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# Eagle Mesa Mine Mining and Reclamation Plan



**Prepared for:**

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## Abbreviations and Acronyms

BLM	Bureau of Land Management
BMP	best management practice
Clearance Area	Eagle Mesa Mine Clearance Area
Contract Area	Eagle Mesa Mine Contract Area
dba	hourly A-weighted sound level in decibels
DOT	Department of Transportation
Ecosphere	Ecosphere Environmental Services
EMNRD	Energy, Minerals, and Natural Resources Department
°F	degrees Fahrenheit
FFO	Farmington Field Office
FA	financial assurance
MBTA	Migratory Bird Treaty Act
Mine	Eagle Mesa Mine
Mining Permit	Minimal Impact Mining Operation Permit
MMD	Mining and Minerals Division
MMSC	Mineral Materials Sales Contract
NAAQS	National Ambient Air Quality Standard
NM	New Mexico
NMCRIS	New Mexico Cultural Resource Information System
NMPM	New Mexico Principal Meridian
NMOSE	New Mexico Office of the State Engineer
NRHP	National Register of Historic Places
Plan	Mining and Reclamation Plan
PM	Particulate Matter
RMP	Resource Management Plan
Rammsco	Rammsco Operations, Inc.
ROW	right-of-way
RPFO	Rio Puerco Field Office
Staging area	Staging/Loading area
SWPPP	Stormwater Pollution Prevention Plan
TCP	Traditional Cultural Property
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	U.S. Geological Survey
WATERS	Water Administration and Technical Engineering Resource System
Woods Canyon	Woods Canyon Archaeological Consultants



# Eagle Mesa Mine Mining and Reclamation Plan

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## 1. MINING PLAN

### 1.1 General Information

Rammsco Operations, Inc. (Rammsco) has contracted Ecosphere Environmental Services (Ecosphere) to prepare an update to their existing Mining and Reclamation Plan (Plan) for the Eagle Mesa Mine (Mine), a minimal impact surface mine. In accordance with the Bureau of Land Management (BLM) Rio Puerco Field Office (RPFO) Resource Management Plan (RMP) (USDI/BLM 1986), this Plan was prepared to evaluate the current state of reclamation at the Mine, to provide an ongoing plan for mining and reclamation, and to provide an interdisciplinary review of the environmental impacts of an application request for additional active mining operations acreage.

Rammsco mines two materials at the Mine—humate and “organic clay.” Humate is an organic material rich with humic acids, occurring as a deposit within carbonaceous shale or claystone. It is used for various purposes, most notably as a soil amendment and livestock feed supplement. A brown, “organic clay” soil layer associated with the humate deposit in this formation is also being mined as part of mining operations. The “organic clay” contains fulvic acids and is also used as a soil amendment and livestock feed supplement. The existing Mine has been in operation since 1997 (16 years).

#### 1.1.1 Permittee

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#### 1.1.2 Administration, Contracts, and Permits

The entire Clearance Area is located on BLM lands. The BLM/RPFO administers the surface and mineral estate across the entire Clearance Area and Contract Area.

Rammsco’s initial Mineral Materials Sales Contract (MMSC) for mining the humate and “organic clay” was registered with the BLM/Farmington Field Office (FFO) as Contract #NMNM128614. The MMSC was renewed in 2014 under the same contract number (NMNM128614, dated April 1, 2014). As of the date of this Plan, the BLM/RPFO is currently working with Rammsco to renew the contract. The new MMSC Contract Number is #                      (to be filled in by BLM/RPFO).

Rammsco also holds an existing Minimal Impact Mining Operation Permit (Mining Permit) with the New Mexico Energy, Minerals, and Natural Resources Department (EMNRD) Mining and Minerals Division (MMD), Permit Number SA009MN Eagle Mesa Mine – Minimal Impact New Mine - Modification 16-1.

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## 1.1.3 Location

The Mine is located approximately 5.5 miles west of Johnson Trading Post, 7.5 miles north of Torreon, 6 miles southeast of Ojo Encino, and 19 miles west-southwest of Cuba, New Mexico (Map A-1, Appendix A).

### 1.1.3.1 Clearance Area

As shown on Map A-2 in Appendix A, the Eagle Mesa Mine Clearance Area (Clearance Area) covers approximately 495 acres in Sections 8 and 9 of Township 19 North, Range 4 West, New Mexico Principal Meridian (NMPM) in Sandoval County, NM. The legal description for the Clearance Area is as follows:

**Table 1-1. Clearance Area Legal Description**

Section 8	Acres
Southeast ¼ Section	160.0
Southeast ¼ of Southwest ¼ Section	40.0
South ½ of Southwest ¼ of Southwest ¼ Section	20.0
Southeast ¼ of Northeast ¼ of Southwest ¼ Section	10.0
Southeast ¼ of Southwest ¼ of Northeast ¼ of Southwest ¼ Section	2.5
Southeast ¼ of Northeast ¼ of Northeast ¼ of Southwest ¼ Section	2.5
<b>Total Acres in Section 8</b>	<b>235.0</b>
Section 9	Acres
South ½ of Northeast ¼ Section	80.0
South ½ of Northwest ¼ Section	80.0
North ½ of Southwest ¼ Section	80.0
South ½ of Northeast ¼ of Northwest ¼ of Section	20.0
<b>Total Acres in Section 9</b>	<b>260.0</b>
<b>TOTAL ACRES</b>	<b>495.0</b>

### 1.1.3.2 Contract Area

The Contract Area is defined as the mine access road, the area currently being mined, and the areas expected to be actively mined within the next 5 years. The active Mine is located within the Contract Area, which is located within the Clearance Area as established under the MRP. The “minable Contract Area” henceforth will refer to the Contract Area minus the portion dedicated to the access road(s), which will not be mined.

#### 2014 Contract Area

As established in the 2013 MRP, the 2014 16.57-acre Contract Area consists of a 1.35-acre active mining area, an additional 14.38 acres to be mined in successive phases, and a 0.84-acre access road (Map A-2, Appendix A). Approximately 4.55 acres outside of the 2014 Contract Area was mined under a previous contract. Earthwork

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and seeding have been completed for this acreage and an “initial reclamation” financial assurance bond was estimated for these 4.55 acres and an additional 1.64 acres at a rate of \$5,144.15 per acre. The financial assurance bond for existing and future mining was estimated for 8.96 acres (the maximum surface that would be disturbed at one time) at \$6,897.16 per acre.

## 2019 Contract Area

The 2019 MRP proposes to establish a new 2019 24.76-acre Contract Area comprising a 4.18-acre active mining area; 2.05 acres of staging and storage areas; an additional 10.23 acres to be mined in successive phases; and the existing 0.84-acre access road, a new 0.61-acre access road to be constructed upon approval of this MRP, and a new 0.29-acre access road to be constructed before Phase IV of mining (Maps A-3 and A-4, Appendix A). Upon approval, the 2019 Contract Area would also include 6.57 partially-reclaimed acres mined under the 2014 MMSC, as well as eliminate 3.83 undisturbed acres of the 2014 Contract Area that will not be affected by future mining. A comparison of acreage and their designations for the 2014 and proposed 2019 Contract Areas is presented in Table 1-2.

**Table 1-2. Comparison of 2014 and 2019 Mineral Materials Sales Contracts (MMSC)**

Location/Details	2014 MMSC (Acres)	2019 MMSC (Acres)
Active Mining Area	1.35	4.18
Staging and Storage	2.74	2.05
Proposed New Mining Units (Minus Existing & Proposed Road Locations)	14.38	10.23
Access Roads (Existing & Proposed)	0.84	1.74
Partially Completed Reclamation Areas	4.55*	6.57
<b>TOTAL</b>	<b>16.57</b>	<b>24.76</b>

\*Not part of 2014 MMSC Contract Area. Has undergone initial reclamation.

### 1.1.4 Plan Updates

The BLM/RPFO requires this Plan to be updated or amended if Rammsco desires to make any changes to the Plan, and/or when Rammsco is prepared to begin explorations in other portions of the Clearance Area outside of the Contract Area. The 2019 MRP reflects mining and reclamation activities performed to date and proposes new areas of mining, road construction, and reclamation.

### 1.1.5 Mining Activities

The thickness of the humate and “organic clay” layers throughout the minable Contract Area vary greatly. Rammsco has documented the humate seam on site as up to 5 feet thick and as thin as 1 foot. Remaining humate reserves in the minable Contract Area are conservatively estimated based on the assumptions of a 4-foot thick continuous humate seam across the area and a density of 1,850 pounds of humate per cubic yard (D. Williams, pers. communication, November 16, 2012). The “organic clay” layer also varies between 2 and 3 feet

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thick across the minable Contract Area. “Organic clay” reserves in the minable Contract Area are conservatively estimated based on the assumptions of a 3-foot thick continuous “organic clay” seam across the area and a density of 2,300 pounds of “organic clay” per cubic yard (D. Williams, pers. communication, November 16, 2012). The estimated amount of humate and “organic clay” in reserve within the 2019 Active and Additional Mining areas is estimated at approximately 40,000 tons.

Reclamation earthwork and seeding has been performed on approximately 10.29 previously-mined acres of the minable Contract Area, including 3.72 acres of the pre-2014 MMSC 4.55-acre initial reclamation area (0.83 acres has been re-disturbed) and 6.57 acres mined since 2014 (Map 3, Appendix A).

The remaining 18.19 acres proposed for mining in the minable Contract Area are contained within separate phases, as illustrated in Map A-4 of Appendix A. Rammsco is actively mining 4.18 acres (Phase II) with approximately 3.79 acres dedicated to access roads (existing and planned/proposed) and staging and storage areas. Rammsco plans to mine an additional 10.23 acres in successively permitted phases (Table 1-3) within the minable Contract Area (Map A-4 in Appendix A).

**Table 1-3. Mining Phases and Acreages**

Mining Phase	Acres
<b>Phase I – Complete</b>	
Storage/Staging/Roads	3.54
Phase II - Active Mining	4.18
Phase IIIa	1.10
Phase IIIb	3.32
Road for Phase IV	0.25
Phase IVa	3.23
Phase IVb	2.58
<b>TOTAL</b>	<b>18.19</b>

The mining process began with Phase I under the 2014 MMSC, Phase II is currently underway, and mining would continue sequentially through Phase IVb. Progressive reclamation would occur simultaneously with mining activities as described in Section 1.3, Proposed Operations, and in Section 2, Reclamation Plan.

Active disturbance will not exceed 40 acres at any time as required by MMD (D. Ohori, pers. communication, August 29, 2018). As mining progresses each calendar year, Rammsco may apply for a partial release of financial assurance (FA) in order to release reclaimed acreage for earthwork.

## 1.2 Existing Environment

### 1.2.1 Regional and Local Topography

The elevation throughout the Clearance Area ranges between 6,600 and 6,820 feet, and the Contract Area lies at approximately 6,660 feet. The Continental Divide runs 8.5 miles northeast of the Clearance Area boundary. The

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natural topography within the mining areas consists of gently rolling hills sloping generally to the east-southeast. Slopes within the Contract Area are gentle, ranging between 0 and 5 percent.

## 1.2.2 Climate

The climate within the general Clearance Area averages maximum year-round temperatures between 40 and 85 degrees Fahrenheit (°F) and minimum temperatures between 9.1°F and 50.2°F ([www.worldclimate.com](http://www.worldclimate.com)). Average annual rainfall in the general vicinity is 12.8 inches per year, with the highest percentage in July and August (2.1 to 2.5 inches).

## 1.2.3 Clearance Area Description and Maps

The Clearance Area is located on the United States Geological Survey (USGS) 7.5-minute quadrangle topographic map for Ojo Encino Mesa, NM. The Clearance Area is not located within any specially designated area such as a Wilderness Area, Wilderness Study Area, or an Area of Critical Environmental Concern. A vicinity map of the Clearance Area is presented in Appendix A (Map A-1). The location of the Clearance Area is described in Section 1.1, Project Description.

## 1.2.4 Major Rights-of-Way

One major maintained gravel road—Tinian Road—crosses through the Clearance Area, connecting Pipeline Road to the south with Indian Service Route 474 to the north. Other unmaintained dirt roads and two-tracks occur across the Clearance Area, including access to a storage shack south of the Contract Area, general rancher access, and the gravel road accessing the Contract Area and active Mine.

An existing oil/gas pipeline right-of-way (ROW) bisects the Clearance Area from northwest to southeast, primarily through the east half of Section 8. This pipeline lies to the west and outside of the Contract Area.

## 1.2.5 Current Land Use

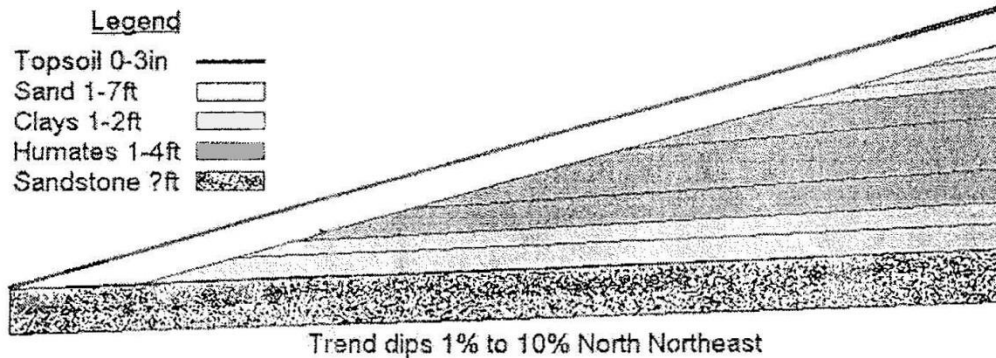
The current land uses within the Clearance Area are livestock grazing, wildlife use, utility corridors, and mineral materials mining. The Contract Area is located within the Star Lake Community grazing allotment. The project area has been previously disturbed by past mining, grazing, and vehicle access. Existing un-improved two-track roads provide access into the Contract Area.

## 1.2.6 Deposit Geology

The desired geological formation containing the humate and “organic clay” material is derived from the Fruitland Formation of the Upper Cretaceous period (Beaumont 1998). There are no known potentially hazardous materials that could be exposed during the extraction of the humate material.

## 1.2.7 Geological Cross-Section

### General Deposit Cross Section



**Figure 1-1. Generalized illustration of the distribution of humates and clays in the minable Contract Area**

The actual humate and “organic clay” deposits in the minable Contract Area are highly variable in sequence, thickness, and extent due to previous mining, erosion, uplifts, and faulting (Figure 1-1). No natural outcroppings occur within the Contract Area. Within the minable Contract Area, site conditions are expected to include (from the surface down):

- A thin layer of topsoil (generally < 1 foot thick)
- A 4- to 6-foot layer of sand and soil overburden
- A 2- to 3-foot layer of “organic clay” (brown clay)
- A 3- to 5-foot layer of unusable (gray) clay
- A 1-foot layer of “organic clay” (brown clay)
- A 1- to 5-foot layer of humate
- Low-grade coal and unusable clay

## 1.2.8 Watershed, Surface, and Ground Water

The Contract Area is located in the Middle Rio Grande Hydrologic Region on the east side of the Continental Divide, within the Arroyo Chico watershed.

