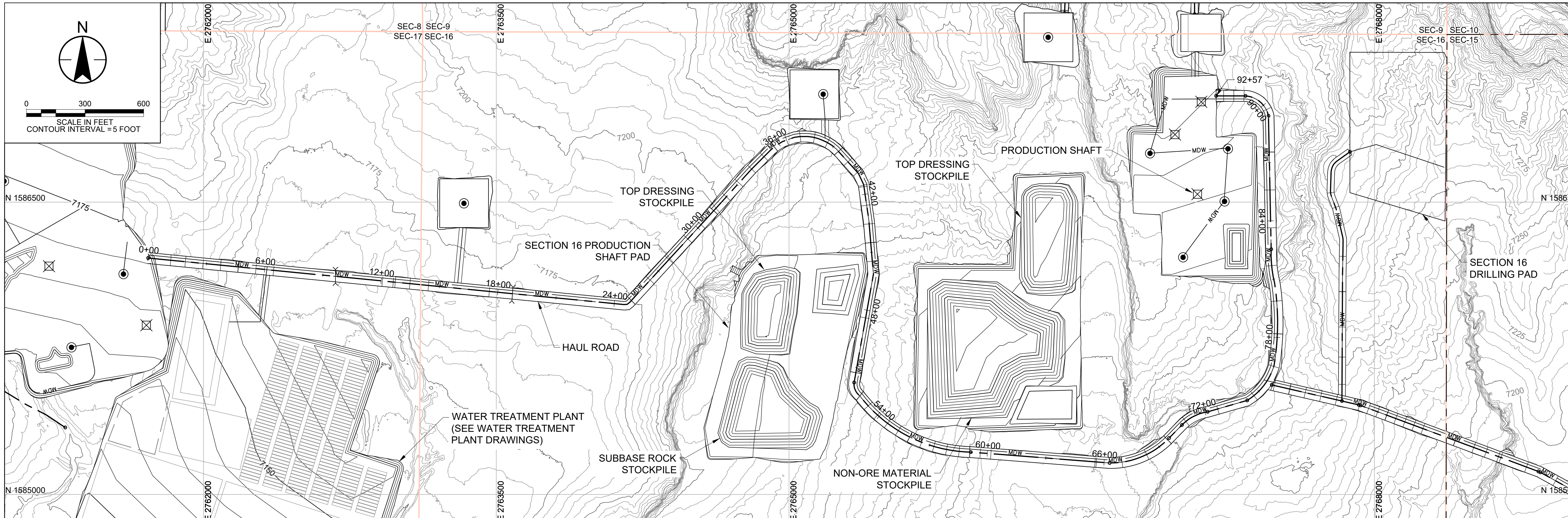
| File Name: | Dwn. | Chkd. | Dsgn. | YY.MM.DD |
|---|---|---|---|---|
| SHEET3_PLAN AND SECTIONS.dwg | CF | NS | NS | 25.10.29 |

Title
SECTION 16 CROSS SECTIONS

Project No. 182925615
Scale AS SHOWN
Drawing No. 6
Revision A

C:\ProjectWise-Drive\Stantec\182925615\6.0 Design\sheet Set\SHEET3_PLAN AND SECTIONS.dwg
2025/10/29 1:25 PM By: Fowler, Camille

ORIGINAL SHEET - ANSI D



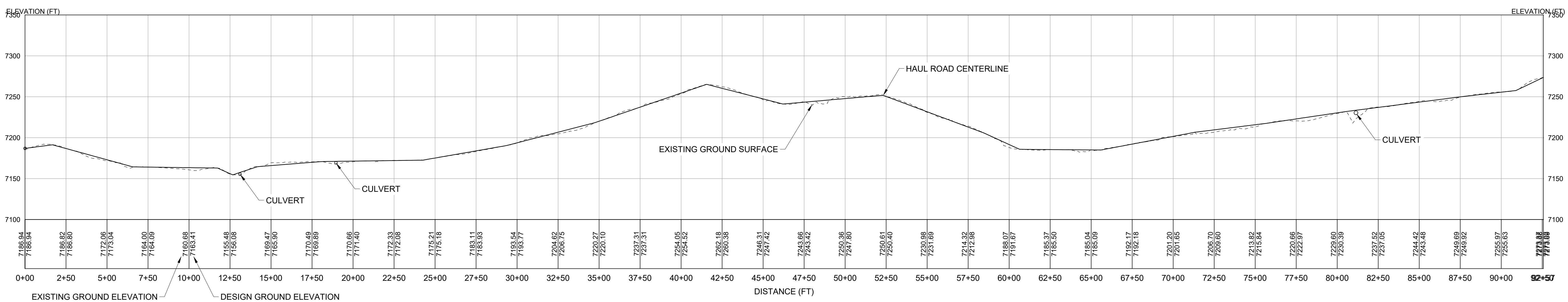

## LEGEND

- 7400 EXISTING GROUND CONTOURS, FT
- 7400 DESIGN GROUND CONTOURS, FT
- SECTION LINES
- EXISTING ROAD
- PERMIT BOUNDARY
- MDW DEWATERING PIPELINE
- CULVERT
- DEWATERING WELL
- VENT SHAFT

## NOTES:

1. COORDINATE SYSTEM REFERENCE: NAD 83 (NSRS 2011) NEW MEXICO STATE PLANE, WEST ZONE, US FOOT.

HAUL ROAD PLAN VIEW




HAUL ROAD PROFILE

HORZ 0 300 600
VERT 0 60 120
SCALE IN FEET

FOR REVIEW ONLY
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

| Ref. Dwg. No. | Ref. Dwg. Title |
|---|---|

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| A | ISSUED FOR REVIEW | 2025-10-23 | CF | NS | NS | |

Permit-Seal

Stantec
3133 West Frye Road Suite 300
Chandler AZ 85226-5110
www.stantec.com



Client/Project
ENERGY FUELS RESOURCES, NEW MEXICO
ROCA HONDA MINE

RHR ROCA HONDA RESOURCES LLC.

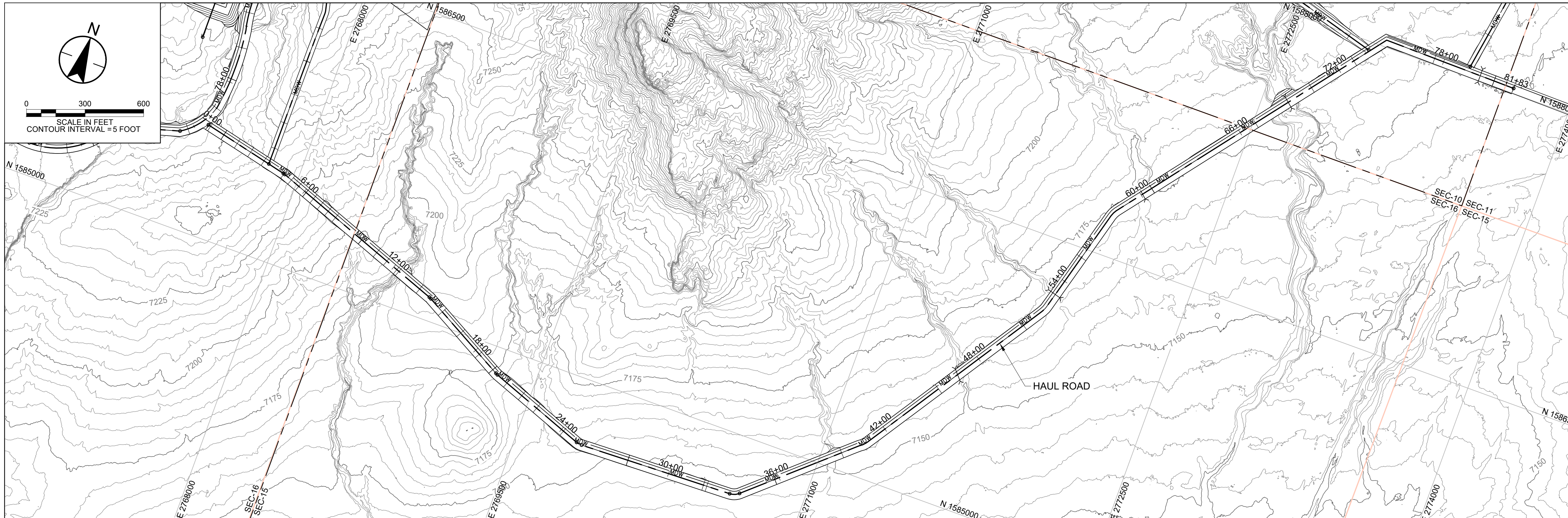
| File Name: SHEET4_HAUL RD PP.dwg | CF | NS | NS | 25.10.29 |
|---|---|---|---|---|
| | Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title
GENERAL ARRANGEMENT
SECTION 16 PLAN VIEW

Project No. 182925615
Scale AS SHOWN
Drawing No. 7
Revision A

C:\ProjectWise-Drive\Stantec\182925615\6.0 Design\sheet set\SHEET4_HAUL RD PP.dwg
2025/10/29 1:26 PM By: Fowler, Camille

ORIGINAL SHEET - ANSI D



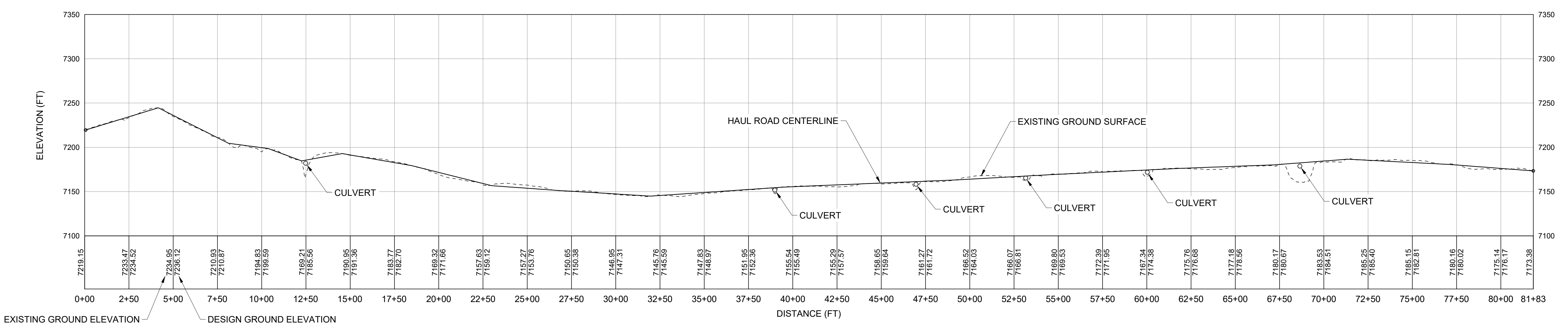

## LEGEND

| | |
|---|---|
| 7400 | EXISTING GROUND CONTOURS, FT |
| 7400 | DESIGN GROUND CONTOURS, FT |
| | SECTION LINES |
| | EXISTING ROAD |
| | PERMIT BOUNDARY |
| MDW | DEWATERING PIPELINE |
| | CULVERT |
| | DEWATERING WELL |
| | VENT SHAFT |

## NOTES:

1. COORDINATE SYSTEM REFERENCE: NAD 83 (NSRS 2011) NEW MEXICO STATE PLANE, WEST ZONE, US FOOT.

HAUL ROAD PLAN VIEW




HAUL ROAD PROFILE

HORZ 0 300 600
VERT 0 60 120
SCALE IN FEET

FOR REVIEW ONLY
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

| Rev. | Description | Date | By | Chk | Eng. | Appd. |
|---|---|---|---|---|---|---|
| A | ISSUED FOR REVIEW | 2025-10-23 | CF | NS | NS | |

Ref. Dwg. No. Ref. Dwg. Title

Permit-Seal

Stantec

3133 West Frye Road Suite 300
Chandler AZ 85226-5110
www.stantec.com



Client/Project
ENERGY FUELS RESOURCES, NEW MEXICO
ROCA HONDA MINE

RHR ROCA HONDA RESOURCES LLC.

| File Name: SHEET5_HAUL RD PP.dwg | CF | NS | NS | 25.10.28 |
|---|---|---|---|---|
| | Dwn. | Chkd. | Dsgn. | YY.MM.DD |

Title
GENERAL ARRANGEMENT
SECTION 16 PLAN VIEW

Project No. 182925615
Scale AS SHOWN
Drawing No. 8
Revision A

C:\ProjectWise-Drive\Stantec\182925615\6.0 Design\sheet Set\SHEET5_HAUL RD PP.dwg
2025/10/29 1:26 PM By: Fowler, Camille

ORIGINAL SHEET - ANSI D

# Appendix B Preliminary Surface Water Management Plan

Stantec

# Roca Honda Mine – Preliminary Surface Water Management Plan

Stantec Consulting Services Inc.

Prepared for:
Energy Fuels

Prepared by:
Stantec

June 26, 2025

Project/File:
Project Number: 182925615

# Disclaimer

The conclusions in the Report titled Roca Honda Mine - Surface Water Management Plan are Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not consider any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

Stantec has assumed all information received from Energy Fuels (the "Client") and third parties in the preparation of the Report to be correct. While Stantec has exercised a customary level of judgment or due diligence in the use of such information, Stantec assumes no responsibility for the consequences of any error or omission contained therein.

This Report is intended solely for use by the Client in accordance with Stantec's contract with the Client. While the Report may be provided by the Client to applicable authorities having jurisdiction and to other third parties in connection with the project, Stantec disclaims any legal duty based upon warranty, reliance or any other theory to any third party, and will not be liable to such third party for any damages or losses of any kind that may result.

| | |
|---|---|
| Prepared by: | |
| | Signature |
| | Salvador Vinay |
| | Printed Name |
| Reviewed by: | Alexander Colburn |
| | Signature |
| | Alexander Colburn |
| | Printed Name |
| Approved by: | Paul Kos |
| | Signature |
| | Paul Kos |
| | Printed Name |

# Table of Contents



## List of Tables



## List of Figures

## List of Appendices

# 1 Introduction

The Roca Honda mine (the site, see Figure 1) is located near San Mateo in McKinley County, New Mexico, approximately 1 mile north from Highway 605. The project is owned by Energy Fuels Resources (EFR) and operated by Roca Honda Resources (RHR), a subsidiary of EFR. Stantec Consulting Service Inc. (Stantec) has been contracted to provide an update to their Mine Operations and Reclamation Plan (MORP) or the site. Energy Fuels is seeking to move most of the proposed surface infrastructure from section 16 into section 17 causing significant changes to the existing MORP. As part of that work, Stantec has been asked to relocate the facilities and evaluate the existing hydrological conditions and develop a preliminary surface water management plan for the proposed site facilities. Other elements of the proposed site development are detailed in the main report text and supporting appendices.

The objective of this report is to analyze the proposed Roca Honda site development plan for potential stormwater related constraints and develop a preliminary surface water management plan for the project. Development of the preliminary surface water management plan is based on combined hydrologic/hydraulic modeling which characterizes flooding in the project area. These results were used to prepare the initial site layouts and identify and locate the necessary features of the surface water management plan. This report provides details of the analysis, management plan, and recommendations for next steps to advance the design.

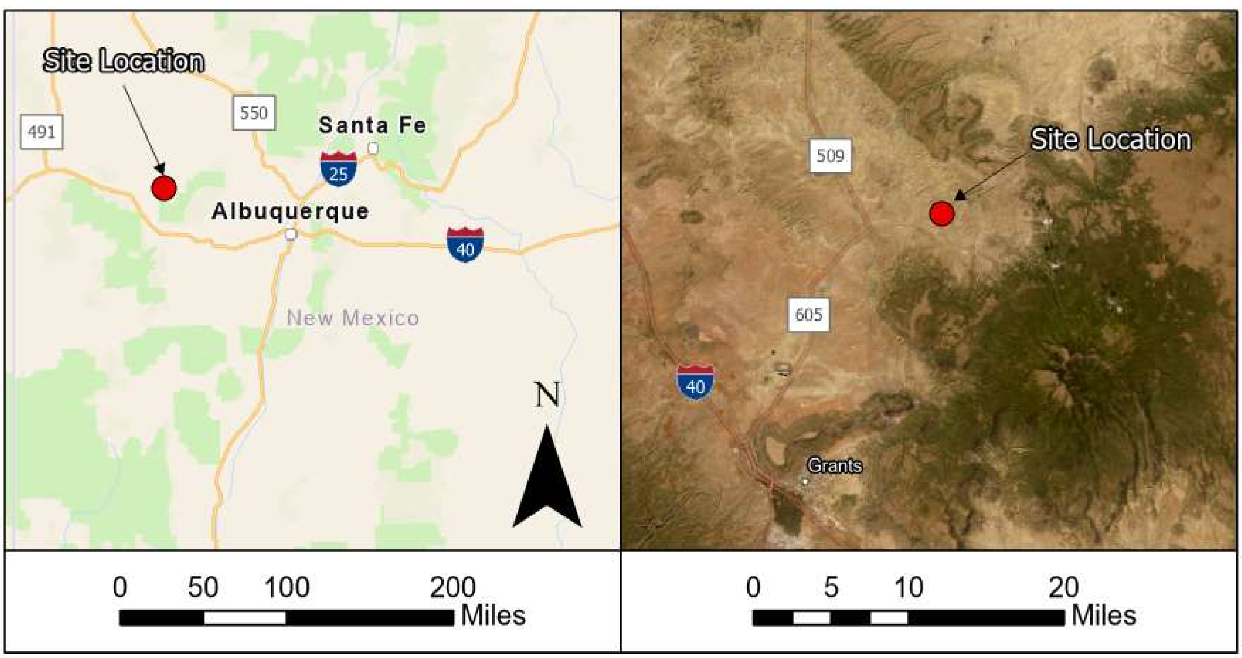



*Figure 1: Project Site Location Map*

## 1.1 Hydrological Setting

The Site is located in the high desert region of the American Southwest along the western edge of the Rio Grande Rift. The hydrologic setting of the project area is shaped by its arid to semi-arid climate, volcanic geology, and proximity to the Grants Mineral Belt. The area experiences low annual precipitation, typically between 10 to 15 inches. The precipitation pattern is bimodal, with most precipitation occurring during summer monsoons and occasional winter storms. There are no major perennial streams or rivers adjacent to the project area. Surface water is mainly limited to ephemeral washes and arroyos that flow during intense rainfall events. Runoff is generally low due to relatively high soil infiltration rates. The region depends heavily on groundwater for domestic, agricultural, and limited industrial use.

The project area is located north of San Mateo Creek which is tributary to the Rio San Jose and eventually the Rio Puerco further downstream. Topography in the vicinity of the site generally drains north to south. The San Mateo Mesa north (upstream) of the site defines the watershed boundary between the San Mateo Creek basin and the Canada la Vacas basin to the north. Several ephemeral washes are evident throughout the region below the San Mateo Mesa, illustrating significant runoff can occur and produce erosive environments in the project area. There are no active flow gages on San Mateo Creek. Two United States Geological Survey (USGS) operated stream gages located in Grants collect data for the Rio San Jose (Station ID 08343000) and Grants Canyon Creek (Station ID 08343100). Data for both gages typically shows no discharge (i.e., no significant baseflow exists), illustrating the intermittent nature of the creeks and rivers throughout the area. There are no known reservoirs or large impoundments of surface water upstream of the site. Bluewater Reservoir, located approximately 25 miles southwest and downstream of the site, is the only substantial impoundment of surface water in the area and retains approximately 38,500 acre-ft of water.

## 1.2 Design Criteria

The design criteria considered in this evaluation are preliminary in nature and should be refined in future work scopes. The criteria/objectives listed below were considered during the development of the preliminary surface water management plan:

- Contact water (i.e., runoff from mine-impacted areas and facilities) and non-contact water (i.e., runoff from native ground not impacted by mining) should, to the extent possible, be separated through the use of stormwater management controls (e.g., diversion channels, berms, etc).
- Contact water generating from mining facilities shall be retained in ponds and treated before it is discharged offsite. These retention ponds should provide adequate volume of the 100-year 24-hour storm (2.43 inches) and include additional volume for sediment eroded from each facility or “pad”. For the purposes of this evaluation, Stantec provided additional volume for one year of eroded sediment for each pad.
- All road crossings of significant washes will require culverts in order to maintain access to site facilities during frequent flow events.

- Facilities will be located, to the extent possible, outside of zones with significant flood hazards. If not possible, mitigations (e.g., diversion channels, berms, etc.) shall be proposed.

# 2 Data Sources

Evaluations supporting the development of the surface water management plan rely on publicly available datasets from several sources. The sources and relevant information for each dataset are discussed in the following subsections.

## 2.1 Topographic Data

Topographic data used for the evaluations described herein was downloaded from the United States Geological Survey's (USGS) National Map website (USGS, 2025), which provides access to publicly available topography survey data. Light detection and ranging (LiDAR) survey collected between 2016 and 2017 and produced through USGS's 3D Elevation Program (3DEP) with a 1-meter horizontal resolution was downloaded and used to represent existing topographic conditions on site. This LiDAR data is shown below in Figure 2.

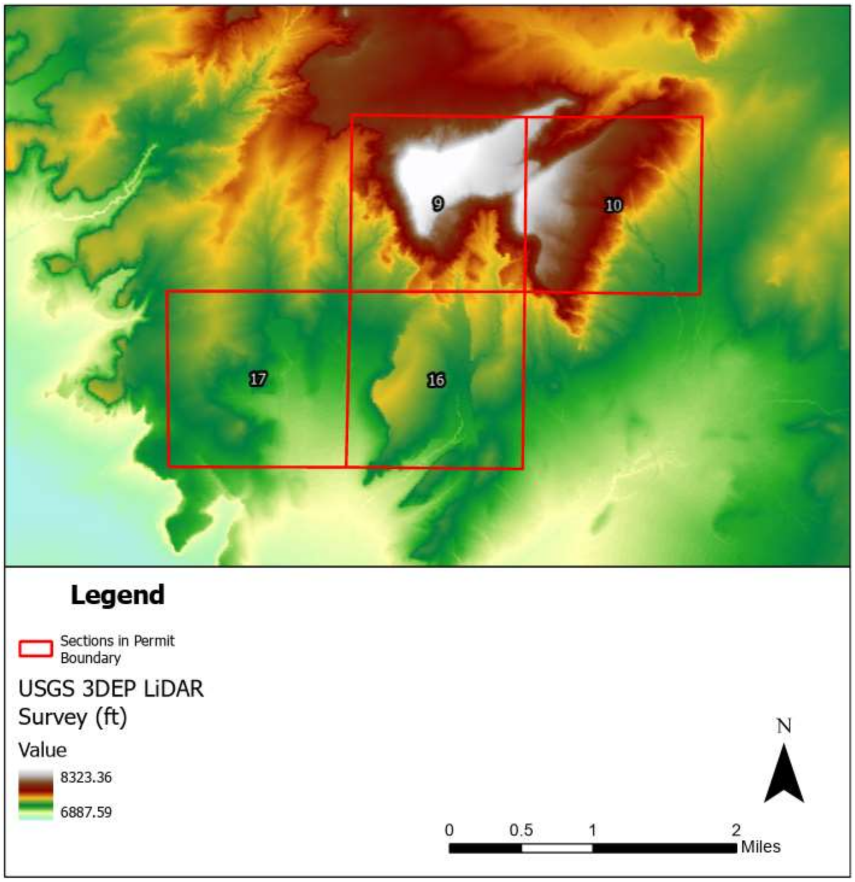



*Figure 2: USGS Topographic Data*

## 2.2 Soil Data

Soil data used to characterize the project area was downloaded from the Natural Resources Conservation Service's (NRCS) web soil survey website (NRCS, 2025). This website provides access to the soil survey geographic database (SSURGO), which contains information about soil as collected by the National Cooperative Soil Survey over the course of a century. The SSURGO database provides estimates of several properties for each soil complex, such as soil texture, hydraulic conductivity, and hydrologic soil group. Soil data available, illustrated by Map Unit Symbol (MUSYM), in the project area is shown in Figure 3. As shown in Figure 3, the SSURGO database is missing data within Sections 9 and 10. Information on assumptions made within the "No Data" region are detailed in Appendix A.

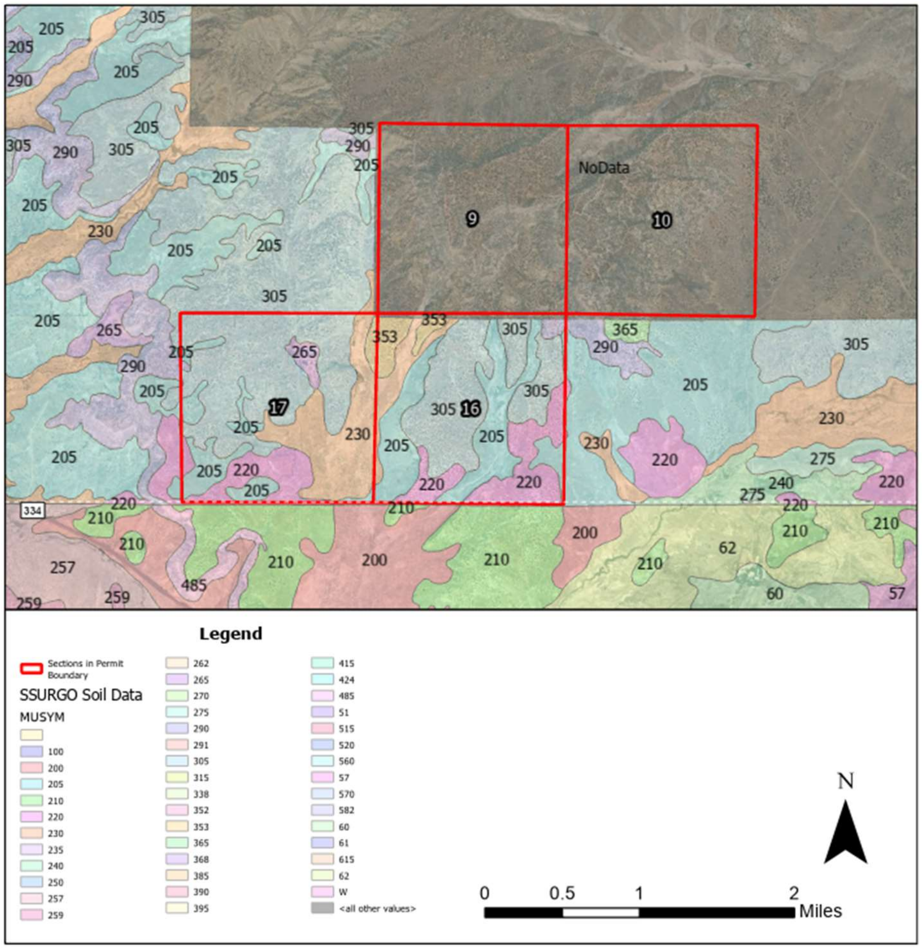



*Figure 3: Web Soil Survey SSURGO Data*

## 2.3 Land Cover

Land cover data within the project area was characterized using survey from the National Land Cover Database (NLCD), available for download online at USGS's EarthExplorer website. The NCLD survey is updated regularly, with the most recent survey available for download being from 2023. Figure 4 shows the 2023 NLCD land cover delineations, where each color and number correspond to a land cover type. Land cover in the project area is dominated by type 52, corresponding to shrub/scrub with the following description "dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions".

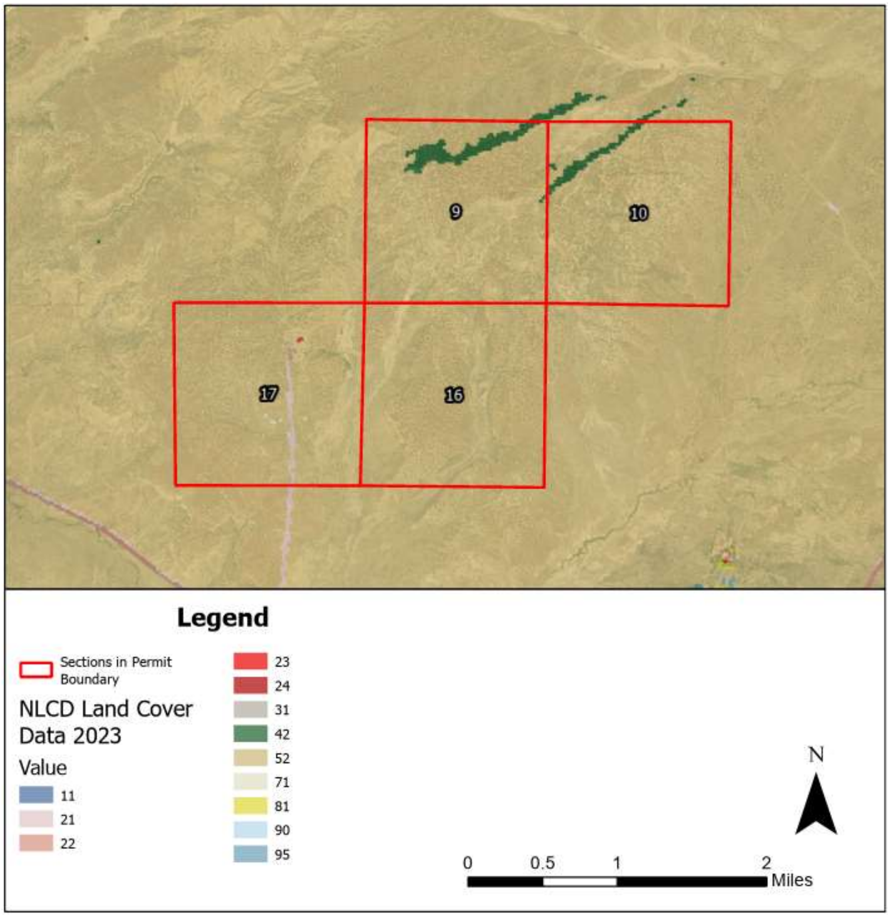



*Figure 4: Land Cover Data*

## 2.4 Rainfall Data

Stantec characterized extreme precipitation in the project area using information from the National Oceanic and Atmospheric Administration's (NOAA) Precipitation Frequency Data Server (PFDS) website (NOAA, 2025). Rainfall data was sourced for an annual maximum time series using the point at latitude/longitude 35.3476° N/ -107.6936° W. The median precipitation-frequency estimates for durations up to 24-hours and return intervals up to 100-years obtained from NOAA are provided in Table 1 below. The median precipitation depth estimate for the 100-year 24-hour rainfall event (bolded in the table below) is 2.43 inches.

