# LAND USE SERVICES DEPARTMENT MAR 18 2013 COUNTY OF SAN BERNARDINO

# Revegetation Plan & Guidelines for Brubaker-Mann's Gold, Brown, and Lilac Quarries Near the Community of Yermo, San Bernardino County, California

(U.S. Geological Survey 7.5' Nebo quadrangle, Township 9 North, Range 1 West, a portion of the Southwest ¼ of Section 1, S.B.B.&M.)

Job #13-003a

# Prepared by:

Circle Mountain Biological Consultants, Inc.
P.O. Box 3197
Wrightwood, California 92397
PH/FAX: 760-249-4948

PH/FAX: 760-249-4948 Contact: Sharon Dougherty

Website: <a href="http://circlemountainbiological.com">http://circlemountainbiological.com</a>
Email: <a href="mailto:sharon\_dougherty@circlemountainbiological.com">http://circlemountainbiological.com</a>

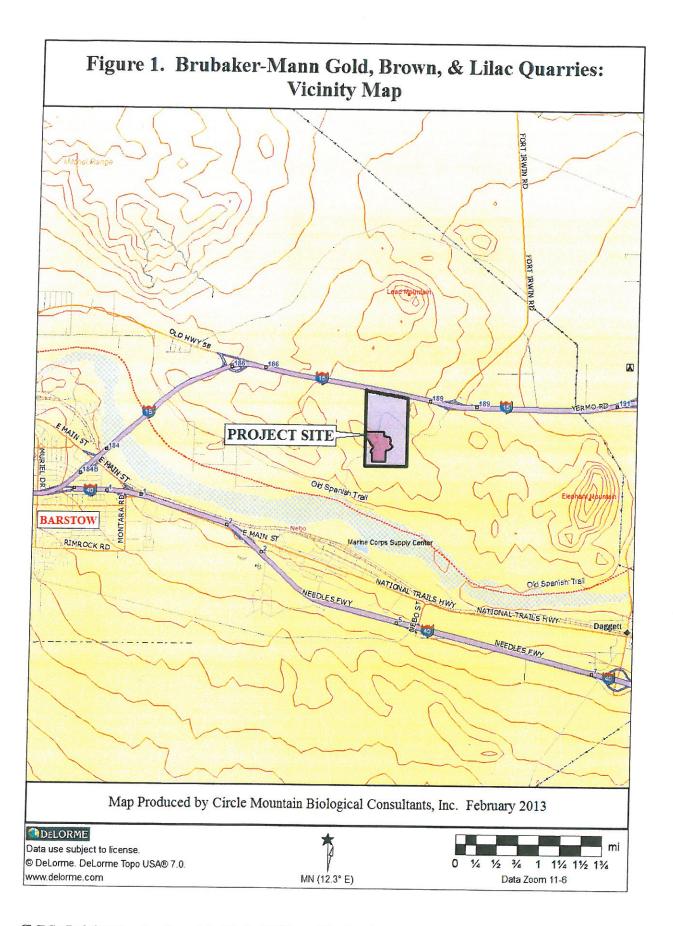
#### Prepared for:

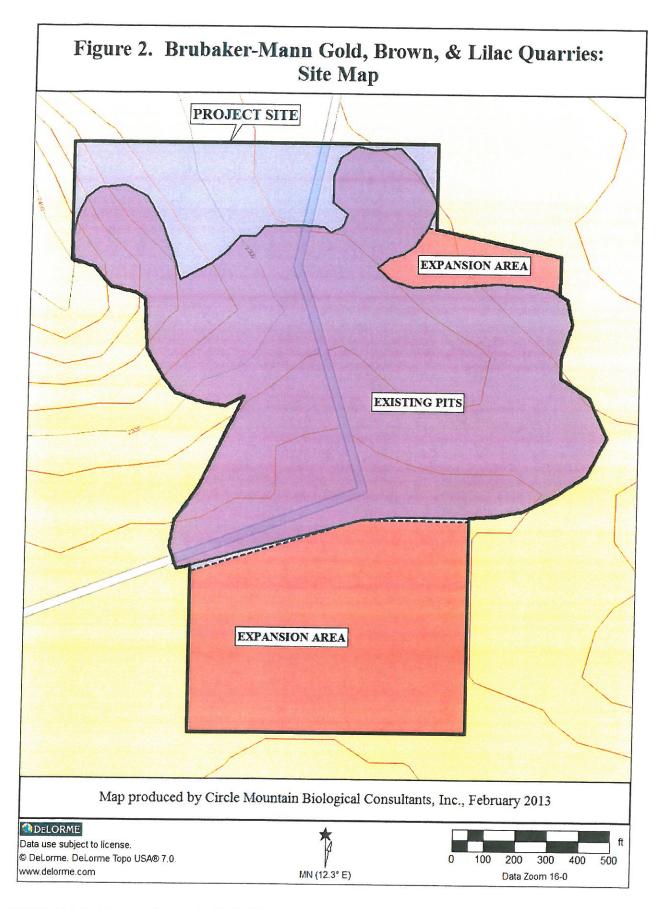
Brubaker-Mann, Inc. PO Box 489 Barstow, CA 92312-0489 PH: 760-256-2520

FAX: 760-256-0127

Contact: Julie Mann Clemmer, President

March 2013





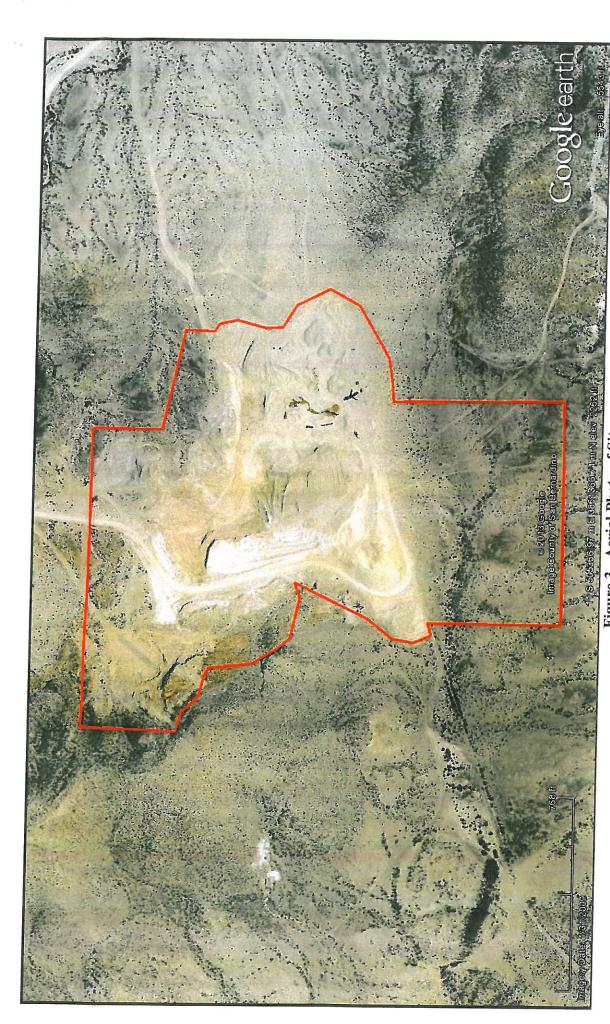


Figure 3. Aerial Photo of Site

## Revegetation Plan & Guidelines for Brubaker-Mann's Gold, Brown, and Lilac Quarries Near the Community of Yermo, San Bernardino County, California

#### 1.0. Introduction

Brubaker-Mann, Inc. is proposing the revegetation of its Gold, Brown, and Lilac Quarries, a mine site, near the community of Yermo, San Bernardino County, California (T.9 N, R.1 W, a portion of the SW 1/4 of Section 1). The site encompasses 47.2 acres, and includes a 29-acre± existing quarry and two expansion areas, 2 acres± to the north and 12 acres± to the south of the existing quarry. Revegetation is planned for only the 43± acres of the quarries and expansion areas. The project area is located approximately 4 miles east of Barstow and about 1½ miles south of I-15. The site is located within a larger property of 275 acres owned by Brubaker-Mann, which is relatively undisturbed, although there is a network of dirt roads. (See Figure 1.) Lands to the west of the property, are open space, administered by the U.S. Bureau of Land Management.