The Contract Area lies approximately 5.1 miles due north of the confluence of the San Isidro Wash and Torreon Wash—both ephemeral drainages. There are no perennial surface water resources in the form of rivers, lakes, ponds, or streams, nor any wetlands, springs, or riparian habitats within the Clearance Area. Precipitation is generally absorbed by the sandy soils or collects as runoff in an unnamed ephemeral drainage southwest of the Contract Area. Within the past 25 years, two small stock ponds have been constructed in sequence on this drainage to collect surface flows—one stock pond was in existence prior to Rammsco’s mining operation. These stock ponds allow sediment to settle out of the water and provide a water source for livestock and wildlife. Outfall from these stock ponds flows 0.25 mile into another unnamed ephemeral drainage, which is a tributary to San Isidro Wash.

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The primary aquifers in the area are the sandstone-based Uinta-Animas and the Mesaverde (USGS 1995). Groundwater is readily available in most of the area and is of fair to poor quality. A search of the New Mexico Office of the State Engineer (NMOSE) Water Administration and Technical Engineering Resource System (WATERS) database for the Clearance Area and vicinity (4-mile radius) was performed (NMOSE 2012). There are no recorded water wells located within 4 miles of the Clearance Area. The nearest water column data available on the WATERS database is located approximately 4.5 miles east of the Contract Area. The minimum depth to water at that windmill location in San Isidro Wash (Section 6, Township 19 N, Range 3 W) is 21 feet. Depth to groundwater within the minable Contract Area is expected to be deeper than at this location since the Contract Area is not located within an existing wash. The next nearest water column data available on the Waters database is 6 miles southwest of the Contract Area. The minimum depth to water at that location (Section 7, Township 30 N, Range 4 W) is 95 feet.

## 1.2.9 Vegetation and Wildlife

The vegetation within the Clearance Area and the surrounding area is limited and does not fall within any documented fire hazard zones. A summary of the vegetation and wildlife occurring within the Clearance Area (including the Contract Area) is provided below. A detailed evaluation of the potential for federal- and state-listed species and other sensitive species designations was submitted to the BLM/RPFO under separate report cover in May 2013: *Biological Survey Report for Rammsco Operations, Inc. Eagle Mesa Mine* (Ecosphere 2013).

The Clearance Area is located within the Great Basin Desert Scrub vegetation community (Dick-Peddie 1993). The overall vegetation ground cover in undisturbed areas was observed to be 20 to 40 percent. Vegetation within the Contract Area consists of big sagebrush (*Artemisia tridentata*) with an understory of broom snakeweed (*Gutierrezia sarothrae*) and blue grama (*Bouteloua gracilis*). Other vegetation includes shrubs such as fourwing saltbush (*Atriplex canescens*), rubber rabbitbrush (*Ericameria nauseosa*), and greasewood (*Sarcobatus vermiculatus*). Common grasses include James' galleta (*Pleuraphis jamesii*), alkali sacaton (*Sporobolus airoides*), and Indian ricegrass (*Achnatherum hymenoides*).

The Great Basin Desert Scrub community (Dick-Peddie 1993) supports a variety of wildlife, including mammals, birds, and reptiles. Common mammal species found in Great Basin Desert Scrub include black-tailed jackrabbit (*Lepus californicus*), prairie dog (*Cynomys gunnisonii*), kangaroo rats (*Dipodomys* spp.), and coyote (*Canis latrans*). Common bird species include American crow (*Corvus brachyrhynchos*), common raven (*Corvus corax*), horned lark (*Eremophila alpestris*), and roadrunner (*Geococcyx californianus*). Reptile species that may occur in the Great Basin Desert Scrub community include collared lizard (*Crotaphytus collaris*), short-horned lizard (*Phrynosoma douglasii*), sagebrush lizard (*Sceloporus graciosus*), prairie lizard (*Sceloporus undulatus*), plateau striped whiptail (*Cnemidophorus velox*), bull snake (*Pituophis melanoleucus*), and western rattlesnake (*Crotalis viridis*).

According to the U.S. Fish and Wildlife Service (USFWS), there are nine federally listed threatened, endangered, proposed endangered, or candidate species with potential to occur in Sandoval County, New Mexico. However, no federally listed species or their habitat were identified within the Clearance Area during field surveys (Ecosphere 2013).

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According to the State of New Mexico, there are 19 state-listed threatened or endangered species with potential to occur in Sandoval County, New Mexico. Aside from the spotted bat (*Euderma maculatum*) (also listed by the BLM, and discussed below), no state-listed species, or habitats thereof, were identified within the Clearance Area during field surveys (Ecosphere 2013).

According to the BLM/RPFO, there are 27 BLM Sensitive species listed as occurring in Sandoval County (USDI/BLM 1986 and 2012). Ten of these species have potential habitat within the Clearance Area — pale Townsend's big-eared bat (*Corynorhinus townsendii pallascens*), spotted bat (also a State-listed species), fringed myotis (*Myotis thysanodes*), ferruginous hawk (*Buteo regalis*), loggerhead shrike (*Lanius ludovicianus*), mountain plover (*Charadrius montanus*), western burrowing owl (*Athene cunicularia hypugaea*), grama grass cactus (*Sclerocactus papyracanthus*), New Mexico spiny milkvetch (*Astragalus kentrophyta var. neomexicana*), and tufted evening primrose (*Oenothera caespitosa*).

One BLM special management species—western burrowing owl—was observed in an active prairie dog colony outside of the Clearance Area during the field survey. However, no habitat for the burrowing owl was identified within the Clearance Area (including the Contract Area). Mountain plovers are also associated with prairie dog colonies (NatureServe 2012), but no suitable mountain plover habitat occurs within the Clearance Area and no mountain plovers were observed during the field surveys. No other special status species were observed within or near the Clearance Area (Ecosphere 2013).

The Clearance Area (including the Contract Area) contains potential nesting habitat for the loggerhead shrike but does not contain any potential breeding habitat for any other BLM-listed animal species. The Clearance Area contains potential foraging habitat for the shrike, ferruginous hawk, pale Townsend's big-eared bat, and spotted bat (Ecosphere 2013).

Potential habitat may exist within the Clearance Area for the sensitive plant species. However, none of these species were observed during the field surveys. The closest documented occurrences of these species on BLM lands are 21 miles away (grama grass cactus), and 60 miles away (tufted evening primrose and New Mexico spiny milkvetch) (Ecosphere 2013).

The Clearance Area also contains potential nesting and foraging habitat for other bird species protected by the Migratory Bird Treaty Act (Ecosphere 2013). No nests were identified in the Clearance Area or Contract Area during the biological survey. However, detailed nest surveys were not conducted, and the field survey was outside of breeding season. Noise and disturbance of native vegetation from ongoing mining activities could affect the utilization of this area by these species for foraging and breeding. Based on readily available suitable nesting habitat in the vicinity of the Clearance Area, impacted individuals would be expected to move to adjacent areas to avoid disturbance. Over time and as reclamation progresses in mined-out portions of the Contract Area, disturbed areas are expected to revert to the Great Basin Desert Scrub vegetation community that currently exists in undisturbed portions of the Clearance Area.

## 1.2.10 Historical, Archaeological, and Cultural Sites

The entire Area of Potential Effect in the Clearance Area was inventoried for archaeological and historic resources by Woods Canyon Archaeological Consultants (Woods Canyon) between August 20 and 23, 2012 and



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between November 5 and 8, 2012 under BLM Permit No. 49-2920-08-S and New Mexico Cultural Resource Information System (NMCRI) #125735. The inventory consisted of a 100 percent Class III pedestrian survey of the Clearance Area on BLM lands. A cultural resources inventory report was prepared and initially submitted to the BLM/FFO archeologist in December 2012, and subsequently revised per the BLM/RPFO archeologist's requests and submitted to the BLM/RPFO in April 2013 in accordance with the *Procedures for Performing Cultural Resources Fieldwork on Public Lands in the Area of New Mexico BLM Responsibilities* (USDI/BLM 2005). The report was submitted to the BLM under separate report cover: *A Class III Cultural Resource Inventory for the Eagle Mesa Humate Mine Expansion, Sandoval County, New Mexico* (Robinson 2013).

In addition to the on-site field survey, the inventory included a literature search and Traditional Cultural Property search at the BLM/FFO and BLM/RPFO, and an online literature search with the New Mexico Cultural Resource Information System Archeological Records Management Section to determine if any sites had been recorded within 0.5 mile of the survey area.

The results of the literature search found that 13 previous archeological surveys had been conducted and 12 previously recorded sites had been documented within 0.5 mile of the Clearance Area—LA22382, LA44699, LA44700, LA44701, LA44702, LA44703, LA58937, LA58938, LA123260, LA123261, LA125715, and LA125716.

The Class III inventory identified 11 sites and 26 isolated finds. Six of the sites (LA174629, LA174630, LA174631, LA174632, LA174633, and LA174634) are newly documented, while five sites (LA22382, LA44699, LA 44700, LA44701, and LA44702) were re-recorded. Two of the previously recorded sites (LA58937 and LA123260) were not relocated during the survey. Of the six newly documented sites, two are recommended eligible for listing with the National Register of Historic Places (NRHP) (LA174632 and LA174633), because they meet Criterion D of 36 Code of Federal Regulations 60.4. Two sites may be eligible but need additional data to make a recommendation (LA174629 and 174631), and the remaining two sites (LA 174630 and 174634) are recommended as ineligible for listing with the NRHP.

Woods Canyon consulted the NRHP and the State Register of Cultural Properties and determined that there were no cultural properties in the survey area on either register. Numerous attempts were made to contact the Ojo Encino Chapter president, Roger Toledo, to discuss and obtain additional information regarding possible TCPs in the Clearance Area, and to determine if the Chapter had any management concerns. Two ethnographically documented ceremonial locations may occur within the Clearance Area (York and Winter 1988), but these locations have not been verified by tribal elders, and repeated efforts to contact the Ojo Encino Chapter House had not yielded a response at the time of the cultural report or this Plan.

Four sites were located in proximity to the mineable Contract Area. Site LA 174632 is recommended as eligible for NRHP listing. Sites 44699, 44701, and 44702 are recommended as ineligible, but could be potentially impacted or destroyed by mining activities, and consultation between the BLM and the Navajo tribal government is pending. All four sites will be protected and avoided through installation of high-visibility fencing using T-posts and orange plastic safety fencing around a 10-meter buffer of each site. Assistance from the BLM/RPFO will be required to locate these fences as the exact site locations are unknown to the mine operator.

If previously undocumented cultural sites are encountered during construction, all activities will stop in the vicinity of the discovery and the BLM/RPFO will be immediately notified. The site would then be evaluated.

Mitigation measures such as data recovery may be required by the BLM/RPFO to prevent impacts to newly identified cultural resources.

## 1.2.11 Paleontological Sites

The Clearance Area was inventoried for paleontological resources by John Burris, Ph.D., BLM-Permitted Consulting Paleontologist (Permit # NM12-001C) on August 10, September 3, and September 22, 2012 (Burris 2013). Within the Clearance Area, all geologic outcrops and anthills in the vicinity of outcrops were examined closely for vertebrate fossils, as were the previously exposed humate mine and spoils piles. The paleontological resources report has been submitted to the BLM/RPFO in association with this Mining and Reclamation Plan, but under the separate report cover—*Paleontology Survey Report, Rammsco Operations, Inc., Eagle Mesa Mine, Section 8 & 9, T19N, R4W, Sandoval County, New Mexico*.

The inventory found no vertebrate fossils and there are no known localities within the Clearance Area. However, determination of the presence or extent of paleontological resources could not be completed for much of the area due to the soil cover over the geologic layer where vertebrate fossils would most likely occur. The subsurface Fruitland Formation geologic layer has the potential to contain significant fossils (Burris 2013). Monitoring during excavation is recommended by the BLM-Permitted Consulting Paleontologist. If previously undocumented paleontological resources are encountered during mine operations, the BLM's Discovery Stipulation would apply.

### ***BLM Discovery Stipulation***

*The permittee shall immediately notify the BLM Authorized Officer of any paleontological resources discovered as a result of operations under this authorization. The permittee shall suspend all activities in the vicinity of such discovery until notified to proceed by the Authorized Officer and shall protect the discovery from damage or looting. The permittee may not be required to suspend all operations if activities can be adjusted to avoid further impacts to a discovered locality or be continued elsewhere. The Authorized Officer will evaluate, or will have evaluated, such discoveries as soon as possible, but not later than 10 working days after being notified. Appropriate measures to mitigate adverse effects to significant paleontological resources will be determined by the Authorized Officer after consulting with the operator. Within 10 days, the operator will be allowed to continue construction through the site, or will be given the choice of either (1) following the Authorized Officer's instructions for stabilizing the fossil resource in place and avoiding further disturbance to the fossil resource, or (2) following the Authorized Officer's instructions for mitigating impacts to the fossil resource prior to continuing construction through the project area.*

## 1.2.12 Noise Levels

Noise levels are measured utilizing instruments that are calibrated to measure hourly A-weighted sound level in decibels (dBA). The dBA scale is a measure of sound levels that are present at a given location that would be audible to the human ear. The dBA scale does not measure levels of noise that would not be audible to the human ear, generally not measuring extremely low range noise, and not measuring high pitched sounds. Some

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urban noises that represent the range of noise levels that are commonly heard are provided in Table 2. Noise levels at the Contract Area are expected to peak at 85 dBA during operating hours at the noise source.

**Table 1-4. Examples of General Noise Levels in Common Activity Areas**

Noise Generator	General Noise Level (dBA)
Construction Site	85
Caterpillar D9H Bulldozer	81 <sup>1</sup>
Caterpillar D7F	81
Caterpillar 950F Wheel Loader	84 <sup>1</sup>
Trojan 3500Z Wheel Loader	84 <sup>1</sup>
Cat Road Grader	85 <sup>1</sup>
Pick-up Truck	80
Automobile	65
Residential Area (daytime)	50
Residential Area (nighttime)	45
Rural Area (nighttime)	35
Hearing threshold	20

<sup>1</sup> Average noise level readings taken at 15 m (USDT-FHWA 2010).

Noise compliance standards for operations within the BLM/RPFO jurisdiction were not located for this Plan. The BLM/FFO uses a noise standard to determine compliance with the BLM/FFO's Notice to Lessees for Noise (USDI/BLM 2004). The sound level must be less than or equal to 48.6 dBA over a continuous 24-hour period based on a distance of 300 feet from the source of noise.

The increase in noise levels associated with the mining activity would be localized to the Mine site and would decrease with increasing distance from the source. Maximum construction hours will be limited to daylight hours, 5 days a week. A minimal amount of equipment would be used on-site, and all equipment would comply with industry and New Mexico Department of Transportation (DOT) standards.

No residences occur within a 1-mile radius of the minable Contract Area. There is an existing residence located approximately 1.3 miles (7,000 feet) west-northwest of the minable Contract Area. Noise levels in the area surrounding the Mine are generally low, given its rural nature.

## 1.2.13 Air Quality

The areas of the Mine lease are considered a Class II air quality area. A Class II area allows moderate amounts of air quality degradation. Air quality in the area near the proposed project is generally good and is not located in any of the areas designated by the United States Environmental Protection Agency (USEPA) as "non-attainment

areas” for any listed pollutants regulated by the Clean Air Act. Currently Sandoval County is in attainment of all federal National Ambient Air Quality Standards (NAAQS).