*Table 1: NOAA Atlas 14 PFDS Precipitation Depths (inches)*

| Duration (minutes) | Return Interval (years) | | | | | |
|---|---|---|---|---|---|---|
| | 2 | 5 | 10 | 25 | 50 | **100** |
| 5 | 0.201 | 0.292 | 0.352 | 0.435 | 0.496 | 0.563 |
| 10 | 0.305 | 0.443 | 0.536 | 0.662 | 0.755 | 0.857 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 15 | 0.379 | 0.55 | 0.664 | 0.82 | 0.936 | 1.06 |
| 30 | 0.51 | 0.74 | 0.895 | 1.1 | 1.26 | 1.43 |
| 60 | 0.632 | 0.916 | 1.11 | 1.37 | 1.56 | 1.77 |
| 120 | 0.705 | 1.01 | 1.22 | 1.5 | 1.72 | 1.97 |
| 180 | 0.728 | 1.02 | 1.23 | 1.52 | 1.74 | 1.98 |
| 360 | 0.803 | 1.11 | 1.32 | 1.6 | 1.81 | 2.05 |
| 720 | 0.9 | 1.23 | 1.45 | 1.74 | 1.95 | 2.18 |
| **1440** | 1.03 | 1.39 | 1.64 | 1.95 | 2.18 | **2.43** |

# 3 Surface Water Management Plan

## 3.1 Existing Conditions Flood Model

Stantec characterized the existing hydrology and flooding extents within the project area using a 2-dimensional (2D) combined hydrologic/hydraulic model using the United States Army Corps of Engineers (USACE) HEC-RAS modeling software. This model simulated the rainfall-runoff response of the project area under the 100-year 24-hour storm to provide a quantitative estimate of runoff rates and delineation of areas prone to flooding during extreme storm events. Details on the development of the model and its results are provided in Appendix A.

Figure 5 and Figure 6 provides a summary of the simulated flow depths and velocities within the project area. Using these results, Stantec characterized the flood hazards in the area using hazard definitions outlined by the United States Bureau of Reclamation (USBR, 1988) and shown in Figure 7. Resulting hazard zones are shown in Figure 8. Results of the model (flow depths/velocities, inundation extent, hazard classifications) were used during development of the site layout plan where Stantec attempted, to the extent possible, to avoid areas with potential for flood related hazards.

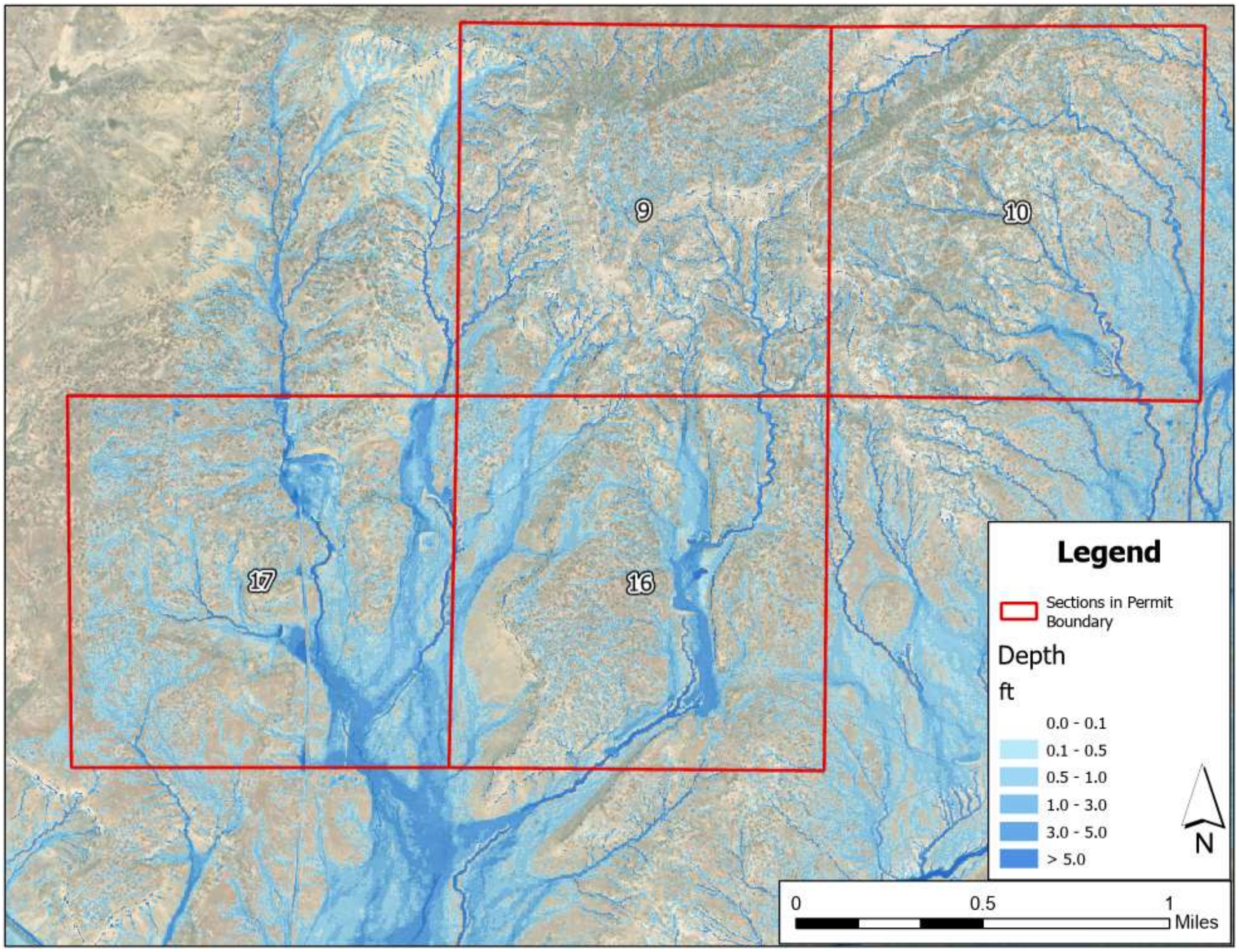



*Figure 5: Flow Depth Results within the project area*

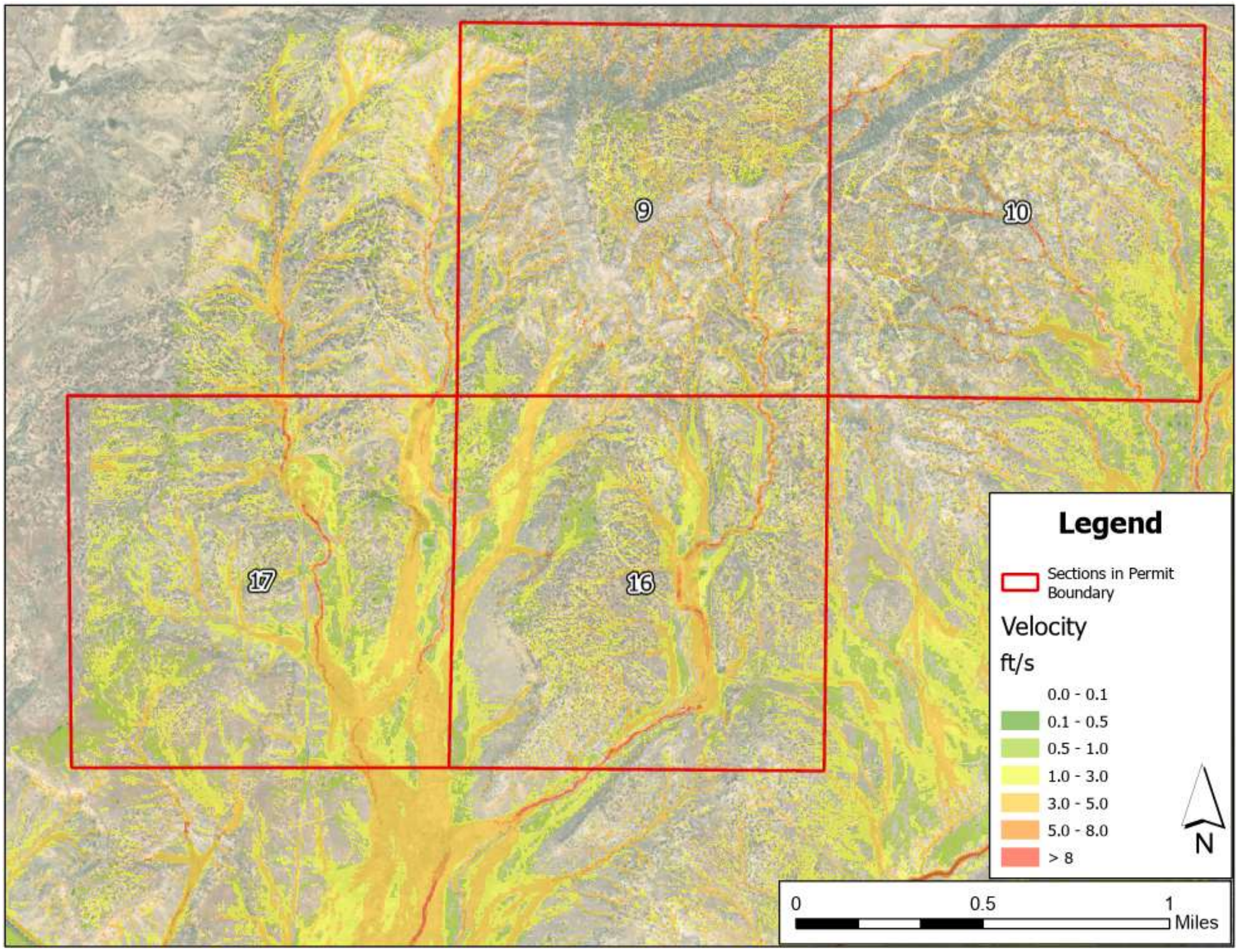



*Figure 6: Velocity Results within the Project Area*

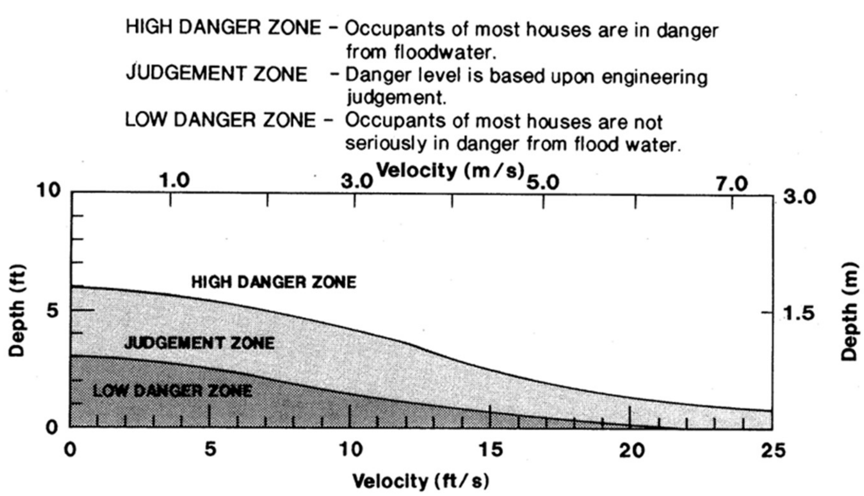



*Figure 7: USBR Flood Hazard Definitions (USBR, 1988)*

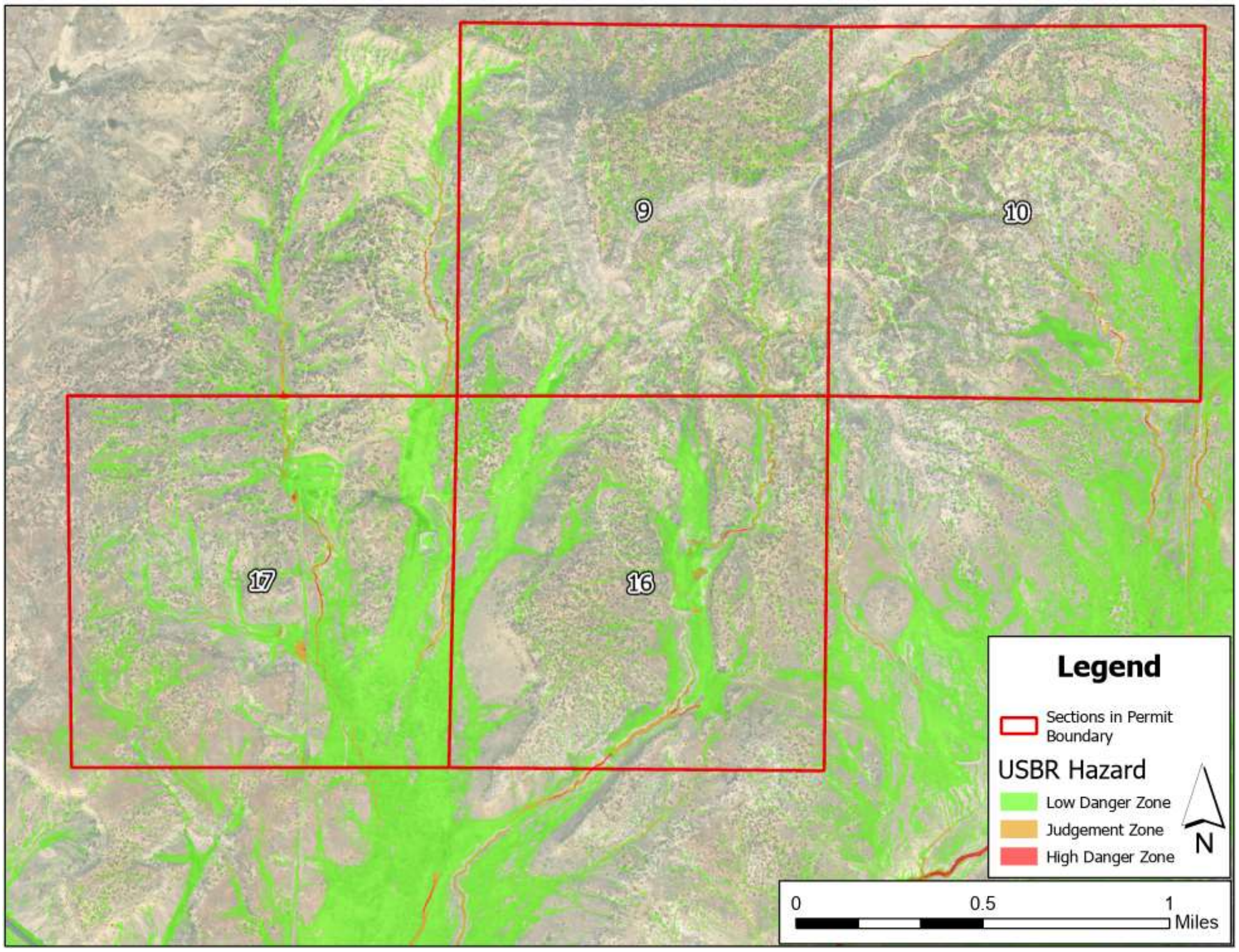



*Figure 8: USBR Hazard Map within the Project Area*

Most areas showing hazards in the high or judgement zones are within the ephemeral washes or at the crossings with existing roadways.

## 3.2 Surface Water Management Plan

Following the siting of the mine-related facilities, Stantec identified several constraints related to flooding adjacent to proposed facilities and developed a preliminary surface water management plan to meet the objectives described in Section 1.2. The preliminary site layout plans developed using the model's results are shown in Figure 9, Figure 10 and Figure 11. The associated constraints and mitigations proposed in the surface water management plan are described in *Table 2*. Additional details on the mitigations are provided in the following subsections. Supporting calculations are provided in Appendix B.

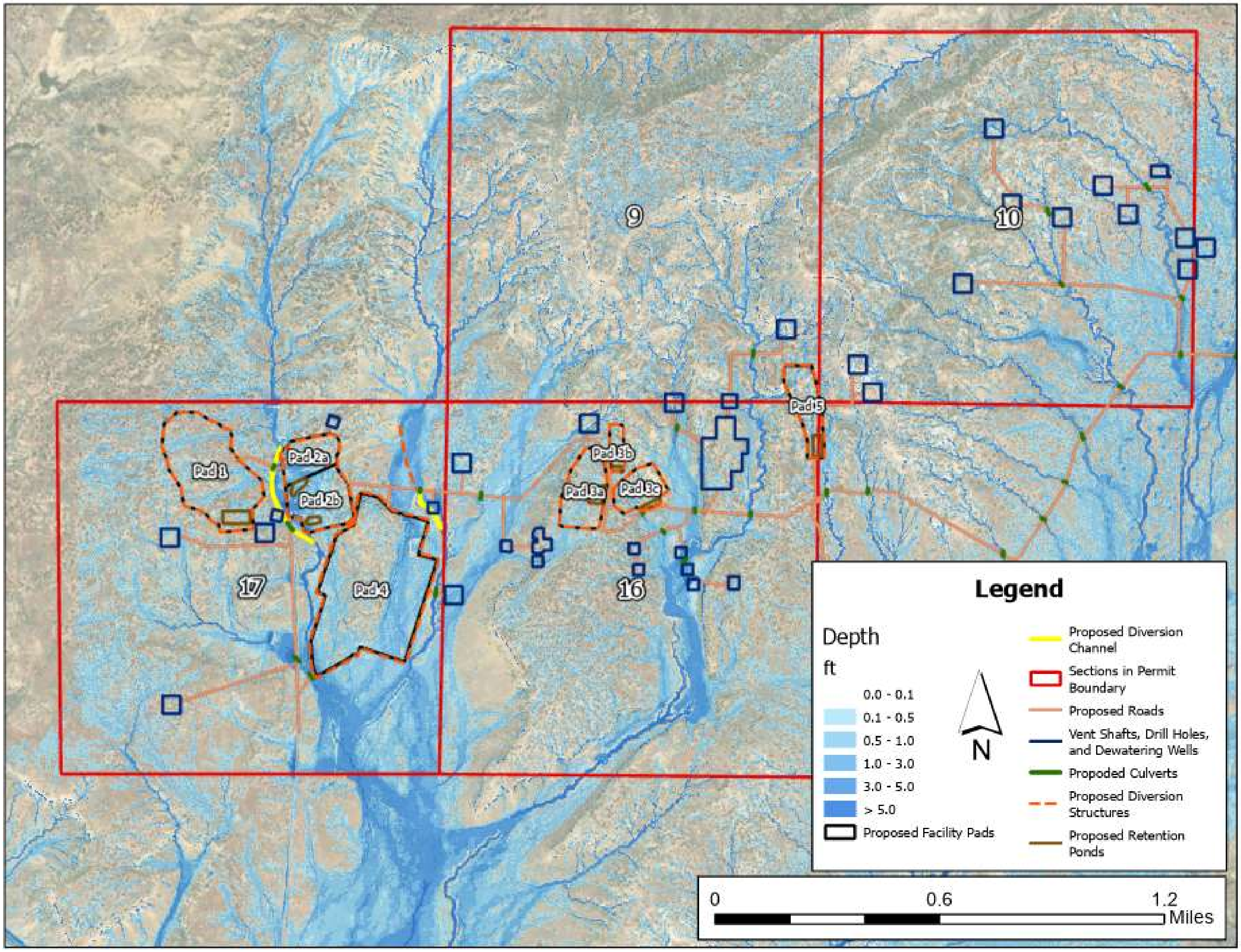



*Figure 9: Preliminary Site Layout Plans for Project Area*

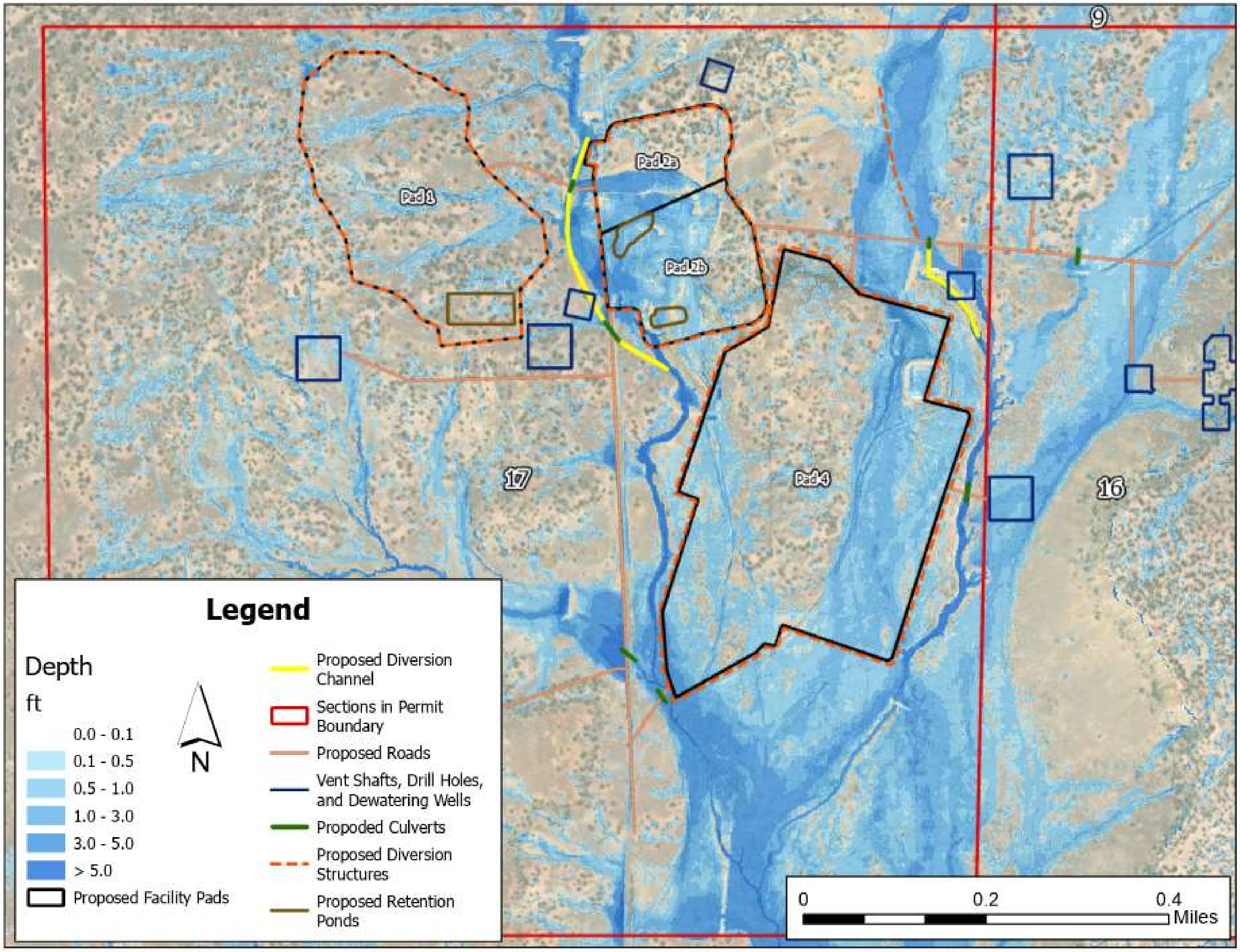



*Figure 10: Preliminary Site Layout - Section 17 Facilities*

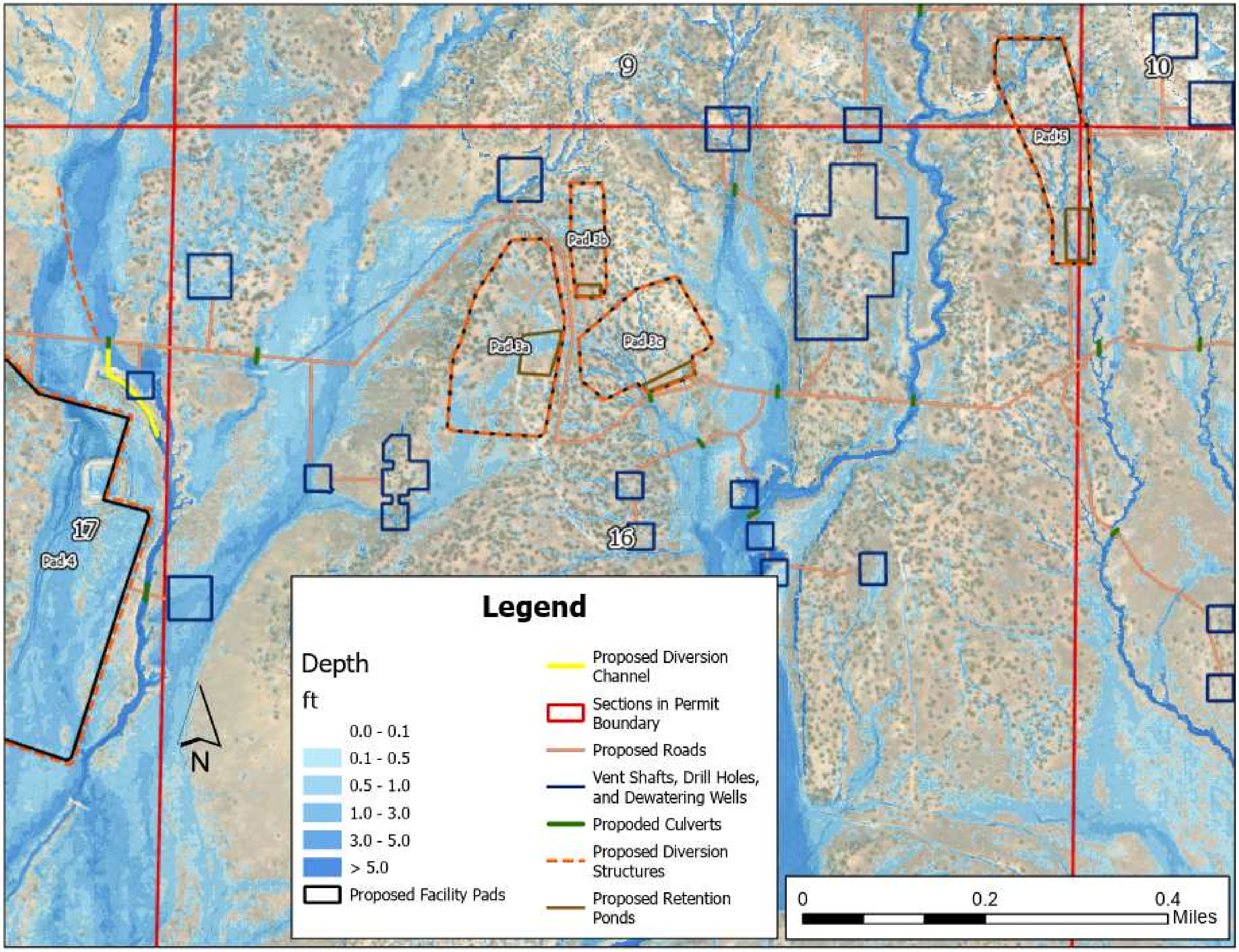



*Figure 11: Preliminary Site Layout - Section 16 Facilities*

*Table 2: Summary of Stormwater Control Elements in Surface Water Management Plan*

| Constraint | Description | Mitigation Strategy |
|---|---|---|
| Flooding Near Portal Pad (Pad 2) | The proposed footprint for the pad containing the mine portal and mine facilities (which is located where the existing production shaft and other existing mine infrastructure currently are) is adjacent to an existing wash. The existing condition model results show that the existing pad is inundated during the 100-year flood (see Figure 10), posing flood related risks to access, operation of facilities, and water ingress into the mine portal. | The proposed mitigation strategy is to divert the existing wash around the proposed footprint of the portal pad. Erosion protection to avoid lateral movement of the channel over time is recommended to manage flood related risks to the portal pad. The proposed diversion alignment also crosses roadways in two locations directly adjacent to the pad which can be managed with culvert crossings. |
| Non-Contact Water Diversions | The model shows that all proposed pad locations receive minimal runoff from upstream contributing areas. Based on project objectives, this water should be diverted away from the pads to prevent potential pollution of non-contact water and the surrounding natural environment. | Contributing areas and associated runoff above the proposed facilities are relatively small and can be diverted with diversion structures (e.g., berms) constructed around the proposed facilities. Some of the proposed berm locations, such as the northeast corner of the Water Treatment Plant pad, receive more significant exposure to elevated hydraulics and may require erosion protection measures (e.g., riprap armoring). |
| Contact Water Capture | Precipitation falling directly onto mine facilities may runoff and erode mine-impacted sediments into the natural environment. | Runoff and eroded sediment will be captured in retention ponds where contact water can be pumped to the water treatment plant and eroded sediments can be managed. Stantec has assumed sediment within the retention ponds will be cleaned out annually. |
| Access Roadway - Wash Crossings | The proposed roadway alignments cross existing washes in several locations. The existing washes are uncontrolled and may erode the proposed roadways or prohibit access for existing roadways with ford (or low water) crossings. | While ford crossings are an option, Stantec has assumed that access to the site is required year-round and cannot be interrupted by frequent storm events that may happen multiple times a year. Culverts are recommended in these locations to pass flow under the roadway and maintain safety and site access. |

### 3.2.1 Diversion Structures

Alignments for diversion structures (e.g., berms and channels) are preliminary and were based on existing ground contours and/or preliminary pad grading plans and should be refined as the footprint and grading plan for each pad are further developed. The most significant diversion structure included in the preliminary plan is the diversion of the existing wash adjacent to the portal pad (see Figure 10). Based on discharge rates in the existing condition model (~800 cfs) and proximity to road crossings, the most effective diversion structure is likely a trapezoidal diversion channel capable of conveying the 100-year flood. This would require a relatively large channel (20+ foot bottom width) with erosion protection along the approximate alignment as shown in Figure 10. A similar diversion structure will be needed to divert the existing wash adjacent to the Water Treatment Plant (WTP) as shown in Figure 12. Existing condition discharge rates are similar to the portal pad area (~800 cfs) and the diversion structure, which may be a berm or channel, will likely require erosion protection. Concepts for diversion structure types and alignments should be refined as the site layout and relevant design criteria are further developed. Sizing and erosion protection requirements for the other, more minor, diversion structures were not evaluated in detail for this preliminary evaluation and should be refined as the design is advanced.

