REVEGETATION PLAN
FOR THE
SIGMA CLAY MINE

SAN BERNARDINO COUNTY, CALIFORNIA

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INTRODUCTION

This Revegetation Plan is designed to comply with Conditions of Mining/Reclamation Plan No. 91-0038/DN259-179N/SAMR approved on March 18, 1992 and with SMARA's performance standards for revegetation. As conditions of approval for Sigma Clay's Reed Dry Lake Mine, a detailed revegetation/habitat restoration plan for the reclamation of the site must be prepared. The goal of the revegetation program is to establish the guidelines to monitor, maintain, and assess the results of the completed revegetation program through comparison to the established baseline data and recommended success criteria.

LOCATION

Sigma Clay's Reed Dry Lake Mine is generally located in the southern Mojave Desert region of San Bernardino County, northeast of the town of Apple Valley, in the Fairview Valley (Figure 1). The mine is specifically located in the Southeast ¼ of the Southwest ¼ of Section 28, Township 6 North, Range 2 West, San Bernardino Meridian as shown on the Fairview Valley Quadrangle. The site comprises approximately 40 acres in the dry lake bed.

EXISTING ENVIRONMENT

The project site is shown within a dry lake bed on the 7.5 minute series Fairview Valley USGS quadrangle map. The surrounding watershed is relatively small with the Fairview Mountains immediately west of the site, Granite Mountains to the south and east, and Sidewinder Mountain and Black Mountain to the north. Vegetation on the project site includes a disturbed and sparse saltbush scrub community, and two non-native communities dominated by tamarisk trees and Russian thistle.

The project site is approximately 1,320 feet by 1,320 feet in size. Access to the site is via Johnson Road (a dirt road approximately 2 miles north of the project site) and an unnamed dirt road from Johnson Road to the northwest corner of the site. Most of the mine site has disturbed by off-road vehicle use.

BASELINE VEGETATION

The BRA documents project impacts to very sparse and disturbed saltbush scrub community. In order to collect data needed to establish revegetation criteria, random reference sites were surveyed for shrub cover, density, and species richness. Transect endpoint locations were recorded on a handheld GPS. To evaluate vegetative cover, a series of 50-meter point-intercept transects were established; a vertical point was projected at each 0.5-meter interval and any plant, stem, or canopy intercepting the point was recorded. Shrub density and species richness were recorded in 100 square meter (m^2) plots located along the edge of the 50-meter transects and extending 2 meters out from its edge; all shrubs rooted in the plots and the number of different shrub species were recorded.

Transects and plot locations were chosen randomly within the reference area. A total of 10 transects in each sample unit area were surveyed to provide baseline data needed to determine seed types and seeding rates, and to establish the success criteria for future revegetation efforts.

For purposes of reclamation, SMARA requires that a sampled area be of adequate size to accurately represent the vegetative cover, density, and richness in a vegetation community. To determine the minimum number of samples required to achieve a minimum of 80% confidence, the following statistical formula is applied, where n is the sample size needed, t^2 is the statistical t value for the sample, s^2 is the variance, and x is the statistical average.

$$n = \frac{t^2 s^2}{(0.2x)^2}$$

BASELINE SURVEY RESULTS

Saltbush scrub was identified as the dominant vegetation type on the site. Average absolute shrub cover measured a mean of 22.1%; average shrub density measured 8.1 shrubs per 100 m^2 plot; and an average of 1.6 species was observed to occur per 100 m^2 plot. Baseline cover results are summarized in Table 1; density and species richness results are summarized in Table 2.