Air quality would be directly impacted with pollution from exhaust emissions and dust. Air pollution from the motorized equipment and dust dissemination would continue for the duration of mining and reclamation activities. Impacts from emissions and dust would generally be localized to the active mining areas within the Contract Area. Other factors that currently affect air quality in the area include dust from use of roads for vehicular traffic, dust from livestock herding activities and recreational use, and emissions from oil and gas production activities. The significance threshold for particulate matter (PM) of 35 micrograms per cubic meter daily PM<sub>2.5</sub> NAAQS is not expected to be exceeded.

## 1.2.14 Traffic Conditions

Tinian Road, traveling through the Clearance Area from northeast to southwest and located north of the Contract Area, is used by local residents, ranchers, oil and gas workers, and mining traffic. The road provides access to State Highway 197 via Indian Service Route 474 and Pipeline Road. The unnamed road receives infrequent maintenance (i.e., graded periodically, but not plowed during snowstorms and with few installed culverts). The Mine has approximately 13 to 15 haul truck-trips per month delivering humate from the Mine to the truck scales. Light vehicles are used to transport the employees to and from the site in the mornings and evenings. Observations of traffic levels on the unnamed road during field visits to the site suggested the road gets approximately 1 to 2 cars per hour, with the majority of the traffic being local residents.

## 1.2.15 Demographics

Demographic information for the area is based on information included in the Chapter Images 2004: Profiles of 110 Navajo Nation Chapters (Navajo Nation 2004) and based on information from the 2010 United States Census (U.S. Census Bureau 2010). The closest population center to the Clearance Area is Ojo Encino. The total population of the Ojo Encino chapter was documented as 709 persons, 350 males, and 359 females. The majority of the people were between 5- and 9-years-old and the second highest between 25- and 34-years-old, the median age being 21.9 years. American Indians/Alaska Natives made up 97.9 percent of the population (Navajo Nation 2004; U.S. Census Bureau 2010).

## 1.2.16 Visual Setting

The Clearance Area, including the Contract Area, is located in a broad valley southwest of Eagle Mesa. The terraced cliffs of Eagle Mesa are visible about 2 miles northeast of the Clearance Area. The valley bottom is dissected by a series of named and unnamed dendritic drainages, including San Isidro Wash and Torreon Wash, and is punctuated by isolated eroded mesas, buttes, and ridges.

The area is currently classified as Visual Resource Management Class IV, as mapped in the BLM/RPFO Resource Management Plan (USDI/BLM 1986). VRM Class IV management objectives provide for activities that require major modification of the existing landscape character. The level of change to the landscape can be high, and management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the visual impact of these activities.

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## 1.3 Proposed Operations

The humate and “organic clay” deposits in the Contract Area are highly variable in thickness and extent. Remaining humate reserves in the 24.57-acre minable Contract Area are conservatively estimated in Section 1.1.5 Mining Activities as approximately 40,000 tons (43,243 bank cubic yards) of humate and “organic clay.”

Total annual humate extraction is estimated to be 3,830 tons (4,140 bank cubic yards) per year, based on an average of 15, 23-cubic yard truckloads of humate extracted per month. Total annual “organic clay” extraction is estimated to be 4,140 tons (3,600 bank cubic yards) per year, based on an average of 15, 20-cubic yard truckloads of “organic clay” extracted per month.

At an extraction rate of approximately 4,140 bank cubic yards of humate per year and approximately 3,600 bank cubic yards of “organic clay” per year, the remaining 24.57 acres of minable Contract Area will take approximately 10 to 15 years to mine.

Rammsco proposes to operate the Mine periodically, and only during daylight hours on weekdays (Monday through Friday) between 8:00 am to 4:00 pm, except for holidays. Orders for humate and “organic clay” product are bunched for pickup into groups of 5 to 10 truckloads at a time, at 23 cubic yards per truckload for humate and 20 cubic yards per truckload for “organic clay.” After a group of pickups is completed, mining operations are put on hold until new orders are received. On average, 13 to 15 truckloads each of humate and “organic clay” are removed from the Mine per month (D. Williams, email message to Ecosphere November 19, 2012).

To accomplish the mining activities and proper reclamation, the mining operations will follow the main Stages as outlined below.

### 1.3.1 Stage I – Initial Reclamation

As described in Section 1.1 General Information, approximately 4.55 acres outside of the 2014 Contract Area was mined under a previous contract; earthwork and seeding has been completed for this acreage. Limited vegetation cover in this area, however, has contributed to ongoing rill-erosion from stormwater run-on in adjacent areas. Areas to be mined in Phase IV and the road proposed to access them, east of the area considered to be fully reclaimed, shall be graded to provide proper drainage and stable slopes (3H:1V or flatter) to prevent additional erosion in the 4.55-acre reclaimed area.

Additionally, Rammsco has completed earthwork and seeding for approximately 6.57 acres of previously mined areas. However, as discussed during the November 2, 2018 site visit to the Mine, saltlover (*Halogeton glomeratus*), a Class B noxious weed in the State of New Mexico, was observed growing in the portion of the mine seeded in 2018, in the northwest section. Rammsco, in accordance with Condition 9.P of MMD Permit Modification 16-1, will continue to:

1. Train on-site personnel to recognize *Halogeton*,
2. Complete two inspections per year (in May-June and after monsoon season) of all disturbed areas,
3. Spot-treat *Halogeton* plants using an appropriate herbicide in strict accordance with the manufacturer’s recommendations or remove *Halogeton* mechanically, and
4. Decontaminate new mining equipment prior to introduction into the Contract Area.

## 1.3.2 Stage II – Mine Operation Staging and Stockpiling

### Step 1: Protection of Cultural and Natural Resources

In November 2018, BLM/RPFO Archaeologist Sean Daugherty flagged the edges of existing cultural resources. At this location, Rammsco will construct protection barriers using metal T-posts and orange plastic safety fence between T-posts. Barriers will be clearly visible to any vehicles traveling the road, both during daylight hours and after dark. If barriers are disturbed or destroyed at any time throughout the life of the mining operation until final reclamation has been achieved, the mine operator will repair or replace them at the same location within 24 hours.

Additionally, to avoid existing cultural resources and to accommodate expansion of the Mine toward the west, a new access road is proposed to approach the Mine from the southwest (Map A-3, Appendix A). This road and any new roads, including haul and access roads, will be constructed to comply with the BLM's Gold Book standards for road design, construction, drainage, and maintenance (USDI/USDA 2007).

All mining activities and associated disturbance will be set back a minimum of 100 feet from any ephemeral watercourses. Erosion control best management practice (BMP) measures will be installed as detailed in the Stormwater Pollution Prevention Plan (SWPPP) (Ecosphere 2019).

### Step 2: Designation of the Staging/Stockpile Area

Currently, the Mine has 2.05 acres dedicated to stockpile areas for mined, salable material and staging/loading areas where haul trucks access the site and are loaded (see Map A- 4 of Appendix A). These areas are large enough to accommodate storage of all personnel vehicles, construction equipment, materials, and supplies; secondary containment for storage of fuel and hazardous materials; and overburden stockpiles from the current Mining phase. Relocation of the stockpile and staging/loading areas during the life of the mining and reclamation operations will be minimized as much as possible.

## 1.3.3 Stage III: Mine Operation

Mining operations will generally move forward in phases. The following steps apply throughout the mining operation and within each Mining phase. Refer to Table 1-5 and Map A-4 of Appendix A for the progressive mining plan.

### Step 1: Removal of Topsoil and Overburden

Topsoil will be removed using a bulldozer and stockpiled within the mining areas separate from any remaining overburden. Overburden ranges from 5 to 15 feet thick across the area and will be removed using a bulldozer and stockpiled within the mining areas for reuse during reclamation. If previously undocumented archeological, cultural, or paleontological resources are encountered during mining operations, all activities will stop in the vicinity of the discovery and the BLM Discovery Stipulation shall be followed (refer to Section 1.2.11, Paleontological Sites for the BLM Discovery Stipulation). No greater than 2 to 4 acres of excavated overburden will be stockpiled at any given time. This will correlate with Stage III, Step 5: Progressive Reclamation.

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Stockpiles will be located and protected so that wind and water erosion are minimized and reclamation potential is maximized. Erosion control and slope stabilization measures for the stockpiles will be implemented according to Section 2.5.5, Erosion Control and Stormwater, and according to the SWPPP prepared for the Mine (Ecosphere 2019).

## Step 2: Removal of the “Organic Clay”

Using a front-end loader, the “organic clay” will be removed and placed in a collection pile. When material orders are ready for pickup, the operator will use a front-end loader to collect and load the material into haul trucks with 36-foot end-dump trailers for transport to the truck scales in the Albuquerque area. Materials processing is completed by the material buyer and is not tracked by Rammsco.

## Step 3: Removal of the Humate

Any overburden occurring between the “organic clay” layer and the humate layer will be removed and stockpiled as described above. Once the humate is ready for extraction, it is removed and placed in a collection pile using a front-end loader. When material orders are ready for pickup, the front-end loader will collect and load the material into haul trucks with 36-foot end-dump trailers for transport to the truck scales in the Albuquerque area. Again, materials processing is completed by the material buyer and is not tracked by Rammsco.

## Step 4: Product Verification and Delivery of the Humate and “organic clay”

Production rates are determined based on weight logs recorded for each load upon arrival at the truck scales. Daily and monthly logs for the humate and the “organic clay” will be presented as verification to the BLM. Copies of all records are kept at the Rammsco office in Katy, Texas. Materials processing and delivery is completed by the material buyer and is not tracked by Rammsco.

## Step 5: Progressive Reclamation

Once the maximum amount of humate and “organic clay” has been extracted from each Mining phase (Map A-4 of Appendix A), reclamation of each progressively mined phase will be initiated as follows (see Section 2, Reclamation Plan, for details):

- Re-placement of stockpiled overburden and topsoil over mined phase.
- Surface re-contouring of mined phase.
- Seeding and mulching of mined phase.
- Protective fencing of reclaimed area.

This reclamation pattern will continue through each phase of the mining operation, as shown in Table 1-5. Table 2-2 in Section 2.4.2, Progressive Reclamation, provides additional detail on mining and reclamation progression. Monitoring of reclaimed areas for revegetation success (see Section 2.8, Revegetation Monitoring, for details) will begin upon completion of the first new reclamation area and will incorporate new reclamation areas as each is completed.

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- All reclamation areas within the Contract Area will be monitored for revegetation success (see Section 2.8, Revegetation Monitoring, for details)
- Reseeding will occur as necessary to achieve revegetation success
- Invasive/noxious species shall be monitored and treated

**Table 1-5. Mining and Reclamation Progression Plan**

Phase	Acres	Mining Actions <sup>1</sup>							
		Period 1 <sup>2</sup>	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8
Phase I	6.57	R							
Storage/Staging	2.66	O	O	O	O	O	O	R	
Phase IIa and IIb/New Access Road	3.51	M	R						
Phase IIc	0.67	M	O	O	O	O	O	R	
Phase IIIa	1.10		M	R					
Phase IIIb	3.32			M	R				
Phase IV Road	0.25				M	O	O	R	
Phase IVa	3.23					M	R		
Phase IVb	2.58						M	R	
Final Closure (Original Access Road) <sup>3</sup>	0.87	O	O	O	O	O	O	O	R
<b>TOTAL OPEN ACRES<sup>4</sup></b>		<b>14.29</b>	<b>8.82</b>	<b>8.62</b>	<b>6.90</b>	<b>7.69</b>	<b>10.27</b>	<b>7.03</b>	<b>0.87</b>

<sup>1</sup> M=Active Mining, O=Open/Disturbed, R=Undergoing Reclamation.

<sup>2</sup> Time duration estimates are provided in Table 2-2 in Section 2.4.2–Progressive Reclamation.

<sup>3</sup> Final Closure incorporates all remaining un-reclaimed areas, including the new main access road.

<sup>4</sup> Includes phases undergoing reclamation activities.

## 1.3.4 Stage IV–Final Reclamation/Final Closure of Contract Area

### Step 1: Final Mine Activity Reclamation

Once all mining phases have been completed (at the end of Period 10, Table 1-5), final reclamation of the Mine will be initiated as follows (Period 11, Table 1-5, see Section 2, Reclamation Plan, for details):

- Re-placement of stockpiled overburden and topsoil over all remaining mined areas, stockpile areas, staging areas, and access roads
- Surface re-contouring of all remaining mined areas, stockpile areas, staging areas, and access roads
- Seeding and mulching of all remaining mined areas, stockpile areas, and staging areas, and access roads
- Protective fencing of reclaimed area



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## Step 2: Monitoring and Maintenance

- All reclamation areas within the Contract Area will be monitored for revegetation success (see Section 2.8, Revegetation Monitoring, for details)
- Reseeding will occur as necessary to achieve revegetation success
- Invasive/noxious species shall be monitored and treated

## Step 3: Final Closure

When reclamation success has been determined by the BLM and MMD, all fencing will be removed, the mine operator will recover the appropriate bond sum, and the Mine will be considered closed.

## 1.4 Equipment and Personnel Information

Rammsco proposes to operate the Mine periodically, and only during daylight hours on weekdays (Monday through Friday) between 8:00 a.m. and 4:00 p.m., except for holidays. The proposed Mine would employ one full-time employee working a maximum 8-hour shift, no more than 5 days a week.

All vehicles will be restricted to haul roads and active mine operations. Once areas are reclaimed, no vehicles will be operated within the reclaimed areas except for the on-site haul road and for restoration maintenance or rehabilitation activities. The following equipment for each phase of the project would be operated by the employee, except for the haul truck and trailer, which are operated by employees of the materials purchaser and are not controlled by the mine operator.

**Table 1-6. Equipment Required for Mining Plan**

Equipment	Stage I Initial Reclamation	Stage II Staging & Stockpiling	Stage III Mine Operation	Stage IV Final Reclamation/Closure
Front-End Loader	X	X	X	X
Bulldozer	X	X	X	X
Haul Truck & 36-foot End Dump Trailer			X	

## 1.5 Production Verification/Inspection and Enforcement

Production rates are determined based on weight logs recorded for each load upon arrival at the truck scales. See Section 1.3.3, Stage III: Mine Operation, for more information.

## 1.6 Committed Procedures

The following procedures will be followed to prevent degradation or destruction to the listed items.

## 1.6.1 Travel/Transport (Roads, Residences, Bridges, Etc.)

The travel route between the Mine site and the scales located at 301 Murray Road SE, Albuquerque, NM is expected to follow Tinian Road north of the Contract Area northeast to Indian Service Route 474, then east to State Highway 197 northeast to US Highway 550, then south to Bernalillo, and south on I-25 to Albuquerque.

All Mine-related vehicles will be required to follow posted speed limits, and all vehicles including haul trucks and personal vehicles, will adhere to load limits outlined by the New Mexico DOT and Navajo DOT. Use will be limited to only necessary travel (e.g., partial loads will not be transported). The maximum weight on bridges will not be exceeded. All loads departing the Mine will be covered for the duration of transport, according to New Mexico DOT standards, to avoid damage to windshields, etc. When encountered, right-of-way will be given to the nearby residents.

## 1.6.2 Post Mining Land Use

All Mine-related disturbance within the entire 24.76-acre Contract Area will be properly reclaimed and returned to grazing use for livestock and wildlife after mining operations have ceased. Reclamation procedures are outlined in Section 2, Reclamation Plan.