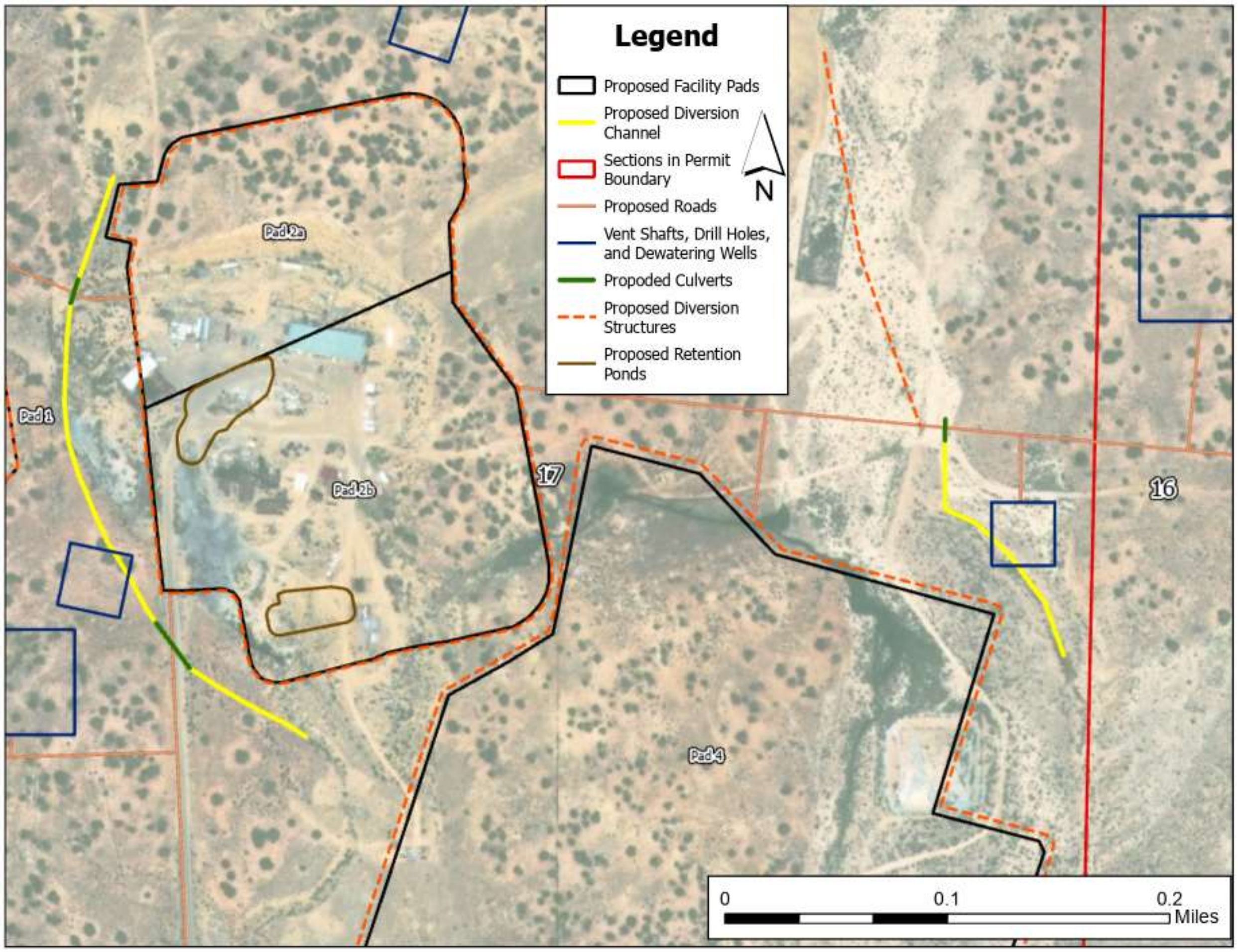



*Figure 12: Diversion Channel Proposed Alignment*

### 3.2.2 Retention Ponds

Retention ponds are included in the design to capture contact water for each mine facility pad. Stantec developed preliminary volume requirements for each pad using the Rational Method for water volume estimation and the Revised Universal Soil Loss Equation (RUSLE) for sediment volume estimation.

The Rational Method adapted for runoff volume estimation is provided below.

$$V = C * \left(\frac{P}{12}\right) * A \qquad \text{Equation 1}$$

Where:

$V$ = Runoff volume ($ft^3$)

$C$ = Runoff coefficient (unitless). Taken as 0.9125 based on average value for heavy industrial areas from Maricopa County (AZ) guidelines (FCDMC, 2018)

| | | |
|---|---|---|
| $P$ | = | 100-year 24-hour precipitation depth, taken as 2.43 inches |
| $A$ | = | Facility pad area ($ft^2$) |

The RUSLE equation for estimating eroded sediment from each pad for a single year is provided below.

$$A = R * K * LS * C * P \qquad \text{Equation 2}$$

Where:

| | | |
|---|---|---|
| A | = | Total Soil Loss per Unit Area (tons/acre) |
| R | = | Rainfall Erosivity Factor (unitless), determined as 19.55 using the EPA's online tool "Rainfall Erosivity Factor for Small Construction" (EPA, 2025) |
| K | = | Soil Erodibility Factor (tons/acre), taken as 0.27 based on guidelines for sandy loam soil from Schwab, G., et al. (1981) |
| LS | = | Slope Length-Steepness Factor (unitless), calculated as $LS = \sqrt{l}\,(0.0076 + 0.53s + 7.6s^2)$ |
| C | = | Cropping-Management Factor (unitless), taken as 1.0 based on guidance from Wischmeier and Smith (1978) using the table for pasture, range, and idle land with no appreciable canopy or vegetal ground coverage |
| P | = | Conservation Support Practice Factor (unitless), taken as 1.0 (no conservation practice) |

Sediment volume was calculated from the estimated weight using an assumed soil density of 110 lbs/$ft^3$. Total required retention volume was calculated as the sum of the 100-year 24-hour event runoff volume and annual sediment yield estimates described above. These estimates do not consider detailed layouts within the pad areas (e.g., building footprints, paved areas, etc.) and should be refined in future design phases. These volumes also do not consider freeboard requirements. Further, the erosion estimates consider a uniform, preliminary estimate of soil type for all pads and should be updated as additional information is available, such as the properties of each stockpiled material type and additional sediment controls that may be implemented. Table 3 summarizes the required retention pond volumes for each major facility/pad, with the exception of the water treatment plant pad where contact water will be collected and treated on site.

*Table 3: Retention Pond Volume Requirements*

| Facility/Pad | Required Retention Volume ($tt^3$) |
|---|---|
| Pad 1 (Section 17 Stockpiles) | 288,627 |
| Pad 2a (Section 17 Portal Pad) | 86,665 |
| Pad 2b (Section 17 Portal Pad) | 77,234 |
| Pad 3a (Section 16 Stockpiles) | 106,829 |
| Pad 3b (Section 16 Stockpiles) | 23,681 |
| Pad 3c (Section 16 Stockpiles) | 67,729 |
| Pad 5 (Section 16 Production Shaft) | 82,115 |

### 3.2.3 Culverts

The surface water management plan identifies several locations where culverts are recommended at crossings between the site access roadways and existing ephemeral washes. Design criteria for culvert sizing should be established in future design phase(s). Culverts are often designed to pass relatively frequent storm events (such as the 10-year flood) with no roadway overtopping and allow shallow overtopping of the roadway in less frequent flood events. This approach may be appropriate for most of the identified crossings that are not located directly adjacent to mine facilities. The exceptions to this are the two culverts located adjacent to the mine portal pad (Pad 1) where overtopping flow may result in flood inundation onto the pad and potential for water ingress into the mine portal. Stantec recommends a more stringent design criteria be considered for these crossings to reduce flood related risk in this area. Preliminary sizing of the two culverts in this area considered the 100-year flood from the 2D model (described in Section 3.1), using calculations made in the Federal Highway Administration's (FHWA) HY-8 culvert analysis software. The preliminary culvert design for these two crossings includes a dual barrel reinforced concrete box culvert with 8' span and 6' rise. Culverts of this type and dimension can be purchased prefabricated to streamline construction and installation efforts. The remainder of the recommended culvert locations were not evaluated in detail as they are either not directly adjacent to critical infrastructure and/or are located in relatively small washes with less discharge.

# 4 Conclusions and Recommendations

This report has been prepared to outline the supporting evaluations and development of the preliminary stormwater management plan for the Roca Honda Mine. Based of review of publicly available data and assessment of existing hydrologic conditions in the project area, Stantec has identified areas with flood-related hazards that were avoided (where possible) during the layout of the mining facilities associated with the project. Following siting of mine facilities, Stantec prepared a preliminary surface water management plan to meet the objectives listed in Section 1.2. This plan includes several diversion channels/berms to separate contact and non-contact water, retention ponds for capturing stormwater and eroded sediments generated within mine-disturbed areas, and culvert locations for the several road crossings of existing ephemeral washes within the project area. The plan presented herein is preliminary in nature and should be refined and the design of mine-related facilities is advanced. The following summarize the recommendations related to surface water that should be completed in future design phase(s).

- Design criteria for surface water infrastructure control elements (i.e., design storm for diversions, culverts, ponds, etc.) should be formally defined for the project. Selection of design criteria is a risk-based decision that can be supported by additional evaluations, as necessary, and should also comply with minimum standards applicable to the operation. Criteria may also consider more stringent standards for high-risk areas and/or potential influences as a result of climate change for features required for mine closure.

- The preliminary surface management plan has identified constraints and recommended high-level mitigations. Following definition of design criteria and advancement of the site facilities plan, future design phases should include the following advancements related to the surface water management plan:

- Update to sitewide hydrologic assessments that consider the proposed grading across the site (e.g., pads, roadways, stockpiles, etc).
- Detailed design of diversion channels/berms that consider the hydrologic conditions for the proposed facility layout. Associated evaluations should support the sizing, alignment, and erosion protection requirements for the diversion structures on site.
- Detailed design of culvert crossings that consider the hydrologic conditions for the proposed facility layout. Design should specify culvert types, sizes, and installation details.
- Refinement to the designs of the facility pads and retention basins including their locations on each pad and appurtenances necessary to direct water into the ponds, water volume estimate updates to consider detailed pad facilities (e.g., impermeable pavement vs permeable soil), and integration with pumps/pipes to transport contact water to the water treatment plant.

# 5 References

EPA. (2025). *Rainfall Erosivity Factor Calculator for Small Construction*. Retrieved from epa.gov: https://lew.epa.gov/

FCDMC. (2018). *Drainage Design Manual for Maricopa County, Arizona.*

G P Smith, E. K. (2014). *Flood Hazard: WRL Technical Report 2014/07.* Water Reseach Laboratory.

NOAA. (2025). *Precipitation Frequency Data Server*. Retrieved from NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: NM: https://hdsc.nws.noaa.gov/pfds/pfds_map_cont.html?bkmrk=nm

NRCS. (2010). *National Engineering Handbook, Part 630 Hydrology.* Urban Hydrology for Small Watersheds.

NRCS. (2020). *Gridded Soil Survey Geographic (gSSURGO) Database.* United States Department of Agrigulture - Natural Resources Conservation Service (NRCS).

NRCS. (2025). *Web Soil Survey*. Retrieved from NRCS.USDA.gov: https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Schwab, G., et al. (1981). *Soil and Water Conservation Engineering.*

USBR. (1988). *ACER TECHNICAL MEMORANDUM NO. 11: DOWNSTREAM HAZARD CLASSIFICATION GUIDELINES.*

USGS. (2025). *National Map*. Retrieved from nationalmap.gov: https://apps.nationalmap.gov/downloader/

# Appendix A

# Appendix A Model Development Details

## A.1 Objective

This appendix was prepared to provide details on the development of the 2-dimensional (2D) combined hydrologic and hydraulic flow model used to assess existing condition flood rates, extents, and potential hazards during the 100-year 24-hour storm within the project area. This document provides the methods used to develop the model, information on model performance, and modeling results.

## A.2 Model Development Details

Stantec evaluated the hydrology and associated hydraulic for the  100-year 24-hour storm event using a combined 2D hydrologic/hydraulic flow model built using the Hydrologic Engineering Center-River Analysis System (HEC-RAS; Version 6.4.1) developed by U.S. Army Corps of Engineers (USACE). The model was constructed as a rain-on-grid simulation, where a rainfall hyetograph is applied to the mode and routing throughout the computational domain according to the terrain data and other model inputs that influence the rainfall-runoff response (e.g., rainfall losses, surface roughness, etc.). Details on the various elements of the model are provided in the following subsections.

### A.2.1 Topographic Data

Stantec used publicly available DEM data provided by the USGS via the National Map Viewer webtool. The USGS DEM resolution is 1-m (U.S.G.S 2024). (See Figure 13)

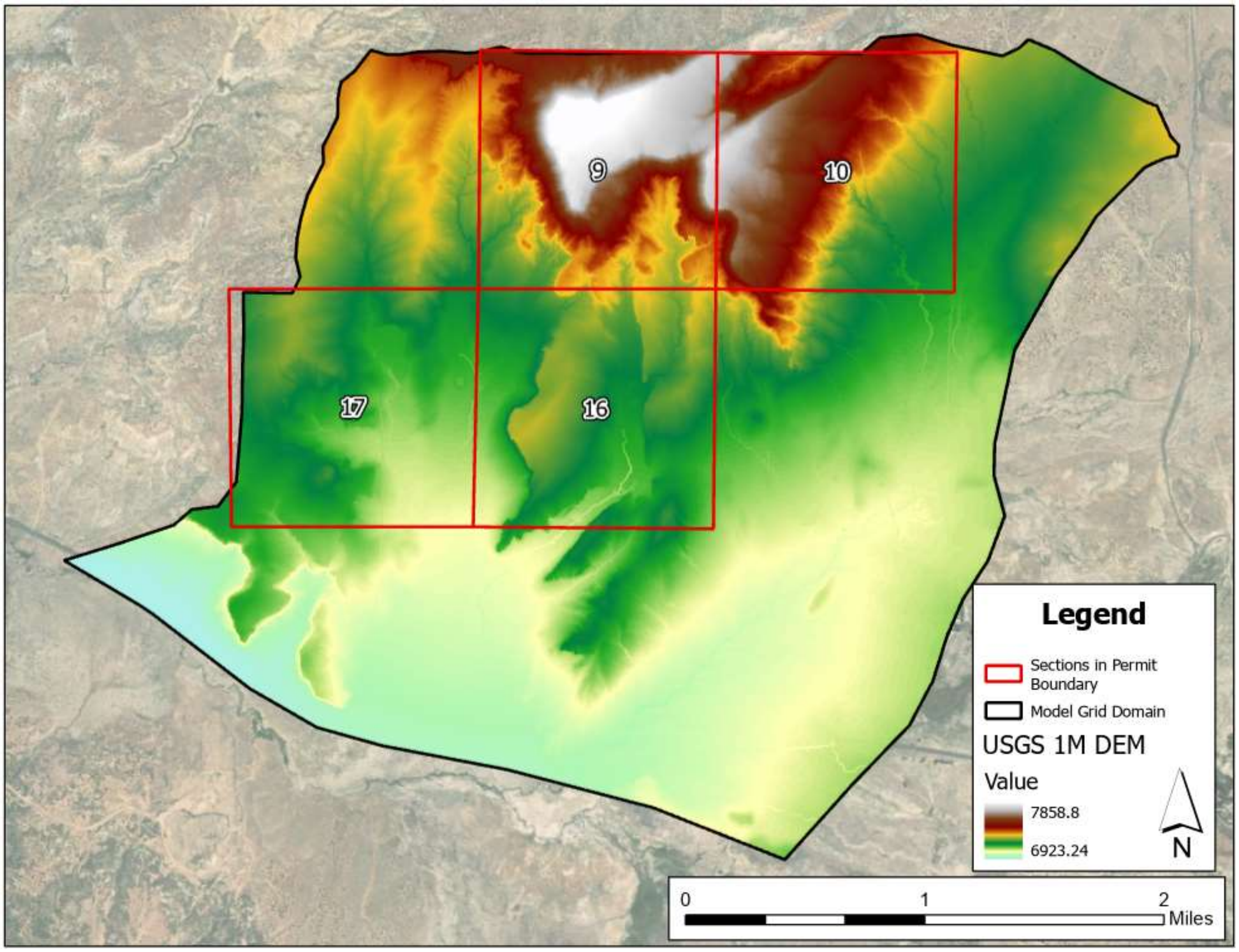



*Figure 13: USGS 1-meter DEM*

## A.2.2 Rain-on-Grid Hyetograph

The 100-year 24-hour storm used in this study was developed based on precipitation estimates from NOAA Atlas 14. These depths were distributed using the alternating block storm patter, which is a stacked, hypothetical distribution that simulates the rainfall intensity for all sub-durations within a 24-hour period. The hyetograph applied in the model is shown in Figure 14. The terrain contains several locations where water is impounded before reporting to the ultimate outlet. To simulate the condition where minor storms preceding the 100-year storm fill these depressions, Stantec included 0.2 inches of incremental rainfall for a period of 18 hours prior to the onset of the 100-year 24-hour storm, as shown in Figure 14.

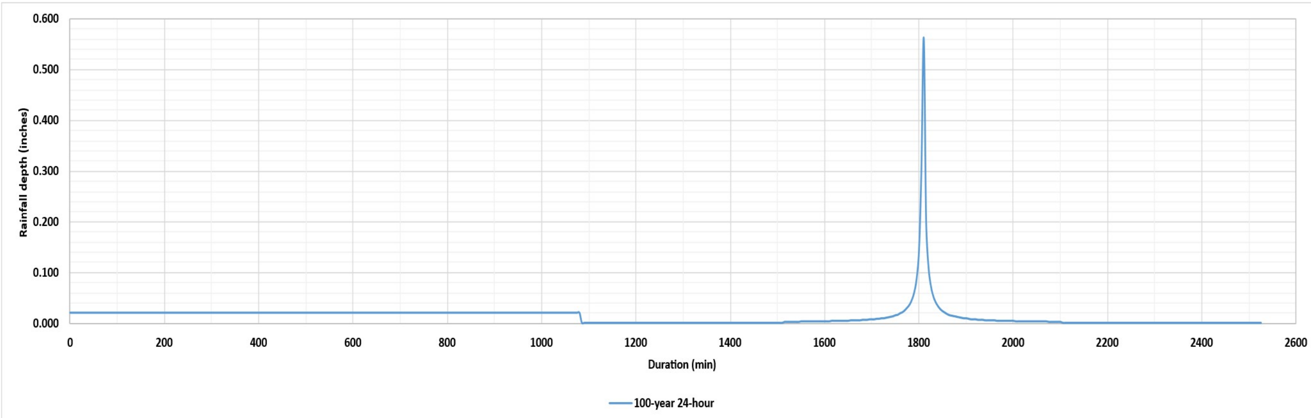



*Figure 14: Rainfall Hyetograph used in HEC-RAS Model*

## A.2.3 Rainfall Loss

The model computed precipitation losses using the curve number (CN) method, which estimates precipitation excess as a function of cumulative precipitation, soil types, land use, and antecedent moisture. The inputs required for this loss method include curve numbers and abstraction ratio which were computed as a function of the local soil type and land cover. The local soil types, or hydrologic soil groups (HSG), were determined using the gridded soil survey geographic database (gSSURGO) (NRCS, 2020) across the domain of the model. The gSSURGO HSG delineations indicate the occurrence of Type A, Type B, Type C, and Type D soils as well as rock outcrops and un-defined “Mined Lands”. Stantec assigned curve numbers assuming the land cover type of “Dessert Shrub” in “good” condition as described in the Technical Release 55 (TR-55) (NRCS, 2010). The curve numbers for the rock outcrop and mined lands areas were determined based on bare soil fallow cover types from TR-55. The CN value for rock outcrop assumed a type D soil due to the high runoff rates associated with shallow depth to bedrock. CN values for mined lands assumed a type C soil. Areas where no data was available assumed a Desert Shrub cover type with HSG group D.

A summary table of the curve numbers used in the model is provided in Table 4 and the spatial delineations of each curve number is displayed on Figure 15.

*Table 4: Summary of Curve Number Values Assumed in the Model*

| Cover Type | Curve Number |
|---|---|
| Desert Shrub – HSG Type A | 49 |
| Desert Shrub – HSG Type B | 68 |

| | |
|---|---|
| Desert Shrub – HSG Type C | 79 |
| Desert Shrub – HSG Type D | 84 |
| Rock Outcrop | 94 |
| Uranium Mined Lands | 91 |

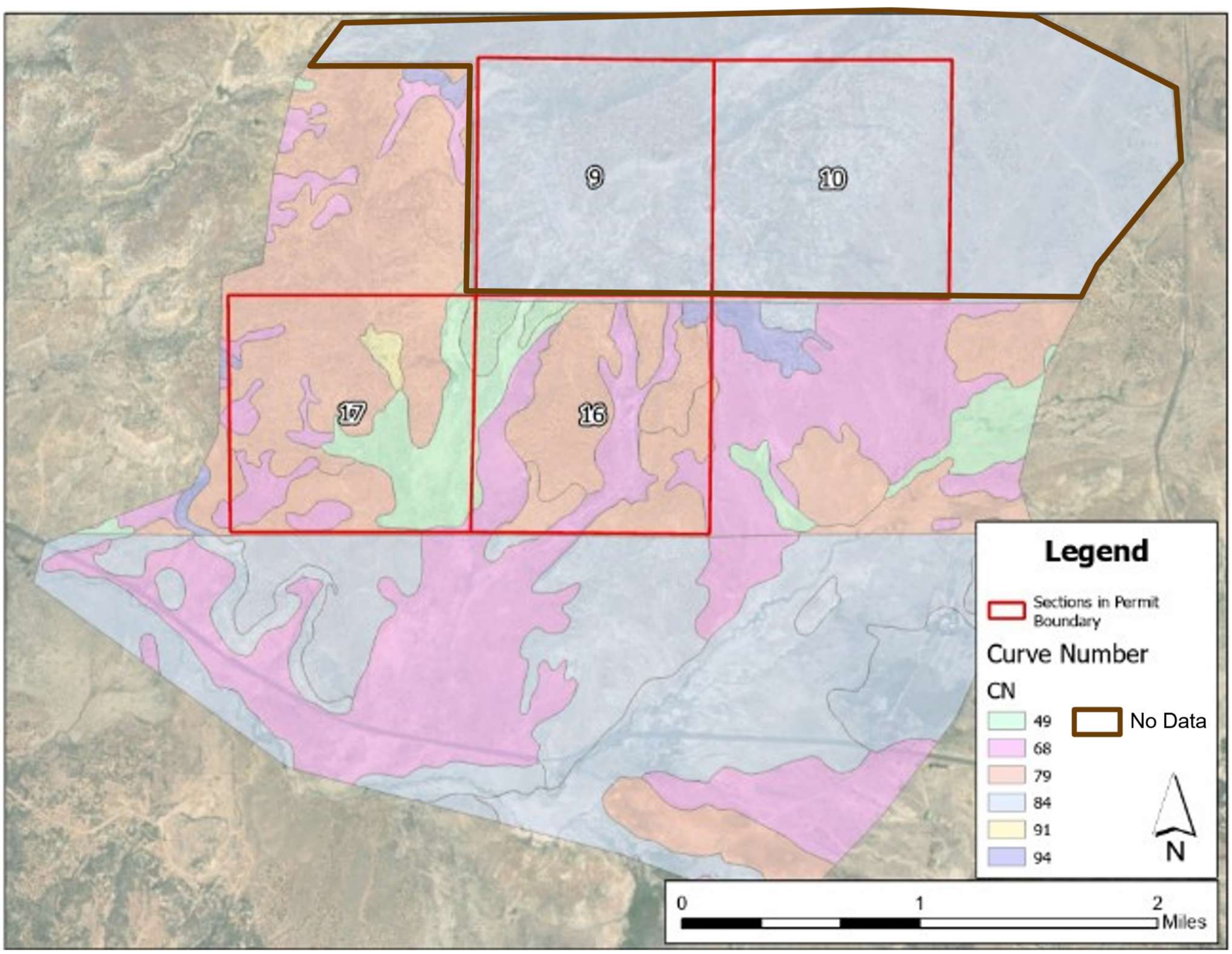



*Figure 15: Final Curve Number Distribution used for Hydrologic Modeling*

The initial abstraction (Ia) term is used to account for stormwater runoff losses to processes other than soil infiltration such as filling of depressions, wetting of vegetation, or evaporation. It can be determined from observed rainfall-runoff events for small watersheds, where lag is minimal, as the rainfall that occurs before runoff begins. Interception and surface depression storage may be estimated from cover and surface conditions, but infiltration during the early part of the storm is highly variable and dependent on such factors as rainfall intensity, soil crusting, and soil moisture. Ia was assumed to be a function of the maximum potential retention (S). An empirical linear relationship between Ia and S was established and an abstraction ratio of 0.05 was selected, based on the lower limit of recommended values from TR-55.

### A.2.4 Manning's Roughness

Roughness values are used in the HEC-RAS model to account for the flow resistance effects caused by obstructions in the flow path such as stones or vegetation. Roughness is quantified through "Manning's n" values. Stantec assumed a "natural range" coverage type in the undisturbed upland areas of the model which contribute flows to the project area. Further, the roughness values assigned considered the effect of a given obstruction can vary depending on the flow depth. For example, a 6-inch diameter stone on the flow conveying surface is a more significant deterrent to a 1 ft deep column of water than a 5 ft deep column of water. As such, Stantec assigned a larger roughness value to the areas where sheeting type flow is anticipated to occur. A lower roughness value was assigned to low lying areas where flow accumulates, and the flow depths increase.

The roughness values assigned to the upland -sheet flow and accumulated flow areas are tabulated in Table 5 and illustrated on Figure 16.

*Table 5: Roughness Values Associated with each Assigned Cover Type.*

| Cover Type | Roughness Value | Justification |
|---|---|---|
| Natural Range – Sheeting Flow (flow depth <1') | 0.12 | Sheet flow roughness for natural range cover (NRCS, 2010) |
| Natural Range – Accumulated Flow (flow depth >1') | 0.06 | Scattered Brush, Heavy Weeds (Chow, 1959) |

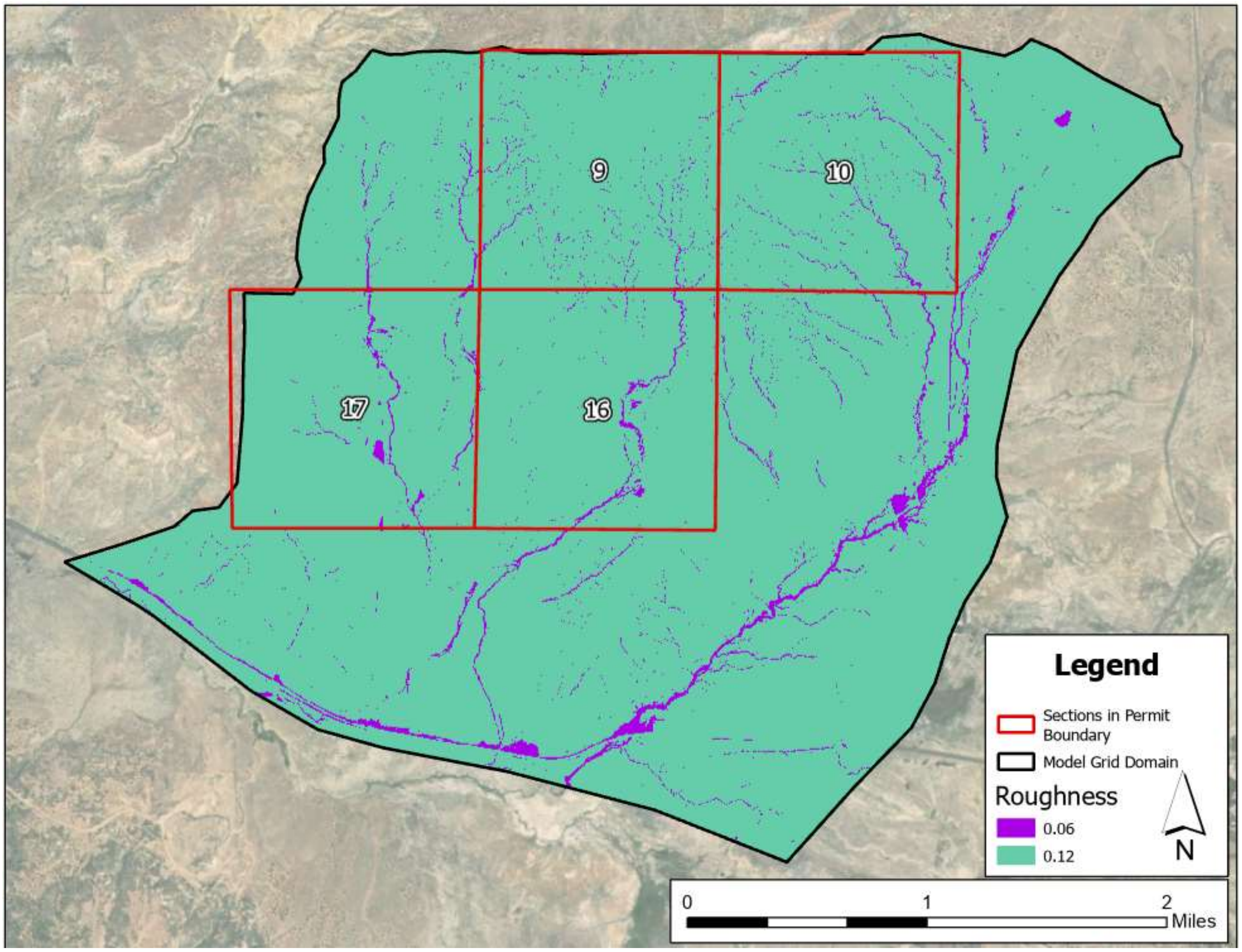



*Figure 16: Manning's Roughness Cover Type used for the Hydrologic Model*

## A.2.5 Development of the Model Grid

Stantec set up the hydrologic model domain to encompass the entire drainage area that routes the proposed infrastructure in the project area. The model domain is made up of thousands of grid cells that represent the underlying terrain along each grid cell face. The base grid cell size used in the model was 25-ft x 25-ft. Breaklines were then used to provide better resolution of features like channels and berms that will convey or restrict water flow. The extent of the computational domain and breaklines used are illustrated in Figure 17.