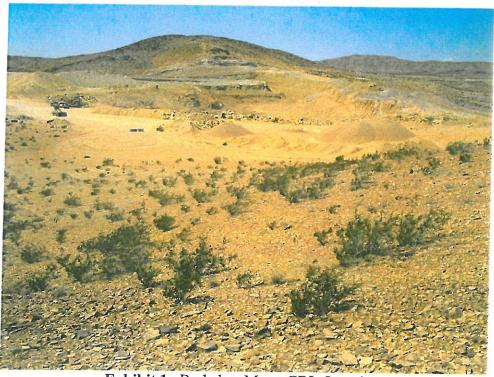


Exhibit 1. Brubaker-Mann GBL Quarries: Overview of existing pit, taken from southeast of the quarry, facing northwest

The mine currently operates under San Bernardino County Reclamation Plan 90M-07, as approved 26 June, 1990. An Amended Mining and Reclamation Plan ("Reclamation Plan") was produced by Webber & Webber Mining Consultants, Inc. on 27 December 2011, and amended on 30 November 2012. This document is intended to expand upon and provide more specific measures and guidance to the revegetation section of the current Reclamation Plan.

In January of 2013, Circle Mountain Biological Consultants, Inc. (CMBC) conducted vegetation analysis of lands in and around the undisturbed expansion areas adjacent to the existing quarry, in order to quantify baseline vegetation conditions. Fourteen 50-m linear transects and fourteen 25 m<sup>2</sup> plots were sampled at random locations to determine baseline vegetation conditions on the site, for use in establishing targets for revegetation success. Results are summarized herein, and presented in more detail in a separate report (Circle Mountain Biological Consultants, Inc. 2013).

## 2.0. Site Usage

The Gold, Brown, and Lilac Quarry project has been operating on the site since the late 1950's producing decorative colored rock, used in landscaping and roofing. The modification of the Reclamation Plan produced by Webber and Webber in 2011 and 2012 will allow the combining of the three smaller quarries (Lilac, Gold Quarry #2, and Gold Quarry #3) into one larger quarry, which will be mined to a deeper level. Gold Quarry #1 will continue to be mined as a separate small quarry. The Brown Quarry, which has never been mined, has been withdrawn from the project. All excavated material will continue to be processed at Brubaker-Mann's mill, located on Soap Mine Road, just east of Barstow. The amended mining and reclamation plan specifies that mining of the site will continue for the next 25 years, or until 31 December 2037 (Webber and Webber 2011, amended 2012).

## 3.0. Existing Conditions

As described previously, the site includes 43± acres of existing quarries and expansion areas within a 47.2 acre area. (See Figure 2.) In addition to vegetation surveys completed by CMBC in January of 2013, CMBC completed a general biological resource assessment and focused surveys for desert tortoise and burrowing owl, and a habitat evaluation for Mohave ground squirrel on the project site and in adjacent, undisturbed areas, including expansion areas, in September of 2011. CMBC completed follow-up surveys in April and May of 2012 (Circle Mountain Biological Consultants, Inc. 2012). Information on the site's flora and fauna has been taken from these surveys, and from the vegetation analysis completed in January of 2013 (Circle Mountain Biological Consultants, Inc. 2013).

Given that the site has been mined since the late 1950's (Webber & Webber Mining Consultants, Inc. 2011, revised 2012), native habitats have been eliminated from the 29-acre± quarry and some adjacent areas have been degraded by ancillary impacts, such as cross-country vehicle travel. These disturbances have provided habitats for both native and non-native weed species, including fiddleneck (Amsinckia tessellata), Saharan mustard (Brassica tournefortii), flixweed (Descurainia sophia), Russian thistle (Salsola tragus), desert skeleton weed (Eriogonum deflexum), little trumpet (Eriogonum trichopes), red brome (Bromus madritensis ssp. rubens), cheat grass (Bromus tectorum), and split grass (Schismus sp.) (Circle Mountain Biological Consultants, Inc. 2012).