## 1.6.3 Surface and Ground Waters

All mining activities and associated disturbance shall be set back a minimum of 100 feet from any ephemeral watercourses. During periods of precipitation, runoff, or snowmelt when soils are wet or saturated, if heavy equipment creates ruts in excess of 6 inches deep, the soil is considered to be too wet to adequately support the equipment, and all vehicular travel on site shall be suspended until soils can again support the equipment. A SWPPP shall be implemented and maintained through the life of the project until final reclamation has been achieved (Ecosphere 2019). Erosion control measures shall be installed and maintained throughout the life of the Mine (see Section 2.5.5, Erosion Control and Stormwater). Hazardous materials in the form of fuel and lubricants for the construction and operation equipment shall be contained in designated secondary containment areas (see Section 1.6.8, Site Housekeeping).

## 1.6.4 Vegetation and Wildlife

All activities during all phases of mining operations will be restricted to the boundaries of the Contract Area (see Map A-4 of Appendix A). Extreme care will be taken to avoid all wildlife or livestock within the roads and surrounding area.

In accordance with the Migratory Bird Treaty Act (MBTA), any vegetation clearing required to prepare undisturbed areas of the Contract Area to be mined shall be cleared between October 1 and March 31 to avoid damaging or destroying any migratory bird nests, which is considered a violation of the MBTA.

## 1.6.5 Invasive Species/Noxious Weeds

In accordance with the standard operating procedures found in BLM/RPFO Instruction Memorandum NM-010-99-01 (USDI/BLM 1999), an approach for weed prevention and treatment is included in this Plan. The mine

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operator will manage and control noxious weeds throughout the life of the mining operation until final reclamation has been achieved. A list of noxious weeds identified as occurring on BLM/RPFO lands is provided in Section 2.7, Invasive/Noxious Species Control, and a list of weeds identified for control by the State of New Mexico is provided in Appendix C: Noxious Weed Information. Control of noxious species is discussed further under Section 2.7, Invasive/Noxious Species Control.

Saltlover (*Halogeton glomeratus*), a state Class B noxious weed species, is scattered across the Contract Area. No other invasive, non-native species listed by the State of New Mexico were identified in the Contract Area during field surveys. Discussion of control and treatment of existing *Halogeton* is included in Section 2.4.1, Initial Reclamation.

## 1.6.6 Air Quality, Noise, Light, and Vibration

Operations will occur only during daylight hours. Minimal amounts of equipment will be used to accomplish the mining operations.

## 1.6.7 Visual Resources

Impacts to visual resources are related to land disturbance, amount and types of equipment, machinery, and vehicles, infrastructure, and project emissions. Siting and design considerations to reduce, avoid, or mitigate visual impacts at the mining site will include:

- Minimization of all surface (ground) disturbances for all road or facilities infrastructure.
- To the extent practicable, location of facility infrastructure or equipment storage will not be on high land features and along "skylines" that are readily visible from nearby sensitive viewpoints.
- Storage of equipment and vehicles will be kept within the limits of the initially disturbed areas.
- Avoiding impacts to public road ROWs. Existing vegetation and topography within the ROWs will be left undisturbed.
- Minimization of vehicular and human activities as practicable during mining operations. Neither vehicular nor human activities will occur outside of daylight hours to minimize disturbance to neighboring landowners.

## 1.6.8 Site Housekeeping

The Contract Area will be regularly maintained to keep a tidy site. Equipment kept on site will be stored neatly in the staging areas when not in use, including heavy equipment, vehicles, hoses, pumps, trash bins, etc. Equipment that is inoperable will be removed from the site and not stored at the site. In general, inoperative equipment and poor housekeeping creates a poor image of the activity in the eyes of the public.

Since Rammsco operates on an on-demand basis for the materials being extracted, the Mine is not active every day. All heavy equipment used in the project area shall be inspected for leaks on each day that the mine operator is on site and the Mine is active/in operation, and a written log of inspections and maintenance will be completed each day that the Mine is active/in operation. The inspection and maintenance logs will be kept on site or in the mine operator's possession whenever the operator is on site.

## 1.6.8.1 Secondary Containment

Within the Staging Area, a secondary containment area shall be constructed by laying an impervious liner on stable, level ground to prevent infiltration to groundwater, and constructing a compacted soil berm to prevent runoff from contaminating other soil or surface water. All surfaces within the secondary containment area including the containment berms shall be sufficiently impervious to contain any spilled or released material. Containment berms are not to be constructed with topsoil or coarse, insufficiently impervious overburden material.

Secondary containment areas shall be constructed to fully accommodate any fuel, lubricant, or other petroleum hydrocarbon material storage as well as any fuel supply vehicles and shall enclose an area sufficient to contain 150 percent of the largest single fuel/lubricant tank. The secondary containment area shall be inspected at regular intervals and maintained in good condition. No potential ignition sources shall be placed or stored inside the secondary containment area. "No Smoking" signs shall be placed prominently around the secondary containment area so as to be visible from all directions.

## 1.6.8.2 Waste Disposal

General domestic solid wastes (garbage) are considered non-hazardous materials, and include food wastes, non-hazardous packaging wastes, non-petroleum oils and greases, and other non-hazardous solid materials considered inert.

Due to possibility of theft and vandalism at the mining site, no waste container will be located on-site. All domestic solid wastes shall be collected daily by the mine operator, removed from the site, and disposed of legally and properly at an appropriate off-site waste disposal facility. No illegal dumping or littering shall occur.

The following materials are considered potentially hazardous materials and shall be disposed of at a legal, appropriate, off-site, permitted hazardous waste disposal facility:

- Spent oil filters and petroleum containers
- Used car/truck/equipment batteries
- Pressurized or empty aerosol cans
- Empty reagent containers or drums
- Other containers holding resins, solvents, glues/cements, cleaners, or paint
- Used petroleum products
- Absorbent materials used in any spill cleanup

Potentially hazardous wastes shall be containerized, and these wastes and empty hazardous materials containers shall be periodically removed for disposal in conformance with all applicable federal and state requirements. At the completion of all mining and reclamation activities, all hazardous materials and hazardous wastes shall be removed from the site and disposed of properly.

## 1.6.8.3 Spill Prevention and Response Plan

Report all spills immediately to the BLM/RPFO and to the NMED as required by the New Mexico Water Quality Control Commission Regulations (20.6.2.1203 NMAC). For non-emergencies during normal business hours, call the NMED at (505) 476-6000. For non-emergencies after hours, call (866) 428-6535 or (505) 428-6535 (voice mail, 24 hours a day). For emergencies only, call (505) 827-9329 24 hours a day (NM Department of Public Safety).

A spill cleanup kit shall be maintained at the Mine site at all times or within the mine operator's work vehicle at the Mine site during all hours of operation. Typically, a spill cleanup kit is capable of cleaning up to a 25-gallon spill. The contents of the spill cleanup kit include absorbent materials, disposable waste bags, and personal protective equipment.

Spills shall be controlled using absorbents. Once the spill source is stopped and the spill is retained, the absorbents shall be removed and placed in the disposable waste bags and stored in a well-ventilated location until they can be disposed of properly off-site. Petroleum hydrocarbon contaminated soils shall be removed completely and placed in the secondary containment area.

Soils contaminated with petroleum hydrocarbons shall be remediated in accordance with the following procedures:

- Excavate and collect all traces of contaminated soil from the spill site immediately after spill or leakage is discovered.
- Contaminated soils shall be collected in clean, covered 50-gallon containers, clearly labeled "Contaminated Soils" and stored within the secondary containment area pending disposal.
- Contaminated soil shall be taken to an off-site solid waste facility permitted to accept petroleum hydrocarbon contaminated soils for disposal in accordance with all applicable federal and state requirements.

A record shall be maintained for all spills and shall contain the following information:

- Date and time of the event
- Name of spill reporter
- Location of the spill
- Spill cause
- Type of contaminant
- Spill volume
- Determination of the affected areas
- Any affected communities
- Corrective actions taken

Where required, a report shall be submitted to the pertinent federal or state authorities. A sample spill report is included in the BLM's Gold Book and can be downloaded online (USDI/USDA 2007). Incident documentation shall be kept on file with Rammsco, Inc. for a minimum of 5 years.

## 1.6.9 Mine Safety

Mining and reclamation operations will be designed and operated to safeguard the general public. *Caution* signs and *Unauthorized Personnel—Keep Out* signs will be posted at the Mine. During mining operations, pit/quarry side slopes will be regularly graded to angle of repose or less to prevent slope collapse or trench stabilizers will be used. Final slopes of all reclaimed areas will not exceed the ratio of 3-foot height to 1-foot vertical (3H:1V). Shafts, adits, highwalls, and tunnels are not present or part of the humate mining process; therefore, these do not pose a hazard to Mine personnel or the public.

## 1.6.10 Archeological, Paleontological, Historical, and Cultural Sites

If previously undocumented archaeological, cultural, or paleontological resources or artifacts are discovered or encountered during any Mine operations, all activities will immediately stop near the discovery and the BLM Discovery Stipulation shall be followed (refer to Section 1.2.11, Paleontological Sites, for the BLM Discovery Stipulation).

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## 2. RECLAMATION PLAN

### 2.1 Objectives

The objective of the Rammsco Eagle Mesa Mine humate mining operation is to extract the permitted mineral resource and reclaim all disturbed areas of the mining operation to a condition as good as or better than the pre-mining surface. The reclaimed areas will be a self-sustaining ecosystem blending with the undisturbed ecosystem surrounding the operation.

Pre-mining land use is livestock grazing and wildlife habitat. Post-mining land use is expected to be the same or similar. The location of the mining operation is within the current Star Lake Community grazing allotment, which receives moderate to heavy grazing use by cattle and horses.

All reclaimed areas shall be stable and exhibit none of the following characteristics:

- Large rills or gullies (greater than 3 inches wide or deep)
- Perceptible soil movement or head cutting in any drainages
- Slope instability on or adjacent to the reclaimed area

### 2.2 Visual Resource Standards

The reclaimed landscape will approximate the visual quality of adjacent and surrounding areas regarding surface contouring, drainage patterns, vegetation, and visual texture. All facilities and infrastructure will be removed upon completion of mining activities and disturbed surfaces, access roads, and the Mine site will be restored to as near-natural contours as feasible according to the progressive reclamation plan. All identified disturbed areas will be revegetated using plant species appropriate to the site (Table 2-2).

### 2.3 Reclamation Bond

As part of the MMD Mining Permit and the BLM/RPFO MMSC, an FA estimate from the mine operator is required. This estimate is based on the cost of reclaiming the site by a third party. The FA bond must be placed jointly in the name of the State of New Mexico EMNRD-MMD and the United States Department of the Interior/BLM. Applicable bonding methods include a Surety Bond, CD, or a cash account. MMD can provide further information on bonding methods if needed. MMD requires a minimum 12-year period after reclamation for withholding release of the FA for third-party re-vegetation costs. Other FA for reclamation costs such as earth moving may be released earlier pursuant to 19.10.12.1210 NMAC.

A reclamation bond estimate is provided in Appendix B. The estimate is for a reclamation area of 14.29 acres, which is the maximum acreage the Mine will have open/ disturbed at any given time under the Mining Permit (see Table 1-5 in Section 1.3.3, Stage III: Mine Operation).

## 2.4 Reclamation Sequence

### 2.4.1 Initial Reclamation

As described in Section 1.1 General Information, approximately 4.55 acres outside of the 2014 Contract Area was mined under a previous contract; earthwork and seeding has been completed for this acreage. Limited vegetation cover in this area, however, has contributed to ongoing rill-erosion from stormwater run-on in adjacent areas. Areas to be mined in Phase IV and the road proposed to access them, east of the area considered to be fully reclaimed, shall be graded to provide proper drainage and stable slopes (3H:1V or flatter) to prevent additional erosion in the 4.55-acre reclaimed area.

Additionally, Rammsco has completed earthwork and seeding for approximately 6.57 acres of previously mined areas. However, as discussed during the November 2, 2018 site visit to the Mine, saltlover (*Halogeton glomeratus*), a Class B noxious weed in the State of New Mexico, was observed growing in the portion of the mine seeded in 2018, in the northwest section. Rammsco, in accordance with Condition 9.P of MMD Permit Modification 16-1, will continue to:

1. Train on-site personnel to recognize *Halogeton*,
2. Complete two inspections per year (in May-June and after monsoon season) of all disturbed areas,
3. Spot-treat *Halogeton* plants using an appropriate herbicide in strict accordance with the manufacturer's recommendations or remove *Halogeton* mechanically, and

Decontaminate new mining equipment prior to introduction into the Contract Area.

### 2.4.2 Progressive Reclamation

As part of the progressive mining and reclamation plan, reclamation of each progressively mined phase will be initiated in the order described in Tables 1-5 and 2-1, and Map A-4 of Appendix A. Implementation of reclamation will follow Section 2.5, Reclamation Activities.

The reclamation of the Mine site shall be accomplished in concert with the mining activities under a progressive reclamation schedule based on mining phases (Table 1-5). Beginning with Phase IIa and IIb, as the mineral resources have been extracted from a mining phase and the mining operation moves into the next mining phase, reclamation of the just-completed mining phase shall be initiated. This sequence shall continue through all Mining phases as described in the Schedule of Mining and Reclamation Work (Table 2-1).

Reclamation of mined areas shall occur as follows:

- Surface Re-contouring and Seedbed Preparation
  - Backfill of excavated areas with stockpiled subsurface overburden materials
  - Contouring of reclaimed subsurface to 3H:1V or flatter
  - Even placement of stockpiled topsoil over area to be reclaimed
  - Harrowing of final topsoil grade for seedbed preparation
- Seeding and Mulching



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- Seed application by broadcast or drill seeding (preferred)
- Application of mulch
- Stabilizing mulch through punching or crimping
- Monitoring
  - Baseline plots established
  - Two monitoring plots randomly located within each reclaimed phase, with two transects each
- Invasive/Noxious Species Control until release of bond

Reclamation of Phase IIc will deviate slightly from the progressive reclamation schedule. Once the mineral materials have been extracted from the mined area, the area will be re-contoured using stockpiled overburden. Subsequently, portions of the Phase IIc area will be used as additional area for overburden stockpiles and to access areas proposed for mining in Phases IVa and IVb until reclaimed in Period 7 (Table 1-5).