Reference Site 1-Saltbush Scrub Series
Baseline Cover Results

Transect	1	2	3	4	5	6	7	8	9	10	Total	Mean	Var.
Atriplex canescens	6	6	27	8	11	7	9	9	5	2	90	9	
Sphaeralcea ambigua	0	0	0	0	0	0	7	1	1	3	12	1.2	
Lycium	0	0	0	0	0	0	0	1	3	0	4	0.4	
Absolute Shrub Cover Percentage	**15**	**14**	**10**	**34**	**35**	**30**	**28**	**29**	**19**	**7**	**221**	**22.1**	**105.88**
% Bare Ground	85	86	90	66	65	70	72	71	81	93	-	90	

Minimum Number of Transects Required to Achieve Confidence									
Sample Size Calculations for Shrub Cover	s^2	$t^2_{(80\%)}$	t^2 (90%)	t^2 (95%)	x	(0.2x)^2	95%	90%	80%
	105.88	1.38	1.83	2.26	22.1	4.00	**12.25**	**9.91**	**7.48**

* Cover values for individual shrub species will not necessarily equal absolute shrub cover due to overlapping vegetation at transect points. s^2 = variance, t^2 = Students' t value for sample, x = sample average

Table 2
Reference Site 1-Saltbush Scrub Series
Baseline Density and Species Richness Results

Transect	1	2	3	4	5	6	7	8	9	10	Total	Mean	Variance
Atriplex canescens	6	6	27	8	11	7	9	9	5	2	41	4.10	
Sphaeralcea ambigua	0	0	0	0	0	0	7	1	1	3	36	3.60	
Lycium	0	0	0	0	0	0	0	1	3	0	4	0.40	
Total Shrub Density	**6**	**6**	**27**	**8**	**11**	**7**	**16**	**11**	**9**	**5**	**106**	**10.60**	**43.82**
Total Species Richness	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**3**	**3**	**2**	**16**	**1.60**	**0.71**

Minimum Number of Transects Required to Achieve Confidence									
Sample Size Calculations for Species Richness	s^2	$t^2_{(80\%)}$	t^2 (90%)	t^2 (95%)	$\bar{x}$	(0.2x)^	95%	90%	80%
	43.82	1.383	1.833	2.262	10.6	3.10	**20.02**	**16.23**	**12.24**
Sample Size Calculations for Species Richness	s^2	$t^2_{(80\%)}$	t^2 (90%)	t^2 (95%)	$\bar{x}$	(0.2x)^	95%	90%	80%
	0.71	1.38	1.83	2.26	1.6	0.25	**16.05**	**12.99**	**9.80**

s^2 = variance, t^2 = Students' t value for sample, x = sample average

REVEGETATION

Revegetation of the site would follow a series of steps. These steps may be modified or changed should new information or techniques that would improve the results of the revegetation activities become available. to be reclaimed and revegetated back to its natural conditions. The mine site would be reclaimed to approximately 40 acres of saltbush scrub series vegetation at the end of operations. Success criteria and revegetation strategies were designed specifically to meet the needs of the vegetative communities and environmental conditions at the site.

SEED COLLECTION

The goal of seed collection is to preserve the local genetic diversity of the existing plant community while providing seed that is well suited for growth at the site. Seed collection must be undertaken and monitored by a professional seed collecting firm or a qualified botanist. When seed collection is not possible, a certified weed free seed mix may be used in lieu of seed collected at the site. Certified weed free seed mixes are available and may be purchased from professional nurseries.

SITE PREPARATION

Where possible, revegetation surfaces would be ripped to about 18 to 36 inches in depth to break up compacted areas and would be left in a textured or rough condition with shallow rills and furrows to create optimal conditions for revegetation with a native seed mix. Any available soils will be deposited in random "islands" up to one-foot thick and seeded.

Quick-growing, shallow-rooted species will be included in the seed mix to provide short-term erosion control. By providing short-term erosion control, more favorable growing conditions will be created for climax species that will provide long-term erosion control.

IRRIGATION

The plant palette proposed for the mine site consists of primarily drought-tolerant plants species that should perform well without additional water. The average precipitation in the area should be sufficient for seed germination and root establishment of native species. Planting in the fall, prior to the winter rains, will be sufficient for seed germination and root establishment and reduce weed growth that is typically associated with supplemental irrigation. Scarification of the soil and the creation of surface rills and furrows will allow for maximized collection of water from rain events and run-off.