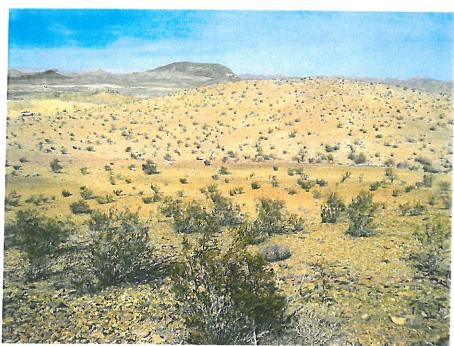


Exhibit 2. Brubaker-Mann GBL Quarries: Vegetation on Site

The plant community found throughout the site and in adjacent areas is best characterized as creosote bush - white bursage series according to the system devised by Sawyer and Keeler-Wolf (1995) for the California Native Plant Society. Dominant species in terms of abundance and distribution include creosote bush (Larrea tridentata), burrobush (Ambrosia dumosa), shadscale (Atriplex confertifolia), and desert holly (Atriplex hymenelytra). Less abundant perennial shrubs include desert goldenhead (Acamptopappus sphaerocephalus), peach thorn (Lycium cooperi), Anderson's boxthorn (Lycium andersonii), desert tea (Ephedra californica), Nevada joint-fir (Ephedra nevadensis), four-winged saltbush (Atriplex confertiflora), paper-bag bush (Salazaria mexicana), interior goldenbush (Ericameria linearifolia), turpentine-broom (Thamnosma montana), and Mojave yucca (Yucca schidigera). Six species of cactus were observed including silver cholla (Cylindropuntia echinocarpa), pencil cholla (C. ramosissima), beavertail cactus (Opuntia basilaris), hedgehog cactus (Echinocereus engelmannii), Yaqui mammillaria (Mammillaria tetrancistra), and cottontop cactus (Echinocactus polycephalus). Catclaw acacia (Acacia greggii) was the one plant species found only in adjacent areas (Circle Mountain Biological Consultants, Inc. 2012).

Rock outcrops are more common in the northwestern and southeastern portions of the site than in other areas. Plant species relatively common in these rocky areas include interior goldenbush, Yaqui mammillaria, cottontop cactus, turpentine-broom, desert aster (Xylorhiza tortifolia), and fagonia (Fagonia laevis). (Circle Mountain Biological Consultants, Inc. 2012).

CMBC found that Agassiz's desert tortoise (Gopherus agasssizii) occurs in the area, particularly to the southwest, southeast, and east of the existing quarry. Except for one older tortoise scat found on the southern expansion area in September 2011 (not found in April 2012), no tortoise sign was found in either of the two proposed expansion areas (Circle Mountain Biological Consultants, Inc. 2012).

Given the distribution of tortoise sign found during CMBC's surveys, CMBC judged that the two expansion areas could be developed without adverse impacts to tortoises so long as certain mitigation measures were implemented (Circle Mountain Biological Consultants, Inc. 2012), specifically the installation of permanent tortoise-proof fences, which took place in October of 2012.

Sharon Dougherty of CMBC and Michael Radakovich, a subcontractor, carried out a vegetation analysis of undisturbed areas in the vicinity of the project site in January of 2013, especially in the expansion areas. The goal of the analysis was to determine basic characteristics of the flora that will be of value in establishing targets for the revegetation effort, including perennial cover, perennial densities, perennial species composition and frequencies. Only perennials were considered during these winter surveys. Results of this analysis are summarized below, with more detailed information presented in a separate report (Circle Mountain Biological Consultants, Inc. 2013).

The total cover from living perennials on fourteen 50 m transects ranged from 0 to 22% (i.e., out of 100 points on the line, live plants were present on 0 to 22 points. The average perennial cover was about 8%. Only five perennial species occurred in sufficient numbers to be represented on linear transects. The most abundant species, in terms of cover, was creosote bush, followed by burrobush, peach thorn, shadscale, and desert holly. Perennial densities measured on the fourteen 25 m² plots were quite low, with an average of only 10.9 perennials per plot. This translates to about 434 perennial plants per square kilometer. Perennial species richness was low, with only seven species recorded in sampled areas. (CMBC's more extensive biological surveys of the site found a total of 24 perennials, including about 17 shrub and subshrub species, one grass, and six species of cactus.)