**Table 2-1. Schedule of Mining and Reclamation Work**

Mining Phase	Operation	Task	Expected Task Duration (days) <sup>1, 2, 3</sup>	Total Mining Phase Duration <sup>3</sup>
<b>PHASE I (6.57 acres)</b>	Reclamation	Treatment for <i>Halogeton</i>	ongoing	ongoing
<b>PHASE IIa and IIb (3.51 acres)</b>	Topsoil & Overburden Removal	Stockpiling	15 days	345 days
	Mining	Humate/"Organic Clay" Removal	300 days	
	Reclamation	Surface Re-contouring	15 days	
		Seedbed Preparation	5 days	
		Seeding and Mulching	5 days	
		Erosion Control	5 days	
<b>New Access Road (0.62 acres)</b>	Topsoil & Overburden Removal	Stockpiling	10 days	12 days
	Initial Reclamation	Surface Re-contouring	1 day	
		Erosion Control	1 day	
<b>PHASE IIc<sup>4</sup> (0.67 acres)</b>	Topsoil & Overburden Removal	Stockpiling	10 days	75 days
	Mining	Humate/"Organic Clay" Removal	60 days	
	Initial Reclamation <sup>4</sup>	Surface Re-contouring	1 day	
		Erosion Control	1 day	
<b>PHASE IIIa</b>	Topsoil & Overburden Removal	Stockpiling	5 days	117 days

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Mining Phase	Operation	Task	Expected Task Duration (days) <sup>1, 2, 3</sup>	Total Mining Phase Duration <sup>3</sup>
<b>(1.10 acres)</b>	Mining	Humate/"Organic Clay" Removal	100 days	
	Reclamation	Surface Re-contouring	3 days	
		Seedbed Preparation	2 days	
		Seeding and Mulching	2 days	
		Erosion Control	5 days	
<b>PHASE IIIb (3.32 acres)</b>	Topsoil & Overburden Removal	Stockpiling	15 days	345 days
	Mining	Humate/"Organic Clay" Removal	300 days	
	Reclamation	Surface Re-contouring	15 days	
		Seedbed Preparation	5 days	
		Seeding and Mulching	5 days	
		Erosion Control	5 days	
<b>PHASE IV Road (0.25 acre)</b>	Topsoil & Overburden Removal	Stockpiling	3 days	5 days
	Initial Reclamation	Surface Re-contouring	1 day	
		Erosion Control	1 day	
<b>PHASE IVa<sup>4</sup> (3.23 acres)</b>	Topsoil & Overburden Removal	Stockpiling	15 days	345 days
	Mining	Humate/"Organic Clay" Removal	300 days	
	Reclamation (with exception of Access Road to Phase IVb <sup>4</sup> )	Surface Re-contouring	15 days	
		Seedbed Preparation	5 days	
		Seeding and Mulching	5 days	
		Erosion Control	5 days	
<b>PHASE IVb (2.58 acres)</b>	Topsoil & Overburden Removal	Stockpiling	10 days	255 days
	Mining	Humate/"Organic Clay" Removal	200 days	
	Reclamation	Surface Re-contouring	10 days	
		Seedbed Preparation	5 days	

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Mining Phase	Operation	Task	Expected Task Duration (days) <sup>1, 2, 3</sup>	Total Mining Phase Duration <sup>3</sup>
		Seeding and Mulching	5 days	
		Erosion Control	5 days	
<b>FINAL RECLAMATION</b> (Period 8 in Table 1-5) <b>(0.87 acres)</b>	Reclamation of all remaining disturbed areas within the Contract Area; Reclamation of all haul/access roads	Rip Haul Road/Re-contouring	2 days	7 days
		Surface Re-contouring	1 day	
		Seedbed Preparation	1 days	
		Seeding and Mulching	2 days	
		Erosion Control	1 days	

<sup>1</sup>Weather permitting.

<sup>2</sup>Based on Section 1.3, Proposed Operations.

<sup>3</sup>Each mining duration period is variable based on the current global economy and the demand for product. The mine operator has no long-term contracts, but instead produces based solely on demand.

<sup>4</sup>Portions of some mined areas will be kept open for stockpiles and access to other areas.

Final reclamation for the Contract Area will include final grading, soil preparation, seeding, mulching, erosion control, and fencing of the all remaining disturbed (un-reclaimed) areas within the Contract Area.

The Schedule of Mining and Reclamation Work shown in Table 2-1 does not account for weather contingencies, but activities that cannot be completed under the schedule due to weather will be completed as soon as the weather allows, limiting exposure of non-reclaimed surfaces.

The MMD requires at least 2 weeks' notice prior to the commencement of reclamation approved in this Reclamation Plan.

## 2.5 Reclamation Activities

### 2.5.1 Surface Re-contouring

Excavated areas shall be backfilled with stockpiled subsurface materials only; topsoil shall not be placed as backfill. Subsurface soils shall then be contoured (graded) to match original slopes as closely as practicable, with no slopes exceeding 3H:1V. Stormwater runoff shall be contained using the existing catch-pond in area R-1, and additional catch-ponds or other BMPs shall be designed to contain surface water runoff within the Contract Area and follow the USEPA's Stormwater discharge regulations for all remaining phases. A proposed post-reclamation contour map is provided as Figure 5 in Appendix A.

### 2.5.2 Seedbed Preparation

Areas of compacted subsoils shall be ripped to a depth of 12 inches, followed by disking to a depth of 6 inches before placement of topsoil. The topsoil layer in the Mine is relatively thin and stockpiled quantities are limited;

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therefore, a minimum of 4 inches of stockpiled topsoil shall be placed evenly over the re-graded subsurface soils. The surface shall then be tine- or chain-harrowed to break up any soil clumps, smooth the surface grade, and prepare the soil for seeding.

No soil amendments or fertilizers shall be applied to reclamation areas. The MMD does not support the use of chemical fertilizers in reclaimed areas, as they generally promote the growth of weedy annual species that may suppress the establishment of native perennial species (D. Ohori, email to Ecosphere November 29, 2012).

## 2.5.3 Seeding

Seed shall be sowed across the mine reclamation areas using broadcast or drill seeding methods. Hydroseeding is not recommended for native seed due to poor seed-soil contact percentage and the tendency of the seed to self-sort by weight and size; therefore, resulting in uneven distribution during application.

Drill seeding is the preferred seeding method, since it places seed below the soil surface where it will have good seed-soil contact and be protected from granivorous rodents and birds. Drill seeding also ensures the proper seed density if used over the entire site and reduces the loss of seed due to wind and water erosion. Drill seeding may be used on well-packed and stable soils on gentler slopes where tractors and drills are safely able to operate. Drill seeders are specifically designed to concurrently apply seed of differing size, shape, and weight, including native seed as specified here, and have a much lower rate of clogging and self-sorting.

Drill seeding shall be accomplished using a disk-type drill with two boxes for various seed sizes. Drill rows shall be 8 to 10 inches apart, and the seed shall be placed no deeper than one-half inch below the surface. After drilling, a packer or roller shall be used to achieve adequate compaction and ensure uniform seed coverage. Drilling shall follow the contour, and not up and down the slope. The recommended seed mix and drill seeding rate is provided in Table 2-3.

Where drill seeding is not practicable due to topography, the contractor shall hand-broadcast seed using a “cyclone” hand seeder or similar broadcast seeder. Seed shall then be raked-in so that it is planted no deeper than one-half inch below the surface. Broadcast application of seed requires a doubling of the drill seeding rate. The recommended drill seeding rate is provided in Table 2-2.

**Table 2-2. Seed Mix and Recommended Drill Seeding Rate**

Species	Application Rate <sup>1</sup> (lbs/acre)	Contribution in Seeds/sq. ft. Based on Planting Rate
Western wheatgrass ( <i>Pascopyrum smithii</i> )	5.0	13
Blue grama ( <i>Bouteloua gracilis</i> )	2.0	38
James' Galleta ( <i>Pleuraphis jamesii</i> )	2.0	8
Indian ricegrass ( <i>Achnatherum hymenoides</i> )	4.0	13
Mountain brome ( <i>Bromus marginatus</i> )	4.0	6
Fourwing saltbush ( <i>Atriplex canescens</i> )	3.0	4
Scarlet globemallow ( <i>Sphaeralcea coccinea</i> )	0.1	2
<b>TOTAL:</b>	<b>20.1</b>	<b>84</b>

<sup>1</sup> If broadcast seeding, this rate shall be doubled.

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The seed mix in Table 2-2 has been recommended by the New Mexico EMNRD MMD in humate mine areas where halogeton is present (D. Otori, email message to Ecosphere, August 8, 2012). Any seed mixture used in reclamation or erosion control activities must be certified weed-free, with no primary or secondary noxious weeds in the seed mixture. Seed labels from each bag shall be kept on site and made available to the BLM staff for inspection during seeding activities.

Seeding shall be repeated if a satisfactory stand has not established as determined by the BLM's authorized officer following evaluation after the second growing season (USDI/BLM 2012), or as determined by the MMD representative for release of the FA bond.

## 2.5.4 Mulching

Previous studies in the southwest have found that mulching provides newly-sown seeds with the best opportunity to utilize what little precipitation occurs (USDA/NRCS, no date). The mulch benefits the seeding effort by reducing evaporation of soil moisture, reducing wind desiccation, limiting soil erosion, insulating the surface from temperature extremes, and increasing the infiltration rate of precipitation by protecting the soil surface from surface sealing. It may further aid revegetation by trapping windblown seeds and soil.

Straw mulch can be applied by hand broadcasting or blowing to a uniform depth of 2 to 3 inches, equivalent to a rate of about 2 tons per acre (one 74-pound bale per 800 square feet). When applied properly, approximately 20 to 40 percent of the original ground surface can be seen. Only certified weed-free straw shall be used for mulching.

Straw mulch shall then be anchored using one of the following methods:

- **Hand Punching**—A spade or shovel is used to punch straw into the slope at 12-inch intervals until all areas have straw standing perpendicularly to the slope and embedded at least 4 inches into the slope.
- **Roller Punching**—A roller equipped with straight studs not less than 6-inches long, from 4- to 6-inches wide and approximately 1-inch thick is rolled over the slope.
- **Crimper Punching**—Like roller punching, the crimper has serrated disk blades about 4-to 8-inches apart, which force straw mulch into the soil. Crimping should be done in two directions with the final pass across the slope.

## 2.5.5 Erosion Control and Stormwater

Discharge of stormwater from disturbed areas to any watercourse may be a violation of the Clean Water Act. At the Mine, stormwater generated from the mining area during precipitation events collects within the closed basin created by the mining pit. Stormwater that collects within the pit is pumped into a constructed sediment basin within the pit to infiltrate slowly back into the subsurface soils. Stormwater is therefore not discharging into any perennial or ephemeral watercourse. The mine operator and a representative from the MMD observed during a May 2013 site visit that there were no apparent outfalls from the minable Contract Area that would discharge stormwater collected during a 100-year precipitation event into any watercourse.

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To prevent any potential, direct impacts to surface water and ephemeral watercourses, a variety of structural and non-structural BMPs shall be used at the Mine to manage stormwater. These BMPs are described in Table 2-3 below and shall comply with BLM Gold Book standards (USDI/USDA 2007). BMPs will be applied to locations described below and shall remain in proper functioning condition until final stabilization is reached. BMPs will be maintained or amended by the mine operator as site conditions change throughout the mining and reclamation process.

**Table 2-3. Erosion Control BMPs**

BMP	How It Works	Location at Eagle Mesa Mine
Setbacks	Setting back ground-disturbing activities from perennial or ephemeral watercourses provides a buffer between potential sediment sources and the watercourse. All mining activities and associated disturbance will be set back a minimum of 100 feet from any perennial or ephemeral watercourses.	Ephemeral drainage southwest of the minable Contract Area.
Berms	Soil berms built on the downhill side of a disturbed area (either in the active mining area or the reclaimed area) trap stormwater. Berms should be 3 feet high and compacted to be effective.	Topsoil and overburden stockpiles, and at the base of any sloped, disturbed areas that drain outside of the Contract Area.
Mining Pit	In the open pit area, all stormwater is contained in the pit.	Active mining area.
Rapid Reclamation	Rapid reclamation (surface contouring, surface roughening, and seeding) help to stabilize soil with vegetation.	Topsoil and overburden stockpiles, reclaimed areas.
Sediment Basin	There is one sediment basin within the Mine, which collects stormwater from the eastern half of the Mine. It is a closed basin (no outlet). Southwest of the minable Contract Area are two sediment basins (or stock ponds), which collect and hold for infiltration some surface runoff from the extreme southwest portion of the active mining area. All three impoundments allow the sediment to settle out of the water, and the water to infiltrate back into the subsurface soils.	Centrally-located among Phase II Mining areas.
Surface Contouring	Surface contouring (grading) creates low spots where water collects or directs stormwater into a sediment pond.	Reclaimed areas.
Stockpile Location Planning	All stockpiles will be located on flat ground, away from drainage areas. This reduces the chance of materials slumping downhill or being carried away by surface water flows.	Active mining and storage areas.
Stockpile Stabilization	Topsoil and overburden soils to remain stockpiled greater than 6 months (180 days) shall be seeded with the herbaceous components of the reclamation seed mix provided in Section 2.5.3–Seeding to provide erosion control. This will protect the soil from eroding or mobilizing and will maintain the existing microorganisms and other soil	Topsoil and overburden stockpiles.

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BMP	How It Works	Location at Eagle Mesa Mine
	constituents through natural nutrient cycling. Shrub seed is not required for stockpile stabilization. Soil berms shall be constructed around the base of the stockpiles to 3 feet high and compacted.	
Surface Roughening	Surface roughening creates small ridges and gullies with the teeth of the bucket of the front end loader or with the grooves of tracked equipment. These ridges and gullies go across the slope (that is, along the contour of the slope), trapping stormwater and helping with revegetation. To create these ridges/gullies with tracked equipment, the equipment should be run up/down the slope (that is, perpendicular to the contour of the slope).	Reclaimed areas.

Additional erosion control and stormwater monitoring procedures are outlined in the *Stormwater Pollution Prevention Plan for Eagle Mesa Mine* (Ecosphere 2019).

## 2.5.6 Reclamation Protection/Fencing

During and following reclamation activities, Rammsco shall monitor and protect the reclaimed landscape to help ensure reclamation success to the BLM and MMD requirements. Fencing of the reclaimed areas is intended to protect the newly seeded areas from livestock impacts and fencing of the 1-acre Vegetation Reference Area (see Section 2.8—Revegetation Monitoring) is intended to exclude livestock and human disturbance. A 3-strand wire fence (top wire smooth, bottom two wires barbed) with wires at 16, 26, and 38 inches above the ground and stays approximately 15 feet apart shall be installed around the 2019 Mine Contract Area (Fenceline, Map A-3, Appendix A). This fencing conforms to New Mexico Department of Game and Fish standards for fencing in big game habitats. Fencing may be removed by the mine operator at the time the reclamation is deemed successful by the BLM/RPFO and the MMD.

## 2.6 Final Reclamation of Haul Roads

When all mining and reclamation activities have been completed within the Contract Area, all remaining haul roads shall be ripped to a minimum depth of 12 inches. After ripping, water bars shall be installed. The haul road alignments shall then be harrowed using a tine- or chain-harrow to break up any soil clumps, smooth the surface grade, and prepare the soil for seeding.

Seed and mulch shall be applied as directed for Reclamation Activities (see Sections 2.5.3, Seeding and 2.5.4, Mulching).

Following seeding and mulching of the haul roads, and upon final exit of the Contract Area with all mining and reclamation equipment, an earthen barricade shall be constructed just south of Tinian Road, across the entrance to the main haul road, to deter future vehicle access to the reclaimed Contract Area.

Invasive and noxious species control requirements as described below shall be applicable to reclamation of all haul roads in addition to all reclaimed mining areas.

## 2.7 Invasive/Noxious Species Control

Noxious weed control is a BLM-required compliance action for surface reclamation (USDI/BLM 2012). The objective of the BLM/RPFO weed management program is to detect invasive plant species populations, prevent the spread of new invasive populations, manage existing populations using the tools of integrated weed management, and eradicate invasive populations using the safest environmental methods available. Preventing the introduction of noxious weeds into an area is the most effective and economical means of weed control and management.

The BLM/RPFO list of invasive, non-native plant species of concern and the New Mexico Noxious Weed List are provided in Appendix C.