FERTILIZATION

No fertilization of the site is recommended. The native seeds used for revegetation will be tolerant of existing soil conditions. Additionally, the mechanical loosening, and creation of surface rills and furrows, will create conditions favorable for seed germination and root

establishment by native species. Widespread use of fertilizers on desert sites appears to benefit non-native weedy species and not the native species sought as the goal of the revegetation plan (Clary, 1987).

WEED CONTROL

The purpose of the non-native invasive species control plan is to reduce or eliminate the occurrence of non-native invasive plant species that may invade the site where active and natural revegetation is taking place. Non-native invasive species (weeds) can compete with native plant species for available moisture and nutrients and consequently interfere with revegetation of the site.

The occurrence of non-native invasive species on-site shall be monitored by visual inspection. The goal is to prevent non-native invasive species from becoming established and depositing seeds in revegetated areas. No areas will be allowed to have more than 10 percent of the ground cover provided by non-native invasive species. If inspections reveal that non-native invasive species are becoming or have established on-site, then removal will be initiated. Inspections shall be made in conjunction with revegetation monitoring.

Non-native invasive species removal will be accomplished through manual, mechanical or chemical methods depending on the specific circumstances. For example, solitary or limited numbers of non-native invasive shrub species will be manually removed (chopped) and the stumps sprayed with an approved weed killer such as Round-Up. Smaller plants (wild oats and bromes) that cover more area may be sprayed, scraped with a tractor, or chopped by hand, depending upon the size of the area of infestation and the number of desired native plants in proximity or mixed in with the non-native invasive species.

Reports of inspections and weed control implementation shall be part of the annual revegetation monitoring and kept on file by the operator.

SEEDING METHODS AND RATES

The revegetation area will be seeded with a certified weed-free seed mix using a broadcast method. Following seeding, the area will be raked in order to cover the seeds and protect them from desiccation and predation. Unique seed mixes were developed for each of the vegetation series occurring in the project impact area. The recommended seed mix and seeding rate for each of the vegetation series is outlined in Table 3 and provides a species selection from which to choose. Depending on availability, no fewer than 3 and no more than 5 species from the recommended seed mix shall be utilized during revegetation.

Table 3
Sigma Clay's Mine
Recommended Seed Mix and Rates

Species	PLS LBS/ Acre
Saltbush Scrub Series	
Encelia farinose	2
Larrea tridentata	5
Ambrosia dumosa	4
Vulpia octoflora	1
Lupinus sparciflorus	1
Sphaeralcea ambigua	2
Baileya multiradiata	1
Lasthenia californica	0.5
Hymenoclea salsola	1
Simmondsia chinensis	1

SCHEDULE OF REVEGETATION

Seeding of the revegetation area shall occur at the appropriate time of the year and at an application rate for optimum seed sprouting and growth. Seeding is recommended to occur in the fall after the first substantial rains but prior to winter rains. Following the initial seeding, revegetation areas will be monitored annually, and as necessary, appropriate remediation action such as reseeding and weed removal will be determined at the time of monitoring.

TEST PLOTS

The operator shall establish at a minimum, three 100 m^2 test plots representative of the area to be revegetated. Test plots will include surface ripping/no seeding; surface ripping and seeding as described; and surface ripping, placement of fines, and seeding as described. Additional tests will be conducted if the initial tests and any active revegetation are not successful and may include various types and amounts of seeds and different surface/soil preparation.

REVEGETATION MONITORING

SUCCESS CRITERIA

Successful revegetation will be achieved when a self-sustaining native plant cover is established in the disturbed areas of the proposed mining activity. The revegetated site must resemble and blend into the natural surrounding environment. The success of the revegetation effort will be determined through statistical comparison of the revegetated areas to the baseline inventory.