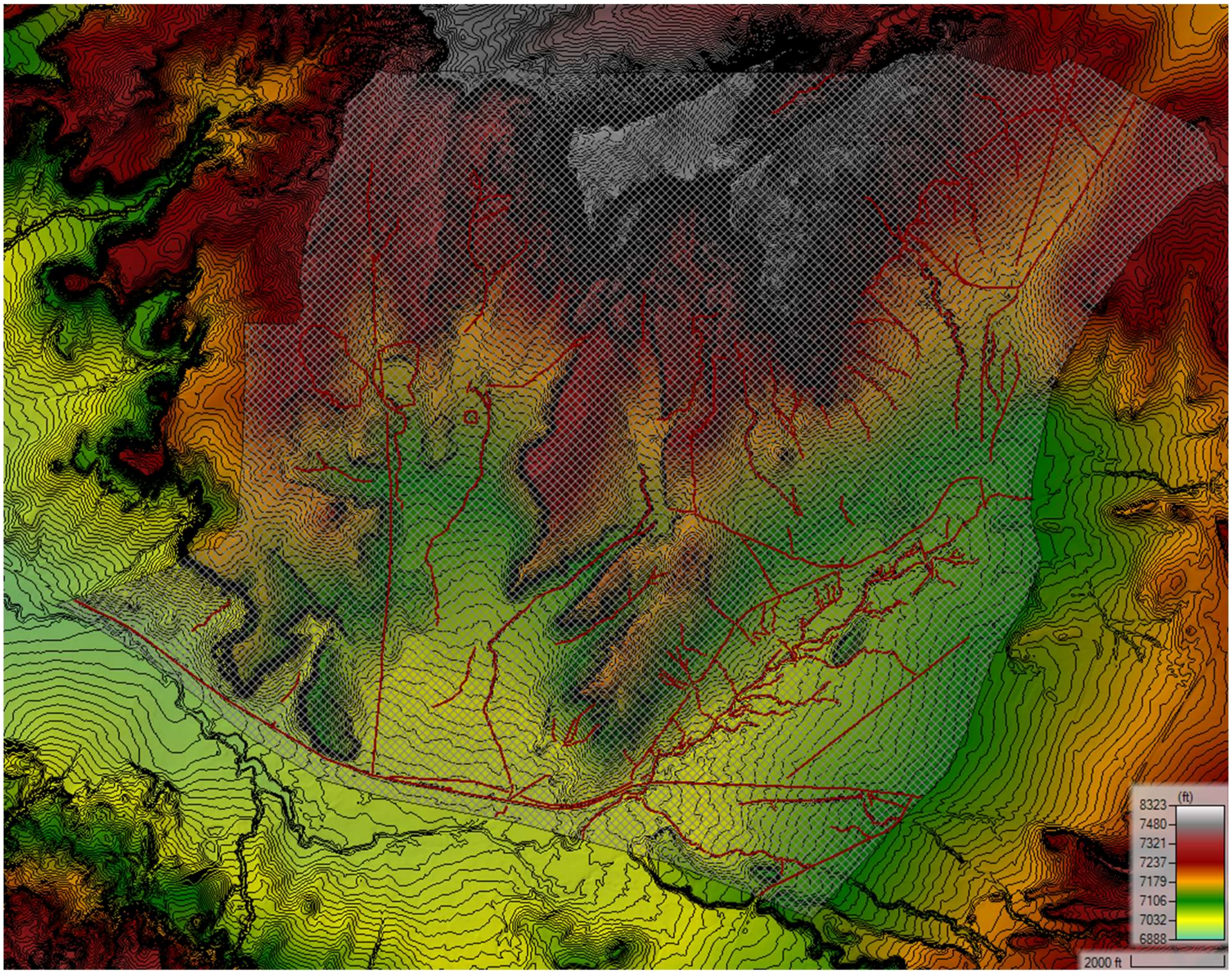



*Figure 17: Model Computational Domain, Grid Cells, and Breaklines*

### A.2.6 Model Boundary Conditions

#### A.2.6.1 Internal Boundary Conditions

The model simulated inflow by applying the 100-year 24-hour event rainfall directly to the model grid using the rain-on-grid boundary condition. The model applied the 100-year 24-hour rainfall uniformly across the entire grid.

#### A.2.6.2 External Boundary Conditions

The external boundary conditions were places as shown in Figure 18. For this study, normal depth condition was selected as the external boundary. This selection allows the modeler to enter an assumed energy slope as shown in Table 6; then HEC-RAS 2D computes the hydraulics at the outflow boundary assuming normal depth at the specified slope.

*Table 6: External Boundary Conditions*

| Element ID | Energy Slope (ft/ft) |
|---|---|
| BC Line 1 | 0.04 |
| BC Line 2 | 0.1 |
| BC Line 3 | 0.08 |
| BC Line 4 | 0.4 |

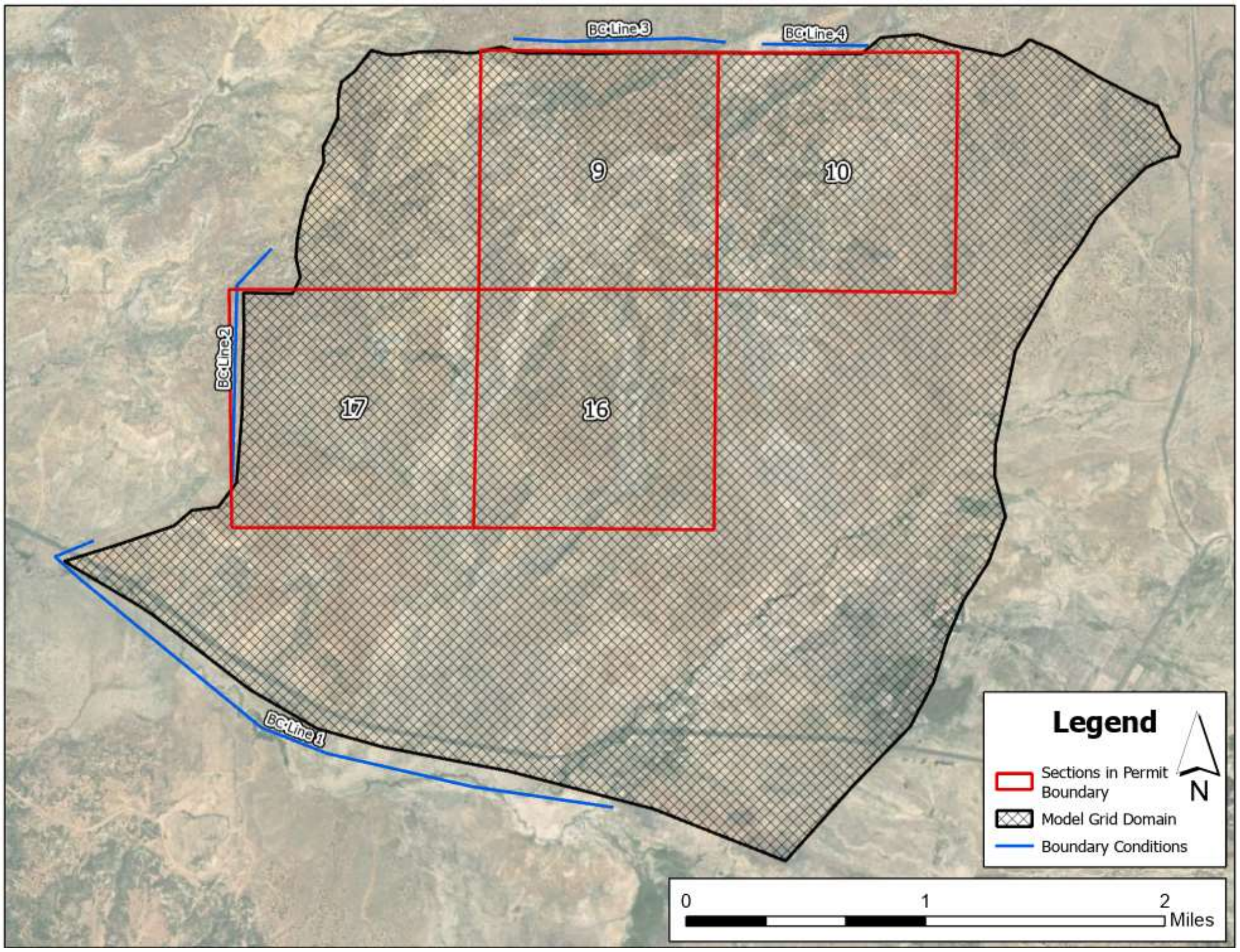



*Figure 18: External Boundary Condition Locations*

## A.2.7 Computations Controls

Model was run using the Diffusion Wave equation set, which is a simplified version of the St. Vedant equations that does not account for the effects of flow momentum. Future assessments may consider the use of more strict equation sets to evaluate hydraulics around specific structures or to support design calculations. The model was run for a period of 36 hours using a Courant Number controlled time step. The model computation control parameters used are displayed in Figure 19 and Figure 20

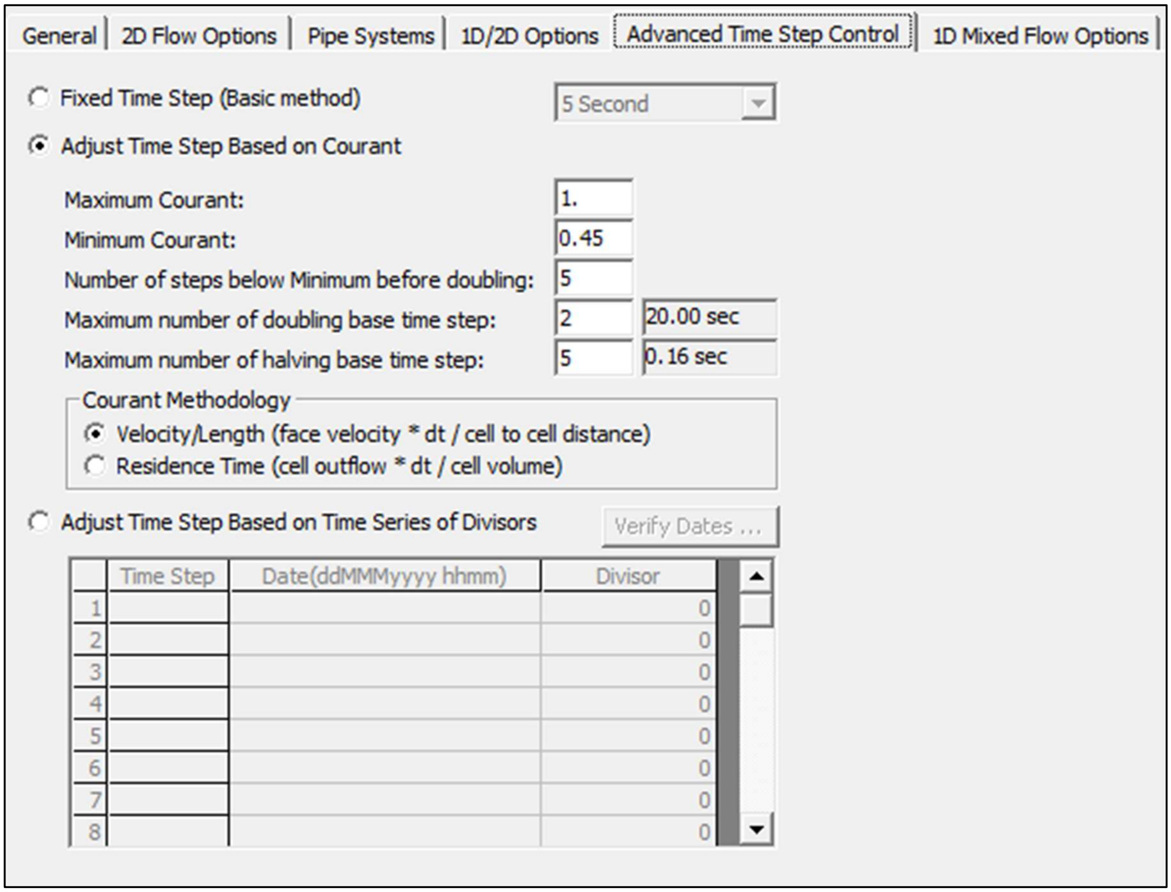



*Figure 19: Time Step Based on Courant Number Control*

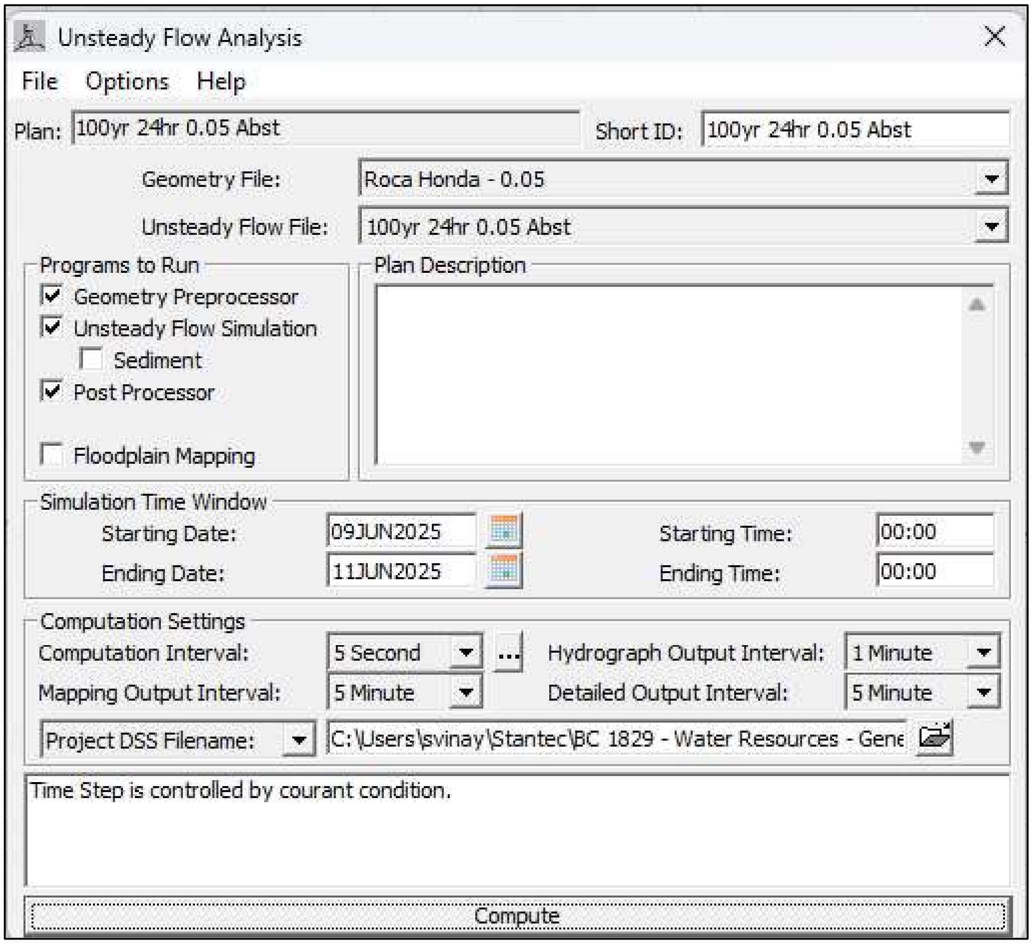



*Figure 20: Set up Computation Plan*

## A.3 Model Results

The results of the hydraulic model were used during development of the site layout plan where Stantec attempted, to the extent possible, to avoid areas with potential for flood related hazards. A flood map showing the hydrologic model results (maximum depth and velocity) predicted for the model are shown in Figure 21 and Figure 22 respectively. Hazard classification following guidelines from Smith (2014) and USBR are shown in Figure 23 and Figure 24, respectively.

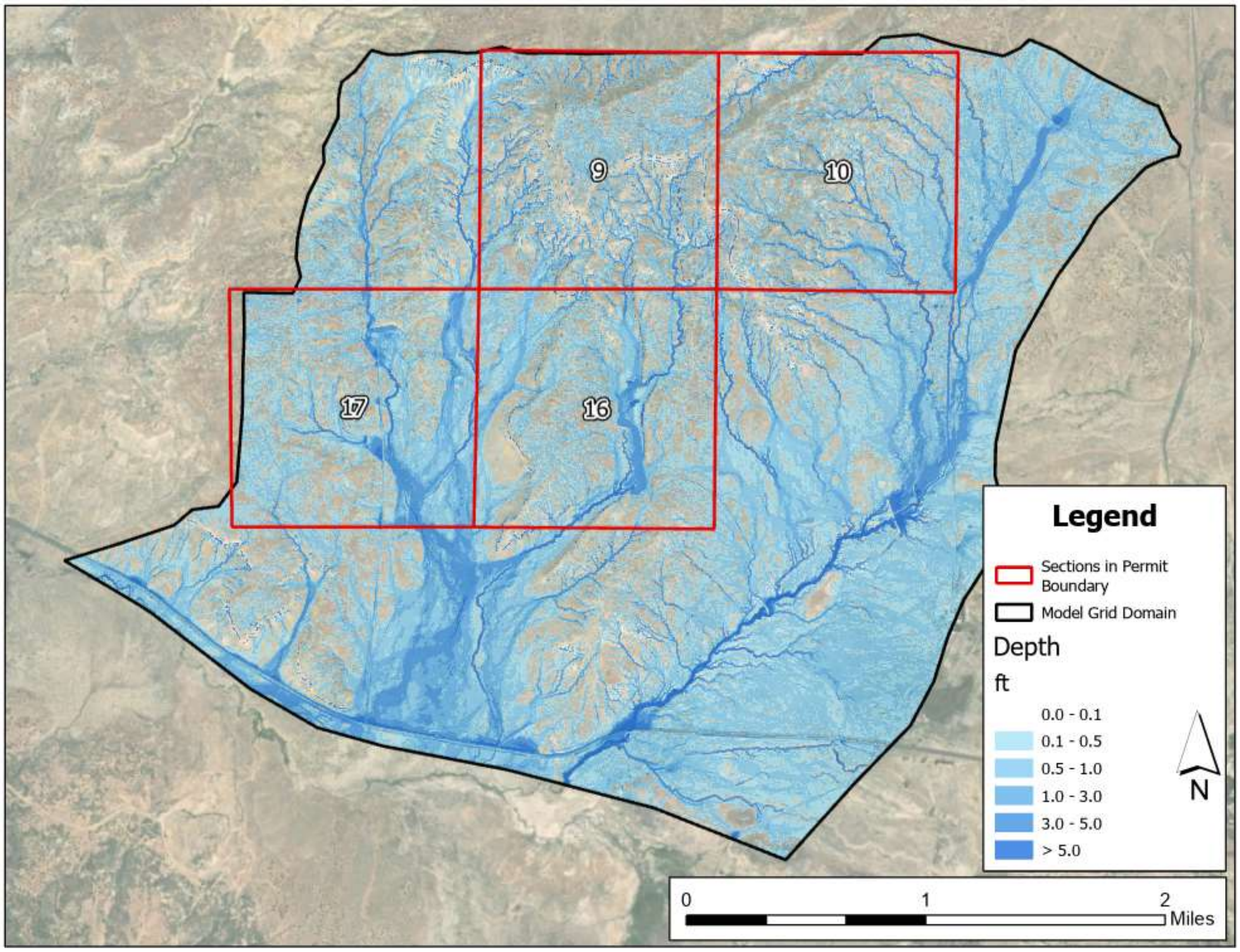



*Figure 21: Flood Map with Maximum Depth for the 100-year 24-hour Storm event*

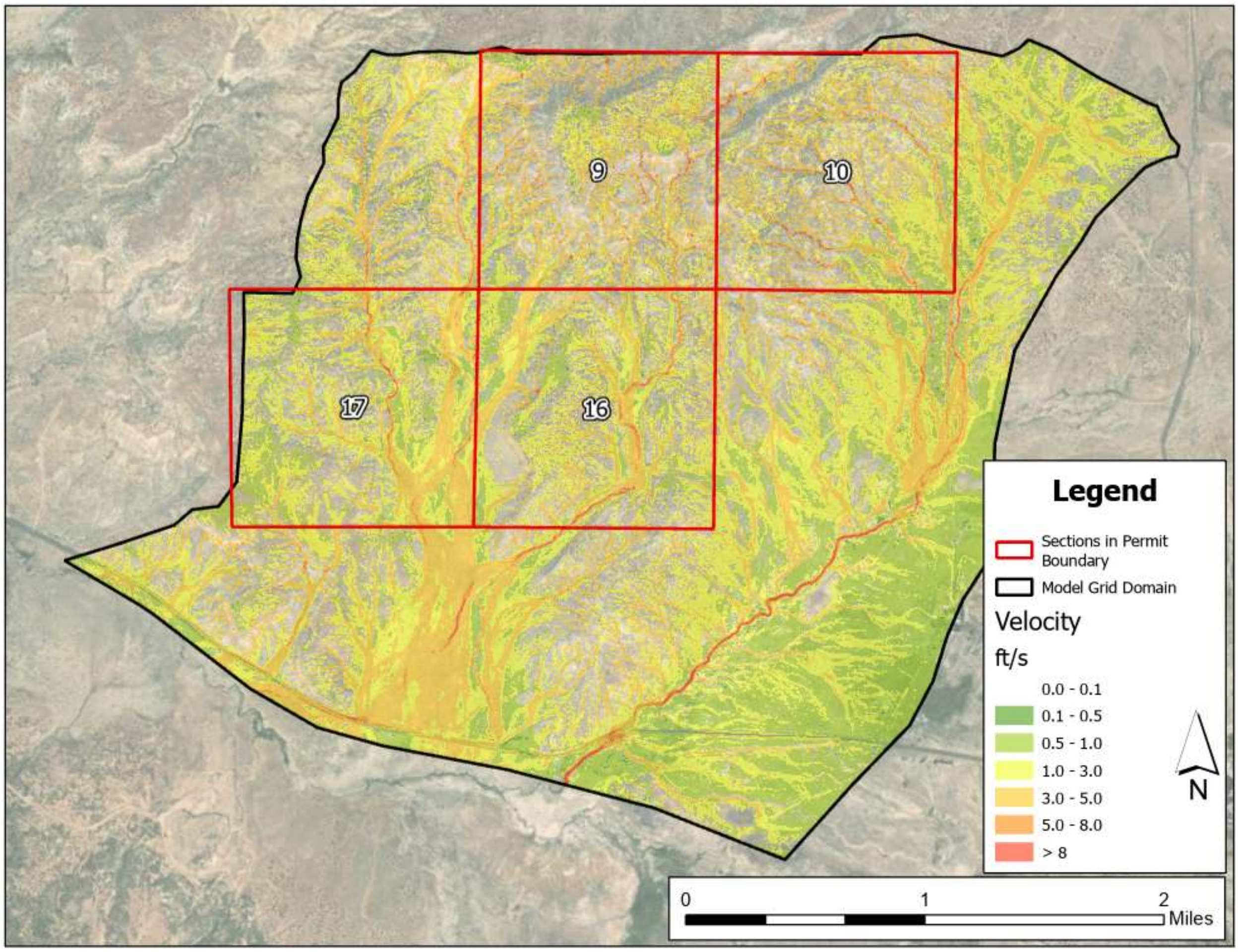



*Figure 22: Flood Map with Maximum Velocity for the 100-year 24-hour Storm event*

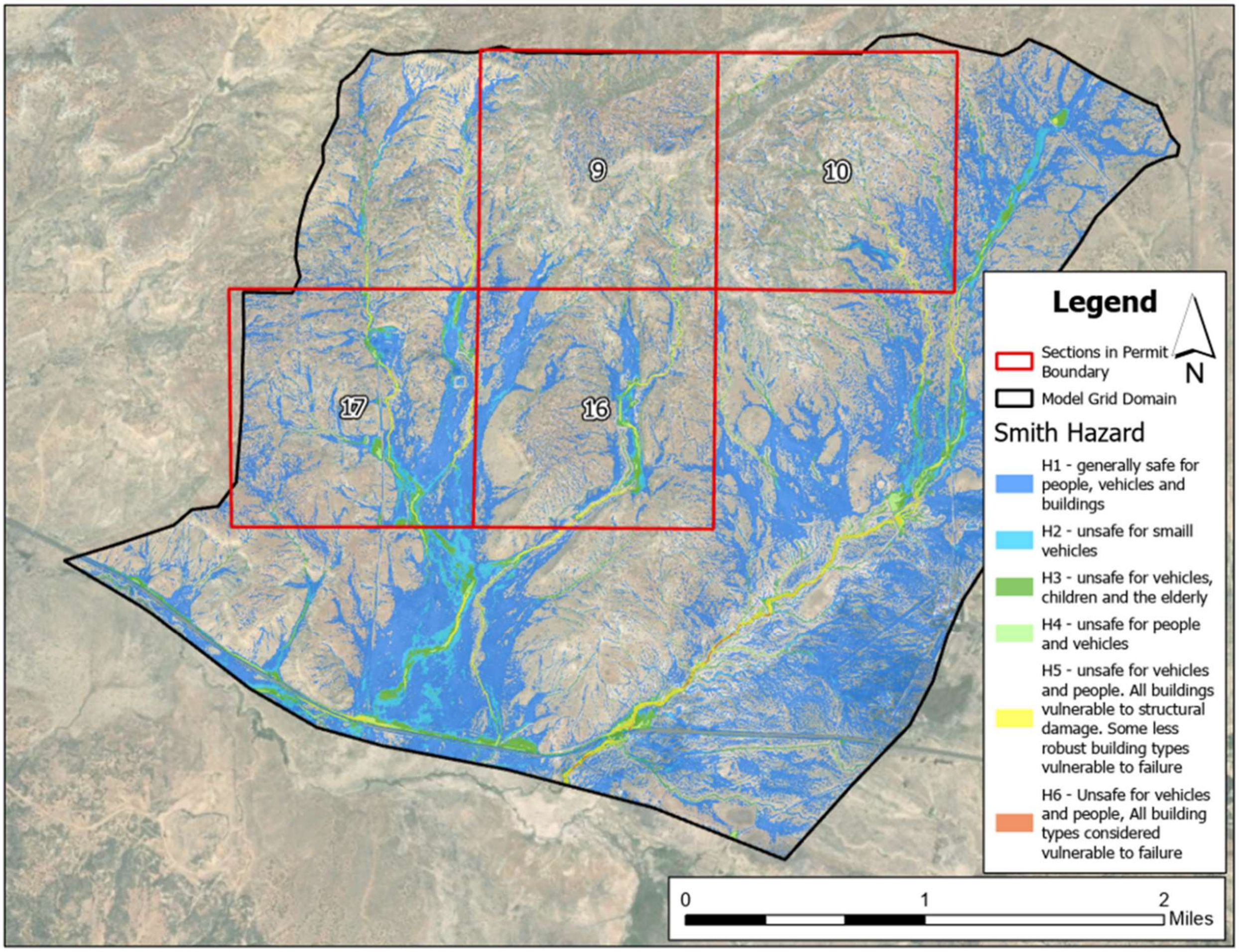



*Figure 23: Flood Hazard Map Following Smith et. al Classifications (G P Smith, 2014)*

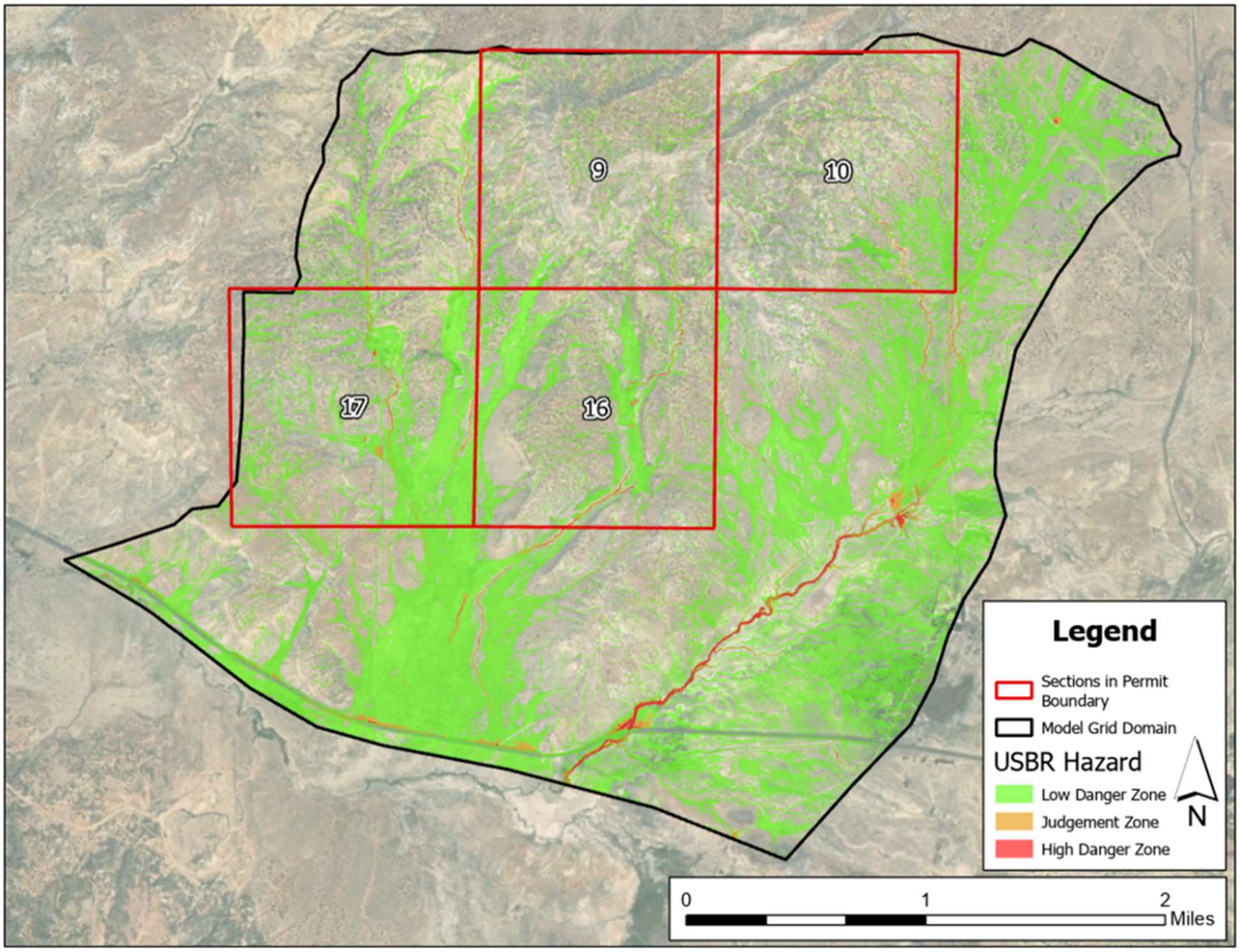



*Figure 24: Flood Hazard Map Following USBR Classifications (USBR, 1988)*

## A.4 References

EPA. (2025). *Rainfall Erosivity Factor Calculator for Small Construction*. Retrieved from epa.gov: https://lew.epa.gov/

FCDMC. (2018). *Drainage Design Manual for Maricopa County, Arizona.*

G P Smith, E. K. (2014). *Flood Hazard: WRL Technical Report 2014/07.* Water Reseach Laboratory.

NOAA. (2025). *Precipitation Frequency Data Server*. Retrieved from NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: NM: https://hdsc.nws.noaa.gov/pfds/pfds_map_cont.html?bkmrk=nm

NRCS. (2010). *National Engineering Handbook, Part 630 Hydrology.* Urban Hydrology for Small Watersheds.

NRCS. (2020). *Gridded Soil Survey Geographic (gSSURGO) Database.* United States Department of Agrigulture - Natural Resources Conservation Service (NRCS).

