DOCKETED

Docket Number:	09-AFC-08C
Project Title:	Genesis Solar Energy Project
TN #:	264498
Document Title:	Genesis 2024 Revegetation Report
Description:	N/A
Filer:	Cynthia Keller
Organization:	NexteraEnergy Resources
Submitter Role:	Applicant
Submission Date:	6/30/2025 7:04:26 AM
Docketed Date:	6/30/2025

Genesis Solar Energy Project

Summary Report for Revegetation

Prepared by:

Alice E. Karl, Ph.D.
P.O. Box 74006
Davis, CA 95617
heliophile@mindspring.com

Prepared for:

Genesis Solar, LLC
700 Universe Blvd.
Juno Beach, FL 33408

and

The California Energy Commission
1516 Ninth St.
Sacramento, CA 95814

June 2024

TABLE OF CONTENTS

List of Figures

List of Tables

Appendices

Genesis Solar Energy Project
Summary Report for Revegetation

1.0 BACKGROUND

The Final Commission Decision[1] for the Genesis Solar Energy Project (GSEP or Project) included the following Condition of Certification (COC):

REVEGETATION OF TEMPORARILY DISTURBED AREAS

BIO-24 The Project owner shall prepare and implement a Revegetation Plan to restore all areas subject to temporary disturbance. The final Revegetation Plan shall be based on the draft Revegetation Plan submitted by the Applicant (TTEC 2010i) and shall include all revisions deemed necessary by the CPM in consultation with BLM. The objectives of the Revegetation Plan shall be to stabilize disturbed soils, minimize erosion and sedimentation impacts to soil and water resources, prevent colonization by noxious weeds and other non-native plants, salvage native plantings and seed from Project Disturbance Areas, and to achieve restoration of disturbed areas to functioning, established early-successional native plant communities.

Target performance standards at the end of the monitoring period shall be as follows:

1. total absolute cover of all plants shall equal at least 30 percent;

2. survivorship of salvaged and transplanted cacti and other native plantings shall equal 30% percent;

3. at least 90 percent (relative cover) of the perennial species observed within the temporarily disturbed areas shall be locally native species that naturally occur in the adjacent desert scrub or dune habitats;

4. relative cover of perennial plant species shall equal at least 60 percent of the total vegetative cover; and

5. Relative cover of non-native plants within the temporarily disturbed areas shall not exceed the relative cover of non-native plants in the adjacent habitats.

Verification: No less than 30 days prior to construction-related ground-disturbance activities the Project owner shall submit to the CPM a final agency-approved Revegetation Plan that has been reviewed and approved by the CPM.

[1] California Energy Commission. September 2010. Genesis Solar Energy Project Commission Decision. CEC=800-2010-011 CMF. Docket Number 09-AFC-08.

> All modifications to the Revegetation Plan shall be made only after approval from the CPM.
>
> Within 30 days after completion of Project construction, the Project owner shall provide to the CPM for review and approval a report identifying which items of the Revegetation Plan have been completed, a summary of all modifications to revegetation measures made during the Project's construction phase, and which items are still outstanding.
>
> The Designated Biologist shall provide reports to the CPM according to the reporting schedule in the Revegetation Plan that that includes: a summary of revegetation activities for the year, a discussion of whether revegetation performance standards for the year were met; and recommendations for revegetation remedial action, if warranted, planned for the upcoming year. Reports shall be submitted on January 31st following the relevant reporting year.

All verification items were completed as required and can be found in earlier annual reports. The overarching goal of the approved Project Revegetation Plan[2] was "*to restore approximately 73.5 acres of temporarily disturbed areas to a condition that will substantially improve the ability of those areas to achieve an ultimate community that is physically and functionally similar to the original, pre-construction condition*". Recognizing that the processes involved in succession from early to late-successional desert habitats are complex and lengthy, the Revegetation Plan identified that "*a thoughtful, active program of initial restoration activities can optimize a site's conditions, thereby "setting the stage" for full and rapid recovery to pre-disturbance conditions*". Hence, the following specific restoration objectives were listed:

- *Result in a perennial plant community that includes well-established, colonizing species and some later successional species that occur locally in native habitats*
- *Design and construct the linear features to minimize soil and vegetation impacts and maintain original hydrology*
- *Restore community functioning for both vertebrates and invertebrates*
- *Preserve native topsoils and seed banks*
- *Control weeds and other invasive plants that interfere with natural succession and restoration and ensure that the revegetation program does not result in enhanced weed populations over existing levels*
- *Provide site-specific information on performance of revegetation methods to inform and improve the design of the decommissioning and closure restoration plan*

Success standards at 10 years mirrored BIO-24, with the addition that plant species composition includes 40 percent of the species seeded or planted.

[2] Karl, A.E. and Tetra Tech EC, Inc. 2010. Revegetation for the Genesis Solar Energy Project. 21 pp.

2.0 METHODS

2.1 LOCATIONS AND METHODS OF ROAD SHOULDER RESTORATION

Restoration of temporarily disturbed areas outside the fenced power plant were primarily the main access road shoulders, which were used for construction access to the site while the access road was being paved. No grading occurred on these road shoulders in an effort to preserve the topsoil and root crowns. While well-intended, this procedure proved to be fruitless because (a) there was so much construction traffic that no shrubs or root crowns originally in the road shoulders survived, and (b) disturbance from trenching in the gas line in the northern road shoulder fully destroyed any remaining root crowns. Turnarounds along the access road were kept to provide places for personnel and delivery trucks to pull off the access road without disturbing the restored road shoulders. Restoration proceeded in phases at GSEP because of phased construction (Table 1).

2.1.1 Fall 2011

After the access road was paved in 2011, no further work was planned for the southern disturbed road shoulder except for the future 230 kV transmission line and the construction for the latter was only planned to disturb the tower pad locations. Accordingly, that side of the road was restored in Fall 2011. It was de-compacted, harrowed, re-contoured, imprinted and drill-seeded as follows:

Decompaction and Testing – Prior to decompacting the soil, compaction tests were conducted according to American Society for Testing Materials (ASTM) standards. The testing company, PSI, tested eight points, representing the different soil types along the access road. Mean percent compaction was 5.125 (S.E. = 1.48; Range = 1-13), greater than the adjacent, undisturbed soils. Despite these test results, the road shoulder was subsequently disced three times to depth of 6-8 inches. Several tractor attachments were tried in an attempt to decompact the soil without digging so deeply that subsoil was turned up. The disc was the only implement that was successful, especially in the finer, more compacted soils.

Spreading Topsoil and Re-Contouring – Topsoil originally had been salvaged from the central 24 ft of the road right-of-way (i.e., the portion that eventually would be paved) and shallowly windrowed approximately 15 ft from the road edges. Following discing, the topsoil windrows were spread back onto the road shoulders. The grader then recontoured the shoulder to match the natural contours. The stems and trunks of several trees from the solar site had also been salvaged prior to site mowing. They were moved to the access road to help provide vertical mulch in the resource islands.