Acceptable performance standards for mine reclamation are based on a percentage of cover, density, and species richness when compared with the baseline. An acceptable standard at the Sigma Clay's Reed Dry Lake Mine would measure success at 25% of the baseline cover, 25% of the baseline density, and 20% of the baseline species richness five years after reclamation. The revegetation success criterion for each of the sampled habitat types is outlined in Table 4.

Table 4
Sigma Clay's Mine
Recommended Success Criteria

	Baseline Mean	Standard Success Percentage[1]	Success Criteria
Saltbush Scrub Series			
Cover	22.1%	25%	5.5% cover of native
Shrub Density	10.6*	25%	3 native perennials per 100 m2
Species Richness	1.6*	20%	1 native perennials per 100 m2

*per 100 m^2 plot

[1] Standard Success Percentages established based upon precedent set forth by previously prepared revegetation plans by RCA Associates, LLC, Scott White Biological Consulting, and White & Leatherman BioServices

TECHNICAL ASSESSMENT

The permanence and sustainability of the revegetated plant communities will be determined annually after the initial seeding. Annual assessments of the reclamation area will be conducted by a qualified botanist to determine the success of the revegetation effort. Interim success standards may be used as thresholds for annual monitoring and to ensure the success of revegetation.

The plant species will be evaluated for relative success as determined by the cover, density, and species richness success criteria. Remedial actions include removing non-native invasive species and reseeding based on annual assessment results. An evaluation of the surviving species will be repeated annually following initial seeding for five years or until the success criteria are achieved.

Annual monitoring will include random transect sampling within the revegetation area. The number of transects and plots will vary in order to produce the 80% confidence level required under SMARA's Performance Standards for Revegetation. The following data will be collected within transects and plots:

a. Survivorship: assessed by absolute counts
b. Plant density
c. Species richness
d. Cover per specified area

All data will be recorded on a standard form and copies will be submitted as an appendix to each Annual Report. Photo documentation will also be included for representative transects in order to visually document annual vegetation changes and community development.

REPORTING

Sigma Clay's Reed Dry Lake Mine will document the progress of the revegetation effort and submit Annual Maintenance and Monitoring reports to the County of San Bernardino. Annual reports are due by December 31st of each year.

CONCLUSION

The site will be prepared for revegetation scarifying the ground surface to create conditions optimal for seeding. The revegetation areas will be covered with available surface materials in "islands," broadcast seeded, and raked to cover seeds and protect them from desiccation and predation. Seeding would occur following the first rain of the fall season and before the winter rains.

The acceptable performance standards for the Sigma Clay Reed Dry Lake Mine would measure success at 25% of the baseline cover, 25% of the baseline density, and 20% of the baseline species richness five years after reclamation until success criteria achieved. Accordingly successful revegetation in the saltbush scrub series revegetation area would be achieved at 5.5% cover by native perennials, three native perennials per 100 m^2 plot, and one species per 100 m^2 plot.

Annual assessments of the reclamation area will be conducted by a revegetation specialist to determine the success of the revegetation effort until said criteria are achieved. Remedial action would occur per the recommendation of the revegetation specialist.