## 4.0. Revegetation Plan

The Reclamation Plan (Webber and Webber 2011, amended 2012) includes a basic plan for revegetation of the site. The plan relies on the establishment of seeded "soil islands" within disturbed areas, with the expectation that vegetation will spread from these islands into adjacent areas over time. As quarry benches and "nonspec" rock piles (of material that is not commercially valuable) become idle and will not be disturbed by future operations, islands of salvaged "topsoil, processing fines (sand, silt, and clay), and any site collected organics (shrubs, bushes, grasses)" will be established in these areas. According to the Reclamation Plan, the soil islands are expected to "cover approximately 25% of the designated initial revegetation area and will average one foot in thickness." These soil islands will be seeded with a mix of native seed tailored to the site. This document is intended to expand upon the concepts included in the Reclamation Plan, and provide more concrete details and methodology.

4.1. Responsible Parties. While the Proponent is ultimately responsible for all aspects of carrying out the Revegetation Plan, it will be helpful for specific tasks to be assigned to a qualified Revegetation Manager. This person will be responsible for scheduling, planning, and implementing all components of the revegetation plan, including test plot studies, scheduling, coordination, and implementation of the plan, weed control, revegetation monitoring and reporting, and adapting the plan to changing conditions over the life of the project, with the approval of the Proponent. The Revegetation Manager will also be responsible for keeping accurate records of all actions.

- 4.2. Revegetation Goals. The Reclamation Plan (Webber and Webber 2011, amended 2012) states that the goal of revegetation efforts on the site is "to accelerate the reestablishment of native vegetation subsequent to mining activities, returning the site to similar conditions that existed prior to mining." Additional goals will include establishing native plant cover to resist the incursion and spread of invasive annual grasses and forbs, and to reestablish appropriate habitat for the Federal and State threatened Agassiz's desert tortoise and other wildlife, and ultimately to meet the success criteria set forth in this document. Criteria for success will be based on current perennial species densities, cover, and species richness, as determined from CMBC's 2013 vegetation analysis.
- 4.3. Site Conditions. Two different types of areas will be revegetated: idled quarry benches and nonspec rock piles. Only about 25% of the area to be revegetated is expected to be covered by soil islands. On quarry benches, the remaining 75% of the area would consist of bare rock, with a relatively hard, smooth surface that would inhibit the retention and germination of seed, accumulation of beneficial organic litter, and the penetration of water. Under these conditions, the likelihood of vegetation spreading from soil islands into adjacent areas is very low. To correct these conditions, CMBC proposes that nonspec material will be spread on the benches to a depth of about 12 inches around the soil islands, to provide a matrix for soil accumulation and allow trapping and germination of wind-blown seed.

If there is a surplus of nonspec material after use on the quarry benches, it will be placed in piles of 20 feet maximum height. Nonspec rock piles are expected to be less compacted than quarry benches, and will have sloping sides, more prone to erosion. In order to establish stable soil islands on rock piles, such islands will be placed on level "pocket terraces" cut into the sides of the piles, as well as on the leveled top surface of the piles. The slope surfaces may be imprinted as well, if the material is amenable to this treatment (see section 4.5.4).

4.4. Test Plots. A series of test plots was established in the mid-1990's, which compared various treatments, including use of salvaged topsoil, furrows, supplemental watering, and use of fertilizers. A detailed analysis of results of this study has not been done, but preliminary results appear to show that plots where topsoil was included and conservative supplemental watering was used produced better establishment of seeded species than plots without these treatments (Van Brunt 1997). These test plots will be updated and expanded to allow representation of the methods of revegetation currently proposed.

New test plots will utilize the seed mix planned for revegetation of the site (See Table 1, Section 4.5.3). They will consist of an array of soil islands surrounded by nonspec material. CMBC proposes establishing a grid of nine 120 m<sup>2</sup> plots (60 m X 2 m), using a 12" high bed of topsoil, fines, and organic material, within a matrix of nonspec material of similar height (the same as proposed for revegetation areas). The table below shows the combinations of treatments to be tested in each plot.