Seed Collection, Seed Mixes and Application – Several seed collection companies were contacted and queried relative to collection availability, flexibility, and prices. I selected

Table 1. Summary of restoration and associated activities at GSEP. See text for details.

Season/Year	Location	Restoration and Associated Construction Activities
2010	Access Road ROW	Habitats along the access road ROW described and mapped
January 2011	Access Road ROW	Quantitative transects established to evaluate revegetation success
2011	Access Road and Main Project Site	1 - Cacti salvaged from the site and access road ROW and planted 2 - Topsoil salvaged and windrowed from Access ROW center 3- Access road paved
Fall 2011	Southern road shoulder	Decompacted, contoured, imprinted, and drill-seeded specific colonizer shrubs and grasses, and local annuals
June and July 2012	Northern road shoulder	Gas line installed
January 2013	Southern road shoulder	230 kv transmission line construction began on south side of access road
Fall 2013	Southern road shoulder	Restoration of southern road shoulder, including extreme surface roughening and seeding
Winter 2013/14	Northern road shoulder	Decision to keep wooden pole line in place.
March 2014	Northern road shoulder	Restoration of northern road shoulder, including extreme surface roughening but no seeding
November 2015, March 2016	Both road shoulders	Began quantitative transects anew (requirement to start in Year 2 after restoration), based on revised restoration date of 2013 for the southern road shoulder and 2014 for the northern shoulder. Standardized the start date to 2016.
2016-2019, March 2024	Both road shoulders	Continued with quantitative transects, Years 2-5 and Year 10

Comstock Seed (Gardnerville, Nevada), who was subsequently approved by BLM[3]. Because of below-average rainfall in the Project area in 2011, alternative locations outside the local watershed, but within 100 miles (not including Mojave Desert locations), were discussed with BLM and approved. The seed was tested for germination before delivery.

One main seed mix was used, comprising *Ambrosia dumosa*, *Atriplex polycarpa* (allscale), *Ambrosia salsola* (cheesebush), and *Larrea tridentata*, planted at a ratio of 4:5:2:1 pure live seed (PLS) per acre, respectively. All are strong colonizers, except *L. tridentata*, and grow in this area. A second mix, strictly for loose-sandy areas, consisted of *Hilaria rigida* (big galleta grass), *Oenothera deltoides* (evening primrose) and *Abronia villosa* (sand verbena), at a PLS per acre ratio of 3:3:3. *Lupinus arizonicus* (Arizona lupine) was added intermittently to the mix.

[3] E-mail from Larry LaPre, BLM California Desert District Wildlife Biologist, to Christina Lund, BLM State Botanist. April 25, 2011.

The main seed mix was drilled into the soil of the road shoulder along the entire length, to the Southern California Edison (SCE) crossing, except where the native habitat was barren. No seed was drilled there. The sand mix was drilled or broadcast with a hand spreader in the sandier ESAs.

Following seed drilling, a sheep's foot roller was used to imprint the soil, to catch seed, water, and sediments (Figure 1). A water truck with a side-sprayer wet the imprinted area repeatedly to create a crust on the newly disturbed soil, in an attempt to stabilize that surface from wind erosion.

Restoration areas were then signed with large, restoration-specific, metal signs.

FIGURE 1. Sheep's foot imprinting on the southern road shoulder after seeding in Fall 2011.

Watering **–** Seeding was done in late October, to take advantage of warm soil plus fall and winter rains. Only a light rain fell in early November, so water trucks with side sprayers were employed to water the road shoulder. The program included two water trucks, travelling short segments over multiple passes, to achieve a soaked soil, as opposed to lightly spraying for dust control. This watering was to be done every three weeks. After the first watering in mid-November, I checked the soil moisture on 26 November 2011 in eight locations with different soil types. The soil was dry to lightly moist in the top 2-3 inches, and moist below that to 7-10 inches. So, this appeared to be an adequate method for wetting the soil in the absence of rain. However, on a site check the following 8 February, no plants, including annuals, had germinated. There had been negligible rain (Table 2) and the level of watering first observed in November had not been maintained, according to the drivers and construction manager[4]. At least some of the reason was that the trucks were needed elsewhere, so the soil would dry between passes. Some of the watering had been done over long stretches of road, rather than short segments, again with the result that the soil dried out between passes. Hence, watering with the water trucks proved unsuccessful, at least in part because the program was not maintained.

No precipitation fell during the winter or throughout the following spring and early summer, resulting in negligible germination. The watering truck process proved to be unsuccessful, likely because of the difficulty of prioritizing this task for the water truck and due to intermittent, inconsistent watering. Without adequate moisture for germination, most planted seed had likely blown away in the heavy spring winds, was consumed by granivores, or washed away in the monsoonal floods that followed in July 2012. This monsoon also caused major erosion across the landscape, especially near the Project solar site. Surface flows accumulated above the northern road shoulder, which was lower than the road, and locally altered the drainages. However, a few small patches on the roadside, especially near the solar site, grew in response to this monsoon.

2.1.2 Fall 2013

Beginning in January 2013, the 230 kV transmission line was constructed along the southern (western) access road. The pole height and short distance between the poles resulted in substantial disturbance to the already-restored road shoulder (which had mostly failed due to lack of rain; see above). As a result, revegetation activities began anew in Fall 2013. Taking advantage of my observations that substantial microtopography, such as dirt berms and cobbles, could result in enhanced sites for germination by backing up water and capturing seed and sediment, I experimented using a Gannon tractor with a box scraper and blade to create a series of swales in several locations. These microtopographical features were attendant to hydrology and soil types, and also were varied to create a more natural, less systematic, outcome (Figure 2). The swales were seeded with mixture of the following species, at roughly the following rates (pounds of bulk seed/acre[5]), with the specific mix varying by habitat type, and the availability of the remaining 2011 seed:

Ambrosia dumosa – 82.3 lb/acre
Ambrosia salsola – 87.5
Atriplex polycarpa – 233.4
Encelia farinosa (brittlebush) – 121.2
Hilaria rigida - 56.4
Lupinus arizonicus – 86.5
Sphaeralcea angustifolia (globemallow) – 154.4 (2013 seed) – 329.7 (2011 seed)

---

[4] C. Bryant, pers. comm. to A. Karl, 8 February 2012.
[5] Seeding rate was calculated from the PLS per pound of bulk seed. Seed remaining from 2011 was broadcast at double the rate, assuming loss of viability.

TABLE 2. Rain history at GSEP during the revegetation program. Winter is from October of the prior year though April of the current year (most spring rain is March, usually little to none in April and May). Summer is June through September. Data are expressed in inches unless specifically shown in mm; the latter are from rain guages on the Project site.