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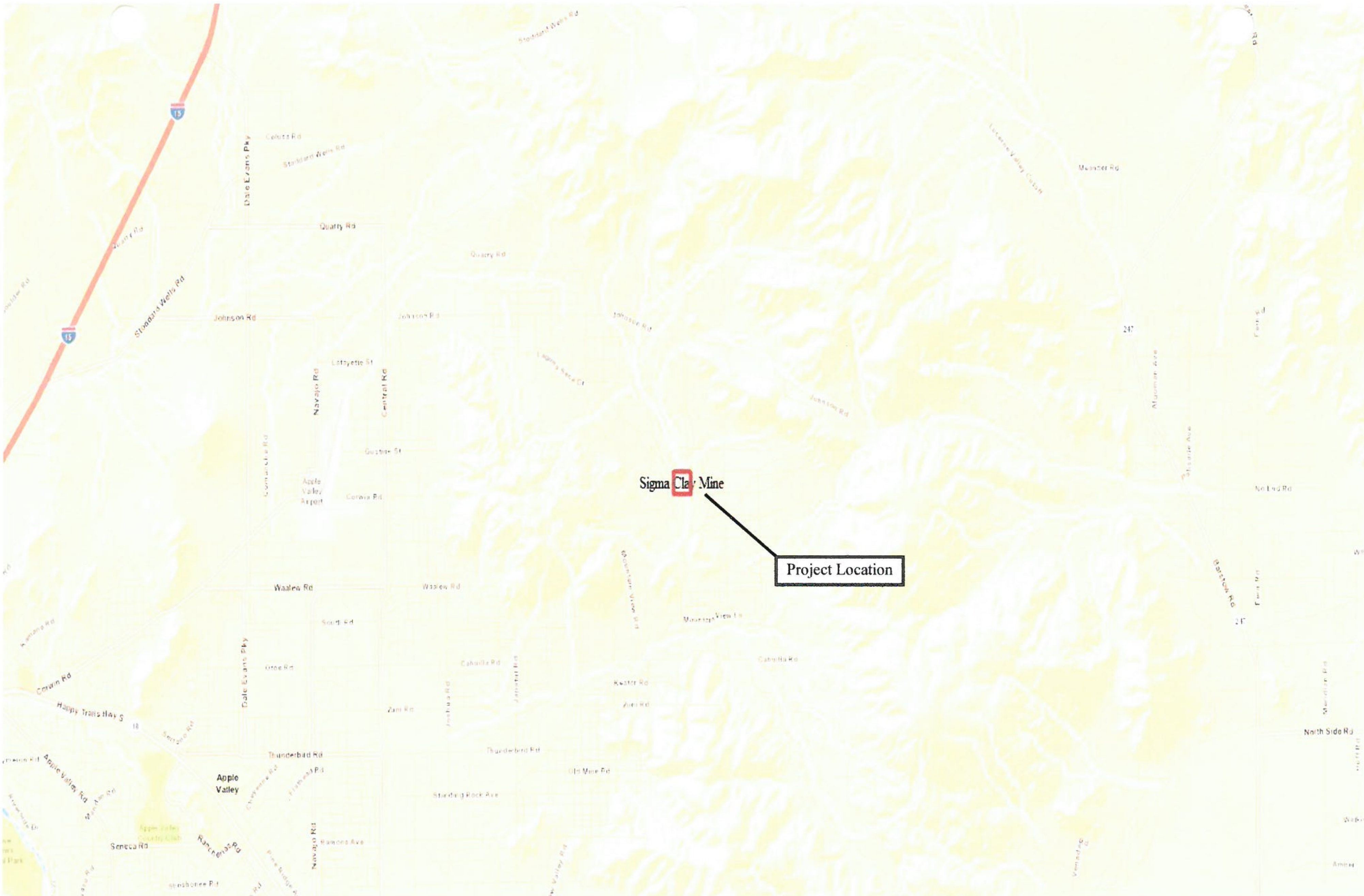
FIGURES