Table 1. Test Plots

The Late of the La						
PLOT	MECHANICAL TREATMENT			BOTANICAL TREATMENT		
	Ripped	Imprinted	None	Seed Only	Seeds + Salvaged Cacti	None
1	X			X	8	2,0110
2	X				X	
3	X					X
4		X		X		- 11
5		X			X	
6		X				X
7			X	X		
8			X		X	
9			X			X

The plots will be established in the fall of 2014 or 2015, when seed is available. Results of the plots will be measured annually for at least five years. If necessary, based on changing conditions and preliminary results, additional combinations of treatments may be tested. The results will be used to develop recommendations for changes to this plan, as needed.

## 4.5. Components of the Revegetation Plan.

- 4.5.1. Topsoil Conservation. Topsoil represents a valuable resource in revegetation efforts, and contributes native seed, beneficial soil microorganisms, as well as organic and mineral nutrients crucial to revegetation success. All available topsoil will be stripped and salvaged prior to mining in expansion areas. (This can be done in stages, as new portions of the expansion areas are prepared for mining.) George Webber, of Webber & Webber Mining Consultants, Inc., estimates that approximate 1-2 feet of topsoil may be present in the expansion areas (pers. comm. 7 March 2012). Topsoil will be stockpiled in areas protected from vehicle traffic and heavy equipment disturbance. The stockpiles must be protected from wind and water erosion through the use of suitable weed-free mulch or matting. As revegetation is expected to be implemented over many years, mounds of stock-piled topsoil will be used in the order they were deposited.
- 4.5.2. Salvage of Plant Materials. Cacti in expansion areas will be salvaged in advance of mining. Cacti are relatively hardy and easy to transplant, and can provide added structure to revegetation areas, creating sites for trapping windblown seed and providing sheltered microclimates for germination. Salvaged cacti will be placed in an area protected from vehicle traffic and heavy equipment disturbance until they are incorporated into revegetation areas.
- 4.5.3. Seed Sources. A possible seed mix for the site is provided in Table 2. The mix is based on species that known to occur within the project area or are regionally common, and includes a number of species from early seral stages (i.e., "pioneer species"). These species will contribute to faster soil stabilization and enable a more rapid rebuilding of the soil microorganism community, facilitating the establishment of climax species. Most of these species are available commercially. This seed mix may be modified as needed, e.g., if some species are too difficult to obtain, or if adjustments are needed based on preliminary results. The Revegetation Manager may prefer to use a customized seed mix developed by a commercial native seed provider, such as S&S Seeds. It is critical that the seed be purchased as pure live seed (PLS). This assures that the seed is viable and will germinate properly. If possible, seed from local sources is preferred.

Table 2. Proposed Seed Mixture and Application Rate

Species	Application Rate (lbs PLS/acre)		
Shrubs			
Ambrosia dumosa, burro bush	2.0		
Atriplex confertifolia, shadscale	2.0		
Atriplex canescens, four-winged saltbush	1.0		
Atriplex hymenelytra, desert holly	0.5		
Acamptopappus sphaerocephalus, desert goldenhead	1.5		
Ephedra nevadensis, Nevada joint-fir	1.0		
Larrea tridentata, creosote bush	5.0		
Lycium cooperi, peach thorn	1.0		
Salazaria mexicana, paper-bag bush	0.5		
Grasses			
Aristida purpurea, purple three awn	1.0		
Achnatherum hymenoides, Indian rice grass	1.0		
Forbs			
Xylorhiza tortifolia, desert aster	0.2		
Phacelia crenulata, purple phacelia	0.2		
Lupinus arizonicus, Arizona lupine	0.5		
Malacothrix glabrata, desert dandelion	0.2		
Plantago ovata, plantain	0.2		
Sphaeralcea ambigua, desert globe mallow	0.2		
TOTAL	18.0		

4.5.4. Site Preparation, Distribution of Seed and Plant Materials. As described in the Reclamation Plan (Webber and Webber 2011, amended 2012), revegetation will be carried out by establishing and seeding soil islands. These islands will be located within a matrix of nonspec material on benches, and on pocket terraces or the leveled top of the pile on nonspec rock piles. The soil islands will include topsoil and retained dead plant material, as well as processing fines (sand, silt, and clay). Where space allows, soil islands will be at least 60 m in length and 10 m wide to allow placement of linear transects and density plots during monitoring efforts. Salvaged cacti will be transplanted into the soil islands, in low densities.