NRCS. (2025). *Web Soil Survey*. Retrieved from NRCS.USDA.gov: https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Schwab, G., et al. (1981). *Soil and Water Conservation Engineering.*

USBR. (1988). *ACER TECHNICAL MEMORANDUM NO. 11: DOWNSTREAM HAZARD CLASSIFICATION GUIDELINES.*

USGS. (2025). *National Map*. Retrieved from nationalmap.gov: https://apps.nationalmap.gov/downloader/

# Appendix B Supporting Calculations

With every community, we redefine what's possible.

Stantec is a global leader in sustainable engineering, architecture, and environmental consulting. The diverse perspectives of our partners and interested parties drive us to think beyond what's previously been done on critical issues like climate change, digital transformation, and future-proofing our cities and infrastructure. We innovate at the intersection of community, creativity, and client relationships to advance communities everywhere, so that together we can redefine what's possible.

**Stantec Consulting Services Inc.**
1001 Bishop Street, Suite 1501
Honolulu HI  96813-3429
stantec.com

# Appendix C Cibola National Forest and National Grasslands Post Mining Land Use Letter

USDA United States Department of Agriculture | Forest Service | Cibola National Forest and National Grasslands | 2113 Osuna Road NE
Albuquerque, NM 87113-1001
(505) 346-3900 FAX: 346-3901

**File Code:** 2800/2810
**Date:** July 21, 2009

Roca Honda Resources, LLC,
In Care of: Juan R. Velasquez
Vice President; Government, Regulatory &
Environmental Affairs
Strathmore Minerals Corp.
4001 Office Court Drive, Suite 102
Santa Fe, NM 87507

Dear Mr. Velasquez:

As a follow up to our phone conversation of June 10, 2009, I am sending you this letter for your inclusion in your mining permit application to the New Mexico Mining and Minerals Division (NMMMD) for the proposed Roca Honda mine. The Roca Honda mine will include sections 9 and 10 in T13N R8W in McKinley County, which are on National Forest System lands, managed by the Cibola National Forest.

I understand that the NMMMD regulations require written approval from the surface owner for reclamation of the disturbed areas to the proposed post-mining land use. The Roca Honda mine proposal is to reclaim the disturbed areas in sections 9 and 10 to a post-mining land use of grazing. This proposal is consistent with the Cibola National Forest Land Management Plan for the area in which the proposed mine is located.

If you have any questions, please contact Mary Lee Dereske, Recreation, Engineering, Archeology, Lands & Minerals Staff Officer, at (505) 346-3871.

Sincerely,

Mary Lee Dereske

For NANCY ROSE
Forest Supervisor

cc: Diane Tafoya, Matt Reidy

RECEIVED 7-23-09

# Appendix D State of New Mexico, State Land Office Post Mining Land Use Letter

**PATRICK H. LYONS**
**COMMISSIONER**

# *State of New Mexico*
## *Commissioner of Public Lands*

310 OLD SANTA FE TRAIL
P.O. BOX 1148
SANTA FE, NEW MEXICO 87504-1148

**COMMISSIONER'S OFFICE**
Phone (505) 827-5760
Fax (505) 827-5766
www.nmstatelands.org

October 8, 2009

Juan R. Velasquez
Strathmore Resources U.S. Ltd.
4001 Office Court Drive, Suite 102
Santa Fe, NM 87507

**Re: State of New Mexico General Mineral Lease No. HG-0036-02 – Roca Honda Resources, LLC**

Dear Mr. Velasquez:

Thank you for informing the State Land Office of your plans to submit a permit application to the New Mexico Mining and Minerals Division for a new mine at the Roca Honda Resources (RHR), LLC project. We understand that the project includes Section 16, Township 13 North, Range 08 West in McKinley County, a state-leased parcel of land to which RHR holds the mineral lease pursuant to General Mining Lease number HG-0036-02. Further, we are aware that your permit application will propose reclamation of the mine to a post-mining land use of grazing and that EMNRD requires our approval for reclamation to that proposed post-mining land use for the aforementioned lease.

According to 19.2.2.24 NMAC, a reclamation plan, consisting of the mining permit or other authorization and any other supplemental requirements deemed necessary by the Commissioner must be reviewed and approved by the Commissioner of Public Lands and shall be incorporated into the lease. Please be sure and send a copy of these documents to the State Land Office when submitting them to EMNRD so that the Commissioner may participate in the process as required in 19.2.2.25 NMAC.

The historic surface use of Section 16 is grazing. The surface grazing lease is currently held by the Fernandez Land Company. Please be advised that the State Land Office concurs with and approves RHR's proposal to reclaim the area of Section 16 disturbed by its mining operation to a post-mining land use of grazing. We believe that such reclamation is consistent with historic and anticipated future use. If you have any questions please feel free to call Michael Mariano, Minerals Manager at (505) 827-5750.

Sincerely,

Jami Bailey, Director
Oil, Gas, and Minerals Division

JB/mm

Cc: John Pheil, EMNRD

# Appendix E Post Mine Radiological Surveys Plan

SENES Consultants Limited
Specialists in Energy, Nuclear and Environmental Sciences

# Post Mine Radiological Surveys

## Addendum to Roca Honda Mine Reclamation Plan (Rev. 1)
## Mine Permit No. MK025RN
## McKinley County, New Mexico

*Prepared for*:

**Roca Honda Resources, LLC**
4001 Office Court, Suite 102
Santa Fe, NM 87505

*Prepared by*:

**SENES Consultants Limited**
8310 South Valley Highway, Suite 3016
Englewood, CO USA 80112

March, 2013

## TABLE OF CONTENTS

## 1.0 INTRODUCTION

Roca Honda Resources, LLC ("RHR") has submitted a Mine Reclamation Plan (Revision 1) for the proposed Roca Honda underground uranium mine ("Site") in McKinley County, New Mexico (RHR, 2011a). As part of the agency review process, the New Mexico Mining and Minerals Division ("MMD") and New Mexico Environmental Department ("NMED") have indicated the need for a post mine radiological survey following removal of all structures, stockpiles and equipment from the site to "demonstrate that the operation has not resulted in radiological conditions that may impact human health and safety beyond the conditions existing prior to mining" (MMD, 2012). Pre-mining radiological baseline conditions were characterized with a radiological survey conducted in 2010 by DeNuke Contracting Services, Inc. ("DeNuke"). Results were presented in Section 13 of the Baseline Data Report (RHR, 2011b).

The purpose of this document is to provide:

- A radiological survey plan to identify, quantify and characterize the locations and spatial extent of post-mine radiological contamination that may exist once mining operations are complete and reclamation commences.
- A measurement protocol to help guide excavation and removal of contamination, as may be necessary, and to ensure that the post-reclamation radiological verification surveys confirm that reclamation objectives have been met.
- A post-reclamation radiological verification survey plan to verify and demonstrate that post-reclamation conditions are consistent with pre-mining baseline conditions and that the operation has not resulted in radiological conditions that may impact human health and safety beyond conditions existing prior to mining.
- Individual cost estimates (in current dollar amounts) for implementation of each of the radiological survey component plans.

The MMD and NMED have indicated that the procedures to be used and radiological parameters to be tested for this radiological survey should be consistent with the pre-mining baseline radiological survey. The intent is to ensure that comparisons are valid and that they can be used to demonstrate spatial and quantitative consistency between post-reclamation radiological conditions and pre-mining radiological baseline conditions. Achieving and demonstrating post-reclamation consistency with baseline radiological conditions will involve a three-stage radiological survey process, with each stage sequenced to occur at specific points in the Mine Reclamation Plan schedule (RHR, 2011a). The nomenclature, general descriptions, sequencing, and the corresponding sections of this document in which the detailed plans for each stage of the radiological survey process are provided are as follows:

1. <u>Post-mining, Pre-Remediation Radiological Survey</u> (Section 2.0): Once mining operations have been completed and primary structures and equipment have been removed from the Site [per sections

2.2.1 – 2.2.7 of the Mine Reclamation Plan (RHR, 2011a)], gamma surveys will be conducted across disturbed and accessible land areas to identify and characterize the extent of residual radiological contamination that may have been caused by the mining operations. This information will be used to determine the horizontal extent of remediation necessary to achieve consistency with baseline radiological conditions.

2. Remedial Support Measurements (Section 3.0): To guide remediation of areas identified to contain residual contamination as identified by step one above, real-time gamma measurements will be performed to determine when soil excavations have achieved consistency with baseline radiological conditions. These measurements will be used to guide excavations prior to any re-grading/contouring activities [per section 2.2.8 of the Mine Reclamation Plan (RHR, 2011a)].

3. Post-Reclamation Verification Survey (Section 4.0): A final "post-reclamation" verification survey will be performed after remediation is deemed complete and re-grading/contouring has been conducted [per sections 2.2.8-2.2.9 of the Mine Reclamation Plan (RHR, 2011a)], but prior to topdressing, seeding and mulching activities [per section 2.2.10 of the Mine Reclamation Plan (RHR, 2011a)] which could be negatively affected by radiological survey activities.

Individual cost estimates for implementation of each stage of the radiological survey process as indicated in items 1, 2, and 3 are provided in Section 5.0 of this document. Section 6.0 details the data quality assurance/quality control methods and protocols that will be used to help minimize and quantify data uncertainty. Information concerning the technical basis and scientific rationale for the approaches and methods that will be used for each stage of the radiological survey process, how these approaches/methods will produce radiological survey data that are compatible with the baseline data set provided in the Baseline Data Report (RHR, 2011b), and the technical basis for how these data will be evaluated to demonstrate consistency with baseline conditions, are provided in Section 7.0 of this document.

In addition, Section 7.0 provides information regarding additional radiological baseline measurements and sampling that will be performed onsite in the spring of 2013 in order to supplement and improve the overall future utility of the radiological baseline data set provided in the Baseline Data Report (RHR, 2011b). The supplemental onsite radiological survey data to be collected, and how these data will be used to update existing radiological baseline data, are detailed in Section 7.0. The results of these supplemental onsite radiological baseline survey data, and related revisions to existing radiological baseline data and/or respective data presentations, will be provided (anticipated summer 2013) as an addendum to Section 13 of the 2011 Baseline Data Report (RHR, 2011b).

It will also be necessary to supplement the Baseline Data Report (BDR) by collecting data along the portions of the proposed haul road corridors in Sections 11 and 17 that have changed, the utility corridor in Section 15, and the corridor of the mine dewatering pipeline that will convey treated water a distance of approximately 8 miles from the water treatment plant. Baseline radiological conditions will be established along these routes. This will include a gamma survey and representative soils sampling in accordance with the methods described in Sections 2.2.3, 4.2.3, 4.2.4 and 7.2 of this document. The results of the survey will also be included in the above referenced addendum to Section 13 of the 2011 Baseline Data Report (RHR, 2011b).

## 2.0 POST-MINING, PRE-REMEDIATION RADIOLOGICAL SURVEY

This section provides the technical basis, rationale and general approach, along with specific methods and procedures that will be used to identify and characterize the locations and spatial extent of radiological contamination upon final closure of the mine operations and removal of surface facilities, but prior to any remediation of disturbed land areas. Cost estimates are provided in Section 5.0. For the purposes of this plan, "contamination" refers to any area of significant horizontal extent where radiological conditions can be clearly identified to exceed pre-mining baseline conditions. This definition is based on MMD's requirement that RHR demonstrate that its mining operation has not resulted in conditions that may impact human health and safety beyond the conditions that existed prior to mining (MMD, 2012). The caveat of "significant horizontal extent" is important with respect to the above definition of contamination for a number of reasons as discussed below.

As indicated in Section 1.0, the overall radiological survey process is designed to help achieve, and ultimately to demonstrate, consistency with pre-mining baseline conditions. An important challenge when the remedial objective is essentially to remediate to pre-existing background levels, is to do so without causing unnecessary collateral damage to the environment and/or without creating new and unintended risks to human health and safety. Cleanup of very low levels of contamination can result in significant environmental degradation without corresponding reductions in human health risks (Whicker et al., 2004). Disturbing/mobilizing soils with low-level contamination can actually increase the potential for human exposures (via inhalation/ingestion pathways) and more generally, can negatively impact overall air and water quality in the vicinity of the site. Such remediation also unnecessarily increases the extent to which remediation workers are exposed to physical hazards.

Federal standards for radiation protection (e.g. 10 CFR 20, 40 CFR 192) are set at increments above background levels (e.g. 25 mrem/yr, 5 pCi/g radium-226, 20 µR/hr, etc.). These standards are based on recommendations from the International Commission on Radiological Protection (ICRP) and the National Council on Radiation Protection (NCRP), and are respectively considered to be well below levels that could result in significant or measurable detriment to human health. Moreover, ICRP recommendations explicitly include the concept that any remedial action should do more "good than harm" (ICRP, 1990). In addition, many locations in the U.S. and abroad have levels of naturally occurring background radiation that are much higher than baseline levels at the Roca Honda Site, yet human health effects have never been demonstrated in epidemiological studies of populations living in such areas (Boice et al., 2010; Hall and Giaccia, 2006). The biological effects of exposure to radiation do not depend on whether the source is naturally occurring or a result of human activities. For all of the above reasons, a caveat concerning "significant horizontal extent" has been included in the definition of contamination for the purposes of this radiological survey plan. Remediating areas that are too small and/or too low level to realistically result in radiological impacts to human health could cause more harm than good.

The MMD and NMED have indicated that the post mine radiological surveys should, at minimum, include the footprint of the facility, areas around shafts and ore bays, beneath impoundments, the pipeline corridor, and the haulage routes within the permit area (MMD, 2012). These areas will be included in pre-remediation surveys, as well as in post-reclamation verification surveys (Section 4.0).

## *2.1 Technical Basis, Rationale and General Approach*

As previously indicated, the stated objective for the radiological survey is to demonstrate that final radiological conditions at the Site will not impact human health and safety beyond conditions that existed prior to mining (MMD, 2012). General consistency with pre-mining baseline conditions is an achievable remedial goal that can be adequately demonstrated with radiological surveys. The primary remedial challenge is to achieve consistency with baseline conditions without creating unnecessary environmental degradation and/or new and unintended increases in risks to human health and safety.

Any radiological contamination due to mining operations at the Site will be limited to naturally occurring radioactive materials including uranium ore and proto-ore, or slightly mineralized non-economically mineralized mine development rock. In addition to uranium, these radioactive constituents can include variable amounts of natural thorium (Th-232) and potassium (K-40), all of which have associated gamma radiation emissions (primarily from decay series products).

As such, gamma surveys will be the primary method used to identify and characterize areas of contamination prior to any remediation that may be required to achieve consistency with baseline radiological conditions. The results of these gamma surveys will be compared against a baseline gamma survey map in corresponding areas (*see* Figure 10, Section 7.3) for evidence of contamination relative to pre-mining baseline conditions. Determination of "contamination" based on such comparisons requires consideration of uncertainty in gamma survey measurements. There are three basic sources of such uncertainty:

1. Instrument variability. This includes variations in response characteristics between different gamma detectors used for scanning, and temporal variability in the performance of individual detectors.

2. Natural temporal variability in gamma radiation at any given location. Radioactive decay is a random probabilistic process that follows a binomial distribution. As a result, gamma exposure rates at a given location will naturally vary somewhat from one second to the next. Across longer time scales, diurnal and seasonal fluctuations in the concentrations of gamma-emitting radon decay products in air near the ground surface can occur due to changes in air stability and/or changes in soil moisture, changes in soil moisture can affect shielding of terrestrial sources of gamma radiation, and changes in barometric pressure can affect atmospheric shielding of cosmic sources of radiation.

3. Spatial variability in terrestrial sources of gamma radiation (on both large and small spatial scales). Knowledge of the spatial variability in soil radionuclides and associated terrestrial gamma radiation

is primarily limited by the density of ground coverage attained by gamma surveys. Baseline gamma survey coverage at the Site was limited to about 2% of the land area within the permit area (RHR, 2011b). On smaller spatial scales, the accuracy of GPS readings is also limiting.

The most common way to help quantify the majority of combined data uncertainty due to instrument variability and natural temporal variability (items 1 and 2 above) is to perform data quality control (QC) measurements of ambient background radiation at a fixed onsite location every day throughout the duration of the gamma survey field work. During the course of baseline gamma surveys in 2010, daily instrument function checks were performed indoors at the Grants Field Office, including ambient background measurements at a consistent indoor location (Figure 1). The data in Figure 1 were reported in units of cpm (RHR, 2011b), but have been converted here into approximate units of exposure rate (μR/hr) based on the regression equation shown in Figure 7, Section 7.1. The amount of observed variability in Figure 1 is similar to that observed for static, fixed-location QC measurements at other sites having similar levels of ambient gamma radiation and general environmental characteristics[1].

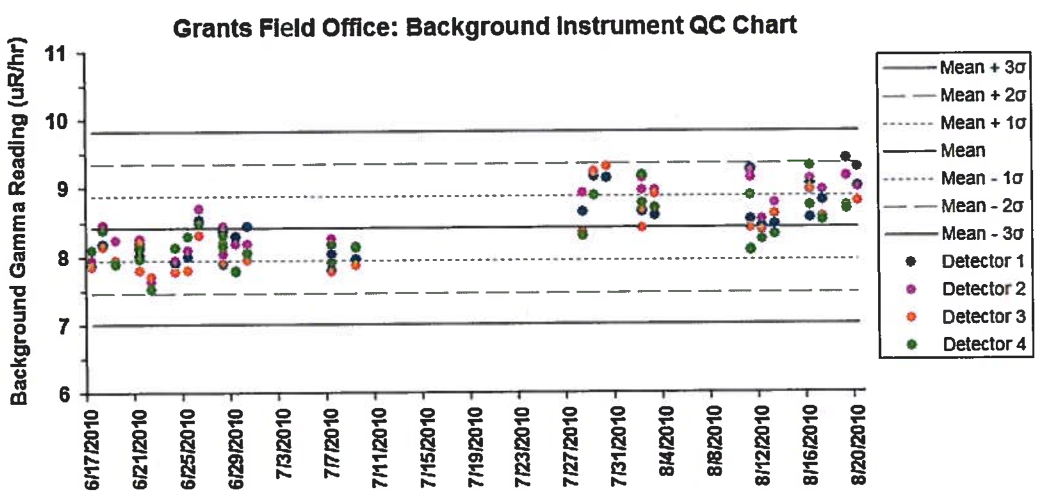



**Figure 1: Variability in background QC measurements over time at the Grants Field Office for detectors used for gamma scanning at the Site (raw data extracted from RHR, 2011b, converted into units of approximate background exposure rate).**

The data in Figure 1 provide a reasonable indication of the uncertainty likely to be present in the baseline gamma survey data set due to instrument variability, combined with natural fluctuations in background radiation, at any given location. The overall range of these measurements (approximately ± 2 μR/hr) suggests that any future measurements at the Site would need to exceed indicated baseline values in corresponding locations by more than 2 μR/hr in order to be considered evidence of potential contamination.

[1] This observation is based on numerous gamma surveys conducted by SENES personnel with the same type of instrument (Ludlum 44-10 detectors) at various sites in nearby western States (CO, UT, WY).

However, baseline scan data were obtained outdoors at the Site, were recorded while in motion, and the reproducibility of the exact location for each individual scan reading has some associated uncertainty. QC measurements repeated daily to test operational scan systems performance while actually scanning along a designated "field strip" (*see* Section 6.0) can demonstrate considerable additional variability due to small spatial differences in actual scan tracks, moving system performance, and temporal variations due to outdoor environmental factors[2] (Figure 2). The example field strip data in Figure 2 illustrate overall scan system variability in the field at a large site in Wyoming (approximately ± 6 µR/hr), which is about twice that which can be expected at the Roca Honda Site as average ambient background gamma radiation levels at the Roca Honda Site are about half that of the Wyoming site (numerical differences in readings between different detectors are generally proportional to the strength of the gamma field). Based on this observation, along with observations of scan system performance at other sites having relatively low levels of ambient background gamma radiation (e.g. less than 15 µR/hr), overall scan data uncertainty at a given location along any given scan transect at the Rocha Honda Site is expected to be about ± 3 µR/hr.

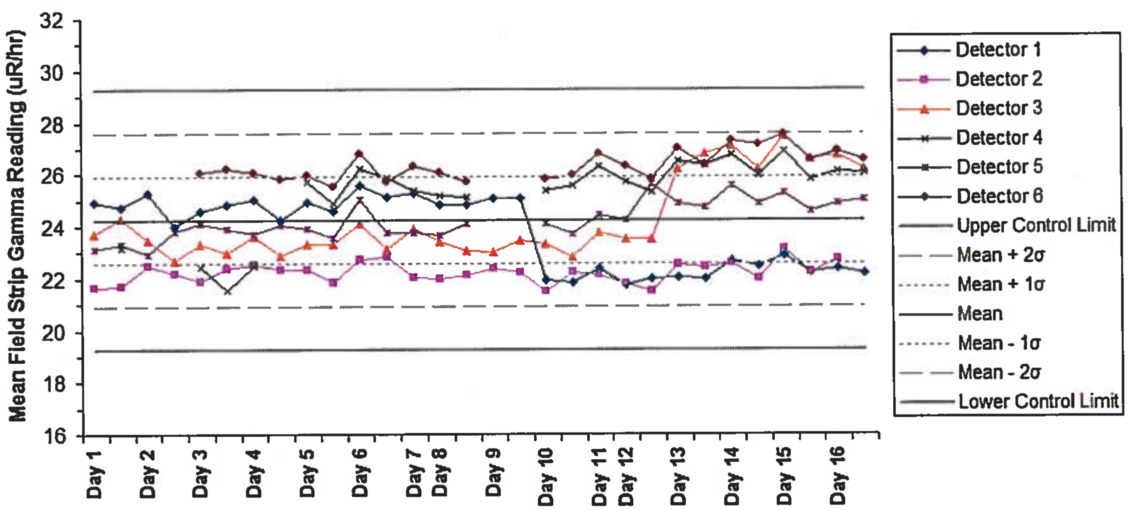



**Figure 2: Example daily operational "field strip" scan system QC chart developed during the course of a large baseline gamma survey project in Wyoming. This particular example was chosen due to the unusually long duration of the project and greater amount of field strip data.**

In addition to the above sources of data uncertainty, uncertainties associated with spatial variability in between scan transects must be also be considered. Because baseline gamma survey transects were spaced 50 meters apart, inferred (interpolated) baseline values in between these transects may not be accurate. Smaller-scale spatial variability in baseline values within these scan coverage gaps could potentially exceed interpolated estimates by more than 3 µR/hr, be mistakenly identified as

[2] On a diurnal basis, outdoor concentrations of gamma-emitting radon decay products in air are likely to be somewhat more variable versus indoor environments, particularly in the summer months, and outdoor temperature variations can slightly affect detector response.

contamination, and lead to cleanup of uncontaminated background soils. To help address spatial uncertainty when comparing future gamma measurements against baseline gamma survey data, a more generalized approach for evaluation of consistency with baseline will be used.

As previously indicated, a reasonable and achievable remedial objective is to excavate all clearly identifiable areas of contamination, yet to the greatest extent possible, avoid the potential to create unintended risks to human health and/or unwarranted environmental degradation by remediating low levels of contamination that may slightly exceed baseline readings at a given location, but do not exceed the degree of uncertainty associated with baseline gamma measurements at that location (the location itself will be somewhat uncertain as GPS data have some degree of associated error). Rather than attempting to draw conclusions about potential contamination based on individual measurements at any given location within the areas specified by MMD and NMED (MMD, 2012), recorded gamma surveys will be conducted across these areas and beyond[3] such that more generalized technical assessments can be performed using an approach that will help to minimize erroneous conclusions about contamination due to overall quantitative and spatial uncertainties in baseline gamma survey data.

Recorded gamma surveys will be conducted using modern technologies and methods that have become standard practice for characterization and remedial applications (e.g. Johnson et al., 2006; Meyer et al., 2005a and 2005b; Whicker et al., 2006 and 2008). This includes use of GPS-based gamma scanning systems with automated electronic data acquisition software and associated methods for data collection, mapping and interpretation. Scanning detectors will be mounted on all-terrain vehicles (ATVs) and/or backpacks at 3 feet above the ground surface (*see* Sections 2.2.3, 4.2.3 and 7.0).

The density of scan transects (Section 2.2.2) will be increased relative to that used for baseline gamma surveys to help reduce uncertainty related to spatial variability in between scan transects (the target scan transect width will be reduced to 20 meters, which at a 3-foot detector height, will increase the effective ground coverage to about 20%). The resulting data will be plotted in ArcGIS, and data interpolation by kriging will be performed (*see* Section 2.2.5) to produce a pre-remediation characterization map similar to the baseline gamma survey map (*see* Figure 10, Section 7.3). This will allow larger-scale spatial differences between pre-mining baseline conditions and pre-remediation conditions to be compared directly.

Interpolation by kriging tends to "smooth out" smaller-scale variability along scan transects and allows more effective interpretation of larger-scale spatial distributions of gamma radiation. Moreover, uncertainty in both baseline and post-mining gamma survey data due to unknown spatial variability between scan transects is somewhat "normalized" by kriging. Comparative use of kriged gamma survey maps to identify contamination will allow identification of contamination across any given area large

[3] A reasonable amount of margin (e.g. 50-100 meters) beyond these areas will also be scanned, with exact widths to be determined in the field based on potential for migration of contamination due to erosional transport mechanisms.

enough to be of potential radiological significance with respect to human health[4], yet will also minimize the potential to create new and unintended risks to human health and/or collateral environmental damage by avoiding unnecessary remediation. Larger-scale distributional differences between baseline and post-mining estimates of gamma exposure rates based on kriged scan data will be considered evidence of contamination if the numerical difference between corresponding averages across the area in question exceeds 3 µR/hr. This metric will be determined using spatial analysis tools in ArcGIS.

## *2.2 Method Specifications*

Pre-remediation gamma surveys will consist of three basic elements: 1) gamma scans of areas potentially affected by mining operations, 2) instrument cross-calibration measurements for energy dependence corrections and related unit conversions to raw gamma scan data, 3) data mapping, interpolation with kriging, and spatial analysis. The technical details and relevant issues regarding these elements are described in the following sub-sections.

### 2.2.1 Gamma Survey Areas

Pre-remediation gamma scans will be performed across the footprint of the facility, areas around shafts and ore bays, beneath impoundments, the pipeline corridor, and the haulage routes within the permit area in accordance with MMD specifications (MMD, 2012). A reasonable amount of additional margin (e.g. 50-100 meters) will be scanned beyond these areas, with exact widths to be determined in the field based on potential for migration of contamination due to erosional transport mechanisms. For example, margins around open areas with potential for significant wind-blown migration of contamination will be wider (e.g. 100 meters) on the downwind sides of the area. Similarly, areas with potential for runoff-driven erosional transport will have wider scan margins on the hydrologically downgradient sides of the area.

### 2.2.2 Density of Gamma Scan Coverage

Sodium iodide (NaI) based detectors (with 2 × 2 inch NaI crystals) will be used for gamma scanning (*see* Section 2.2.3). All NaI detectors will be mounted on ATVs (for vehicle surveys) or backpacks (for walkover surveys) at approximately 3 feet above the ground surface during scanning. Based on previous observations and experience in the field, at this detector height, lateral NaI detector response to significantly elevated planar (non-point) gamma sources at the ground surface is estimated to be about 2 meters, giving each detector an estimated "field of view" of about 4 meters in diameter at the ground surface. This does not imply a system detector can register increased gamma readings from a small

[4] Areas smaller than the distance between gamma scan transects (e.g. < 50 meters in diameter) with exposure rates elevated by as little as 3 µR/hr above baseline will not realistically pose health risks beyond the existing range of baseline levels at the Site. Baseline variability across the Site is considerably greater than such small incremental changes. For comparison, a Federal gamma radiation cleanup standard for inactive uranium processing sites is 20 µR/hr above background levels (40 CFR 192, Part B). (*See Section 2.0 for additional relevant information*).

point source 2 meters away, but does indicate that scattered photons from larger, more radiologically significant, elevated source areas (e.g. 100 $m^2$) are likely to be detected at that distance.

The goal for ground scan coverage will be on the order of 20% for impact characterization surveys, meaning a distance between adjacent scan transects of about 20 meters. Practical considerations such as safety, terrain, and natural obstructions will dictate actual distances that can reasonably be maintained between adjacent scan transects. In terrain deemed unsafe for ATV scanning, efforts will be made to scan as closely as possible along the perimeters of such terrain, and/or walking surveys with a backpack mounted system will be performed. Scanning speeds will typically range between 1 and 5 mph depending on the roughness of the terrain and mode of scanning.

Scan data will be downloaded daily into a project database and plotted on preliminary maps to assess adequacy of scan coverage and screen the data for evidence of elevated gamma exposure rates. Wherever possible, areas identified to have notably higher levels of terrestrial gamma radiation will be re-scanned at higher density scan coverage (e.g. 5-10 meter transects) in order to better define the spatial distribution and horizontal extent of the elevated readings.

### 2.2.3 Scanning Protocols, Instrumentation and System Specifications

All NaI detectors will be mounted on ATVs (for vehicle scanning) or backpacks (for walkover scanning) at approximately 3 feet above the ground surface during scanning (*see* Section 4.2.3 for additional details, and Section 7.0 regarding the technical basis for these specifications). For ATV-mounted systems, detectors will be mounted as far as practicable away from the vehicle (e.g. 2-3 feet) to minimize any shielding effects from the ATV (potential for shielding effects is negligible for backpack scanning). The GPS receivers will be mounted with a clear view of the sky during scanning. Each scanning system will be coupled to a field computer with appropriate data acquisition software. The mounting system configuration may be modified to suit site conditions, but detector height will be maintained as specified and the functionality of the basic system will not change.

All detectors used for gamma surveys will be properly calibrated within a year prior to use in the field, and daily quality control (QC) measurements will be performed to document proper instrument function, temporal variability, variability between instruments, and to provide quantitative information on data precision and uncertainty (*see* Section 6.0). Base maps showing specified scan areas (Section 2.2.1) and relevant Site features should be loaded on field computers with GPS-based tracking software to help guide the scanning and ensure coverage across all intended survey areas. This will also help to minimize trajectory overlap and ensure adequate scan density coverage.

Ludlum Model 44-10 NaI detectors will be used for all gamma scanning. This instrument is the most commonly used NaI detector for large-area gamma surveys. The Ludlum 44-10 is a separate probe comprised of a 2"x2" NaI crystal and photomultiplier tube. This probe has proven to be a reliable and durable field instrument over many decades and has long been considered an industry standard. Each 44-10 detector will be paired with either a Ludlum Model 2350 rate meter, or a Model 2221 scaler/rate meter, equipped with RS232 data output capability. Each detector/rate meter system will be programmed to integrate gamma counts every one second and provide corresponding readings in units of µR/hr or cpm as data output through a RS232 serial port. Each detector/rate meter pairing will have been properly calibrated against a Cs-137 source within one year prior to use for the survey (digital copies of calibration certificates will be kept on file in the project records).