Rammsco shall take all reasonable precautions to prevent the introduction, establishment, and spread of noxious weeds on lands covered by this Mine project and on adjacent lands. Noxious weed treatment and control shall be done as necessary to promote revegetation with native plants and prevent the spread of noxious weeds. Prevention methods shall be implemented before, during, and after all mining and reclamation activities to reduce the spread of noxious weeds or the invasion of disturbed areas by undesirable plant species. These prevention methods include:

- Removing all mud, dirt, and plant parts from all off-road equipment used at other projects before moving them into the Contract Area
- Using only defined and established travel routes to minimize soil disturbance
- Using mulch to protect establishing vegetation

The mine operator shall be responsible for weed identification and control on disturbed and reclaimed areas within the limits of the Mine and associated roads. The mine operator shall conduct a weed survey to identify noxious species twice every year (once early in the growing season [May] and once after the monsoon season [September]). The mine operator is responsible for consultation with the BLM and/or local authorities for acceptable weed control methods. During any Stage of mining operations (see Section 1.3—Proposed Operations), any noxious or invasive species observed within the mining area shall be treated in a manner consistent with the BLM/RPFO standards.

Use of pesticides and herbicides shall comply with applicable federal/state laws. Pesticides and herbicides shall be used only in accordance with their registered uses and within limitations imposed by the Secretary of the Interior. Prior to the use of pesticides or herbicides, the mine operator shall obtain from the BLM written approval of a plan showing the type and quantity of material to be used, pest(s) to be controlled, method of application, location of storage and disposal of containers, and any other information deemed necessary. Emergency use of pesticides or herbicides shall be approved in writing by the BLM/RPFO prior to use.



## 2.8 Revegetation Monitoring

Revegetation monitoring will occur during the last 2 years of the bonding period.

### 2.8.1 Vegetation Reference Area

The Vegetation Reference Area will be used as a standard of comparison for determining revegetation success for perennial vegetation cover. The Vegetation Reference Area is a 1-acre area undisturbed by mining operations, located immediately west of the minable Contract Area and north of the access road into the Contract Area, and containing established native vegetation cover equivalent to the undisturbed areas of the Mine. The location of the Vegetation Reference Area established for the 2013 MRP is within areas proposed for new mining. Thus, a new Vegetation Reference Area is proposed west of the 2019 Contract Area, between the old access road and the proposed new access road. Upon final approval of the location by the MMD, the Vegetation Reference Area will be fenced to prevent human or livestock disturbance.

### 2.8.2 Methodology and Success Criteria

Reclamation revegetation monitoring will incorporate two methodologies—ocular estimation for overall vegetative cover and belt transects for shrub cover. Data gathered from the Vegetation Reference Area will constitute the basis of performance standards for determining reclamation success. Revegetation monitoring locations, methods, and success criteria will be approved by the MMD prior to monitoring commencement.

#### 2.8.2.1 Ocular Estimation (Overall Vegetation)

Vegetation cover monitoring will be conducted by ocular estimation, a vegetation monitoring technique used to determine the vegetative cover of a reclamation area compared to vegetative cover in a pre-designated reference area (the Vegetation Reference Area).

A quadrat or frame plot 20 cm x 50 cm in size will be utilized. Ten quadrats will be randomly placed in the Vegetation Reference Area and data from the quadrat plots collected. In the area of reclamation, 10 quadrats will be randomly placed for every full acre of reclamation and data from the quadrat plots collected. For reclamation acreage under one full acre, at least 10 quadrats will be randomly placed within the reclamation area. One hundred percent bare soil will not be accepted as reference data for a quadrat plot.

The percent of ground covered within the quadrat will be estimated (to the nearest percent) as a vertical projection. Ground cover will be recorded by vegetation, litter (including woody debris), rock, or bare soil. Vegetation data should be reported by individual species and by total vegetation cover. Species values can exceed 100 percent due to overlap. Total vegetation cover, when added to the vertical projection of litter, rock, or bare solid contained within the plot, will equal 100 percent.

Total vegetation cover for the Vegetation Reference Area will be determined as an average of the total vegetation cover of the 10 quadrat plots. This total vegetation cover constitutes the basis of performance standards for the reclamation areas.

Total vegetation cover for the reclamation area will be determined as an average of the total vegetation cover across all quadrat plots for the reclamation area. This total vegetation cover will be compared to the Vegetation Reference Area cover as part of determining overall reclamation success.

Sorensen's Similarity Index for vegetation cover will be provided in the final monitoring report for review by the BLM/RPFO and MMD. Sorensen's Similarity Index can be calculated as follows (Sorensen 1948):

$$SI = \frac{2C}{A + B} \times 100$$

Where: *SI* = Similarity Index;

*A* = Total number of species in Vegetation Reference Area;

*B* = Total number of species in Reclamation Area; and

*C* = Number of species common to both communities.

## 2.8.2.2 Belt Transect (Shrubs)

Revegetation monitoring of shrub cover/density per acre will be determined through belt transect methodology. A randomly-placed 50-meter straight-line transect is established within the survey area (Vegetation Reference Area or Reclamation Area) using a 50-meter tape secured at both ends. Shrubs are counted within the area extending one meter from the transect line, on one side of the tape only (the 'belt'). The number of shrubs that are rooted within the 1-meter-wide belt are counted, even if all of the shrub canopy is not within the belt. Shrubs that are not rooted within the belt are not counted. The number of shrubs per acre is obtained by multiplying the number of shrubs counted in the belt by 43,560, then dividing the product by the area of the belt, or 538.196 (50 square meters = 538.196 square feet).

Two shrub belt transects will be counted within the Vegetation Reference Area, and the number of shrubs per acre averaged between the two transects. This shrub cover/density per acre constitutes the basis of performance standards for the reclamation areas.

For the reclamation areas, two shrub belt transects for every 1 acre of reclamation will be counted. Acreages will be rounded to the nearest whole number. For example, if the reclamation area is 4.6 acres in size, the acreage would be rounded to 5, and ten randomly placed belt transects will be counted. Similarly, a 4.3-acre reclamation area would be rounded to 4 acres, and eight belt transects counted. The number of shrubs per acre within the reclamation area will be an average of all the shrubs-per-acre counts for all the belt transects in the reclamation area. This total shrub cover/density per acre will be compared to the Vegetation Reference Area cover/density as part of determining overall reclamation success.

## 2.8.2.3 Success Criteria

Revegetation success criteria is based on professional judgment of reasonable expectations for revegetation in the arid Great Basin Desert Scrub vegetation community over the course of a 12-year FA bonding period. Success criteria may be revised by the BLM/RPFO or the MMD based on agency-specific requirements.

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Vegetation cover at the Mine will be considered successfully attained if the reclaimed area equals at least 75 percent of the vegetation cover in the Vegetation Reference Area. Species diversity using the Sorenson Similarity Index shall approximate Vegetation Reference Area conditions, and invasive species percent cover does not exceed that of the Vegetation Reference Area.

Shrub cover/density per acre will be considered successfully attained if the reclaimed area shrub density per acre equals at least 35 percent of the shrub density of the Vegetation Reference Area.

## 2.8.3 Bond Release

Once the FA bond period is attained and the vegetative success criteria standards are met, Rammsco will prepare and submit a letter requesting the BLM and MMD release Rammsco from financial responsibility for the mining area. MMD requires a minimum 12-year period after reclamation for withholding release of FA for third-party revegetation costs. Other FA for reclamation costs, such as earth-moving, may be released earlier pursuant to 19.10.12.1210 NMAC (D. Otori, email message to Ecosphere, November 29, 2012).

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# Eagle Mesa Mine Mining and Reclamation Plan

Ecosphere Environmental Services, Inc.

## 4. List of Preparers

Name	Title	Role
Jerusha Rawlings	Project Manager	<ul style="list-style-type: none"><li>▪ Project Management</li><li>▪ Technical Review</li><li>▪ GIS and Mapping</li></ul>
Karin Freeman	GIS	<ul style="list-style-type: none"><li>▪ Technical Review</li><li>▪ GIS Support</li></ul>
Cindy Lancaster	Senior Technical Editor	<ul style="list-style-type: none"><li>▪ Document Formatting</li><li>▪ Editing</li><li>▪ Quality Control</li></ul>



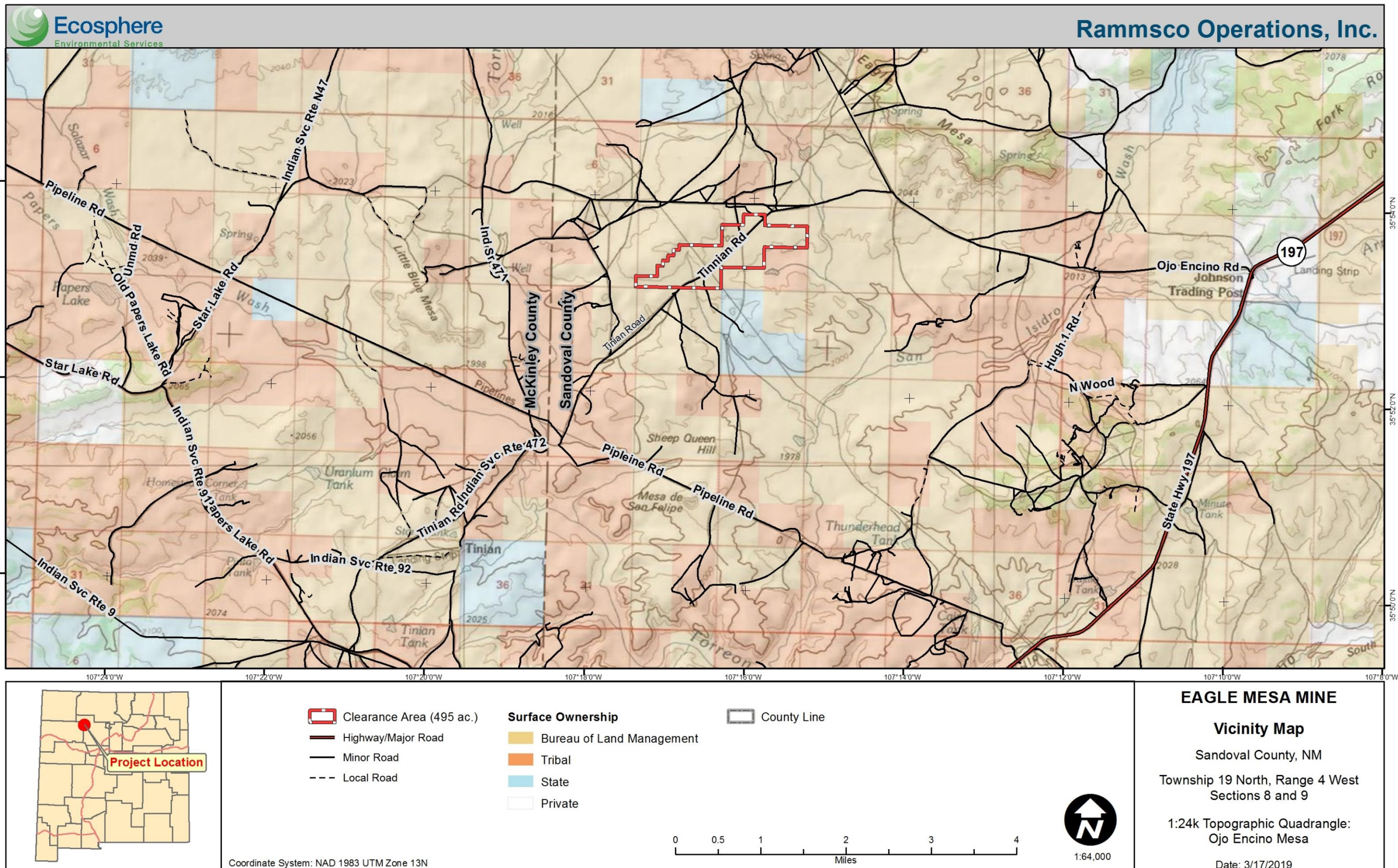


# Eagle Mesa Mine Mining and Reclamation Plan

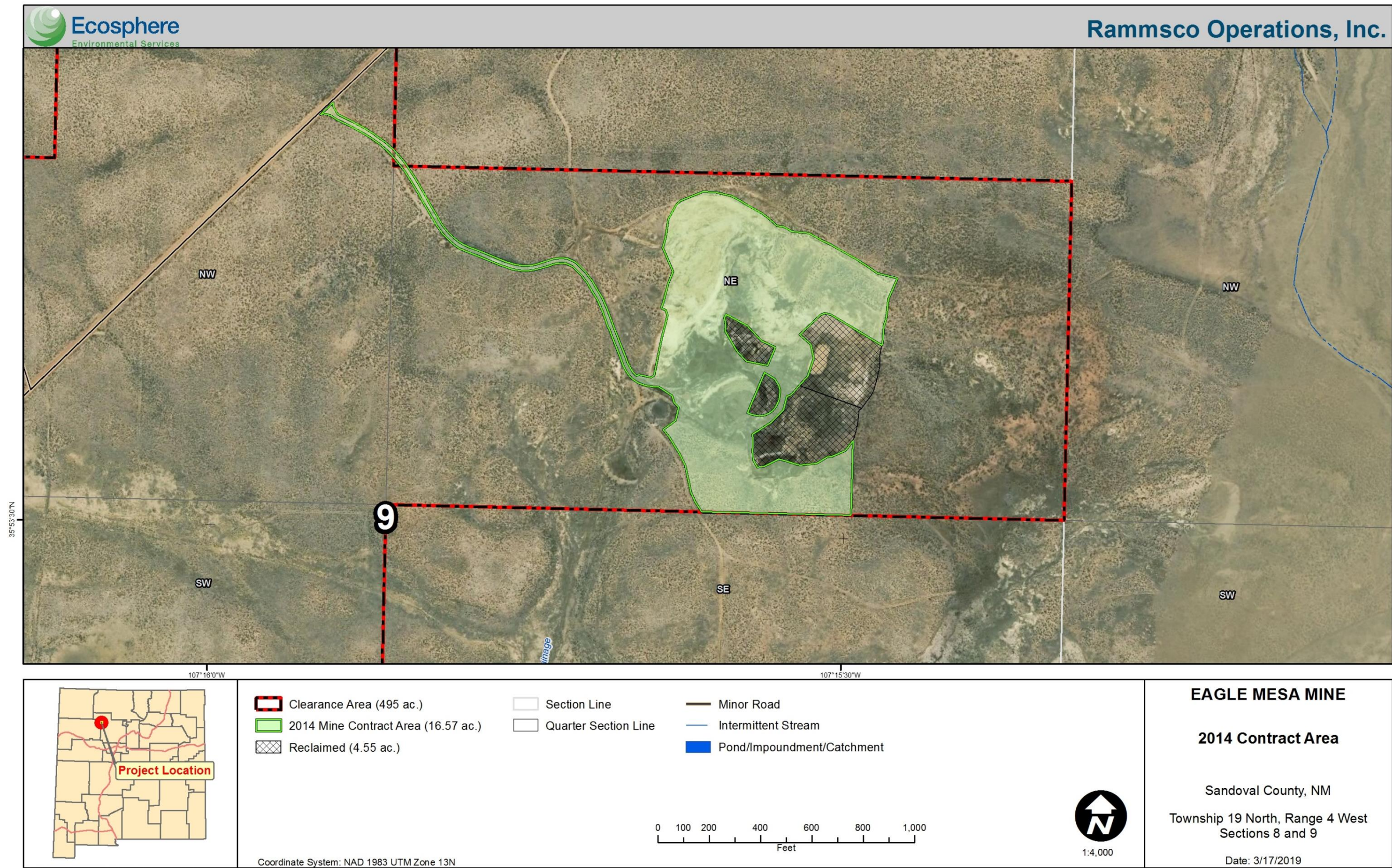
Ecosphere Environmental Services, Inc.