	Observations of Primary Production at Site		Blythe Airport Station Meterological Station 040927 [1]			
Year	Winter Annuals (Spring Flowering)	Summer Annuals	Winter	Summer	Long-Term Average	
					Winter	Summer
					2.27	1.19
2012[2]	None. No rain fell at site, despite some rain in Blythe	Good. Large monsoon in July plus storms in June and August.	1.35	3.00		
2013	Poor based on *Brassica* growth, but otherwise not documented onsite	Good	1.94	1.27		
2014	None. Rain on site in November but mostly neglible for winter	Good. More rainfall on site than in Blythe.	0.89	0.68		
2015	Poor. Above average rainfall at Blythe, but almost no growth of winter annuals, indicating little rainfall at the site	None, with a few minor patches in east	2.44	0.31		
2016	Poor	Poor	0.76 (0.4 mm)	0.54 (<1 mm)		
2017	Good. Three winter storms October to February	Good. Late rainfall onsite in August and September despite lower rainfall in Blythe	4.14 (76 mm)	0.7 (57 mm)		
2018	None	Poor. Only 0.9 mm onsite (0.04") compared to 0.7" in Blythe in the largest summer event.	0.17	0.83		
2019	Good	None	2.6	0.03		
2020	Good. March "miracle" rains.	None	5.07 (104 mm)	0		
2021	None	Moderate. Slightly >1" rain at site.	0.92	0.38		
2022	None	Good	0.28 in (1.8 mm)	2.37 (40 mm)		
2023	Moderate. Most of winter rain occurred in October, minor through March	Moderate. One storm in August.	1.93 in (21 mm)	1.2 in (13.2 mm)		
2024	Good at site even with mostly late rains.	None	2.08 (20.3 mm)	NA (3.9 mm)		

1/ Source: National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Service. Available online at: https://www.ncdc.noaa.gov.

2/ Initial restoration on the southern shoulder was Fall 2013. Revised restoration effort began November 2013 on the south shoulder and March 2014 for the northern shoulder.

The seed was broadcast with a hand-seeder and manually raked in. This was immediately followed by watering with the water truck to crust the soil surface and minimize loss of seed and soil to wind. Again, Comstock Seed provided the seed. They collected it locally in Spring 2013, primarily in the Bradshaw Trail area south of the site and tested germination before delivery. Seed remaining from the 2011 revegetation effort was also used.

2.1.3 March 2014

In 2014 and after much debate, Genesis Solar, LLC, decided to leave the wooden pole distribution line in place in the northern (eastern) road shoulder. Restoration of this side of the road originally had been postponed until after the poles were removed. After the decision to leave the poles in place, I began restoration in March 2014. Based on the very successful experimental techniques employed the previous fall (see *Revegetation Success*, below), we used a gannon to first rip the compacted road shoulder to approximately 8", then pull and spread the topsoil windrow back onto the shoulder, and finally create a very roughened surface of swales, depressions and furrows, similar to the southern road shoulder the prior year (Figure 2). We also created more swales and roughened areas on the southern shoulder where no restoration had yet been done due to construction conflicts. Pole pads were ripped. Cobble riprap was placed in two locations where runoff across the road tended to be high and the road shoulder repeatedly washed out. (Ultimately, cobble riprap was deposited in several locations along the southern road shoulder over the 10 years of the restoration program, due to high flow.) This time, no seeding was implemented on either shoulder because of the timing[6]. Seeding is best accomplished in autumn for spring-blooming (i.e., winter) annuals and, arguably, summer for woody species.

2.2 TOWER PAD RESTORATION

East of the access road, to the Colorado River Substation**,** major surface disturbance was limited to pole pads and stringing/pulling sites. A road was not graded for access for most of the alignment and vehicle damage was generally low, with minimal compaction. Each pad and disturbed area was individually evaluated to determine the best method for restoration. Most of the terrain traversed was loose-sandy, including low dunes, which are extremely dynamic. Any active restoration would have been masked by continuous sand deposition, but the same processes would restore any disturbed area naturally. The pads were also small. Accordingly, the tower pads in the dunes or very loose areas were not actively restored. For tower pads and pulling sites outside these areas, restoration was limited to recontouring and shallow ripping. Re-contouring was implemented where restoration of natural drainage was necessary. Seeding was not implemented because the tower pads comprised very small patches of disturbance in generally depauperate habitat.

[6] Project management wanted to finish all construction activities in Spring 2014, requiring road restoration to be completed in spring.

FIGURE 2. Different swale configurations created to capture moisture, sediment and seed. Techniques on the left were implemented experimentally on portions of the southern access road shoulder in Fall 2013. Those on the right were implemented in March 2014 on remaining areas on the southern road shoulder and on the northern road shoulder.

2.3 CACTUS SALVAGE

In April 2011, 37 *Cylindropuntia echinocarpa* (silver cholla), 3 *C. ramosissima* (pencil cholla) and 5 *Mammillaria tetrancistra* (fishhook cactus) were excavated and removed from the solar plant site prior to the site being mowed Eleven days after salvage (to allow roots to partially dry, thereby avoiding fungal growth), they were planted outside of the topsoil berms[7]. Cacti were planted in 16 groups of one to four plants each; all were planted, because of continued construction in the road shoulders. Most plants were planted in the partial shade of a shrub, typically *L. tridentata*, to provide some ameliorating benefit to ambient air and soil temperature and thereby minimize translocation stress; all *M. tetrancistra* were planted in the shade of shrubs, often typical of the species. Cacti were handwatered one or two gallons monthly for 15 months, unless there was rain. At each watering, plant condition was assessed. Plant condition was assessed annually through 2015.

2.4 QUANTITATIVE TRANSECTS TO ASSESS REVEGETATION PROGRESS

Quantitative baseline transects to evaluate revegetation success, specifically perennial plant growth and habitat functioning, were initially established in January 2011 outside the planned width for the paved road (plus three ft of compacted shoulder on each pavement edge). The Revegetation Plan required monitoring in Years 2 through 5 and Year 10 after restoration. Time "Zero" for the south side was Fall 2013. However, with the northern side restored in March 2014, it was logistically practical to restart the clock for both shoulders to Spring 2014. Hence, we re-ran the transects in 2016, Year 2.

The initial transects comprised sets of transect pairs, one in the area to be disturbed for road construction and a control transect approximately 100 meters upslope of the road road right-of-way (ROW), in the same habitat. Two randomly selected transect sets were established in each habitat type along the ROW (previously mapped in 2010) within the constraint of at least two transect sets per mile of the access road. In 2015, transects on the opposite road shoulder from the initial transects were added, plus some additional transects and a few minor modifications to the original, baseline transects that:

- attended to changes in hydrology due to monsoonal overland flow in July 2011
- compared different restoration techniques
- avoided unforeseen impacts (e.g., pole pad compaction, application of cobble riprap on the road shoulder, bulldozing blow sand off the road)
- provided additional replicates

This final transect set is shown in Table 3.