Each scanning system will utilize a WAAS enabled GPS receiver to provide GPS readings (latitude, longitude) every one second to pair with each individual gamma reading. Data acquisition will involve appropriate software installed on a portable field computer or on an appropriate alternate type of data logging device. Scan data will be downloaded daily into a project database and plotted on maps to assess adequacy of scan coverage on a daily basis and to help identify any problems that may have occurred with data acquisition.

### 2.2.4 Instrument Cross-Calibration Measurements

Gamma exposure rates measured by Ludlum 44-10 NaI detectors are only relative measurements as response characteristics of NaI detectors are energy dependent (Figure 3). True gamma exposure rates are best measured with a less energy dependent system that exhibits relatively "flat" response characteristics across the energy range of primary interest such as a Micro-Rem Meter or RadEye PRD from Thermo Scientific. For terrestrial radiation at uranium recovery sites, this range of interest is generally below the photon emission energy of Cs-137 [662 kilo-electron volts (keV)]. Cesium-137 is the most commonly used source for instrument calibrations. The majority of terrestrial gamma radiation at uranium recovery sites is comprised of scattered photons with kinetic energies well below 662 keV and as a result, Ludlum 44-10 NaI detectors will generally overestimate true gamma exposure rates (Figure 3).

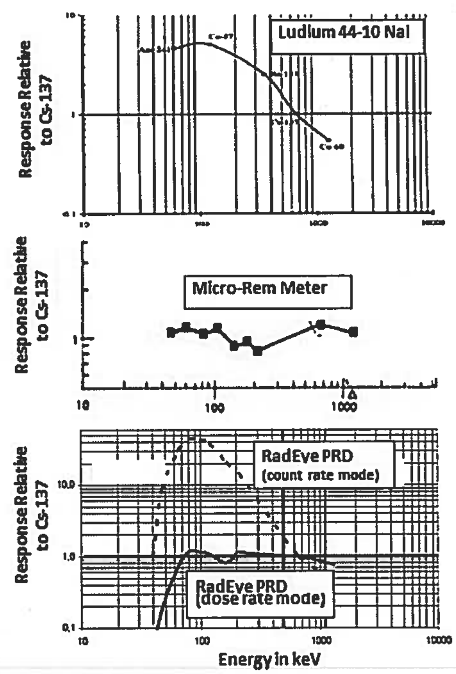



**Figure 3: Energy response curves for Ludlum 44-10 NaI detector, a Micro-Rem meter, and a RadEye PRD (both count rate mode and energy-compensated dose rate mode).**

NaI systems are useful for uranium recovery sites because they can quickly and effectively demonstrate relative differences in the spatial distribution of terrestrial gamma radiation before, during and after operational phases of the project. However, unless the same equipment and scanning geometry is used for all of these surveys, which can occur over project life spans on the order of decades, it is necessary to normalize the data to a common basis of comparison. This is the primary purpose of performing cross-calibration measurements, though as indicated in Sections 7.1 and 7.2.2, conversion of any data that are provided only in units of cpm into more generally useful units of exposure rate (µR/hr) is also important.

Cross-calibration ensures that the results of future gamma scans, which may use different NaI detectors, and perhaps different detector heights, detector models, or measurement technologies, can be meaningfully compared against the results of pre-operational baseline gamma surveys. When mining operations at the Site are completed years into the future, cross-calibration measurements will be necessary.

Either of two alternative instruments can be used for cross-calibrations at the Roca Honda Site as part of the post-mining impact characterization gamma survey. As indicated above, one is a Micro-Rem Meter (a "tissue equivalent" plastic scintillometer from Thermo Scientific), and the other is a RadEye PRD, a specialized NaI detector from Thermo Scientific that has energy compensated response characteristics when used in "dose rate mode". A comparison of energy response characteristics for the Ludlum 44-10 NaI detector, the Micro-Rem meter, and the RadEye PRD is provided in Figure 3.

For each cross-calibration instrument (Ludlum 44-10, Micro-Rem Meter and/or RadEye PRD), static measurements will be taken at 10-15 discrete locations covering a range of exposure rates representative of the site. These locations will be determined based on current and/or pre-mining baseline maps of gamma exposure rates across the Site. At each cross-calibration measurement location, 10-20 individual readings from each cross-calibration instrument will be recorded and averaged. Measurement geometry for collection of cross-calibration data will be 3 feet above the ground surface. Regression analyses will be performed on resulting values to determine statistical relationships between NaI detectors and Micro-Rem/RadEye-PRD[5] instruments. The resulting cross-calibration equations will be used to convert raw scan data (e.g. in units of cpm) into energy corrected units of dose rate (µrem/hr) or exposure rate (µR/hr). Though technically slightly different, for practical purposes the latter two units of measure are commonly considered essentially equivalent. Modified scan data resulting from these energy dependence corrections will be mapped and kriged to represent official gamma survey results for comparisons against similarly normalized and kriged baseline gamma survey maps.

### 2.2.5 Spatial Analysis of Gamma Survey Data

Once all individual gamma survey data have been collected, uploaded into the project database, and converted into energy-corrected units of µR/hr, they will be plotted in ArcGIS. Appropriate color-coded increments of exposure rate will be applied to allow visual interpretation and spatial analysis. The data will be reviewed initially to insure there are no "bad" data points that can on rare occasion result from small electrical surges or interruptions, for example due to unusually jarring vibrations during scanning, or upon initial start-up of data recording. Clear outliers will be discarded from the scan database.

[5] In addition to general low-energy dependence compensation, the RadEye PRD includes an energy discrimination algorithm to ignore the contribution of high-energy photons (> about 1.3 MeV, e.g., from cosmic sources of radiation) to the gamma field in order to measure only the exposure rate attributable to low-energy terrestrial sources of gamma radiation. As a result, two adjustments must be made to all RadEye measurement values that will be used for instrument cross calibration purposes. Technical details and formulas for these adjustments are provided in Appendix A.

Finalized gamma scan data will be mapped as individual discrete measurement points using a high quality base maps and/or aerial photos as base layers. In addition, the finalized gamma scan data will be interpolated by kriging to produce continuous estimates of gamma exposure rates across all scanned areas (consistent with the format shown in Figure 10, Section 7.3). Robust kriging software such as that included in the Spatial Analyst utility in ArcGIS will be used. Kriging is a geo-statistical interpolation procedure that fits a mathematical function to a specified number of nearest points within a defined radius to determine an output value for each location. A given "location" is represented by a cell of specified areal dimensions that may or may not include any measured data points. Values closer to the cell are given more weight than values further away and distances, directions, and overall variability in the data set are all considered in the predictive semivariogram model. Input parameters used for this application should be consistent with those used for the baseline survey data (*see* Figure 10, Section 7.3):

| | |
|---|---|
| Cell size: | 10 feet × 10 feet |
| Maximum search radius: | 300 feet |
| Semivariogram model: | Exponential |
| Number of nearest data points: | 10 |

As previously indicated, kriged maps of baseline gamma exposure rates will be compared against post-mining exposure rates to identify any significant areas of radiological contamination. To help illustrate the utility and visual effectiveness of such comparisons, example kriged gamma survey data from a site cleanup in Colorado are shown in Figure 4. In this example, the data on the left show gamma exposure rates and corresponding gamma-based estimates of soil Ra-226 concentrations prior to remediation, while the data on the right show interim changes for these radiological parameters in corresponding areas part way through the cleanup progress.

Detailed quantitative/spatial differences in radiological parameters due to cleanup progress are clearly apparent in Figure 4, even on relatively small spatial scales (e.g. to within about 10 meters in this particular example). This same approach to spatial analysis will be used not only to identify any contamination resulting from mining operations at the Roca Honda Site, but to also demonstrate consistency with baseline conditions after reclamation is complete (Section 4.0).

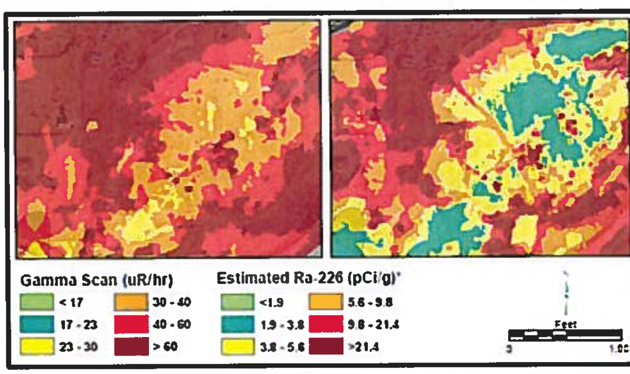



**Figure 4: Example quantitative/spatial comparisons between kriged gamma survey data for a radiologically impacted site in Colorado. Left: pre-remediation gamma exposure rates and gamma-based estimates of soil Ra-226 concentrations* (e.g. *see* correlations, Sections 2.1 and 2.2.2). Right: corresponding interim radiological parameters part way through the cleanup.**

Once a kriged map of pre-remediation gamma survey data is available for comparative spatial analysis against the kriged map of baseline gamma survey data (*see* Section 7.3, Figure 10), any areas of significant size, for example with horizontal dimensions greater than the range of gamma scan transect spacing (e.g. > 50 meters), that have differences in average kriged gamma data greater than about 3 µR/hr will be delineated on maps for remedial action. The averaging used to determine such contaminated areas will be performed using spatial analysis tools and techniques in ArcGIS, and for each individual delineated area, the sum of the average baseline gamma exposure rate, plus an added value of 3 µR/hr to account for data uncertainty, will be annotated on the pre-remediation map to serve as a remedial goal for use during remedial support surveys (Section 3.0)[6].

These spatial assessments will require some professional judgement, for example in the event that the data suggest only slight potential contamination in relatively small areas that are well removed from primary areas of contamination, and where considerations of environmental and ecological degradation must be weighed against potential remediation that would not realistically result in corresponding reductions in human health risks, and could actually increase such risks unintentionally. Costs associated with the pre remediation survey are provided in Section 5.0.

## 3.0 REMEDIAL SUPPORT MEASUREMENTS

Gamma measurements for remedial support purposes will involve unrecorded interim measurements to semi-quantitatively guide the horizontal/vertical extent of excavations necessary to achieve consistency with baseline conditions. As indicated in the previous section, a map showing areas of delineated contamination (> 3 µR/hr above average baseline in each delineated area) will be annotated such that each delineated area will show an area-specific numeric value that is equivalent to the sum of its respective average baseline value, plus an additional 3 µR/hr to account for data uncertainty. This annotated value will be used as an area-specific remedial goal for guiding excavations within the area in question based on the real-time gamma measurements being used to assess corresponding reductions in gamma radiation.

Because all official gamma survey krig maps will be based on energy-corrected scan values, it will be necessary to utilize the same instrument used to correct raw scan data based on instrument cross-calibration measurements. In other words, if a RadEye PRD instrument, reading out in energy compensated dose rate mode (Figure 3), is used for instrument cross-calibrations (Section 2.2.4), then a properly calibrated RadEye PRD instrument should be used for real-time field assessment of remedial reductions in gamma radiation relative to the remedial goal in each area delineated for remedial action. Once remedial excavations appear to have achieved compliance with the remedial action goal based on these measurements, excavations within the area in question will be terminated pending an official inspection by the project health physicist as described below. Soils removed from each radiologically

[6] If a RadEye PRD is used for remedial support measurements, the adjustments indicated in Appendix A should not be reflected in the remedial goal values annotated on this map. This will allow direct comparison of raw RadEye PRD readings against the remedial goal value without having to add estimated contributions from high-energy photons associated with K-40 and cosmic sources of radiation (see Appendix A).

contaminated area will be properly disposed of in accordance with the Roca Honda Mine Reclamation Plan (RHR, 2011a).

Guiding excavations based on remedial support gamma measurements is not a technically complicated activity, and can be performed by a properly trained environmental technician or remediation worker. However, a qualified and experienced environmental health physicist will oversee the project remotely, will be updated periodically throughout the cleanup regarding progress, and will provide technical advising should unusual circumstances or issues arise. Once excavations across all areas delineated for remedial action are believed to be complete based on remedial support gamma measurements, the overseeing health physicist will conduct a Site visit to perform independent measurements and develop a professional opinion as to whether post-reclamation radiological verification surveys (Section 4.0) are likely to quantitatively and spatially demonstrate consistency with baseline radiological conditions. If not, additional excavations will be performed until the project health physicist is confident that this remedial objective has been achieved. Costs for remedial support measurements are provided in Section 5.0.

## 4.0 POST-RECLAMATION VERIFICATION SURVEY

This section describes the radiological surveys that will be used to verify that after reclamation, radiological conditions across the site are consistent with pre-existing baseline conditions. Many of the technical bases, analytical approaches, methods and criteria described in detail for pre-remediation radiological surveys (Section 2.0) are applicable to post-reclamation verification surveys and are thus generally summarized or referenced rather than repeated in detail. Special considerations, differences or additions are discussed in this section, as is a plan for limited direct soil sampling for additional verification. Cost estimates are provided in Section 5.0.

### *4.1 Technical Basis, Rationale and General Approach*

As previously indicated, the stated objective for post-reclamation radiological surveys is to demonstrate that final radiological conditions at the Site will not impact human health and safety beyond conditions that existed prior to mining (MMD, 2012). For the technical reasons detailed in Section 2.0, the general criterion against which post-reclamation survey data will be evaluated is "consistency with baseline conditions". This does not imply that every atom of radiological contamination generated by mining must have been identified and removed from the Site, but does require that any residuals due to mining are too low-level to be clearly distinguishable from baseline levels and/or are too small in areal extent to be of significance with respect to potential for human exposures and related impacts (*see* Section 2.1).

All of the radionuclides that could potentially be generated by mining at the Site occur naturally in all rocks and soils. Any residual radiological contamination that may remain after reclamation will have associated gamma radiation emissions (primarily from radioactive decay series products). As a result, gamma surveys will be the primary method used to verify that post-reclamation radiological conditions are consistent with pre-mining baseline conditions. Verification of this outcome will require evidence that residual sources of gamma radiation due to mining are not present at average levels that exceed average baseline conditions in a given area by more than the estimated amount of uncertainty inherent in gamma survey measurement data. The advantage of gamma surveys is that gamma emissions from soil radionuclides are easily detected in-situ in the field and thus, a much higher density of measurements is possible. Gamma scanning produces spatially comprehensive and reliable characterization with respect to evaluations of potential contamination from mining activities and/or consistency with baseline conditions.

The amount of uncertainty in baseline gamma scan data at any given measurement location is estimated to be about ± 3 μR/hr (Section 2.1). A similar amount of individual measurement uncertainty can be expected in post-reclamation verification gamma survey data. In addition, there is uncertainty associated with actual spatial variability in soil radionuclides and associated gamma radiation that exists between gamma scan transects. To help mitigate spatial sources of uncertainty, larger-scale distributional differences (e.g. differences across areas larger than 50 meters in diameter) between baseline and post-reclamation estimates of gamma exposure rates will be evaluated based on respective maps of kriged gamma scan data (*see* Section 2.2.5). In addition, the density of scan transects for post-reclamation gamma verification surveys (Section 4.2.2) will be increased relative to that used for baseline gamma surveys (increasing the effective ground coverage to about 20%) in order to better characterize small-scale spatial variability which can potentially be somewhat greater relative to baseline conditions once a contaminated area has been remediated.

Based on comparative spatial analysis between kriged baseline and post-reclamation gamma scan data, any areas of significant size, for example with horizontal dimensions greater than the range of gamma scan transect spacing (e.g. > 50 meters), where the average of post-reclamation krig data exceeds the corresponding average of baseline krig data by more than about 3 μR/hr will be considered inconsistent with (i.e. elevated relative to) baseline radiological conditions. In this circumstance, further remedial action may be required depending on the size of the area, the degree of exceedance, and whether a realistic potential exists for human health impacts beyond what can already be attributed to baseline radiological conditions across the Site[7]. Otherwise, the area in question will be considered consistent with corresponding radiological baseline conditions. This qualitative and quantitative spatial analysis process will be performed by a qualified environmental health physicist and professional GIS analyst using accepted health physics principles along with spatial analysis tools and techniques in ArcGIS.

In addition to comparisons of gamma exposure rates between baseline gamma surveys and post-reclamation gamma surveys, raw gamma scan data from both surveys will be converted into estimates of radionuclide concentrations in surface soils (e.g. Ra-226, U-nat) based on the results of the supplemental baseline gamma/soil radionuclide correlation study detailed in Section 7.2.2 (provided that any such correlations are shown to be statistically significant). In addition, a limited amount of direct soil sampling will be conducted in all areas potentially affected by mining operations for

[7] Baseline gamma exposure rates across the Site generally range from 6-14 μR/hr (*see* Figure 10), meaning that natural variability within the permit area is significantly greater than ± 3 μR/hr.

post-reclamation radiological verification surveys (Section 4.2.4), with samples to be analyzed at a qualified commercial laboratory. Results will be used for general Site-wide comparisons with direct soil sampling results from the supplemental gamma/soil radionuclide study (Section 7.2.2), with soil sampling results provided in the Radiological Baseline Report (RHR, 2011b), and with any gamma-based estimates of baseline radionuclide concentrations in surface soils generated as a result of the supplemental gamma/soil radionuclide study (Section 7.2.2).

All post-reclamation radiological verification survey results, including data, maps, evaluations and conclusions will be provided in a detailed technical report (Section 4.2.5).

## *4.2 Methods and Specifications*

Post-reclamation radiological verification surveys will consist of three basic elements: 1) gamma scans of all areas potentially affected by mining operations (Section 4.2.1) which at minimum, will mimic the areas scanned for the pre-remediation surveys (Section 2.2.1); 2) limited soil sampling and laboratory analysis (Section 4.2.4); 3) data mapping, interpolation of gamma survey data by kriging, data analysis and reporting (Section 4.2.5).[8] The technical details and are described in the following sub-sections.

### 4.2.1 Gamma Survey Areas

Post-reclamation gamma verification scans will be performed across the footprint of the facility, areas around shafts and ore bays, beneath impoundments, the pipeline corridor, and the haulage routes within the permit area. As with pre-remediation gamma scans, a reasonable amount of additional margin (e.g. 50-100 meters) will be scanned beyond these areas (*see* Section 2.2.1). Depending on additional information and Site knowledge that may be acquired during the pre-remediation survey and remedial support measurement activities, additional areas may need to be scanned to ensure that the final post-reclamation radiological status of the Site can be verified as being consistent with baseline radiological conditions on a Site-wide scale (and beyond the permit area as applicable).

### 4.2.2 Density of Gamma Scan Coverage

As with pre-remediation surveys, the goal for ground scan coverage will be on the order of 20% for post-reclamation gamma verification surveys, meaning a distance between adjacent scan transects of about 20 meters. Considerations and limitations regarding scan coverage are discussed in Section 2.2.2. If

[8] Instrument cross-calibration measurements are not listed here as it is assumed that the amount of time elapsed between pre-remediation surveys (Section 2.0), remedial support activities (Section 3.0), and initiation of post-reclamation verification surveys (Section 4.0) will be relatively short (e.g. 1-2 years) and that the same gamma measurement instruments and scanning systems will be available for use during all of these radiological survey activities. If so, instrument cross-calibration measurements performed for pre-remediation surveys (Section 2.2.4) need not be repeated for verification gamma surveys, provided that the instruments are in current calibration during field use. If not, new cross-calibration measurements will be necessary for post-remediation gamma verification surveys (following the methods detailed in Section 2.2.4) to ensure proper data normalization for comparisons against baseline gamma survey data (Section 7.2.2).

additional area scans are performed, scan coverage may be increased to 50-meter scan transects. Modes of scanning will include ATV and/or backpack based systems (Section 4.2.3). Scan data will be downloaded daily into a project database and plotted on preliminary maps to assess adequacy of scan coverage.

### 4.2.3 Scanning Protocols, Instrumentation and System Specifications

As indicated in Section 2.2.3, all NaI detectors will be mounted on ATVs (for vehicle scanning) or backpacks (for walkover scanning) at approximately 3 feet above the ground surface during scanning (*see* Section 7.0 regarding the technical basis for these specifications). Example detector mounting configurations are shown in Figure 5. The specifications for scan data acquisition indicated in Section 2.2.3 are applicable to post-remediation gamma verification surveys and will be observed accordingly. All detectors used for gamma surveys will be properly calibrated within a year prior to use in the field, and daily quality control (QC) measurements will be performed to document proper instrument function, temporal and instrument variability, and to provide quantitative information on data uncertainty (*see* Section 6.0). As with pre-remediation surveys, base map shape files of specified scan areas (Section 4.2.1) and relevant Site features should be loaded on field computers with GPS-based tracking software to help guide the scanning and ensure coverage across all intended survey areas. Scanning speeds will range between 1 and 5 mph depending on the terrain and mode of scanning.

As previously indicated, Ludlum Model 44-10 NaI detectors will be used for all gamma scanning activities. Each 44-10 detector will be paired with either a Ludlum Model 2350 rate meter, or a Model 2221 scaler/rate meter, equipped with RS232 data output capability. Each detector/rate meter system will be programmed to integrate gamma counts every one second and provide corresponding readings in units of μR/hr or cpm as data output through a RS232 serial port. Each detector/rate meter pairing will have been properly calibrated against a Cs-137 source within one year prior to use for the survey (digital copies of calibration certificates will be kept on file in the project records).

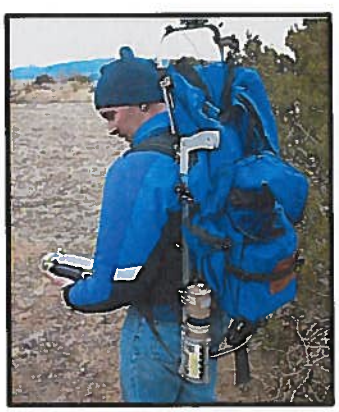


**Figure 5: Example detector mounting configurations for backpack and ATV gamma scanning systems.**

Each scanning system will utilize a WAAS enabled GPS receiver to provide GPS readings (latitude, longitude) every one second to pair with each individual gamma reading. GPS receivers will be mounted above each detector with a clear view of the sky. Data acquisition will involve appropriate software installed on a portable field computer or on an appropriate alternate type of data logging device. Scan data will be downloaded at the end of each day of survey field work into a project database and plotted on maps to assess adequacy of scan coverage on a daily basis and to help identify any problems that may have occurred with data acquisition.

#### 4.2.4 Soil Sampling

One or more composite samples of surface soils will be collected to a depth of 15 cm in each area specified by the MMD for post-reclamation radiological verification surveys (MMD, 2012). This includes the footprint of the facility, areas around shafts and ore bays, beneath impoundments, the pipeline corridor, and haulage routes within the permit area. At each location, soil sampling and compositing will be conducted in accordance with the protocols indicated in Section 7.2.2 for the supplementary baseline gamma/soil radionuclide correlation study. All soil samples will be analyzed for U-nat, Ra-226, Th-232 and K-40 in accordance with the protocols indicated in Section 7.2.2.

#### 4.2.5 Data Analysis, Presentation and Reporting

Once all individual gamma survey data have been collected, uploaded into the project database, and converted into energy-corrected units of µR/hr, they will be plotted in ArcGIS. Appropriate color-coded increments of exposure rate will be applied to allow visual interpretation and spatial analysis. The data will be reviewed for quality control and any clearly identified outliers will be discarded from the scan database. Mapping and kriging will be performed in the same manner described for pre-remediation surveys (Section 2.2.5).

Kriged maps of post-reclamation gamma survey data will be compared against baseline gamma survey data to identify any significant spatial/quantitative differences. Any areas of significant size (e.g. greater than the 20-50 meter spacing for scan transects), and where the average of post-reclamation krig data exceeds the average baseline krig data by more than about 3 µR/hr, will be considered inconsistent with baseline radiological conditions (i.e. "elevated") and additional remediation may be necessary. Otherwise, the area in question will be considered to be confirmed as consistent with pre-mining radiological baseline conditions. This qualitative and quantitative spatial analysis process will be performed by a qualified environmental health physicist and professional GIS analyst using accepted health physics principles along with standard spatial analysis tools and techniques in ArcGIS.

Raw gamma scan data from both baseline and post-reclamation gamma surveys will be converted into estimates of radionuclide concentrations in surface soils based on the results of the supplemental baseline gamma/soil radionuclide correlation study as detailed in Section 7.2.2 (provided that any such correlations are shown to be statistically significant). In addition, a limited amount of direct soil sampling will be collected in all areas specified by the MMD for post-reclamation radiological verification surveys (Section 4.2.4) and analyzed at a qualified commercial laboratory. Results will be used for general Site-wide comparisons with direct soil sampling results from the supplemental baseline gamma/soil radionuclide study (Section 7.2.2), with soil sampling results provided in the Radiological Baseline Report (RHR, 2011b), and with any gamma-based estimates of baseline radionuclide concentrations in surface soils generated as a result of the supplemental gamma/soil radionuclide study (Section 7.2.2). All post-reclamation radiological verification survey results, including data, maps, evaluations and conclusions will be provided in a detailed technical report.

## 5.0 ESTIMATED COSTS

Estimated costs for the pre-remediation gamma survey (Section 2.0), remedial support gamma measurements (Section 3.0), and the post-reclamation verification survey (Section 4.0), are provided in the following tables.

**Cost estimate for Pre-Remediation Gamma Survey:**

| Task / Cost Category | Cost Item | Quantity | Unit[1] | Cost[2] | Task Cost |
|---|---|---|---|---|---|
| ***Gamma Surveys & Associated Measurements*** | | | | | |
| Environmental Health Physicist | Rad Survey Lead[3] | 6 | DY | $6,000 | |
| Field Technician | Rad Tech[3] | 6 | DY | $4,320 | |
| Gamma Survey Systems (ATVs, detectors, etc.) | Scan equipment[3] | 6 | DY | $2,790 | |
| Transportation | Truck useage, fuel[3] | 6 | DY | $585 | |
| Lodging & Per Diem | Lodging & per diem | 12 | Staff-DY | $2,040 | |
| Miscellaneous (field supplies, etc.) | Field supplies | 6 | DY | $120 | $15,855 |
| ***Data Analysis*** | | | | | |
| Data Analysis to Delineate Contamination | Rad Survey Lead | 15 | Hr | $1,875 | |
| Mapping | GIS Analyst | 15 | Hr | $1,500 | $3,375 |
| | | | | **Total[2] =** | **$19,230** |

**Assumptions**
[1]DY = 8-hour workday
[1]Staff-DY = Combined daily lodging and per diem for field staff for duration of field work
[2]Based on current (2013) dollar amounts
[3]Technical resources based out of Albuquerque, NM

**Cost estimate for Remedial Support Gamma Measurements:**

| Task / Cost Category | Cost Item | Quantity | Unit[1] | Cost[2] | Task Cost |
|---|---|---|---|---|---|
| ***Gamma Surveys & Associated Measurements*** | | | | | |
| Environmental Health Physicist | Technical Oversight | 4 | DY | $4,000 | |
| Field Measurement Personnel[3] | Reclamation Worker | 30 | DY | $4,800 | |
| Gamma Measurement Instrument[4] | Instrument Rental | 90 | DY | $1,350 | |
| Transportation[5] | Truck useage, fuel | 2 | DY | $345 | |
| Lodging & Per Diem[5] | Lodging & per diem | 2 | DY | $340 | $10,835 |
| | | | | **Total[2] =** | **$10,835** |

**Assumptions**
[1]DY = 8-hour workday
[2]Based on current (2013) dollar amounts
[3]Cleanup takes three months, cleanup worker spends 1/3 of each day taking measurements to help guide excavations
[4]Rental of RadEye PRD or Micro-Rem Meter for duration of cleanup
[5]Travel/lodging expenses for reclamation worker covered under general Reclamation Plan, technical oversight based out of Albuquerque, NM

**Cost estimate for Post-Reclamation Radiological Verification Surveys:**

| Task / Cost Category | Cost Item | Quantity | Unit[1] | Cost[2] | Task Cost |
|---|---|---|---|---|---|
| ***Radiological Surveys & Associated Measurements/Sampling*** | | | | | |
| Environmental Health Physicist | Rad Survey Lead[3] | 7 | DY | $7,000 | |
| Field Technician | Rad Tech[3] | 7 | DY | $5,040 | |
| Gamma Survey Systems (ATVs, detectors, etc.) | Scan equipment[3] | 7 | DY | $3,255 | |
| Transportation | Truck useage, fuel[3] | 7 | DY | $645 | |
| Lodging & Per Diem | Lodging & per diem | 14 | Staff-DY | $2,380 | |
| Miscellaneous (field supplies, etc.) | Field supplies | 7 | DY | $140 | $18,460 |
| ***Outside Services*** | | | | | |
| Soil Sample Radionuclide Analysis | Laboratory Analysis | 15 | Samples | $3,300 | $3,300 |
| ***Data Analysis and Reporting*** | | | | | |
| Data Analysis, Verification Reporting | Rad Survey Lead | 50 | Hr | $6,250 | |
| Mapping | GIS Analyst | 20 | Hr | $2,000 | $8,250 |
| | | | | **Total[2] =** | **$30,010** |

**Assumptions**

[1]DY = 8-hour workday

[1]Staff-DY = Combined daily lodging and per diem for field staff for duration of field work

[2]Based on current (2013) dollar amounts

[3]Technical resources based out of Albuquerque, NM

## 6.0 DATA QUALITY ASSURANCE / QUALITY CONTROL

All gamma surveys, supporting radiological measurements and soil sampling will include a data QA/QC program to provide confidence in the results and ensure that the data generated are reliable, with a minimal amount of uncertainty introduced by variability in instruments and field survey methods. The program is designed to help quantify data uncertainty due to these sources of variability as well as those associated with natural environmental factors (e.g. changes in soil moisture, barometric pressure, etc.). In general, quality assurance (QA) includes qualitative factors that provide confidence in the results, while quality control (QC) includes quantitative evidence that enables estimation of data uncertainty (accuracy and precision).

Data QA protocols/factors include the following:

- Documentation of field activities and any relevant observations regarding environmental or equipment related conditions that could affect survey data.
- Daily review of scan data for general consistency with scan data from other systems and/or adjacent scan tracks.
- The radiological survey designs contained in this plan were developed by qualified environmental health physics professionals with highly specialized experience and expertise in radiological surveys and spatial analysis techniques for uranium recovery site applications.
- Implementation of radiological surveys and data assessments will be conducted by qualified professionals with specialized experience and expertise with these types of surveys based on

education/experience in environmental health physics, preferably with specific experience regarding uranium recovery site applications.