## Appendix A – Maps

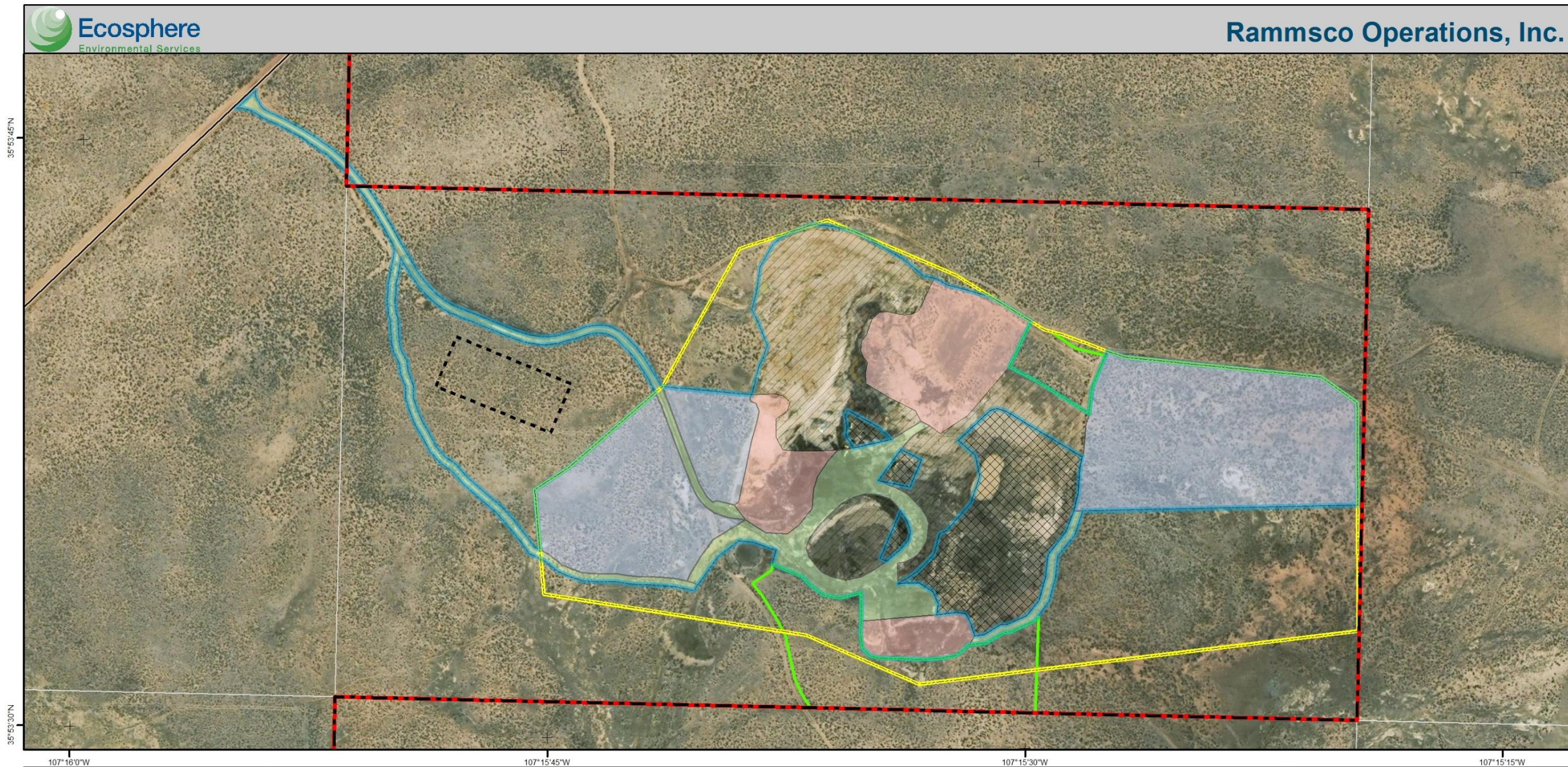




Map A-1. Vicinity Map



Map A-2. 2014 Contract Area



<ul style="list-style-type: none"> <li><span style="border: 2px dashed red; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Clearance Area (495 ac.)</li> <li><span style="border-bottom: 2px dashed yellow; width: 20px; margin-right: 5px;"></span> Fenceline</li> <li><span style="border: 2px solid blue; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> 2019 Mine Contract Area (24.76 acres)</li> <li><span style="background-color: #f8d7da; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Active Mining Areas (4.18 acres)</li> <li><span style="background-color: #d1ecf1; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Additional Mining Area (10.23 acres)</li> <li><span style="background-color: #d4edda; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Storage, Staging, and Roads (3.79 acres)</li> </ul>	<ul style="list-style-type: none"> <li><span style="border: 2px solid green; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Acreage Removed from 2014 MMSC (3.83 acres)</li> <li><span style="background: repeating-linear-gradient(45deg, transparent, transparent 2px, black 2px, black 4px); border: 1px solid black; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Fully Reclaimed, BLM Approved - Previously mined (pre-2014, 3.72 acres)</li> <li><span style="background: repeating-linear-gradient(-45deg, transparent, transparent 2px, black 2px, black 4px); border: 1px solid black; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Earthwork and seeding performed - Previously Mined (Since 2014, 6.57 acres)</li> <li><span style="border: 2px dashed black; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Vegetation Reference Area</li> <li><span style="border-bottom: 1px solid white; width: 15px; display: inline-block; margin-right: 5px;"></span> Quarter Section Line</li> </ul>
--	---

Coordinate System: NAD 1983 UTM Zone 13N

0 100 200 400 600 800 1,000  
Feet

1:3,000

**EAGLE MESA MINE**

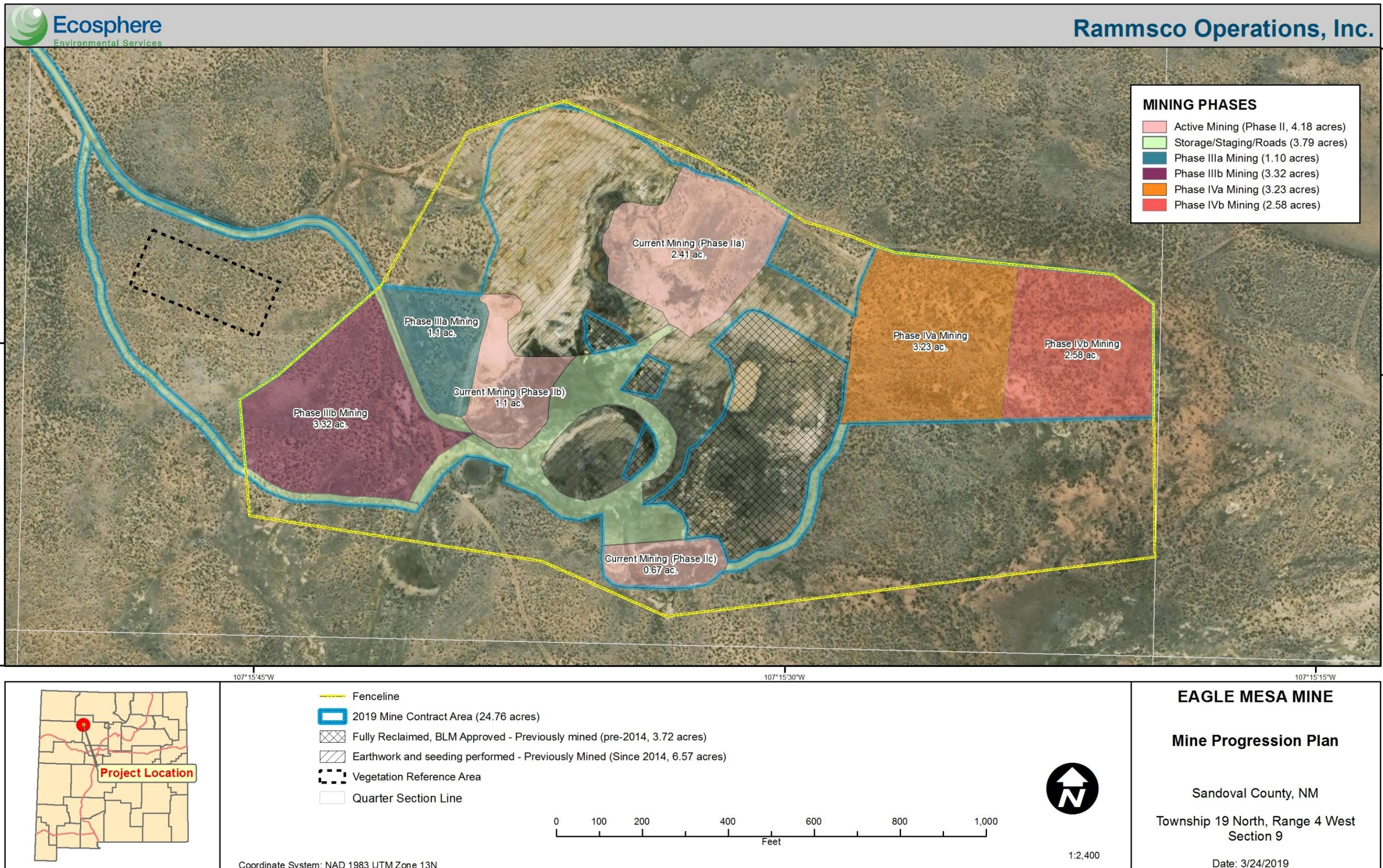
**2019 Contract Area**

Sandoval County, NM  
Township 19 North, Range 4 West  
Section 9

Date: 3/23/2019

Name: Eagle Mesa Mine\_2019MRP\_Fig3\_2019ContractArea

**Map A-3. 2019 Contract Area**



Map A-4. Mine Progression Plan

## Appendix B – Reclamation Cost Estimate

# Eagle Mesa Mine Mining and Reclamation Plan

Ecosphere Environmental Services, Inc.

RAMMSCO - EAGLE MESA HUMATE MINE  
 Estimate for Reclamation Activities for Financial Assurance Bond  
 Project Size: 14.29 Acres

Item	Number of Units	Units	Amt. Needed for 14.29 Acres	Units	Unit Cost <sup>1</sup>	TOTAL	Rate Notes <sup>2</sup>
<b>Direct Costs</b>							
Light Equipment Mobilization/Demobilization (Trailer Rental) Costs <sup>3</sup>	--	Unit Cost	4	Weeks <sup>4</sup>	\$180.00	\$771.66	SWA: 22' trailer rental, \$180/week when rented with tractor
Light Equipment Mobilization/Demobilization Mileage	--	Unit Cost	300.00	Miles	\$0.55	\$165.00	300 miles RT to/from Southwest Ag. Inc., in Gem Village, CO.
Heavy Equipment (Loader, Dozer) Mobilization/Demobilization Costs <sup>5</sup>	--	Unit Cost	1.00	Delivery/ Pick Up Unit Cost	\$2,896.00	\$2,896.00	WR: \$900 delivery & pickup charge for Dozer; WRD: \$1,996 delivery & pickup charge for Loader
Bulldozer Rental	2.5	Days/Acre	1.2	Month <sup>4</sup>	\$5,582.00	\$6,540.71	WR: CAT D6; \$5,582/month
Front End Loader Rental	1	Days/Acre	0.8	Month <sup>4</sup>	\$12,337.00	\$10,048.49	WRD: CAT 972; \$12,337/month
Water Truck Rental <sup>6</sup>	2.5	Days/Acre	2.00	Month <sup>4</sup>	\$3,095.00	\$6,190.00	WR: 2,000 gal. truck at \$3,095/month
Kubota Mx 5200 (52 hp)	1.5	Days/Acre	0.7	Month <sup>4</sup>	\$1,600.00	\$1,143.20	SWA: \$640/Week, \$1600/Month
Proprietary Seed Mix- Drill Seeding Rates	10.5	Lbs/Acre	150.05	Lbs	\$11.79	\$1,769.03	SWS
6 ft. 3-point Tandem Disk Implement Rental	0.5	Days/Acre	10.00	Days <sup>4</sup>	\$71.43	\$714.29	SWA: \$500/week when rented with tractor
12x6/Blanket Harrow Rental	0.5	Days/Acre	10.00	Days <sup>4</sup>	\$45.71	\$457.14	SWA: \$320/week when rented with tractor
Drill Seeder (2-box) Rental	0.5	Days/Acre	10.00	Days <sup>4</sup>	\$160.00	\$1,600.00	SWA: \$160/day
Mulch	0.5	Tons/Acre	7.00	Tons	\$139.00	\$973.00	SWA: \$139/ton
Skid-mounted Straw Blower (18 hp) Rental	0.25	Days/Acre	6.00	Weeks <sup>4</sup>	\$400.00	\$400.00	SWA: \$100/day, \$400/week, can be skid-mounted in pickup
3-point Straw Crimper Rental	0.25	Days/Acre	1.00	Weeks <sup>4</sup>	\$600.00	\$600.00	SWA: \$150.00/day, \$600/week when rented with tractor
<b>SUBTOTAL DIRECT COSTS:</b>						<b>\$34,268.51</b>	
<b>Labor Costs</b>							
Reclamation Labor Cost	4.00	Days/Acre	115.00	Days	\$120.00	\$13,800.00	(assumes \$15/hour rate, and 2 employees) <sup>7</sup>
Mobilization/Demobilization Labor Cost	--	Unit Cost	12.00	Days	\$104.00	\$1,248.00	(assumes \$13/hour rate and 2 employees) <sup>8</sup>



# Eagle Mesa Mine Mining and Reclamation Plan

Ecosphere Environmental Services, Inc.

Item	Number of Units	Units	Amt. Needed for 14.29 Acres	Units	Unit Cost <sup>1</sup>	TOTAL	Rate Notes <sup>2</sup>
Vegetation Monitoring & Reporting, Bond Period Yrs. 11 and 12	--	Unit Cost	2.00	Years	\$3,600.00	\$7,200.00	
<b>SUBTOTAL LABOR COSTS:</b>						<b>\$22,248.00</b>	
<b>Third-Party Indirect Costs<sup>9</sup></b>							
Project Management						\$2,056.11	6% of Direct Costs
Contractor Profit and Overhead						\$10,280.55	30% of Direct Costs
Contingencies						\$685.37	2% of Direct Costs
Engineering Re-design						\$685.37	2% of Direct Costs
MMD Procurement Costs						\$3,426.85	10% of Direct Costs
<b>SUBTOTAL THIRD-PARTY INDIRECT COSTS:</b>						<b>\$17,134.26</b>	
<b>TOTAL</b>						<b>\$73,650.77</b>	
<b>Total per Acre</b>						<b>\$5,154.01</b>	

<sup>1</sup>Cost includes taxes unless otherwise noted.