[7] Continued construction in the road shoulders precluded planting in the revegetation zone, as identified in the Revegetation Plan. Few cacti actually grew naturally on the access road – only one was salvaged. Most grew upslope. However, marginal habitats were available along the access road so it was considered acceptable for planting transplants there.

TABLE 3. Final locations and habitats of transects for perennials and habitat functioning.

Road Shoulder Transects						Control Transects			
Transect I.D.	Side of Shoulder	Notes	UTM (NAD 83) East End Easting	Habitat Designation[1]	Relevant Mile of Access Road Wherein Transects Occur	Transect I.D.	UTM (NAD 83) East End Easting	UTM (NAD 83) Northing	Habitat Designation[1]
A	N		693745	SS+D	1	C1	693802	3721225	SS/D
	S		693745	SS+D					
B	N		693344	SS					
	S_1	Two, 50m-long transects	693344	SS					
	S_2		693275	SS					
C	N		693028	CBs		C2	693060	3721353	CBs
	S		693004	CBs					
D	N		692880	SS	2	C3	692574	3721734	D
	S_1	Two, 50m-long transects	692880	SS					
	S_2		692715	SS					
E	N		692240	Ss					
	S_1	Two, 50m-long transects	692281	Ss					
	S_2		692204	Ss					
F	N		692018	SS+Ha+W		C4	692172	3722138	SS+Ha+W
	S		692018	SS+Ha+W					
G	N		691804	Ss		C5	692011	3722270	Ss
	S		691804	Ss					
H	N		691330	Ss					
	S		691328	$Ss+S_L$					

Road Shoulder Transects						Control Transects			
Transect I.D.	Side of Shoulder	Notes	UTM (NAD 83) East End Easting	Habitat Designation[1]	Relevant Mile of Access Road Wherein Transects Occur	Transect I.D.	UTM (NAD 83) East End Easting	UTM (NAD 83) Northing	Habitat Designation[1]
I	N		690925	SS+ Ha with S_L	3	C6	690949	3723113	SS+Ha+W
	S		690925	Ss+S_L					
J	N		690634	Ss		C7	690735	3723227	Ss
	S		690634	L+S_L					
K	N		690200	Ha+W+S_L	4	C8	689461	3724089	Ss+S_L
	S_1	Two, 50m-long transects	690239	L+S_L					
	S_2		690200	Ss					
L	N		689678	Ss					
	S		689454	L+S_L					
M	N		689235	Ss+S_L					
	S		689234	L+S_L					
N	N		688634	Ha+W	5	C9	688651	3724940	Ha+W
	S		688634	Ha+W					
O	S	1 transect, S side only	688562	CBs+Ss		C10	688578	3725018	CBs+Ss
P	N		688356	CBs		C11	688411	3725201	CBs
	S		688356	CBs					
Q	N		688270	CBs+Ss		C12	688259	3725337	CBs+Ss
	S		688270	CBs+Ss					

[1/] Habitat Designations:

D	Dunes (aeolian)
SS	Sand Sheets (aeolian)
Ha	Hilaria-dominated, sandy washes
W	High-water volume washes and coalescing runnels
Ss	Swales and runnels on compacted sand; may be hummocky
S_L	Small runnels over ancient lakebed
L	Ancient lakebed, very sparse shrubs
CBs	Creosote bush scrub; loamy sand with some fine-gravelly substrate; may be hummocky but few runnels

Transects examined perennial growth based on percent cover, density, frequency, and plant height. Each transect was 100 meters long by one meter wide. To measure percent cover, a standard line intercept method measured the intersection of all shrub foliage with the measuring tape, by species. The height of each intersecting plant was measured to document robustness. The belt was divided into 10, 1 x 10 m quadrats along the tape, in which density and frequency were measured by species. Habitat functioning was measured by counting ant mounds and rodent holes within a 2 m belt centered on the transect tape; lizards were counted in a 4 m belt centered on the tape. While annual plant growth is highly variable among years and seasons, annuals indicate fertility, organic material, and biological functioning. Hence, percent cover of annuals, by species and in total, were counted in 10 random 1 x 1 m plots, one randomly sited in each 10 m of the belt. Representative photographs were taken at each end of the transect (Appendix 3)

3.0 RESULTS AND DISCUSSION

3.1 RESTORED ROAD SHOULDERS

3.1.1 BIO-24 Target Performance Standards

Performance Standards 1 and 4: The target percent cover for all plants is 30%, including 18 percent cover of perennials (60% of the total 30%) and 12% cover of annuals.

Transect data were evaluated by habitat subtype, the latter based on the abundance and quality of the drainages:

D - Dunes (aeolian); no drainages
SS - Sand Sheets (aeolian); no drainages
Ha - Hilaria-dominated, sandy washes
W - High-water volume washes and coalescing runnels
Ss - Swales and runnels on compacted sand; sometimes hummocky (sand)
S_L - Small runnels over ancient lakebed
L - Ancient lakebed; very sparse shrubs
CBs - Creosote bush scrub; loamy sand with some fine-gravelly substrate; may be hummocky but few runnels

In general, the road ROW and immediately adjacent area is characterized by shallow, soft to loose sand over an old lakebed, with sand gathering in scattered low dunes and sand sheets. The hydrology is represented by intermittent to frequent runnels and scattered larger washes. While the edges of the fine-grained habitat subdivisions listed above are a little indistinct and fluid (the latter depending on monsoonal activity), the quality and abundance of drainages does influence plant growth. Further, the percentage of the transects for each location group (northern road shoulder, southern road shoulder, and control) was dissimilar. The northern road shoulder also had a different treatment than the southern. Hence, splitting the analysis by habitat subtype and location group, rather than simply comparing a total for both shoulders to the control, was appropriate.

For perennials (shrubs and bunch grasses), at least one road shoulder for each habitat subtype, except CBs, reached or exceeded 18 percent cover (Table 4, Appendix 1a). Combined with the percent cover of annuals, these habitat subtypes nearly reached 30 percent cover. Inarguably, including annuals in the total percent vegetation cover is specious because annuals' percent cover fluctuates dramatically depending on the rainfall, season and timing within the season. Drought years produce no annuals; winter and summer species are different, with different coverage; and seedlings early in the season have much less coverage than mature plants. For instance, mean annuals' percent cover over all road shoulder transects in 2017, when transects were completed after a summer of good rainfall, was 26.9%, compared to 7.6% in March 2024 (Appendices 1d and 2[8]). The percent cover for annuals plus perennials would have easily exceeded the target of 30%. (For 2024, autumn not only would have been more than 10 years since restoration, there was no way to predict whether it would rain in the summer. In fact, it did not.) Timing and rainfall matter for annuals.