- Technical information regarding the methods used, including supporting references to relevant regulatory guidance, scientific research journal articles or other peer-reviewed technical literature are provided in this document.

Data QC protocols/factors will include the following:

- Technical information on survey instrument calibrations to help quantify accuracy.
- Routine QC measurements will be performed in the field to ensure proper instrument performance and to quantify data precision/reproducibility.

### *6.1 Quality Control Protocols for Gamma Survey Data*

All recorded gamma surveys and interim supporting gamma measurements at the Site will include instrument QC measurements performed at a designated location for each NaI detector that may be used. Preferably this location will be onsite and outdoors, but regardless must always be at the precise same location and positioned in the exact same measurement geometry each day. The purpose is to quantify the consistency of readings between detectors before, during and after the project at a precisely controlled location. Prior to initiation of field work, the mean of 10-20 individual readings of ambient background radiation, as well as radiation from a gamma check-source (e.g. a Cs-137 button source), will be recorded for each detector at the same location and under identical counting geometries. Under these circumstances, all data from any given set of properly calibrated and correctly functioning NaI scanning detectors should approximate a normal (Gaussian) distribution (Figure 6).

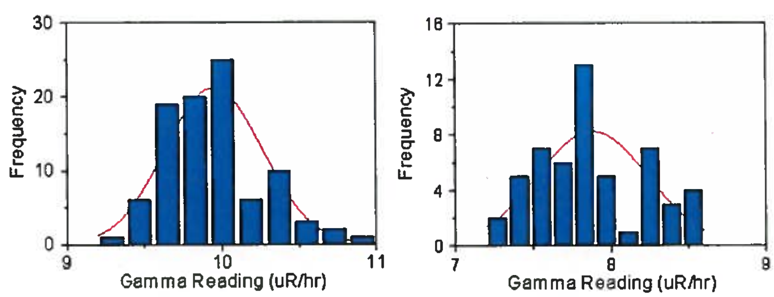



**Figure 6: Example frequency histograms for several series of QC measurements from different NaI detector sets used for two separate gamma survey projects. The red lines represent theoretical normal distributions.**

This information will be used to construct instrument control charts (*see* Figure 1, Section 2.1), the limits of which will be periodically updated throughout the duration of the field work as appropriate based on cumulative data from all daily QC measurements. This protocol will help account for natural temporal variability in ambient gamma radiation due to fluctuations in atmospheric or other conditions (e.g. changes in barometric pressure, soil moisture, radon decay products, etc.). For normally distributed data, over 99% of measurements are expected to fall within ± 3 standard deviations from the mean. Any instrument with a QC measurement result falling outside ± 3 standard deviations from the mean of all previous QC measurements warrants investigation. If a detector exceeds control limits on both background and check-source control charts, it will be replaced with a factory-calibrated spare detector and sent back to the manufacturer for repair and recalibration. An example of an instrument "background" QC chart for NaI detector readings is shown in Figure 1 (Section 2.1).

In addition to daily static QC measurements for any gamma instrument to be used in the field, an additional form of daily data QC protocols will be specifically employed for all recorded gamma surveys (i.e. for both post-mining impact characterization surveys, and post-reclamation gamma verification surveys). The actual operational field performance of each scanning system to be used will be tested onsite each day by obtaining average scan readings along a designated "field strip" (see Figure 2, Section 2.1 for an example of a field strip QC chart). The field strip will be in the range of 20-40 meters in length, and ideally will be located in an area that has relatively uniform gamma readings on all sides. Field strip scans will be conducted before and after each day's scanning activities in order to evaluate overall system performance and to provide quantitative information regarding the combined amount of data uncertainty attributable to variations in instrument readings (detectors/scanning systems), temporal variations in ambient gamma radiation in the field due to changes in atmospheric or other environmental conditions (e.g. barometric pressure, soil moisture, etc.), and small differences in detector locations and geometry when attempting to replicate measurements along a given scan track. Field strip data for each scanning system must remain within acceptable QC limits throughout the project. In cases where a scan system develops suspect performance during the day's scanning (e.g. later identified by an unacceptable evening field strip result), the subject data file(s) will be eliminated from the project data base and the system (or detector) in question will be not be used again until repaired or replaced with properly performing spare equipment (also subject to routine field strip QC measurements).

## *6.2 Data QA/QC for Soil Sampling*

A consistent methodology as described in Section 7.2.2 will be followed for all composite soil sampling. At each composite sampling location, the amount of soil collected at each sub-sampling location within the sampling plot will be as equal as possible. Location ID numbers, date, and GPS coordinates for each sampling location will be recorded in the field log book, along with notes of any observations that could potentially affect the data. After samples have been collected, they will be maintained under proper chain-of-custody (COC) protocols. Field sampling personnel will complete a COC form for each shipping container of soil samples to be delivered to the laboratory for analysis. COC/analytical request forms will be provided by the laboratory.

On the COC/analytical request form, the laboratory will be specifically advised as to the crucial importance of thorough homogenization of each soil sample in accordance with the lab's standard sample preparation protocols. For samples analyzed for Ra-226 by HPGe gamma spectroscopy, aliquots of homogenized samples will be weighed and placed into counting tins, then sealed for a minimum of 21 days prior to counting to allow ingrowth of short-lived Ra-226 progeny and approximate equilibrium conditions to become established. Separate aliquots of the homogenized samples will be used for analyses requiring wet radiochemical methods.

The contract laboratory will have fully qualified radiochemistry capabilities that include appropriate accreditations (e.g. NLAP, EPA, etc.). Each batch of laboratory analyses will include QC measurements (e.g. sample spikes, method blanks, duplicate analyses, etc.) and QC results will be provided with each data report to provide indications of measurement accuracy. The laboratory will use NIST certified standards for instrument calibrations, and for gamma spectroscopy, will utilize NIST or EPA certified soil Ra-226 reference material standards for such calibrations. Laboratory QC data will be reviewed for data quality verification purposes.

The analytical results for Ra-226 concentrations in surface soil samples will be compared against the gamma survey map, as well as a map of estimated Ra-226 concentrations in surface soils across the Site based on gamma/soil radionuclide correlations. Any unusual or dramatic spatial/quantitative discrepancies will be investigated to determine if the subject data can be considered valid results.

## 7.0 RADIOLOGICAL BASELINE DATA REVIEW AND SUPPLEMENTAL SURVEYS

### *7.1 Review of Existing Radiological Baseline Data*

The radiological baseline data collected by DeNuke in connection with the proposed Roca Honda Mine Site are technically rigorous and spatially comprehensive. While appropriately focused primarily on gamma radiation surveys, certain aspects of the gamma survey methodologies, and how the data are presented in the Baseline Data Report, have practical limitations with respect to direct comparative use for operational purposes (e.g. relative to routine gamma exposure rate measurements for radiation safety evaluations, worker dose assessments, and related Site inspections), and also with respect to the efficiency and timeliness with which data can be collected and analyzed for pre-remediation surveys, remedial support measurements, and post-reclamation verification surveys. It is important to be able to readily evaluate any above-background gamma measurements in terms of doses to humans, and also to maximize the effectiveness, practicality, and efficiency of the gamma survey methodology such that it will be cost-effective over the lifespan of the project. There are also some relatively minor issues related to baseline soil sampling that have been identified in terms of maximizing the future utility of the overall radiological baseline data set. The above considerations are detailed as follows:

1. Based on information provided by DeNuke in the Baseline Data Report (RHR, 2011b), the gamma detectors used to perform baseline gamma surveys were positioned at a detector height of about 10 inches above the ground surface. The Radiological Baseline Report (RHR, 2011b) provides no direct reference to the detector height used for gamma scanning, but shows pictures of DeNuke field personnel scanning with detectors positioned at about 10 inches above the ground surface, and also cites from a table in MARSSIM (NRC, 2000) a value of 2.9 pCi/g as the minimum detectable Ra-226 concentration for the scanning technique used (i.e. the "scan MDC"). This cited value is based on a

detector height of 10 inches above the ground surface. Use of a 10-inch detector height is an unconventional approach for conducting baseline gamma surveys across large areas, yet is appropriate for helping to detect small amounts of contamination that could potentially exist at historic exploratory drilling locations, which was an additional baseline survey objective. A lower detector height has greater sensitivity for detecting small amounts of contamination. However, for general baseline or final verification gamma surveys, a 3-foot detector height is a more standard practice as this height is more representative of whole-body exposure rates, and is also more practical and efficient in terms large-scale field use as it allows sufficient clearance above most vegetation or other types of obstacles when mounted on backpacks or all-terrain vehicles (ATVs). Moreover, the primary data quality objective (DQO) for large-area baseline gamma surveys is to provide characterization of larger-scale spatial distributions across the site, rather than to detect very small and/or subtle anomalies that have little importance in terms of human health risks, or in terms of practical relevance with respect to the likely scope of future remediation needed to achieve consistency with baseline conditions on a site-wide scale.

2. Gamma survey data in the original Radiological Baseline Report were presented in units of counts per minute (cpm) (RHR, 2011b). For comparative assessments with operational and post-remediation gamma surveys, where potential radiological doses to humans are typically of interest, it is appropriate and useful to present baseline gamma survey data in units of exposure rate [micro-roentgens per hour (µR/hr)] or dose rate [micro-rem per hour (µrem/hr)]. Instrument cross-calibration measurements necessary to convert raw energy-dependent gamma scan data (in units of cpm) into estimates of true exposure rate (in µR/hr) were performed by DeNuke field personnel. Although a linear trend in the data provided in the report is apparent, the statistical relationship is not significant (Figure 7). In addition, the scan data presented in the original report were plotted in smaller sub-sections of the Site and legend color scale increments represent a range of values much greater than the range of values actually present. A more useful data presentation will resolve variability in gamma radiation on a more applicable scale, and respectively illustrate both quantitative and spatial distributions simultaneously across the Site on quality aerial imagery to facilitate interpretation of quantitative/spatial relationships relative to planned facilities areas and relevant land features. This is important for identifying contamination, guiding remedial efforts, and demonstrating that post-reclamation gamma survey data are spatially consistent with pre-mining baseline data in corresponding areas.

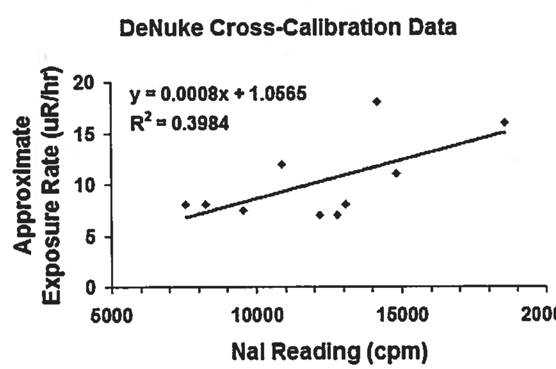



**Figure 7: Relationship between energy dependent readings from a NaI-based scanning detector (in cpm) versus approximate gamma exposure rates (in µR/hr) based on readings from a less energy dependent micro-rem meter.**

3. Characterization of Soil Ra-226 concentrations is a particularly important aspect of radiological baseline studies because it is the immediate long-lived parent of a number of short-lived radionuclides, including radon gas and gamma-emitting decay products which are responsible for a vast majority of the potential for radiation doses to humans. For this reason, Ra-226 is typically a key constituent in terms of remedial objectives. Direct soil sampling is an inherently limited approach for characterizing the spatial distributions of Ra-226 concentrations in surface soils, particularly when the study area is large and spatial variability is relatively high (a fairly common occurrence when geology, soils and land features are variable). A well-established, effective and widely-used analytical approach for spatially comprehensive characterization of Ra-226 concentrations in surface soils involves gamma/soil Ra-226 correlations (NRC, 2003; Johnson et al., 2006; Meyer et al., 2005a and 2005b; Whicker et al., 2006 and 2008). If a gamma/Ra-226 correlation is statistically significant, Ra-226 concentrations in surface soils can be estimated indirectly with reasonable accuracy based on gamma readings across all scanned areas. As part of the 2010 radiological baseline study at the Site, 10 discrete soil samples were collected by DeNuke and analyzed for Ra-226 at a commercial laboratory. At each soil sampling location, discrete gamma measurements were also taken at detector height of 1 meter. Linear regression analysis of the resulting data suggests essentially no statistical relationship ($R^2 = 0.15$) between gamma readings and soil Ra-226 concentrations (Figure 8, top). Part of the reason for this result may be due to the methodology. A discrete measurement and sampling approach is typically less effective versus composite measurements and sampling across larger, more generally representative areas at each correlation assessment location (e.g. across 10 × 10 meter plots). In addition, note that the statistical linear relationship between gamma readings and U-238 concentrations at these same soil sampling locations is significantly stronger ($R^2 = 0.67$) (Figure 8, bottom). Although U-238 is not a gamma emitter like Ra-226 and its short-lived decay products, both should be expected to display a similar, and reasonably significant, linear relationship with gamma readings as in nature Ra-226 normally exists in a state of approximate radiological equilibrium with its U-238 parent (i.e. respective radioactivity concentrations are approximately equal). The implication of this observation is that there appears to be considerable analytical error associated with Ra-226 results. Potential reasons for such error are discussed in bullet point number 4 below. In order to supplement and further characterize baseline

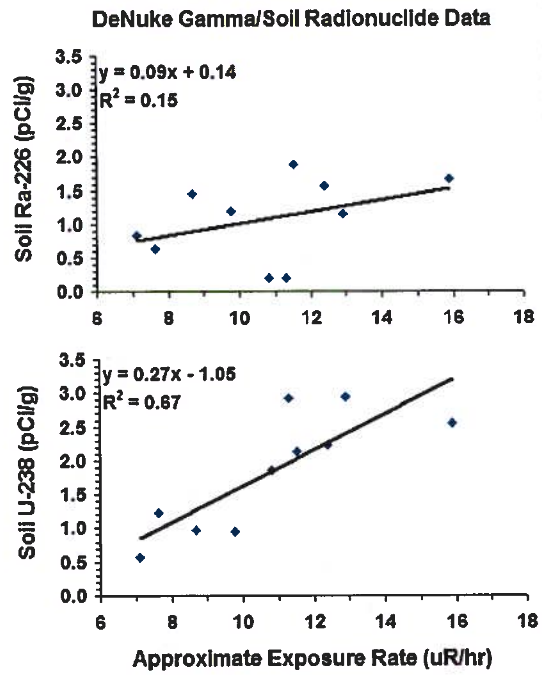



**Figure 8: Relationships between approximate gamma exposure rate versus soil Ra-226 concentration (top) and U-238 concentration (bottom) based on data provided in the Radiological Baseline Report (RHR, 2011b).**

concentrations of Ra-226 in surface soils across the Roca Honda permit area, additional gamma measurements and soil sampling will be conducted using a methodology specifically designed to establish a more robust gamma/soil Ra-226 correlation that can be used to estimate soil Ra-226 concentrations based on gamma survey data (*see* Section 7.2.2).

4. EPA Method 907.0, a wet radiochemical separation method, was used by DeNuke for analysis of Ra-226 concentrations in radiological baseline soil samples. Radiochemical separation methods are known to have a tendency to underestimate Ra-226 concentrations relative to direct gamma spectroscopy on an unaltered bulk soil sample using a high-purity germanium (HPGe) detector (EPA Method 901.1, modified for soil samples). Several baseline soil samples collected at the Site were reported by the laboratory to have concentrations of Ra-226 that are exceptionally low for natural soils (e.g. approximately 0.2 pCi/g). In general, there is poor analytical agreement between Ra-226 results and U-238 results at corresponding locations (Figure 8) which as previously mentioned, is a potential indication of analytical uncertainty given the expectation of radiological equilibrium between these radionuclides in natural soils.

   Use of the radiochemical separation methodology for Ra-226 analysis has limitations including:

   - The sample size is very small (e.g. < 1 gram) raising issues of representativeness,
   - There can be self-absorption of alpha emissions from sample precipitate mounting filters,
   - It is not possible to dissolve 100% of the radium present in the crystalline soil mineral matrix without the use of expensive and difficult chemical fusion methods or highly aggressive acid digestion techniques, and;
   - Radiotracer techniques can introduce analytical errors with respect to estimating the overall chemical yield of Ra-226 resulting from the chemical separation and filter mounting process.

   With gamma spectroscopy, these potential sources of data uncertainty are avoided as the radioactivity associated with short-lived decay products of Ra-226 (Pb-214 and Bi-214) from a much larger sample can be measured directly[9]. The use of gamma spectroscopy is appropriate for analysis of Ra-226 in soils, particularly when attempting to correlate gamma survey readings in the field with soil Ra-226 concentrations. Additional soil sampling will be conducted as part of the supplemental gamma/Ra-226 correlation study (as indicated above in bullet point number 3), and these soil samples will be analyzed for Ra-226 using gamma spectroscopy (EPA Method 901.1, modified)[10].

[9] Once radiological equilibrium between Ra-226 and its short-lived decay products is attained (about 21 days after sealing the soil sample in a counting tin), gamma energy peaks associated with Pb-214 and Bi-214, which are unique and lack major interferences from other radionuclide emissions, can be easily and directly measured and the resulting radioactivity concentration will be equivalent to the parent Ra-226 concentration. Because a large sample is used (e.g. 200 grams), the signal to noise ratio is typically high and data uncertainty is minimized.

[10] These samples will also be analyzed for natural thorium (Th-232) and uranium (U-nat), as well as K-40 (see Section 7.2.2)

5. The 2010 Radiological Baseline Surveys at the Site included analysis of isotopic uranium (U-238, U-235 and U-234). A radiological rationale is not apparent for analysis of isotopic uranium at a uranium mine site. The relative abundances of U-238, U-235, and U-234 contained in uranium as it exists in natural soils and rocks, as well as in uranium ore is essentially constant[11]. Future soils analysis for uranium at the Site will be performed for natural (total) uranium (U-nat). The analytical method should be EPA Method 200.8 (ICP-MS) or equivalent, preferably with soil matrix digestion using EPA Method 3052 (microwave assisted acid digestion) or equivalent (EPA Method 3050B or equivalent may alternatively be used, recognizing that digestion will not be as complete). With respect to earlier baseline soil analysis results for isotopic uranium, total uranium (U-nat) concentrations will be estimated by summing the isotopic results.

## *7.2 Supplemental Radiological Baseline Surveys*

### 7.2.1 Reuse Water Pipeline, Access Routes and Utility Corridor

A gamma survey will be conducted along the modified access and utility corridors and the mine water pipeline corridor using gamma scanning equipment specifications and methodologies described in Sections 2.2.3 and 4.2.3 of this document. A backpack or ATV-mounted scanning system will be used while traveling along the corridors in order to accomplish this scanning in an efficient manner. If the ATV-mounted scanning is not appropriate or possible, a backpack-mounted walking or bicycle survey methodology will be used where necessary (e.g. in rough terrain or across areas of limited access). Regardless of the mode of scanning used, the detector will be positioned at approximately 3 feet above the ground surface, with scanning speeds of 1-5 mph depending on the terrain encountered.

Based on initial field review of corridor gamma survey data, 5-10 representative locations will be selected along the corridor for composite sampling of surface soils (to a depth of 15 cm) and analysis for U-nat, Ra-226, Th-232 and K-40 concentrations in accordance with the protocols/methods described in Section 7.2.2 (*see* Correlation Study) and Section 4.2.4.

### 7.2.2 Supplemental Onsite Measurements/Sampling

Within the permit area, 10-15 representative locations will be selected for supplementary onsite radiological baseline measurements and soil sampling. Supplemental measurement/sampling locations will be selected based on the range of known gamma survey readings across the Site (*see* Figure 10, Section 7.3). At each location, the following measurement/sampling will be performed:

[11] The total amount of radioactivity contained in natural uranium is partitioned according to the following isotopic percentages: 48.6% is due to U-238, 49.2% is due to U-234, and 2.2% is due to U-235 (cited percentages in health physics literature can vary slightly, but all are close to these values).

*Normalization of Gamma Survey Detector Heights:*

1. At each location, 10-20 individual readings (cpm) from a properly calibrated Ludlum 44-10/2221 instrument pairing will be recorded at two different detector heights: 10 inches and 3 feet above the exact same point on the ground surface. The average gamma reading (cpm) for each set of individual detector readings for each detector height at each location will be calculated and recorded.

2. Regression analysis will be performed on resulting values to determine the Site-wide statistical relationship between gamma readings at 10 inches versus 3 feet above the ground surface. The resulting statistical relationship, if apparent and statistically significant, will be used to normalize all raw gamma survey data from the original 2010 radiological baseline survey (RHR, 2011b) to approximately equivalent readings at a detector height of 3 feet above the ground surface.

*Instrument Cross-Calibration Measurements:*

1. At each location, 10-20 individual readings from a properly calibrated Ludlum 44-10/2221 instrument pairing (in units of cpm), along with 10-20 individual readings from a properly calibrated Thermo Scientific Micro-Rem meter (in units of µrem/hr) and/or a RadEye PRD (used in energy-compensated dose rate mode with units of µR/hr), will be recorded and averaged. Measurement geometry for collection of instrument cross-calibration data will be 3 feet above the ground surface.

2. Regression analyses will be performed on resulting paired values to determine statistical relationships between NaI detectors and Micro Rem and/or RadEye-PRD[12] instruments. The resulting cross-calibration equations will be used to convert 3-foot normalized original scan data (cpm) into energy-corrected units of dose rate (µrem/hr) and/or exposure rate (µR/hr).

*Gamma/Soil Radionuclide Correlation Study:*

1. At each location, a 100 $m^2$ plot for correlation measurements and soil sampling will be established with pin flags. A gamma scan will be performed across each correlation plot (100% scan coverage at a detector height of 3 feet). The average gamma reading (cpm) from scan data across each correlation plot will be calculated and recorded in the field logbook.

2. Within each correlation plot, 9 sub-samples of surface soils will be collected across the plot (to a depth of 15 cm) and composited into a single sample to represent average soil radionuclide characteristics across the plot. Composite surface soil samples from each correlation plot will be submitted to a qualified commercial laboratory for analysis of Ra-226, U-nat, Th-232 and K-40. The correlation plot scanning/sampling design for each location is illustrated in Figure 9.

[12] Adjustments must be made to all RadEye PRD measurements for cross-calibration purposes (*see* Footnote 5, Section 2.2.4 and Appendix A).

3. The laboratory chain of custody/analysis request form to be submitted with composite correlation plot soil samples will specify the following requirements:

    a. Thorough homogenization of each sample at the laboratory.

    b. Ra-226 analysis by EPA method 901.1 (modified for soil samples) with sample counting to be performed at least 21 days after sealing in the counting tin to ensure full ingrowth of Rn-222 and its decay products. Analysis of K-40 will also be conducted with EPA method 901.1, as will analysis of Ra-228 (to determine Th-232 concentrations under the assumption of radiological equilibrium).

    c. U-nat analysis by EPA Method 200.8 (ICP-MS) or equivalent, preferably with soil matrix digestion using EPA Method 3052 (microwave assisted acid digestion) or equivalent (EPA Method 3050B may alternatively be used, recognizing that digestion will not be as complete).

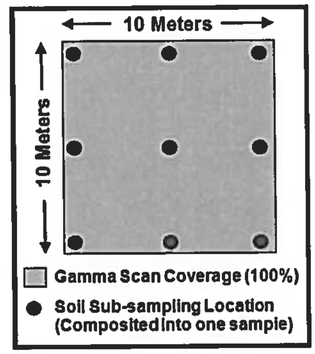



**Figure 9: Correlation plot soil sampling and gamma scanning design.**

4. Upon receiving soil analysis results from the laboratory, regression analysis will be performed to determine if a significant statistical correlation exists between average gamma readings and soil Ra-226, U-nat, Th-232 and K-40 concentrations based on paired data from all correlation plots.

Based on the results of the above supplemental baseline survey elements, modified gamma scan data resulting from 3-foot detector height normalizations and energy dependence corrections will represent additional final results for the baseline gamma survey. In addition, if any of the gamma/radionuclide correlations are statistically significant, existing gamma survey data from the 2010 radiological baseline survey will be converted into estimates of applicable radionuclides in the top 15 cm of the soil profile across the entire Site (after normalization of raw gamma scan data to a 3-foot detector height).

### *7.3 Updated Radiological Baseline Data Presentations*

In order to better understand the quantitative and spatial distributions of ambient gamma radiation across the Site, raw scan data from the 2010 baseline gamma survey (RHR, 2011b) were converted to estimates of approximate exposure rate using the linear equation from Figure 7, and the results were kriged (a geo-statistical interpolation procedure) using Spatial Analyst (an ArcGIS program) (Figure 10). The exposure rates shown in Figure 10 represent only approximate interim estimates for temporary use (e.g. for selecting supplemental radiological measurement/sampling locations) and are subject to change pending normalization of raw gamma scan data to a 3-foot detector measurement height and energy/unit-basis conversions based on supplemental instrument cross-calibration measurements (Section 7.2.2). Once these data adjustments are accomplished, the updated gamma survey data set will be considered finalized and ready for mapping on aerial imagery as shown in Figure 10. Final baseline maps of individual gamma point data as well as gamma krig data will be developed for inclusion in the supplemental report to be submitted to the MMD as an addendum to Section 13 of the 2011 Baseline Data Report (RHR, 2011b).

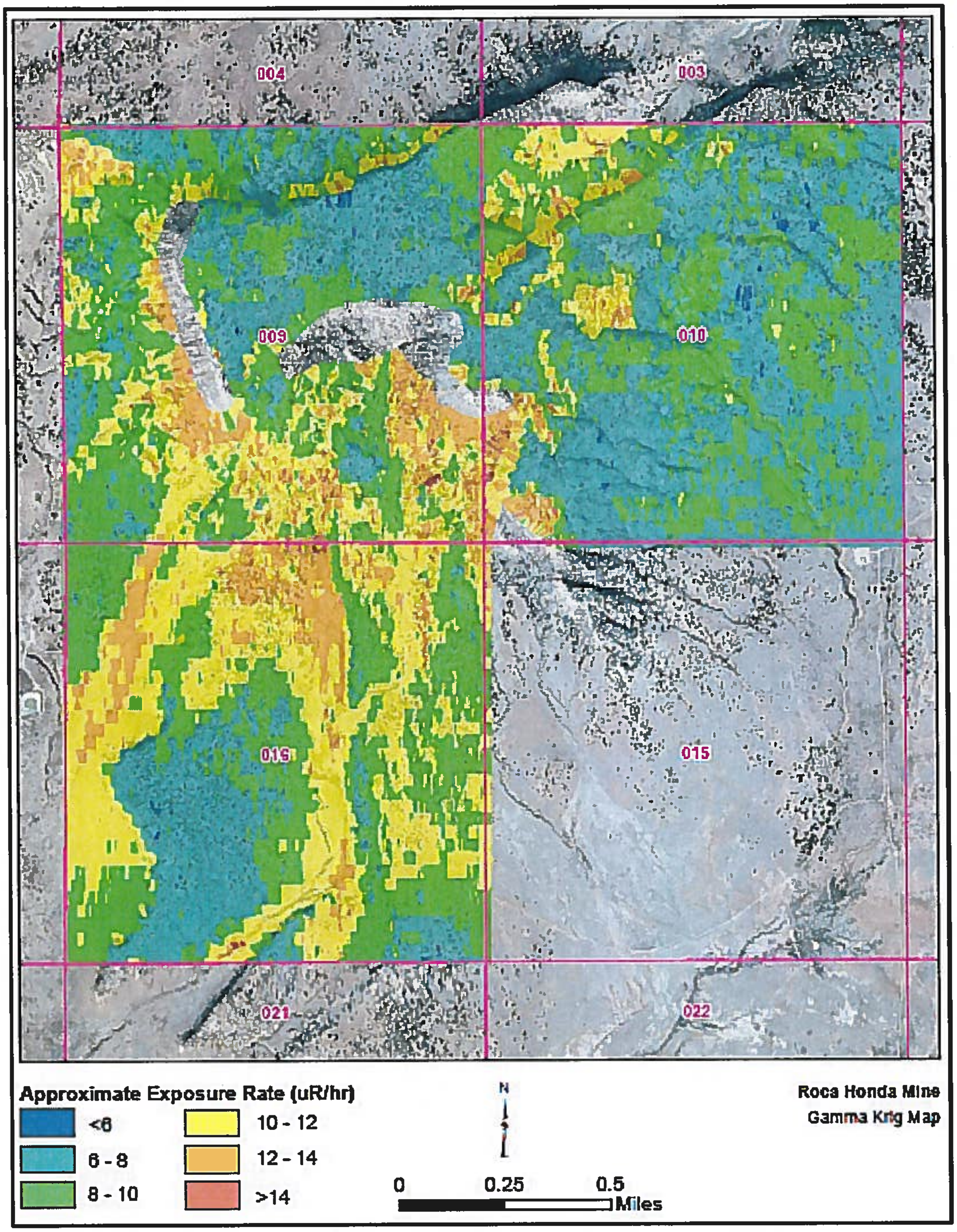



**Figure 10: Interim estimates of the spatial distribution of baseline gamma exposure rates across the permit area. A final baseline data set and respective version of this map requires normalization of raw gamma scan data to a 3-foot detector height and energy/unit-basis conversions based on formal instrument cross-calibration measurements (*see* Section 2.2.2).**

## 8.0 REFERENCES


Boice JD, Jr., Hendry JH, Nakamura N, Niwa O, Nakamura S, Yoshida K. 2010. Low-dose-rate epidemiology of high background radiation areas. Radiation Research, 173:849-854.

Hall EJ, Giaccia AJ. 2006. Radiobiology for the Radiobiologist. 6 ed. Philadelphia, PA: Lippincott Williams & Wilkins.

Johnson, J.A. Meyer, H.R., and Vidyasagar, M. 2006. Characterization of Surface Soils at a Former Uranium Mill. Operational Radiation Safety. Supplement to Health Physics, Vol. 90, February, 2006.

International Commission on Radiological Protection (ICRP). 1990. Recommendations of the International Commission on Radiological Protection, ICRP Publication 60. Annals of the ICRP ICRP, Pergamon Press, Oxford.

Meyer, R.; Shields, M.; Green, S. 2005a. A GPS-based system for preliminary or remedial action gamma scanning. American Nuclear Society Topical Meeting on Decommissioning, Decontamination, & Reutilization. Denver, Colorado, August 7-11, 2005.

Meyer, R.; Shields, M.; Green, S.; Johnson, J. 2005b. A GPS-based system for radium/uranium contamination gamma scanning. Uranium Mining and Hydrogeology IV. Broder J. Merkel, Andrea Hasche-Berger (Editors). Uranium in the Environment, conference proceedings, Freiberg, September 2005.