<sup>2</sup>Rates provided by the following companies: AF=American Fence, Farmington, NM. BC=Basin Co-op in Durango, CO. SWA=South West Ag, Inc. in Gem Village, CO. SWS=Southwest Seed in Dolores, CO. WR=Wagner Rents in Flora Vista, NM. WRD=Wagner Rents in Durango, CO.

<sup>3</sup>Cost of Transportation of Light Equipment to/from site for tractor and various implements using a 22' rental trailer pulled by a 3/4-ton pickup truck; assumes employee truck used.

<sup>4</sup>Includes Rental cost for days of reclamation work and for transportation days.

<sup>5</sup>Cost of Transportation of Heavy Equipment to/from site for front-end loader and bulldozer; Wagner Rents labor cost is included in fee.

<sup>6</sup>Assumes CDL-licensed driver on reclamation staff available to drive truck for delivery to site and return to dealer at close of project. Otherwise delivery and pickup of truck will cost \$450 each way.

<sup>7</sup>Assumes a total of 73 days for site reclamation work on an 14.29-acre site, 2 employees, and 8-hour workdays.

<sup>8</sup>Assumes 2 employees 1 day each for: fertilizer/seed/straw pick up in Durango, pick up light equipment rental in Gem Village, unload/mobilization on-site, and load/demobilization on-site, return light equipment rental in Gem Village. Assumes 1 employee 1/2 day each for: pick up water truck from Flora Vista, return water truck to Flora Vista.

<sup>9</sup>Third Party Indirect Costs are as directed by MMD (D. Otori, pers. comm., 29 November 2012)



## Appendix C – Noxious Weed Information

# Eagle Mesa Mine Mining and Reclamation Plan

Ecosphere Environmental Services, Inc.

## Invasive, Non-Native Plant Species of Concern within the BLM/RPFO<sup>1</sup>

Common Name	Scientific Name
Camelthorn	<i>Alhagi maurorum</i>
Tree of Heaven	<i>Ailanthus altissima</i>
Cheatgrass	<i>Bromus tectorum</i>
Hoary cress (Whitetop)	<i>Cardaria draba</i>
Musk thistle	<i>Carduus nutans</i>
Diffuse knapweed	<i>Centaurea diffusa</i>
Spotted knapweed	<i>Centaurea maculosa</i>
Russian knapweed	<i>Centaurea repens</i>
Yellow starthistle	<i>Centaurea solstitialis</i>
Canada thistle	<i>Cirsium arvense</i>
Bull thistle	<i>Cirsium vulgare</i>
Halogeton	<i>Halogeton glomeratus</i>
Tall whitetop (Perennial pepperweed)	<i>Lepidium latifolium</i>
Dalmatian toadflax	<i>Linaria dalmatica</i>
Yellow toadflax	<i>Linaria vulgaris</i>
Scotch thistle	<i>Onopordum acanthium</i>
African rue	<i>Peganum harmala</i>
Saltcedar	<i>Tamarix spp.</i>

<sup>1</sup>USDI/BLM 2012

## New Mexico Noxious Weed List

Updated September 2016

### Class A Species

Class A species are currently not present in New Mexico, or have limited distribution. Preventing new infestations of these species and eradicating existing infestations is the highest priority.

<u>Common Name</u>	<u>Scientific Name</u>
Alfombrilla	<i>Drymaria arenariodes</i>
Black henbane	<i>Hyoscyamus niger</i>
Brazilian egeria	<i>Egeria densa</i>
Camelthorn	<i>Alhagi psuedalhagi</i>
Canada thistle	<i>Cirsium arvense</i>
Dalmation toadflax	<i>Linaria dalmatica</i>
Diffuse knapweed	<i>Centaurea diffusa</i>
Dyer's woad	<i>Isatis tinctoria</i>
Giant salvinia	<i>Salvinia molesta</i>
Hoary cress	<i>Cardaria spp.</i>
Leafy spurge	<i>Euphorbia esula</i>
Oxeye daisy	<i>Leucanthemum vulgare</i>
Purple loosestrife	<i>Lythrum salicaria</i>
Purple starthistle	<i>Centaurea calcitrapa</i>
Ravenna grass	<i>Saccharum ravennae</i>
Scentless chamomile	<i>Matricaria perforata</i>
Scotch thistle	<i>Onopordum acanthium</i>
Spotted knapweed	<i>Centaurea biebersteinii</i>
Yellow starthistle	<i>Centaurea solstitialis</i>
Yellow toadflax	<i>Linaria vulgaris</i>

### Class B Species

Class B Species are limited to portions of the state. In areas with severe infestations, management should be designed to contain the infestation and stop any further spread.

<u>Common Name</u>	<u>Scientific Name</u>
African rue	<i>Peganum harmala</i>
Bull thistle	<i>Cirsium vulgare</i>
Chicory	<i>Cichorium intybus</i>
Halogeton	<i>Halogeton glomeratus</i>
Malta starthistle	<i>Centaurea melitensis</i>
Perennial pepperweed	<i>Lepidium latifolium</i>
Poison hemlock	<i>Conium maculatum</i>

# Eagle Mesa Mine Mining and Reclamation Plan

Ecosphere Environmental Services, Inc.

Quackgrass	<i>Elytrigia repens</i>
Russian knapweed	<i>Acroptilon repens</i>
Spiny cocklebur	<i>Xanthium spinosum</i>
Teasel	<i>Dipsacus fullonum</i>

## **Class C Species**

Class C species are wide-spread in the state. Management decisions for these species should be determined at the local level, based on feasibility of control and level of infestation.

<u>Common Name</u>	<u>Scientific Name</u>
Cheatgrass	<i>Bromus tectorum</i>
Curlyleaf pondweed	<i>Potamogeton crispus</i>
Eurasian watermilfoil	<i>Myriophyllum spicatum</i>
Giant cane	<i>Arundo donax</i>
Hydrilla	<i>Hydrilla verticillata</i>
Jointed goatgrass	<i>Aegilops cylindrica</i>
Musk thistle	<i>Carduus nutans</i>
Parrotfeather	<i>Myriophyllum aquaticum</i>
Russian olive	<i>Elaeagnus angustifolia</i>
Saltcedar	<i>Tamarix spp.</i>
Siberian elm	<i>Ulmus pumila</i>
Tree of heaven	<i>Ailanthus altissima</i>

## **Watch List Species**

Watch List species are species of concern in the state. These species have the potential to become problematic. More data is needed to determine if these species should be listed. When these species are encountered please document their location and contact appropriate authorities.

<u>Common Name</u>	<u>Scientific Name</u>
Crimson fountaingrass	<i>Pennisetum setaceum</i>
Meadow knapweed	<i>Centaurea pratensis</i>
Myrtle spurge	<i>Euphorbia myrsinites</i>
Pampas grass	<i>Cortaderia sellonana</i>
Sahara mustard	<i>Brassica tournefortii</i>
Syrian beancaper	<i>Zygophyllum fabago L.</i>
Wall rocket	<i>Diploaxis tenuifolia</i>

From NMDA 2016

# Eagle Mesa Mine Mining and Reclamation Plan

Ecosphere Environmental Services, Inc.

A WEED REPORT from the book *Weed Control in Natural Areas in the Western United States*

This WEED REPORT does not constitute a formal recommendation. When using herbicides always read the label, and when in doubt consult your farm advisor or county agent.

This WEED REPORT is an excerpt from the book *Weed Control in Natural Areas in the Western United States* and is available wholesale through the UC Weed Research & Information Center ([wric.ucdavis.edu](http://wric.ucdavis.edu)) or retail through the Western Society of Weed Science ([wsweedsociety.org](http://wsweedsociety.org)) or the California Invasive Species Council ([cal-ipc.org](http://cal-ipc.org)).

*Halogeton glomeratus* (M. Bieb.) C.A. Meyer

## Halogeton

Family: Chenopodiaceae

Range: Throughout the dry arid regions of the western U.S.

Habitat: Disturbed open sites, dry lakebeds, shrublands, roadsides, typically where native vegetation is sparse. Inhabits arid and semi-arid regions, especially where winters are cold. Primarily adapted to alkaline and saline soils.

Origin: Native to the cold desert regions of Eurasia.

Impacts: Plant tissues accumulate salts from lower soil horizons. The salts leach from dead plant material, increasing topsoil salinity and favoring halogeton seed germination and seedling establishment. The foliage contains variable amounts of soluble sodium oxalates and can be fatally toxic to livestock, especially sheep, when ingested in quantity. Impacts grazing capacity as animals generally avoid consuming the bitter-tasting foliage if more palatable forage is available. Caution should be exercised, however, when unloading hungry livestock onto halogeton-infested rangeland.

Western states listed as Noxious Weed: Arizona, California, Colorado, New Mexico, Oregon

California Invasive Plant Council (Cal-IPC) Inventory: Moderate Invasiveness



Halogeton is an erect winter or summer annual to 1.5 ft tall, with small fleshy leaves. Stems are usually tinged reddish or purple and the leaves are alternate, sessile, dull green to bluish-green, with a stiff bristle tip.

The flower clusters are numerous and dense in most leaf axils. Flowers lack petals and produce one-seeded fruits (utricles) with the sepals forming a fan-shaped structure concealing the black or brown seeds. Plants reproduce only by seed, which are dispersed by seed-gathering ants, animals, and when dry plants break off at ground level and tumble with the wind. Many seeds survive ingestion by animals, including sheep and rabbits. Black seeds can imbibe water and germinate in less than 1 hour. Because seed form small coiled embryos in fruit, they do not persist long in the soil.

### NON-CHEMICAL CONTROL

**Mechanical**  
(pulling, cutting,  
disking)

Because halogeton is a simple shallow-rooted annual, it can be controlled effectively by tillage or pulling. Plants are easiest to control as seedlings or in early vegetative growth. Plants not controlled until after flowering begins may contain seeds and should be removed and destroyed to prevent reseeding. Periodic mowing close to the soil surface can significantly reduce but not completely prevent seed production. Surviving branches below the reach of mower blades will continue to produce viable seeds. It is best to avoid increasing disturbance unless successful restoration of perennials is highly probable.

# Eagle Mesa Mine Mining and Reclamation Plan

Ecosphere Environmental Services, Inc.

A WEED REPORT from the book *Weed Control in Natural Areas in the Western United States*

Halogeton

Cultural	<p>Disturbances such as overgrazing and fire typically reduce desirable vegetation and increase open sites with bare soil. This can encourage invasion and establishment of halogeton. Any cultural control strategy should increase perennial vegetation, as halogeton has been shown to compete poorly with established perennial species.</p> <p>Grazing alone is not a control option because of the toxicity of the plant. However, timely grazing of desired vegetation has been shown to reduce halogeton spread. For example, halogeton in Nevada decreased under late spring to early summer (mid-April to mid-June) grazing at moderate intensity, compared to high intensity grazing in early spring (March to April).</p> <p>While fire can kill standing halogeton plants, fire disturbance often enhances seed germination and favors the growth of dense stands when the burns are not hot enough. In most cases, halogeton is one of the first plants to reestablish following wildfire on infested rangeland.</p>
Biological	<p>No biological control agents are available for the control of halogeton. A stem-boring moth (<i>Coleophora parthenica</i>) from Pakistan was released for halogeton control in the U.S. However, it failed to establish. Other potential biological control agents have been identified in Central Asia, but they have not yet been developed and tested.</p>

## CHEMICAL CONTROL

The following specific use information is based on reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

### GROWTH REGULATORS

2,4-D	Rate: 2 to 6 pt product/acre for ester formulation (0.95 to 2.85 lb a.e./acre)
Several names	<p>Timing: Postemergence in early spring when plants are growing rapidly before bloom stage.</p> <p>Remarks: 2,4-D gives good, but not excellent, control and may damage desirable broadleaf natives, particularly at high rates. Reapplications are required to control subsequent germinants. Ester formulations are considered more effective than amine formulations. Apply with a crop oil concentrate for consistent control. Because of injury to native shrubs and a lack of desirable forage species adapted to alkali conditions, the use of 2,4-D for halogeton control has declined in recent years.</p>
Aminocyclopyrachlor + chlorsulfuron	Rate: 3 to 4.5 oz product/acre
Perspective	<p>Timing: Postemergence in early spring when plants are growing rapidly before bloom stage.</p> <p>Remarks: Perspective provides broad-spectrum control of many broadleaf species. Although generally safe to grasses, it may suppress or injure certain annual and perennial grass species. Little is known of the herbicide for halogeton control as its registration is relatively new. However, it has been shown to be very effective in herbicide trials. Do not treat in the root zone of desirable trees and shrubs. Do not apply more than 11 oz product/acre per year. At this high rate, cool-season grasses will be damaged, including bluebunch wheatgrass. Not yet labeled for grazing lands. Add an adjuvant to the spray solution. This product is not approved for use in California and some counties of Colorado (San Luis Valley).</p>

### AROMATIC AMINO ACID INHIBITORS

Glyphosate	Rate: Spot treatment, 2% v/v solution Roundup ProMax
Roundup, Accord XRT II, and others	<p>Timing: Postemergence in summer before plants bloom.</p> <p>Remarks: Use as a spot treatment on small infestations. Repeat treatments are necessary to control flushes emerging later in the season.</p>

### BRANCHED-CHAIN AMINO ACID INHIBITORS

Chlorsulfuron	Rate: Label recommends 0.5 to 1 oz product/acre (0.375 to 0.75 oz a.i./acre), but field results have shown 0.2 to 0.5 oz product/acre (0.15 to 0.375 oz a.i./acre) to be effective. Apply with surfactant.
Telar	<p>Timing: Postemergence in late spring or early summer when plants are only 1 to 3 inches tall.</p> <p>Remarks: Chlorsulfuron has been shown to be more effective than metsulfuron in western rangelands. Chlorsulfuron can damage some native shrubs, including Nuttall's saltbush (<i>Atriplex nuttallii</i>). Chlorsulfuron is considered the most effective herbicide for control of halogeton in</p>



# Eagle Mesa Mine Mining and Reclamation Plan

Ecosphere Environmental Services, Inc.

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	rangelands.
Imazapic Plataou	<p><b>Rate:</b> 4 to 6 oz product/acre (1 to 1.5 oz a.e./acre)</p> <p><b>Timing:</b> Preemergence or early postemergence to seedlings 1 to 3 inches tall.</p> <p><b>Remarks:</b> For postemergence application, add a surfactant at about 1.5 oz/acre. Imazapic is selective to most native grasses, but will injure some species. Higher rates may suppress seedlings of some cool-season grasses. Imazapic is not registered for use in California.</p>
Metsulfuron Escort	<p><b>Rate:</b> 0.5 to 1 oz product/acre (0.3 to 0.6 oz a.i./acre). Apply with surfactant.</p> <p><b>Timing:</b> Postemergence in the late spring or early summer when seedlings have emerged and are growing rapidly, generally 1 to 3 inches tall.</p> <p><b>Remarks:</b> Metsulfuron does not cause injury to grasses and this may be a desirable feature in areas with crested wheatgrass or other forage grasses. Metsulfuron is not registered for use in California.</p>
<b>PHOTOSYNTHETIC INHIBITORS</b>	
Tebuthiuron Spike 20P	<p>Tebuthiuron is a pelleted formulation that provides total vegetation control for several years and may be desirable for use on railroad ballast and oil field locations, where halogeton is often found. It has a very long soil residual activity and will provide total vegetation control for 3 to 5 years.</p>

**RECOMMENDED CITATION:** DiTomaso, J.M., G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California. 544 pp.