Further, there is no basis for a target value of 18% for perennials. The local perennial cover is well below this value, 0.3-8.85 (Table 4), not including the lake habitat which was not measured but is extremely sparse. What is more pragmatic for examining revegetation success is the comparison of perennials' percent cover to the adjacent undisturbed area. By 2024, the absolute percent cover for one or both road shoulders was substantially higher than the undisturbed control habitat (Table 4). For D/SS and Ss/SL, the difference was statistically significant[9]. Annuals, even though specious to fold into a total plant percent cover, were not significantly different between either road shoulder or the control transects for any habitat subtype except Ss/SL, where annual cover on the roadside transects was significantly greater than controls (Table 4, Appendix 1d).

While absent from BIO-24, density is an excellent additional measure of revegetation success. Density plus height is also a reasonable surrogate for percent cover as it measures both germination and growth of the vegetation, similar to percent cover. As of 2024, both restored road shoulders have much higher plant densities than the undisturbed control habitat[10] (Table 5, Appendices 1b,c). Generally, the species mean heights were similar among road shoulder and control transects (Table 5). Only in the CBs habitat was *L. tridentata* was significantly shorter (p=0.04) on the southern road shoulder than in the control. Considering that the road shoulder plants were only 11 years old at the time of the 2024 surveys, it's not surprising that some shrubs might be shorter in some areas. Given sufficient time, they will likely reach the heights of adjacent transects.

[8] Karl, A.E. 2018. Genesis Solar Energy Project. Summary report for botanical measures and issues Year 2017. Prepared for Genesis Solar, LLC and the California Energy Commission. 20 pp.
[9] The variance was large for the northern road shoulder, due to one transect with very high percent cover – 30.34 - and the p-value was nearly significant – 0.056. More transects for both the control and road shoulder would probably have resulted in statistical significance.
[10] Densities on the road shoulders were so much higher than the controls that statistics were unnecessary.

Table 4. Mean percent cover of perennials and annuals in 2024, by transect and habitat type. Superscript letters for means' values denote significance (same different letters are significantly different means).

Habitat Type	Perennial Shrubs and Bunch Grasses						Annuals			Perennials +Annuals			Weeds- Mustards only			Weeds - *Schismus* only			Weeds (Mustards + *Schismus*)		
	Northern Road Shoulder		Southern Road Shoulder		Control		Northern Road Shoulder	Southern Road Shoulder	Control	Northern Road Shoulder	Southern Road Shoulder	Control	Northern Road Shoulder	Southern Road Shoulder	Control	Northern Road Shoulder	Southern Road Shoulder	Control	Northern Road Shoulder	Southern Road Shoulder	Control
	Transect	% Cover	Transect	% Cover	Transect	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover
D/SS	A	5.1	A	21.8	C1	1.44	4.12	11.29	11.67				0.05	0.39	0.3	0	0.39	0.02	0.05	0.39	0.32
	B	12.02	BS1-2	25.6	C3	0.66	8.34	3.05	9.55				0.56	0.05	0.02	0.13	0.05	0	0.69	0.05	0.02
	D	3.55	DS1-2	19.57			8.4	6.62					0.09	0.1		0.15	0.1		0.24	0.19	
Mean ±1 S.D.		**6.89 ±4.51^{a}**		**22.32 ±3.05^{b}**		**0.30 ±0.55^{c}**	**6.95 ±2.45^{a}**	**6.99 ±4.13^{a}**	**10.61 ±1.50^{a}**	**13.84**	**29.31**	**10.91**	**0.23 ±0.28^{a}**	**0.18 ±0.18^{a}**	**0.16 ±0.20^{a}**	**0.09 ±0.08^{a}**	**0.03 ±0.05^{a}**	**0.01 ±0.01^{a}**	**0.16 ±0.20**	**0.11 ±0.15**	**0.09 ±0.14**
Ha/W with or w/o SS,Ss, S_L	F	15.01	F	7.18	C4	7.39	7.7	8.6	5.75				0.07	0.07	0	0.41	0.39	0.31	0.48	0.46	0.31
	I	30.34	N	6.7	C6	7.46	8.9	6.4	13.95				0.02	0	0.3	2.4	0.52	3.92	2.42	0.52	4.22
	K	15.99			C9	11.7	19.8		8.5				0.14		0.02	2.3		0.42	2.44		0.44
	N	10.65					6.9						0.12			1.05			1.17		
Mean ±1 S.D.		**18.00 ±8.55^{a}**		**6.94 ±0.34^{b}**		**8.85 ±2.47^{ab}**	**10.83 ±6.04^{a}**	**7.5 ±1.56^{a}**	**9.4 ±4.17^{a}**	**28.83**	**14.44**	**18.25**	**0.09 ±0.05^{a}**	**0.04 ±0.05^{a}**	**0.11 ±0.17^{a}**	**1.54 ±0.97**	**0.46 ±0.09**	**1.55 ±2.05**	**0.82 ±1.00**	**0.25 ±0.25**	**0.83 ±1.53**
Ss/S_L, S_L+L	M	17.64	H	9.73	C8	0.72	9.7	3.75	3.7				0.09	0.07	0	1.1	0.07	0.04	1.19	0.14	0.04
	E	12.57	I	6.35	C5	3.16	11.2	6.5	3.75				0.04	0.07	0	2.05	0.39	0.02	2.09	0.46	0.02
	G	25.49	J	11.87	C7	4.31	4.3	13.7	2.7				0.07	0.05	0.04	0.42	0.87	0.16	0.49	0.92	0.2
	H	6.64	KS1-2	10.42			2.9	5.05					0	0		0.02	0.67		0.02	0.67	
	J	26.04	L	8.73			14.7	2.6					0.02	0		0.59	0.02		0.61	0.02	
	L	17.92	M	8.72			14.8	2.8					0.07	0.02		2.55	0.02		2.62	0.04	
			ES1-2	27.86				6.3						0.07			0.26			0.33	
			G	6.06				7.6						0.24			0.11			0.35	
Mean ±1 S.D.		**17.72 ±7.47^{a}**		**11.21 ±7.0^{a}**		**2.73 ±1.83^{b}**	**9.6 ±5.07^{a}**	**6.04 ±3.58^{a}**	**3.38 ±0.59^{b}**	**27.32**	**17.25**	**6.11**	**0.05 ±0.03**	**0.04 ±0.03**	**0.01 ±0.02**	**1.12 ±1.00^{a}**	**0.34 ±0.37^{a}**	**0.07 ±0.08^{b}**	**0.59 ±0.87**	**0.19 ±0.29**	**0.04 ±0.06**
CBs, CBs+Ss	C	20.15	C	23.73	C2	2.78	15.65	2.15	12.8				0.05	0	0.04	0.37	0.07	0.1	0.42	0.07	0.14
	P	13.61	O	2.98	C10	2.13	3.1	8.35	5.4				0.1	0	0	0.39	0.36	0.19	0.49	0.36	0.19
	Q	3.03	P	3.36	C11	7.81	10.2	3.4	4.4				0.21	0.05	0	0.55	0.09	0.06	0.76	0.14	0.06
			Q	2.62	C12	3.65		9.9	2.6					0.19	0.2		0.32	0.14		0.51	0.34
Mean ±1 S.D.		**12.26 ±8.64^{a}**		**8.17 ±10.38^{a}**		**4.09 ±2.56^{a}**	**9.65 ±6.29^{a}**	**5.95 ±3.76^{a}**	**6.3 ±4.49^{a}**	**21.91**	**14.12**	**10.39**	**0.12 ±0.08^{a}**	**0.02 ±0.03^{a}**	**0.01 ±0.02^{a}**	**0.44 ±0.10^{a}**	**0.17 ±0.17^{b}**	**0.12 ±0.07^{b}**	**0.28 ±0.19**	**0.10 ±0.13**	**0.07 ±0.07**