Two alternative site preparation and seed distribution methods are proposed. In the first, an imprinter will be used to create an irregular surface on the revegetation areas and distribute the seed mix. Imprinting is a process using a heavy drum roller with patterns of V-shaped teeth, drawn by a tractor. The roller breaks up and incorporates dead plant material into the top soil, while creating a pattern of pockets in the soil surface. These pockets are persistent over a period of years, and serve as micro-sites for retention and germination of seeds, trapping water and sheltering seedlings from sun and wind, while decreasing erosion. Seed is distributed from an attached hopper. Planting will be planned for the fall months, to take advantage of winter rains.

Ripping and use of a hand-held seed spreader will be considered as an alternative method to imprinting. If test plots show comparable results to imprinting, this alternative may be less expensive.

Supplemental watering with a side-spraying water truck, timed to water the plots every two weeks at a rate totaling 0.5 inches of water per month, appeared to benefit germination and survival of plants on the previously established test plots (Van Brunt 1997). Since water trucks will be on-site for the purpose of dust control, CMBC recommends that watering at similar rates be implemented on the revegetated areas for the first two years after planting. However, if it appears that supplemental watering is encouraging the growth of invasive exotics, or appears to have little benefit, it will be discontinued.

4.4.5. Maintenance & Erosion Control. Revegetated areas will be checked monthly for erosion damage, and corrective action taken if damage is found. Treatments may include placement of rice straw bales or wattles, fiber blankets, mats, etc. Use of heavy equipment that may compact soils and destroy imprinting will be avoided.

Revegetated areas will be checked in the spring months, annually, for disturbance-adapted, invasive, exotic species, such as Saharan mustard or Russian thistle. These plants will be removed by hand before they mature and set seed. (Annual exotic grasses, such as Mediterranean split grass, are present throughout the region, even in relatively undisturbed areas, and it is not practical to try to remove these species from revegetated areas.)

The tortoise proof fencing will also be regularly checked and repaired as needed to prevent potential violation of State and Federal Endangered Species Acts. Fencing will be removed when mining and revegetation operations are completed.

4.4.6. Revegetation Monitoring. Revegetated areas will be sampled by a qualified botanist or biologist, using the same methodology used in CMBC's 2013 vegetation analysis, with the addition of Daubenmire plots to sample annual densities. (See Appendix A.) Since revegetation efforts will be carried out over a period of many years, CMBC proposes that spring sampling visits be scheduled every three years over the life of the project.

It is crucial that a log of revegetation activities should be kept, with details on the treatments applied. The Revegetation Manager will be responsible for ensuring that the log is kept current and complete. Information kept will include the locations (as determined by a hand-held GPS or similarly accurate method) and size of the revegetation sites, dates of activities, types of equipment used, seed mix and application rates, schedule of supplemental watering (if any), dates and nature of any invasive plant control activities. A report on revegetation efforts and results will be prepared after each monitoring effort. The report will include recommendations on changes that may be necessary to improve the success of the efforts.

4.4.7. Criteria for Success of Revegetation Effort. Given the relatively low levels of perennial plant cover, densities, and species richness found during CMBC's vegetation analysis, and the goal of revegetation to approximate site conditions found prior to mining, it is reasonable to aim for at least 80% of the pre-mining levels of cover, density, and species richness. These success criteria are:

- Perennial Cover: at least 80% of that found in undisturbed areas (6.4%)
- Perennial Densities: at least 80% of that found in undisturbed areas (8.7 perennials per 25 m<sup>2</sup> plot).
- Perennial Species Richness: at least 80% of that found in undisturbed areas (5.6 perennial species)
- 4.4.8. Adaptive Management of Revegetation Efforts. The Revegetation Manager responsible for the revegetation effort will have the prerogative to change elements of the plan with the approval of the Proponent, as the project proceeds, to improve the likelihood of success. For example, if the seed mix as proposed is prohibitively expensive, or includes species that are not readily available from commercial sources, changes can be made so long as the new mix includes locally common native species or species native to the region that have been used successfully in other comparable revegetation efforts. Other techniques or elements that have proven effective in comparable efforts may be added or substituted, as needed, i.e., use of soil mycorhizzae inoculants, use of baby powder or other materials to discourage seed predation by rodents, etc.