New Mexico Mining and Minerals Division (MMD). 2012. Agency Comments, Roca Honda Mine Reclamation Plan – Revision 1, and Biological Survey of the Reuse Pipeline Route, Permit Application No. MK025RN. October 4, 2012.

Roca Honda Resources, LLC (RHR). 2011a. Reclamation Plan for Roca Honda Mine, Revision 1, August, 2011, as further revised, May 2012.

Roca Honda Resources, LLC (RHR). 2011b. Baseline Data Report, Section 13.0, Radiological Survey. January, 2011.

U.S. Nuclear Regulatory Commission (NRC). 2000. Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Revision 1. NUREG 1575. Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2003. Standard Review Plan for In Situ Leach Uranium Extraction License Applications. NUREG-1569. Final Report. U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards. Washington, D.C.

Whicker, F.W.; Hinton, T.G.; MacDonell, M.M.; Pinder III, J.E.; Habegger, L.J.. 2004. Avoiding Destructive Remediation at DOE Sites. Science, Volume 303. March 12, 2004.

Whicker, R.; Cartier, P.; Cain, J.; Milmine, K.; Griffin, M. 2008. Radiological Site Characterizations: Gamma Surveys, Gamma/Ra-226 Correlations and Related Spatial Analysis Techniques. Operational Radiation Safety, Health Physics, Vol. 95 (Supplement 5): S180-S189; November, 2008.

Whicker, R.; Whicker, M.; Johnson, J.; and Meyer, H. 2006. Mobile Soils Lab: On-site Radiological Analysis Supporting Remedial Activities. Health Physics. Operational Radiation Safety. 91(2) Supplement 1:S24-S31, August.

## APPENDIX A: RadEye PRD Measurement Adjustments for Instrument Cross-Calibrations

The RadEye PRD instrument is a specialized NaI detector from Thermo Scientific that includes multi-channel energy discrimination for low-energy terrestrial radiation and respective algorithms to provide respective energy compensated response characteristics when used in "dose rate mode". The manufacturer's "dose rate" terminology as applied to this NaI detector is based on a commonly used rule-of-thumb that dose rate to tissue is approximately equivalent to exposure rate in air (the detector actually reads out in units of µR/hr which are generally used in reference to the gamma exposure rate in air, though this radiological unit is technically defined in terms of an absorbed dose rate to air). In addition to general low-energy dependence compensation, the RadEye PRD includes an energy discrimination algorithm to ignore the contribution of high-energy photons (> about 1.3 MeV) to the background gamma radiation field in order to measure only the exposure rate attributable to low-energy terrestrial sources of gamma radiation. As a result, two adjustments must be made to all RadEye measurement values that will be used for instrument cross calibration purposes.

When the RadEye PRD instrument is first turned on in dose rate mode, it will go through a "learning" procedure that takes about 20-30 seconds to complete. During this start-up procedure, the instrument will calculate the exposure rate attributable to interactions in the NaI crystal from ambient background photons with energies greater than about 1.3 mega-electron volts (MeV). This high-energy component of the background radiation field is ignored for all subsequent measurements while low-energy dependence compensation algorithms are applied to the remaining gamma energy spectra to measure the "true" exposure rate associated only with lower-energy photons from terrestrial sources. Essentially, this procedure "strips out" instrument response due to high-energy cosmic sources of background radiation, as well as that due to high-energy terrestrial radiation from K-40 (which emits a 1.46 MeV photon). To correct for this background "stripping" of the portion of the total gamma field attributable to cosmic and K-40 photons, the following calculations and adjustments must be made when RadEye measurement data are to be used for instrument cross-calibration purposes:

ADJUSTMENT FOR COSMIC RADIATION:

1. Elevations at Site range from about 7,135 to 7,800 feet. The estimated approximate average elevation of the site is about 7,400 feet (2,255 meters).

2. Based on the average elevation (2,255 meters) as estimated above, the approximate average exposure rate from cosmic sources at the Site is calculated to be 6.9 µR/hr, using the following relationship as provided in Stone et al. (1999):

$$D_c = \left(7\times10^{-6}(E)^2 - 1.2\times10^{-3}(E) + 27.38\right)0.114$$

<u>Where</u>:
$D_c$ = Cosmic component of total exposure rate (µR/hr)
E = Average elevation in meters (from Step 1 above)

0.114 = Unit conversion factor from nGy/hr to μR/hr

3. For each average RadEye PRD reading obtained at each cross-calibration measurement location, add 6.9 μR/hr as calculated in Step 2 above to account for the cosmic component of the total exposure rate (note: the cosmic component of exposure rates at the Site will vary only slightly due to differences in elevation, e.g. ranging from about 6.6 to 7.3 μR/hr).

ADJUSTMENT FOR TERRESTRIAL GAMMA RADIATION FROM K-40:

1. For each cross-calibration measurement location at the site, determine the corresponding local concentration of K-40 in surface soil based on the composite surface soil sample collected across the corresponding gamma/soil radionuclide correlation plot (in pCi/g) (see Section 2.5).
2. Multiply the result in Step 1 above by 0.184 (μR/hr)/(pCi/g) (a conversion factor for an infinite plane as indicated in NCRP, 1987) to determine approximate average exposure rate due to K-40 in surface soil at each cross-calibration measurement location.
3. For each average RadEye PRD reading obtained at each cross-calibration measurement location, add the corresponding terrestrial exposure rate value for K-40 as calculated in Step 2 above.

Once the contributions of cosmic sources and terrestrial K-40 sources to the total "true" exposure rate at each cross-calibration location have been added to the average RadEye PRD reading at each location, perform a linear regression of average NaI detector reading (x axis) versus average "adjusted" RadEye PRD reading (y axis). The resulting linear regression equation will be used to convert all raw NaI-based gamma survey data into estimates of "true" exposure rate.

REFERENCES:

Stone, J.M.; Whicker, R.D. Ibrahim, S.A.; Whicker, F.W. 1999. Spatial Variations in Natural Background Radiation: Absorbed Dose Rates in Air in Colorado. Health Physics, Vol. 9(5), May, 1999.

NCRP (National Council on Radiation Protection and Measurements). 1987. Exposure of the Population in the United States and Canada from Natural Background Radiation. NCRP Report No. 94. NCRP, 7910 Woodmont Avenue, Bethesda, MD 20814.

# Appendix F Weed Control Plan

**Noxious Weed Control Plan for the Roca Honda Mine Project Area**

## Introduction and Current Condition

Certain invasive, non-native plant species are classed as "noxious weeds" by the State of New Mexico. Only species classified as such will be managed at the project site. The New Mexico State Noxious Weed List was revised in April 2009. Because of the dynamic nature of biological systems, the plant species recognized as noxious and management guidelines for noxious weeds may change in the future (Wanstall 2008). For example, field bindweed *(Convolvulus arvense)* observed at the project site in 2008 was listed as a Class C weed in 1999, but not in 2009. In contrast, cheatgrass *(Bromus tectorum)*, which was also observed at the project site in 2008, was not listed in 1999, but was listed as a Class C weed in 2009 (Dubois 1999, Gonzalez 2009).

Ongoing, continual observations for noxious weeds will be carried out by site personnel, and known identified noxious weed species will be treated during the appropriate season to minimize the potential of spread. In addition, on a Bi-Annual basis, a more structured pedestrian survey for noxious weeds will be carried out at the project site so that any infestations can be identified and controlled in a timely manner.

The only noxious weeds observed in 2008 were saltcedar (*Tamarix* species) and cheatgrass (*Bromus tectorum*). These non-native species are both considered to be a Class C noxious weed by the state of New Mexico (Gonzalez 2009). Class C weeds are "species that are widespread in the state. Management decisions for these species should be determined at the local level based on feasibility to control and level of infestation" (Gonzalez 2009). Saltcedar trees are a persistent, high moisture obligate species, and were observed in the central area of Section 16 at the stock pond and infrequently along the arroyo that leads from this area to San Mateo Creek. This species can be difficult to control if left unmanaged.

Cheatgrass is an annual grass that can invade and dominate grassland areas if unmanaged. It is not only a poor forage species for livestock and wildlife, once is passes the green phase, it becomes dry and brittle and can pose a significant wildfire threat if established in high numbers. Currently it appears to exist in sparse occurrence, with less than five (5) cheatgrass plants were observed in the area beside a rock water pocket in a canyon Section 10.

In 2006, two additional species of noxious weeds were observed; Canada thistle (*Cirsium arvense*) and musk thistle (*Carduus nutans*). Both of these species were observed in drainage areas in Section 16.

Canada thistle is considered a Class A noxious weed while Musk thistle is considered a Class B noxious weed by the state of New Mexico (Gonzalez 2009). Class A weeds are "species that currently are not present in New Mexico or have limited distribution; preventing new infestations of these species and eradicating existing infestations is the highest priority" and Class B weeds are "species that are limited to portions of the state. In areas that are not infested, these species should be treated as Class A weeds. In areas with severe infestations, management plans should be designed to contain the infestation and stop any further spread" (Gonzalez 2009).

## Noxious Weed Control

The techniques used to manage noxious weeds must consider the species, its location, and distance from native species that may be susceptible to eradication treatments. More selective and fewer types of chemical treatments are appropriate for weeds near standing water or in arroyos. Low-disturbance mechanical treatments may be the best alternative in these situations. There are many different herbicides that achieve good levels of control and eventual elimination of most noxious weed species. Biological control methods have also been developed for certain noxious weed species. Generally all control methods must be repeated annually for 4 to 5 years.

There are a few potential control methods for species currently identified on the site:

a. Since saltcedar trees were few at the site, they could easily be eliminated. One effective way to control saltcedar in this situation is to employ a procedure known as the cut-stump herbicide or cut-stump/frill herbicide methods (e.g. Neill 1990, Hughes 1996). This procedure involves physically cutting the above ground stems as close to the ground surface as possible and then immediately painting the cut stems with an appropriate herbicide (e. g., Triclopyr (Garlon 4 or Remedy).

b. Cheat grass is not common at the site. In 2008 the only places where it was found was adjacent to the water pocket in Section 10. If population density remains at current levels, hand-pulling cheatgrass before it sets seed at the pool sites could be accomplished on an annual basis for the duration of the project. Should plant number increase enough to make t his impracticable, herbicides such as Roundup (glyphosate), Journey (imazapic plus glyphosate), or Plateau (imazapic) provide management options for cheatgrass infestations. Application when in proximity to open water or ephemeral watercourses would be with wick or other physical application method, and not spray application. This would likely control the growth at the water pocket and also stop the species progressing down the arroyos.

c. The thistles can be managed with herbicide application. No details were given as to the size of the infestations in 2006 except that they were relatively small. Therefore possible herbicide application might be Stinger (clopyralid), for example at ~2 teaspoons/gal/1000 square foot, or Confront (triclopyr + clopyralid) for example at ~4.5 teaspoons/gal/1000 square foot. Both herbicides should be applied in the spring, or possibly in the fall, when the plants are at the rosette stage.

**References**

DuBois, FA. 1999. Memorandum - New Mexico Noxious Weed List available online at: http://www.nmda.nmsu.edu/animal-and-plant-protection/noxious-weeds/noxious20weed_memo_list.pdf [accessed February 23, 2009] in Noxious Weed Information for New Mexico available online at: http://www.nmda.nmsu.edu/animal-and-plant-protection/noxious-weeds [accessed February 23, 2009]

Gonzalez, I. Miley. 2009. Memorandum to General Public, subject: New Mexico Noxious Weed List. Update April 2009 Available online: http://www.emnrd.state.nm.us/FD/documents/weedlist2009_final.pdf

Hughes, D. 1996. Restoring native riparian vegetation. In: Desired future conditions for South western riparian ecosystems: Bringing interests and concerns together. General Technical Report RMGTR- 272. U.S. Department of Agriculture, Forest Service, Fort Collins, CO.

Neill, W.M. 1990. Control of Tamarisk by cut-stump herbicide treatment. In: Tamarisk control in Southwestern United States. Special Report 9. Cooperative National Park Resources Studies Unit. p. 91-98.

Peck, Clint. 2010. Beating The Cheater Offers Ways to Control Cheatgrass in Grazing Pastures and On Range. Article in Beef Magazine, available online at: http://beefmagazine.com/pasture-range/control-cheatgrass-in-grazing-pastures-0301

Wanstall, J. 2008. Memorandum: State Noxious Weed List Updating Procedure. Available online at: http://www.nmda.nmsu.edu/animal-and-plant-protection/noxious-weeds/State%20Noxious%20Weed%20List%20Update.html [accessed February 23, 2009]

# Appendix G Proposed Reference Area at the Roca Honda Project Site

# Proposed Reference Area at the Roca Honda Project Site

## Introduction

As presented in Section 4, Appendix 4-C of the BDR (RHR, 2020), transect lines were surveyed for canopy cover throughout the proposed project site. These lines were located to support the preparation of a vegetation map. The lines were placed in the various vegetation types encountered within the project area.

Eighty one (81) transects were surveyed throughout the permit area to characterize the vegetation types (see Figure 3 in Appendix 4-C). Five vegetation types were identified in the permit area (see Figure 5 in Appendix 4-C). Three vegetation types dominate Section 16, juniper savanna, shrub-grassland, and pinon juniper woodland. The juniper savanna and shrub-grassland vegetation types were similar with respect to total cover characteristics: (i) total vegetation cover (grass, forb, shrub and microbiotic cover; tree canopy excluded), (ii) the sum of bare ground, gravel and rock cover, and (iii) litter cover. The pinon juniper woodland areas have steeper slopes and valleys which are not conducive for grazing. Revegetation efforts will focus on restoring a generalized matrix of native grasses, forbs and shrubs on the landscape rather than specifically attempting to recreate both the juniper savanna and shrub-grassland now present. Therefore, combining these two vegetation types is appropriate since species composition and vegetative structure were similar.

A total of 35 of the 81 transects in these two vegetation types were distributed across Sections 9, 10, 11 and 16. Fifteen (15) transect lines are in areas where no mining disturbance is planned. The remaining 20 transect lines will most likely be disturbed by mining activity. Eight (8) of the 15 lines that are anticipated to remain undisturbed by future mining activity are located in Section 16. A revegetation reference area, which includes the 8 transect lines that will be undisturbed by mining activity is proposed in Section 16 (see Figure 3-3 in this Reclamation Plan, Revision 2).

## Methodology

As discussed in the BDR, data collection for vegetation cover estimates was conducted in June, July and September 2008. Vegetation cover was measured using the point intercept method along a 50 m (164 ft) long transect line. The cover that intercepted the line at 1m intervals along the 50 m (164 ft) transect line was measured using an optical device. Using this method, the different classes of cover were calculated as the percentage of interceptions ("hits"), relative to the total number of points sampled. During the survey, bare ground was defined as soil alone. Gravel and coarse sand were combined and classified as particles up to 7.6 cm (3 inches). Rocks are particles greater than 7.6 cm (3 inches). Litter was dead plant material directly covering the ground, dead perennial vegetative bases, or animal scat, including cow dung. If a small stem or piece of litter was not considered large enough to intercept a raindrop, the "hit" was the ground covering, or lack of covering, below it. Dead annual forbs were considered as litter cover when unattached to the roots and potentially windblown. A dead annual forb that was attached to its root and recognizable to species was recorded as that species.

Species were recorded when the sampling point fell on any part of the vegetation. When the canopy of multiple species overlapped, canopy overhung bare ground, litter, or gravel/coarse sand, all the cover-types were recorded. However, to estimate cover, only the uppermost layer was analyzed so that total cover added up to 100%. Basal cover was not measured.

Transect line percent-cover results were reported as the average (arithmetic mean). The variance and standard deviation of the mean was computed using a computer statistics package Statgraphics® Plus. Median values for each class of cover were also calculated. The Statgraphics® Plus software statistics package was also used to measure standard kurtosis, skewness and confidence intervals to make sure the samples came from a normal population before comparing the values using the T-test.

**Analysis of ground cover data that supports the use of a reference site in Section 16**

Total vegetation canopy and microbiotic cover, total bare ground plus gravel plus rock, and litter cover were compared between the transect lines in areas anticipated to be disturbed by mining and those areas that are not.

Table 1 describes the summary statistics for the two samples of total vegetation cover, inorganic ground cover and litter cover. Standardized skewness and standardized kurtosis can be used to determine whether the samples come from normal distributions. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate the statistical tests that compare the standard deviations. In this case, both standardized skewness values and both standardized kurtosis values for all samples are within the range expected if the samples came from a normal distribution. Therefore, confidence levels can be constructed for each sample mean and the T-test can be used to compare sample means between the cover values.

Confidence intervals were constructed for each mean and the difference between the means (see Table 2 below). A T-test was also run to determine the likelihood that the means of both samples were not statistically different from each other. No differences between the standard deviations of the two samples were detected so that all tests can assume equal variances.

The confidence interval for the difference between the means of total vegetation cover extends from -13.7 to 11.5. Since the interval contains the value 0.0, there is not a statistically significant difference between the means of the two samples at the 95.0% confidence level. The T-tests also support this conclusion; $t = -0.18$ and P-value = 0.86. P values below 0.05 would have indicated significant differences between the two means. An F-test was used to compare the variances of the two samples and indicated that there is not a statistically significant difference between the standard deviations of the two samples at the 95.0% confidence level. Median values for each population were also compared using the Mann-Whitney (Wilcoxon) W test. This test is constructed by combining the two samples, sorting the data from smallest to largest, and comparing the average ranks of the two samples in the combined data. There is not a statistically significant difference between the medians at the 95.0% confidence level.

*Table 1: Summary Statistics for total vegetation (vascular plant canopy and microbiotic) cover, total inorganic (bare ground, gravels and rock) cover and litter.*

| Value | Areas not to be disturbed | Areas within or near the disturbance zones |
|---|---|---|
| Number of transect lines | 8 | 20 |
| | | |
| Average - total vegetation cover | 43.5 | 44.6 |
| Variance - total vegetation cover | 280.9 | 188.7 |
| Standard deviation - total vegetation cover | 16.8 | 13.7 |
| Minimum - total vegetation cover | 16.0 | 22.0 |
| Maximum - total vegetation cover | 62.0 | 74.0 |
| Stnd. Skewness - total vegetation cover | -0.74 | 0.89 |
| Stnd. Kurtosis - total vegetation cover | -0.51 | -0.28 |
| Median - total vegetation cover | 47 | 43 |
| | | |
| Average - total inorganic cover | 27.3 | 24.7 |
| Variance - total inorganic cover | 98.2 | 118.4 |
| Standard deviation - total inorganic cover | 9.9 | 10.9 |
| Minimum - total inorganic cover | 8.0 | 2.0 |
| Maximum - total inorganic cover | 38.0 | 46.0 |
| Stnd. Skewness - total inorganic cover | -1.109 | -0.228 |
| Stnd. Kurtosis - total inorganic cover | 0.605 | -0.101 |
| Median - total inorganic cover | 28 | 25 |
| | | |
| Average - litter cover | 29.3 | 30.7 |
| Variance - litter cover | 146.2 | 107.484 |
| Standard deviation - litter cover | 12.1 | 10.4 |
| Minimum - litter cover | 18.0 | 8.0 |
| Maximum- litter cover | 52.0 | 46.0 |
| Stnd. Skewness - litter cover | 1.114 | -0.535 |
| Stnd. Kurtosis- litter cover | 0.076 | -0.514 |
| Median - litter cover | 25.0 | 32 |

Mining Act Reclamation Bureau 1996. CLOSEOUT PLAN GUIDELINES FOR EXISTING MINES. April 30, 1996. Mining and Minerals Division, New Mexico Energy, Minerals and Natural Resources Department, 2040 S. Pacheco St., Santa Fe, New Mexico Available online at: http://www.emnrd.state.nm.us/MMD/MARP/Documents/MARP_Closeout_Plan_Guidelines_Main_Text.pdf

T*able 2: Confidence intervals for each mean and the difference between the means.*

| Value | 95.0% confidence interval |
|---|---|

| | |
|---|---|
| mean of total vegetation cover along undisturbed Transects | 43.5 +/- 14.0 |
| mean of total vegetation cover along potentially disturbed transects | 44.6 +/- 6.4 |
| difference between the means of total vegetation cover assuming equal variances | -1.1 +/- 12.6 |
| | |
| mean of inorganic cover along potentially undisturbed lines | 27.3 +/- 8.3 |
| mean of inorganic cover along potentially disturbed lines | 24.7 +/- 5.1 |
| difference between the means of inorganic cover samples with equal variances | 2.6 +/- 9.1 |
| | |
| mean of litter cover along potentially undisturbed lines | 29.3 +/- 10.1 |
| mean of litter cover along potentially disturbed lines | 30.7 +/- 4.9 |
| difference between the means of litter cover samples with equal variances | -1.5 +/- 9.3 |

The confidence interval for the difference between the means of inorganic cover (bare ground, gravels and rock) extends from -6.6 to 11.7 (Table 2). Since the interval contains the value 0.0, there is not a statistically significant difference between the means of the two samples at the 95.0% confidence level. The T-tests ($t = 0.57$; P-value = 0.57) also arrived at the same conclusion. P-values below 0.05 indicate significant differences between the two means. An F-test was used to compare the variances of the two samples and indicated that there is not a statistically significant difference between the standard deviations of the two samples at the 95.0% confidence level. Median values for each population were also compared using the Mann-Whitney (Wilcoxon) W test. There was no statistically significant between the median values of the two samples (Table 1) at the 95.0% confidence level.

The confidence interval for the difference between the means of litter cover extends from -10.79 to 7.89. Since the interval contains the value 0.0, there is not a statistically significant difference between the means of the two samples at the 95.0% confidence level. The T-tests also arrived at the same conclusion; $t = -0.32$, P-value = 0.75. P-values below 0.05 indicate significant differences between the two means. An F-test to compare the variances of the two samples was run and the results were consistent with the confidence intervals constructed for each standard deviation and for the ratio of the variances, which indicated that there is not a statistically significant difference between the standard deviations of the two samples at the 95.0% confidence level. Median values for each population were also compared using the Mann-Whitney (Wilcoxon) W test. There was no statistically significant difference between the median values of the two samples (Table 1) at the 95.0% confidence level.
Adequate sampling entails making sufficient measurements of a given parameter in order to obtain a mean value that is within 10 percent of the populations' true mean value with a 90 percent statistical confidence level.

$$nmin = \frac{T^2 S^2}{(dx)^2}$$

(Equation 1)

Where:

*nmin* = the minimum number of sample points needed in a given vegetation type
S= the sample deviation
t = the two-tailed t statistic at the appropriate number of degrees of freedom
d = the acceptable amount of inherent variability to be identified between the sample mean and the true population mean = 0.1
x = the sample mean.

Using Equation 1 and the results from all (35) transect lines within the project site, the minimum number (*nmin*) of transect lines required to obtain a mean value that is within 10 percent of the populations' true mean value with a 90 percent statistical confidence level for total vegetation cover is 27, for litter *nmin* is 36, and for total inorganic cover (bare ground, gravel and rock) *nmin* is 48. The higher numbers required for litter and inorganic ground cover reflect the higher variability and the fact that some values fell outside the 30 to 70% threshold that is cited to indicate that data transformation is necessary (Hofmann and Ries 1990, Li 1964, Steel and Torrie 1980, Snedecor 1956). When the data was transformed by taking the square root of the value plus one, *nmin* was recalculated to be 14 for inorganic cover and 10 for litter cover.

**Conclusion**

An area of 137 acres containing 8 transects in Section 16 has been identified as a reference area to be utilized to determine revegetation/reclamation success. Although this area contains some pinon-juniper, re-planting of trees will not be done due to the low probability of success. In addition, the invasion of junipers, particularly in the absence of fire can lead to reduced rangeland quality. Therefore, portions of the reference area transects will not be sampled during the reclamation performance surveys, i.e., the mature pinion juniper woodland, the rock barrens, gullies and breached stock pond dikes. The seed mix provided in Table 3-3 of the Plan includes a diversity of native grasses and shrubs that can be easily established to prevent erosion, meet groundcover diversity and density objectives in Section 3.7 of the Plan, and provide forage for livestock and value for wildlife as recommended in the habitat guidelines published by the NMDGF (2004).

# Appendix H Preliminary Reclamation Cost Estimate

**ROCA HONDA RESOURCES, LLC**
**ROCA HONDA UNDERGROUND URANIUM MINE PROJECT**
**APPENDIX H - PRELIMINARY RECLAMATION COST SUMMARY**
**Section 9**
Date: September 2, 2025

| Item | Updated Cost |
|---|---|
| Mob/Demob | $7,500 |
| Well/Drill Hole Pads & Mud Pits | $35,000 |
| Well/Drill Hole Access Roads | $2,418 |
| Dewatering Wells decommissioned and plugged (1) | $15,000 |
| Dewatering Wells pipelines | $5,000 |
| Vent Closures | $60,000 |
| Haul Roads (+culverts) | $25,000 |
| Arroyo Diversions & Armorment | $10,000 |
| Access Roads | $25,000 |
| Revegetation | $20,000 |
| Fence Revegetated Area | $10,000 |
| **TOTAL** | **$214,918** |

**ROCA HONDA RESOURCES, LLC**
**ROCA HONDA UNDERGROUND URANIUM MINE PROJECT**
**APPENDIX H - PRELIMINARY RECLAMATION COST SUMMARY**
**Section 10**
Date: September 2, 2025

| Item | Updated Cost |
|---|---|
| Mob/Demob | $15,000 |
| Well/Drill Hole Pads & Mud Pits | $25,296 |
| Well/Drill Hole Access Roads | $2,418 |
| Dewatering Wells decommissioned and plugged (7) | $95,500 |
| Dewatering Wells pipelines | $18,000 |
| Vent Closures | $89,137 |
| Haul Roads (+culverts) | $100,000 |
| Arroyo Diversions & Armorment | $25,000 |
| Access Roads | $54,312 |
| Revegetation | $45,000 |
| Fence Revegetated Area | $22,500 |
| **TOTAL** | **$492,163** |

**ROCA HONDA RESOURCES, LLC**
**ROCA HONDA UNDERGROUND URANIUM MINE PROJECT**
**APPENDIX H - PRELIMINARY RECLAMATION COST SUMMARY**
**Section 16**
Date: September 2, 2025

| Project Area / Facility | Cost |
|---|---|
| Mobilization / Demobilization | $30,021.65 |
| Well/Drill Hole Pads & Mud Pits (11) | $157,469.05 |
| Well/Drill Hole Access Roads | $20,180.14 |
| Section 16 non-ore material stockpile area | $101,212.14 |
| Section 16 Shaft Excavation Material stockpile | $840,731.00 |
| Removal of equipment from underground | $0.00 |
| Ore Pad/Bays | $36,165.23 |
| Explosives Magazine | $9,944.94 |
| Dewatering Wells decommissioned and plugged (5) | $299,609.97 |
| Dewatering wells pipelines | $67,257.97 |
| Headframe & Facility Demolition | $72,097.60 |
| Shaft/Vent Closure | $70,118.81 |
| Truck Wash/Wash Pad | $0.00 |
| Admin - Office / Dry | $0.00 |
| Hoist House | $81,115.11 |
| Scale/Assay House | $0.00 |
| Employee Parking Lot | $27,242.18 |
| Fencing Removal | $102,313.65 |
| Electric Substation | $61,177.64 |
| Emergency Generator | $10,985.91 |
| Maintenance Shop | $0.00 |
| Storage and Laydown Yard | $14,009.66 |
| Haul Roads (+ culverts) | $215,479.70 |
| Wastewater Treatment Plant | $0.00 |
| Water Tank | $13,201.69 |
| Fuel Depot | $30,521.29 |
| Evaporation ponds | $0.00 |
| Evap Ponds sludge disposal | $0.00 |
| Detention Ponds | $122,682.03 |
| Arroyo Diversions & Armorment | $51,148.74 |
| Subbase rock stockpile | $182,681.09 |
| East Subsoil stockpile | $30,383.88 |
| Topdressing stockpiles | $285,189.21 |
| Water Treatment Facility | $15,000.00 |
| Access Roads | $36,285.07 |
| Revegetation | $217,005.90 |
| Fence Revegetated Area | $60,427.07 |
| **TOTAL:** | **$3,261,658.29** |

**Note:**
Costs developed for bringing all equipment up through Section 17 Shaft / none for Section 16 Shaft

**ROCA HONDA RESOURCES, LLC**
**ROCA HONDA UNDERGROUND URANIUM MINE PROJECT**
**APPENDIX H - PRELIMINARY RECLAMATION COST SUMMARY**
**Section 17**
Date: September 2, 2025

| Project Area / Facility | Cost |
|---|---|
| Mobilization / Demobilization | $30,021.65 |
| Well/Drill Hole Pads & Mud Pits (11) | $157,469.05 |
| Well/Drill Hole Access Roads | $22,333.81 |
| Section 17 non-ore material stockpile area | $101,212.14 |
| Section 17 Shaft Excavation Material stockpile | $402,161.97 |
| Removal of equipment from underground | $288,866.14 |
| Ore Pad/Bays | $45,958.75 |
| Explosives Magazine | $9,944.94 |
| Dewatering Wells decommissioned and plugged (5) | $136,392.82 |
| Dewatering wells pipelines | $36,168.61 |
| Headframe & Facility Demolition | $72,097.60 |
| Shaft/Vent Closure | $70,118.81 |
| Truck Wash/Wash Pad | $37,020.83 |
| Admin - Office / Dry | $116,682.43 |
| Hoist House | $81,115.11 |
| Scale/Assay House | $48,180.04 |
| Employee Parking Lot | $27,242.18 |
| Fencing Removal | $102,313.65 |
| Electric Substation | $61,177.64 |
| Emergency Generator | $10,985.91 |
| Maintenance Shop | $164,140.74 |
| Storage and Laydown Yard | $12,434.66 |
| Haul Roads (+ culverts) | $318,536.98 |
| Wastewater Treatment Plant | $32,236.78 |
| Water Tank | $13,201.69 |
| Fuel Depot | $30,521.29 |
| Evaporation ponds | $94,567.38 |
| Evap Ponds sludge disposal | $36,380.05 |
| Detention Ponds | $94,488.58 |
| Arroyo Diversions & Armorment | $108,672.06 |
| Subbase rock stockpile | $94,628.19 |
| East Subsoil stockpile | $30,383.88 |
| Topdressing stockpiles | $388,171.68 |
| Water Treatment Facility | $305,758.91 |
| Access Roads | $36,285.07 |
| Revegetation | $379,223.39 |
| Fence Revegetated Area | $88,901.36 |
| **TOTAL:** | **$4,085,996.75** |

**Note:**
Costs developed for bringing all equipment up through Section 17 Shaft / none for Section 16 Shaft