Table 5. Summary mean density and height for perennial shrubs and bunch grasses. Total is for all species, but data for the most common species are also shown. Transects for each habitat type and location are the same as for Table 3. Blank cells equal zero. Superscript letters for means denote significance (i.e., different letters are significantly different means).

Habitat Type and Location	# of Transects	Mean Density (# plants/m^2)						Mean Height (cm)				
		Total	*Larrea tridentata*	*Ambrosia dumosa*	*Hilaria rigida*	*Ambrosia salsola*	*Atriplex polycarpa*	*Larrea tridentata*	*Ambrosia dumosa*	*Hilaria rigida*	*Ambrosia salsola*	*Atriplex polycarpa*
D/SS												
Northern Road Shoulder	3	14.00	0.67	12.33	0.67		0.33	139.8	33.9	55.0		45.5
Southern Road Shoulder	3	31.67	2.33	14.33	1.33	3.67	10.00	94.0	36.4	71.3	76.5	60.6
Control	2	2.50	2.50					122.8				
Ha/W with or w/o SS,Ss, S_L												
Northern Road Shoulder	4	45.25	0.25	25.50	3.50	1.75	8.00	112.2	41.7	69.8	80.5	54.0
Southern Road Shoulder	2	21.50	0.50	3.00	1.50	0.50	16.00	179.0	23.9	44.5	66.0	46.5
Control	3	12.33	1.67	8.00	2.67			157.3	41.7	68.1		
Ss/S_L, S_L+L												
Northern Road Shoulder	6	63.17	3.00	56.00	1.83	0.83	0.33	137.9^{a}	39.83	67.90	64.17	29.50
Southern Road Shoulder	8	32.25	2.00	18.50	0.38	2.38	8.38	98.8^{b}	32.6	72.0	77.0	58.2
Control	3	4.33	1.67	2.67				142.9^{ab}	43.0	97.0[1]		
CBs, CBs+Ss												
Northern Road Shoulder	3	20.00	2.67	7.67		0.67	0.00	122.7^{ab}	36.7		83.6	76.0
Southern Road Shoulder	4	16.00	0.50	3.25	1.50	3.75	2.75	94.1^{b}	40.9	55.0	63.9	56.8
Control	4	2.00	2.00					155.65^{a}	51.0			

1. A single plant on one transect

For almost all measurements, the north side was more vegetated than the south, despite active seeding and slightly earlier restoration on the south. This is largely because of greater water availability on the northern shoulder. The access road is higher than the road shoulders and the water drains north to south, so more water is caught on the north shoulder. Further, the access road blocks natural flow and, unless a strong storm causes overland flooding, the only water reaching the southern shoulder is runoff from the road. The original habitat for at least one transect (NS) was altered during the monitoring period due to this. When a storm does cause major flow over the road, it can also scour the southern shoulder. GSEP has applied cobble riprap to most areas on the south side where this has occurred to maintain the pavement edge.

Overall, species richness was higher on the road shoulders than in the control area. Not surprisingly, two iconic Mojave and Colorado desert species, *Larrea tridentata* and *Ambrosia dumosa*, were generally the most common species on all areas. Exceptions included (a) the sparsest habitats sampled in the control area (D/SS and CBs), where species composition was primarily limited to *L. tridentata,* and (b) some patches on the southern shoulder where seeded *Atriplex polycarpa* and/or *Ambrosia salsola* grew densely.

Performance Standard 3: At least 90 percent (relative cover) of the perennial species observed within the temporarily disturbed areas shall be locally native species that naturally occur in the adjacent desert scrub or dune habitats.

All of the perennial species growing in the temporarily disturbed areas were native and found locally. *Ambrosia salsola* and *Atriplex polycarpa* were not found on the control transects but are known locally, primarily associated with shallow watercourses (*A. salsola*) and post-disturbance (both species). (In a 2009 reconnaissance, I found a several-acre, previously disturbed site upslope that had completely regrown naturally with *A. polycarpa*.) Both are excellent native colonizers and were in the seed mix for the southern shoulder, which is why they are not as common on the northern.

Performance Standard 4: Relative cover of non-native plants within the temporarily disturbed areas shall not exceed the relative cover of non-native plants in the adjacent habitats.

No non-native perennials grew on the restored shoulders.

The primary non-native annuals growing in the area are annual mustards (*Brassica tournefortii* [Sahara mustard], *Sisymbrium* spp.[London rocket]) and *Salsola tragus* (Russian thistle), all of which are responsive to disturbance. *Schismus* sp. (split grass), a ubiquitous and common exotic annual in the southwestern deserts and in the Project area, is not a disturbance associate.

For mustards, nowhere on the road shoulders was the percent cover statistically significantly higher than in the control area (Table 4, Appendix 1d). *Schismus* had significantly higher cover on one or both road shoulders in the Ss/SL and CBs habitats, but the means were only 1.12 and 0.44%. Throughout, weed presence was very sparse, with percent cover of combined weed species generally ≤3% of the total annual cover on the road shoulders and ~1% in the adjacent habitat (Table 4). Transects were completed prior to the annual weeding on the road shoulders, so the weeds present were a realistic snapshot of their typical abundance on the restored shoulders. Manual weeding for mustards and Russian thistle will continue as long as required by the CEC because of the dynamic nature of the dunes and drainages and the presence of these weed species in the surrounding area. Seeds will continue to enter the restoration area by wind or water. For Schismus, there is currently no herbicide that has been shown to be effective, while maintaining safety for wildlife and other plant species; hand pulling is impractical.

3.1.2 BIO-24 VERIFICATION: APPROVED REVEGETATION PLAN

Overarching Goal: Restore temporarily disturbed areas to a condition that will substantially improve the ability of those areas to achieve an ultimate community that is physically and functionally similar to the original, pre-construction condition.