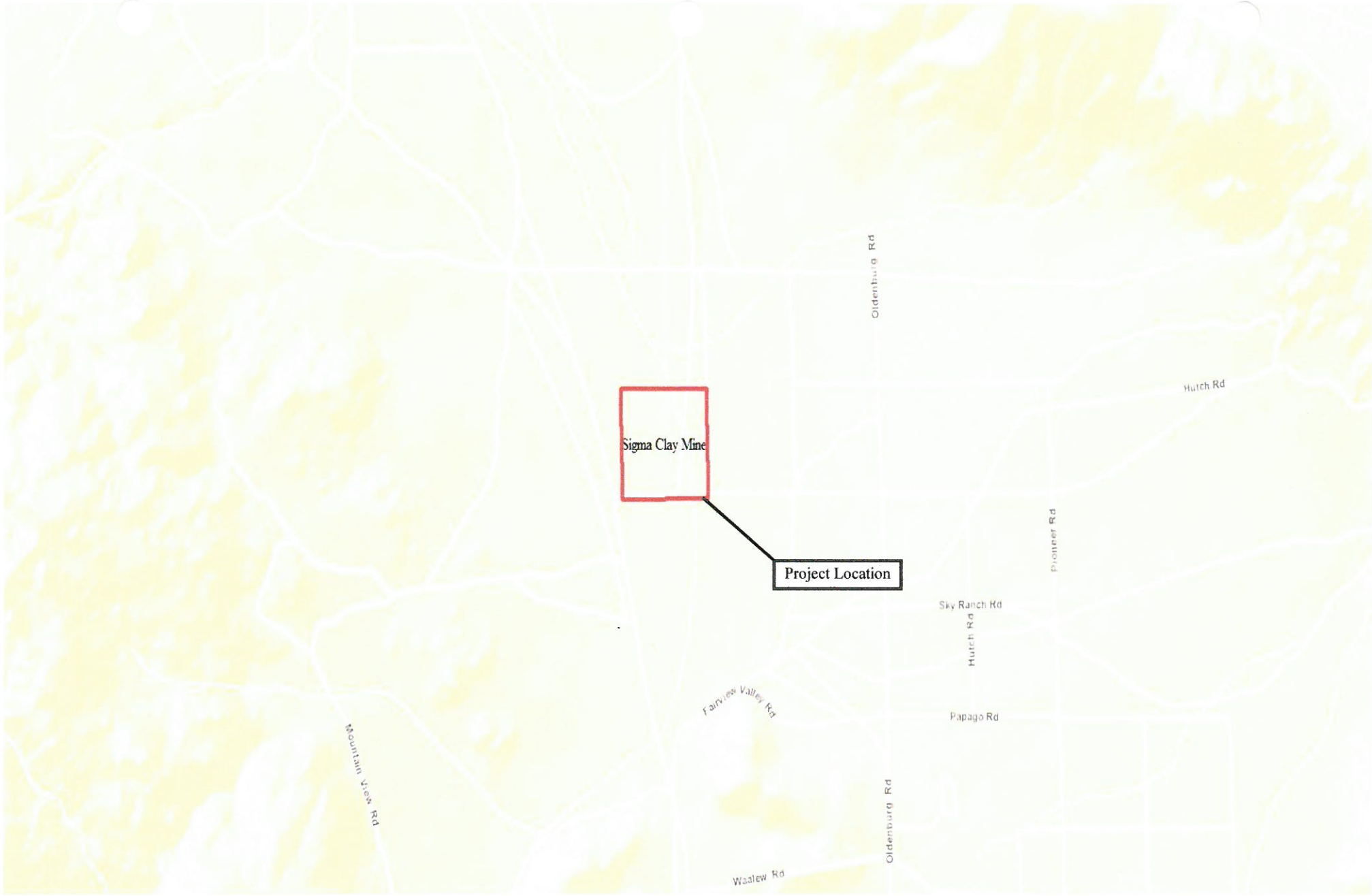


Vicinity Map

Revegetation Plan
Sigma Clay Mine
San Bernardino County, California

Figure 1

Regulatory Permitting Specialists



Location Map

Revegetation Plan
Sigma Clay Mine
San Bernardino County, California

Figure 2

N

0 1750 Feet