## 5.0. Summary and Conclusions

Brubaker-Mann, Inc. plans revegetation of its Gold, Brown, and Lilac Quarries, located on 43± acres within a 47.2-acre mine site, near the community of Yermo, San Bernardino County, California. A Reclamation Plan was produced by Webber & Webber Mining Consultants, Inc. on 27 December 2011, and amended on 30 November 2012, which modifies and updates San Bernardino County Reclamation Plan 90M-07, as approved 26 June, 1990. This revegetation plan expands upon the general program for revegetation described in Webber's Reclamation Plan.

This plan calls for the designation of a Revegetation Manager who will be responsible for scheduling, planning, and implementing all components of the revegetation plan, including test plot studies, scheduling, coordination, and implementation of the plan, weed control, revegetation monitoring and reporting, and adapting the plan to changing conditions over the life of the project, with the approval of the Proponent. The Revegetation Manager will also be responsible for keeping accurate records of all actions.

Proposed criteria for success include: perennial cover: at least 80% of that found in undisturbed areas (6.4%), perennial densities: at least 80% of that found in undisturbed areas (8.7 perennials per 25 m<sup>2</sup> plot), perennial species richness: at least 80% of that found in undisturbed areas (5.6 perennial species)

The Revegetation Manager responsible for the revegetation effort will have the prerogative to change elements of the plan with the approval of the Proponent, as the project proceeds, to improve the likelihood of success.

Elements of the revegetation plan and timelines are listed below in Table 3.

Table 3. Tasks and Timeline

Tasks	Description	Timeline
Seed mix	Refine mix, arrange for purchase, or collection and storage of seed	Year 1 (for test plots) & ongoing as needed
Cacti	Salvage & transplant	Year 1 (salvage) & ongoing (transplant)
Topsoil	Salvage & storage	Ongoing, until expansion areas are fully utilized.
Nonspec material	Salvage & storage	Ongoing, as part of daily operations
Test plots	Establishment	Year 2
Test plots	Measure & evaluate	Years 3-8
Revegetation	Planning	Year 3 & ongoing
Revegetation	Implementation, adaptive management	Ongoing, as mined areas are idled.
Revegetation	Monitor success, report	Ongoing, every 3 years
Maintenance	Check conditions and take corrective actions as needed	Ongoing, as part of daily operations

#### 6.0. Literature Cited

- Circle Mountain Biological Consultants, Inc. 2012. "Focused Survey and Resurvey for Agassiz's Desert Tortoise, Habitat Assessments for Burrowing Owl and Mohave Ground Squirrel, and General Biological Resource Assessment for the Brubaker-Mann, Inc. Gold, Brown, Lilac Quarries Proposed Expansion Areas near the Community of Yermo, San Bernardino County, California. Unpublished report. Produced for Brubaker-Mann, Inc. Wrightwood, CA.
- Circle Mountain Biological Consultants, Inc. 2013. "Baseline Vegetation Analysis for Brubaker-Mann's Gold, Brown, and Lilac Quarries near the Community of Yermo, San Bernardino County, California." Unpublished report. Produced for Brubaker-Mann, Inc. Wrightwood, CA.
- Van Brunt, J. April 1997. "Description of Plot Development for Testing Plant Revegetation as a Component of a Total Reclamation Program." Unpublished report. Prepared for Brubaker-Mann, Inc.
- Webber & Webber Mining Consultants, Inc. December 27, 2011. Amended: November 20 2012. "Gold, Brown, Lilac Quarries Amended Mining and Reclamation Plan. Revision 2011." Unpublished. Produced for Brubaker-Mann, Inc. Redlands, CA.