The Project revegetation program has fully met the goal of the BIO-24 Revegetation Plan to establish a functioning habitat that is connected to the adjacent community. Seedlings not only germinated, but the plants thrived and established a robust shrub and annual plant community that will continue to promote a functioning ecological community. Rodents and ants quickly moved into the restoration area (Table 6, Appendix 1e). Even by 2016, both taxa were active in the restoration area. Whether this occupation was strictly due to the cover and forage offered by the plant growth, or some other unknown factor (e.g., road temperature) is unclear, but these taxa quickly began carrying on important community functions such as seed dispersal and planting, tilling the soil, and fertilizing the site. In 2024, the control transects had many fewer rodent burrows and ant colonies than the road shoulders: 0.22 rodent burrows per square meter vs 1.43 on the road shoulders, and 0.16 ant mounds vs 1.31. While this difference could have been due to localized factors other than vegetation, these two faunal taxa were well inhabiting the road shoulders.

There is no evidence of non-riparian species initially germinating in the road shoulders but failing to establish, including the runnel species. The only species that failed to establish once germinated was *Olneya tesota* (ironwood), a species strongly associated with the larger washes found upslope. It never grew along the road shoulder but germinated in a few locations in the July 2012 monsoon where water backed up. However, this unusually wet environment was ephemeral and few seedlings have survived.

TABLE 6. Rodent and ant activity in the restored shoulders over time. Year 2016 was the first monitoring year, 2024 the last. Totals for all transects combined are shown.

Year	Sampling Time	Rodent Holes			Ant Colonies		
		Active	Inactive	Combined	Active	Inactive	Combined
2016	October	10	289	299	13	70	83
2019	March	21	200	221	95	487	582
2024	March	58	228	286	286	134	420

3.2 SALVAGED CACTUS

Performance Standard 2: Survivorship of salvaged and transplanted cacti and other native plantings shall equal 30% percent.

Irrespective of continuous winter drought since being planted in 2011 (Table 2), survival of transplanted cacti through November 2015 remained high – 40.0 to 66.7% - especially for *C. echinocarpa* and *M. tetrancistra* (Table 7). Even with three years of good summer rain on the site, this high survival is somewhat surprising, given that very few cacti grew along the access road naturally. Further, sand drifting over the plants was a continual problem for some plants and wind frequently exposed the roots of some plants. In late 2015 many of the plants appeared slightly dehydrated with little seed production, consistent with the drought for the entire 2015 year. However, live plants were robust and had clearly produced many new stems by 2014.

TABLE 7. Survival of transplanted cacti through November 2015.

Species	# Transplanted	Buried by Blowsand or Destroyed during Construction	Survival in 2015 of Plants not Buried or Destroyed				Survival in 2015 of All Transplants	
			Alive	Dead	Could Not Locate	% Survival	Alive	% Survival
Cylindropuntia echinocarpa (Silver Cholla)	37	15	19	3	0	86.4	19	51.3
C. ramosissima (Pencil Cholla)	3	-	2	1	1	≥66.7	2	≥66.7
Mammillaria tetrancistra (Fishhook Cactus)	5	2	2	1	1	≥66.7	2	≥40.0

4.0 CONCLUSIONS AND RECOMMENDATIONS

While the restoration program has met the expectations of the BIO-24 Revegetation Plan, lack of rainfall has been an ongoing difficulty for restoration at GSEP. The first five years following the initial 2011 restoration were drought winters, followed by three drought winters in the next eight (Table 2). In the 13 summers since the initial restoration, almost half (six) have been droughts. The initial (2011) restoration followed common desert revegetation techniques[11] that were unsuccessful at least in part due to lack of rain. The techniques implemented in 2013 at GSEP were novel and previously unpublished for desert restoration. The aggressive surface roughening resulted in highly successful revegetation of the road shoulders, substantially aided by water flow off the road, despite the lack of consistent rain. While some natural restoration resulted from this flow, the enhanced microtopography engendered a higher response in the created swales (Figures 3 and 4). The swales caught and retained moisture from the road and natural drainages, but also caught seed and sediment, neither of which were provided by water flow off the road. This was especially evident on the northern road shoulder, where no seed was planted. Virtually the entire roadside, except in the driest locations, had plant growth from the active restoration and natural road runoff (see Appendix 3 for transect photos).

4.1 Specific Topics for Desert Restoration Learned at GSEP

A specific objective of the Project Revegetation Plan was "*to provide site-specific information on performance of revegetation methods to inform and improve the design of the decommissioning and closure restoration plan*".

Pragmatic Restoration Requirements.
Restoration success standards and requirements should attend to the local plant community and recent trends in weather. Given the trend since 1989 for two or more consecutive years of drought in one or both rainfall seasons[12], restoration expectations should be reasonable both for plant growth and timelines. In general, restoration requirements should target a functioning community fully connected to and usable by the adjacent community. Percent cover should be based on the adjacent community, not a generalized concept. Timelines should be based on the life of the project, the restoration area size, and impact of the restoration area on the adjacent population, including the value of this restoration site to rare species.

Is Seeding Necessary? This really depends on the proximity of the natural seed source. If the salvaged topsoil only has been stored a short time such that seeds are still viable (i.e., <1 year) and other soil biota are functional, and/or the restoration site is small enough and shaped such that local seed can blow or flow in, then seeding should not

[11] For example, Bainbridge, D. 2007. A guide for desert and dryland restoration. Island Press, Washington, D.C. 391 pp.
[12] Source: A. Karl, unpublished research.

FIGURE 3. Examples of seedling growth in created swales, October 2014 (first two photos) and October 2015.

FIGURE 4. Transect BS2 - Example of high growth of seeded shrub species in created berms and swales through time. The upper photo is from October 2014, one year after restoration; the middle shows continued high survival and growth in November 2015; the lower is from 2024, the vegetation thriving.

be necessary. As shown on the north shoulder of the GSEP access road, seed will be deposited on the site by wind and water, irrespective of active seeding. By contrast, natural seed deposition into a very large (e.g., several acres), approximately square site will be delayed simply due to the distance require for seeds to populate the site, and exotics may outcompete the natives because of this delay. In such a situation, seeding might be recommended.

If a rapid restoration timeline is necessary, to provide habitat for a listed species for instance, then seeding might accelerate, or at least enhance, the revegetation process. At GSEP, two colonizing species (*Atriplex polycarpa* and *Ambrosia salsola*) were seeded only on the southern shoulder, providing a natural experiment to evaluate the efficacy of seeding. Both shoulders received the same rainfall, although the north had more available water. Both species grew densely and quickly in several patches on the south shoulder, despite the limited water availability, suggesting that seeding might enhance regrowth where rainfall is highly limited. Whether seeding is employed or not, rain is vital, so surface preparation is critical. If no rain falls, seed and the associated expense will be wasted (e.g., Year 2011).