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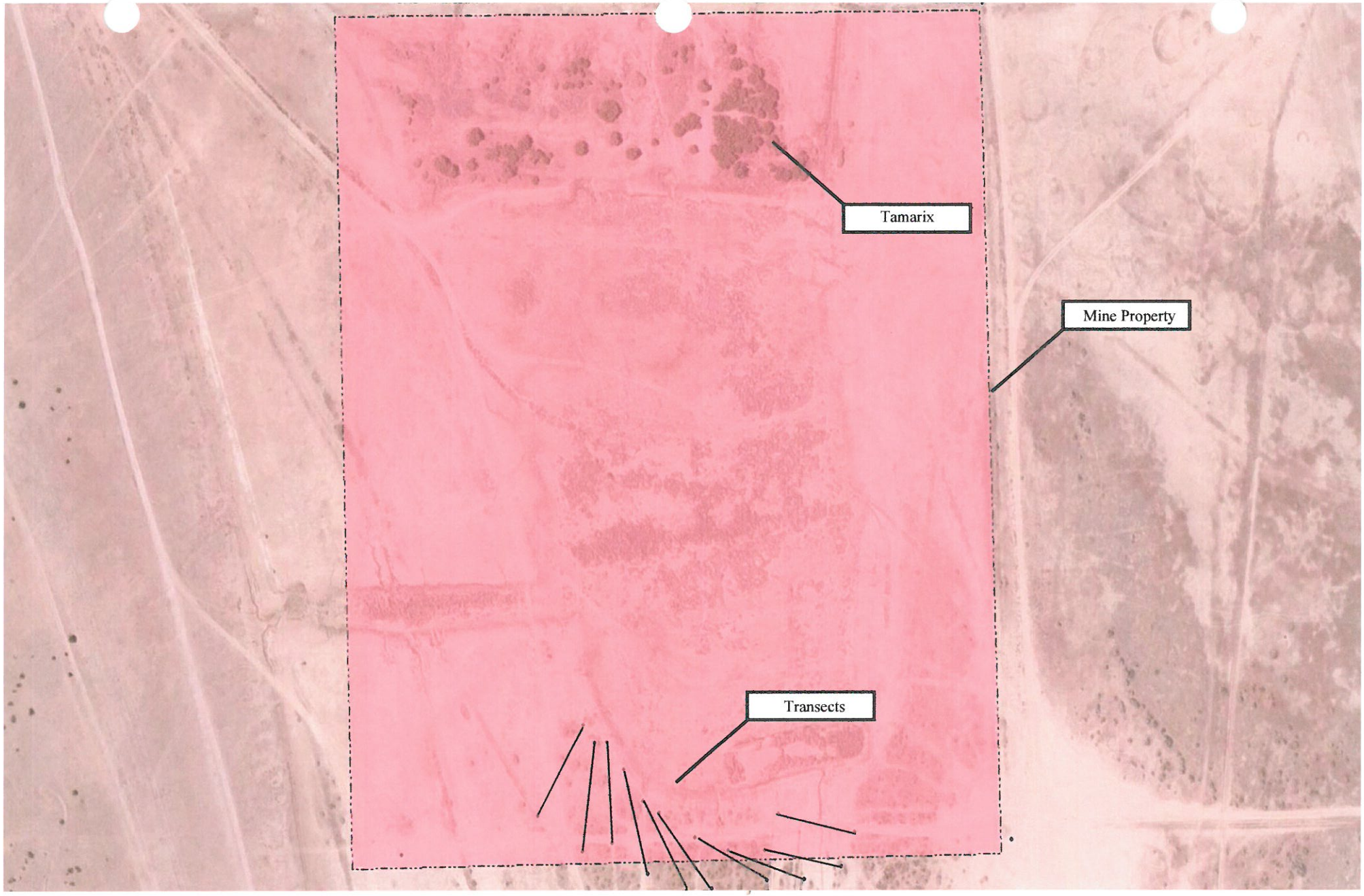
Permitting
Specialists



Transect Location Map

Revegetation Plan
Sigma Clay Mine
San Bernardino County, California

Figure 3

N

0 250 Feet

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