Is Outplanting Worth the Expense and Effort? Outplanting requires that nursery-grown plants be planted and carefully watered post planting until established, all in all an expensive process. As with seeding, the need for this process probably depends on the need for an advanced restoration timeline necessary to restore the community for a rare species, the size of the area, and anticipated rainfall in the project area. With global warming, storms may increase in intensity but decrease in frequency. The former will germinate plants, while the latter will result in lower germination and seed loss, as well as decreased seedling survival. At GSEP, despite many consecutive winters and/or summers of drought, the surface preparation captured enough rainfall to both germinate and grow plants, negating the need for outplanting. The GSEP Revegetation Plan provided for evaluating the site in Year 2 to determine the need for outplanting. Evaluation at some early point(s) is an appropriate measure, as it takes into account that collecting seed and growing plants in a nursery may take several years. However, the evaluation should consider rainfall at the restoration site up to that date, and recent rainfall history in the area. More than a single evaluation point may be prudent.

Overall Recommendations. Certainly, if there's a seed source nearby that can either blow in or flow in, and enough moisture, then a site ultimately will revegetate without assistance. However, revegetation data from GSEP indicate that the technique of well-placed extreme surface roughening, attending to natural flow, accelerates the restoration process. Drought in the desert southwest is frequent and is always unpredictable, so maximizing catch is critical. Use of a gannon or similar farm implement to quickly roughen a site is cost effective. Several factors at the site need to be evaluated to determine if seeding or outplanting is practical and justified. However, the site must be well-prepared, capturing all possible water, sediment and seed.

Appendix 1. Results of 2024 Quantitative Surveys

1a. Perennials - Percent Cover
1b. Perennials - Density
1c. Perennials - Height
1d. Annuals – Percent Cover (sent as separate file)
1e. Rodents and Ant

Appendix 1a. Mean percent cover for perennial shrubs and bunch grasses, by species and transect, on 2024 quantitative transects. Blank cells are zeros.

	TRANSECT I.D.	For Transect	*Larrea tridentata*	*Ambrosia dumosa*	*Hilaria rigida*	*Ambrosia salsola*	*Atriplex polycarpa*	*Aristida purpurea*	*Dicoria canscens*	*Encelia farinosa*	*Olneya tesota*	*Parkinsonia florida*	*Prosopis glandulosa*
Road Shoulder	A-N	5.1	2.85	1.75	0.5								
	A-S	21.77	4.83	11.12	2.76	3.1							
	B-N	12.02	4.73	7.29									
	B-S1	*29.3*	*9.02*	*19.18*		*2.54*							
	B-S2	*23.12*		*0.8*			*22.32*						
	BS	**25.6**	**4.51**	**9.38**		**1.27**	**11.16**						
	C-N	20.15		12.72		6.1	1.59						
	C-S	23.73	0.85	8.07		6.43	4.47						
	D-N	3.55		0.89			2.66						
	D-S1	*31.34*		*2.28*		*8.34*	*21.22*						
	D-S2	*9.1*	*1.58*	*7.52*									
	DS	**19.57**	**0.79**	**4.9**		**4.17**	**9.96**						
	E-N	12.57	5.21	3.9	0.05	0.85						3.11	
	E-S1	*5.74*		*5.74*									
	E-S2	*49.98*		*1.32*		*23.98*	*24.26*				*0.76*		
	ES	**27.86**		**3.53**		**11.99**	**12.13**				**0.38**		
	F-N	15.01		12.9		2.17	0.8						
	F-S	7.18		0.5		1.3	5.38						
	G-N	25.49	6.33	15.04		3.16	1.04						
	G-S	6.06	2.01	0.37		0.95	2.13			0.6			
	H-N	6.64	6.64										
	H-S	9.73	1.59	7.92		0.69							
	I-N	30.34	7.3	19.41	0.39		0.16				1.21	4	
	I-S	6.35	3.79	2.56									
	J-N	26.04	9.2	13.9	0.83	0.61							1.7
	J-S	11.87		6.95			4.92						
	K-N	15.99	0.87	13.7	0.42	1.23							
	K-S1	*10.12*	*3.3*	*6.82*									
	K-S2	*11.02*		*8.82*		*2.2*							
	KS	**10.42**	**1.65**	**7.67**		**1.1**							
	L-N	17.92	5.3	11.28	4.18								
	L-S	8.73	7.46	1.27									
	M-N	17.64	3.59	14.54									

	TRANSECT I.D.	For Transect	*Larrea tridentata*	*Ambrosia dumosa*	*Hilaria rigida*	*Ambrosia salsola*	*Atriplex polycarpa*	*Aristida purpurea*	*Dicoria canscens*	*Encelia farinosa*	*Olneya tesota*	*Parkinsonia florida*	*Prosopis glandulosa*
	M-S	8.72	3.34	5.02	0.36								
	N-N	10.65	2.18	3.51	5.19								
	N-S	6.7	4.44	0.7	0.83	0.73							
	O-S	2.98		1.07	1.91								
	P-N	13.61	12.97								0.64		
	P-S	3.36	2.31								1.05		
	Q-N	3.03	1.6	0.73							0.7		
	Q-S	2.62	0.76	0.3	0.09	0.82					0.65		
	TRANSECT I.D.	**For Transect**	***Larrea tridentata***	***Ambrosia dumosa***	***Hilaria rigida***	***Ambrosia salsola***	***Atriplex polycarpa***	***Aristida purpurea***	***Dicoria canscens***	***Encelia farinosa***	***Olneya tesota***	***Parkinsonia florida***	***Prosopis glandulosa***
Control	C-1	1.44	1.44										
	C-2	2.78	2.78										
	C-3	0.66	0.66										
	C-4	7.39	5.9	1.09	0.4								
	C-5	3.16		2.14	1.02								
	C-6	7.46	2.15	2.58	2.73								
	C-7	4.31	4.31										
	C-8	0.72	0.72										
	C-9	11.7	8.1	1.84	1.76								
	C-10	2.13	1.18		0.95								
	C-11	7.81	7.81										
	C-12	3.65	3.65										

Appendix 1b. Mean density for perennial shrubs and bunch grasses (#/m^2), by species and transect, on 2024 quantitative transects. Blank cells are zeros.

	TRANSECT	For Transect	*Larrea tridentata*	*Ambrosia dumosa*	*Hilaria rigida*	*Ambrosia salsola*	*Atriplex polycarpa*	*Aristida purpurea*	*Dicoria canscens*	*Encelia farinosa*	*Olneya tesota*	*Parkinsonia florida*	*Prosopis glandulosa*	*Ambrosia dumosa* Seedling
Road Shoulder	A-N	0.34	0.01	0.32	0.01									0.18
	A-S	0.21	0.01	0.12	0.04	0.04								
	B-N	0.06	0.01	0.04	0.01									
	B-S1	*0.36*	*0.1*	*0.26*										
	B-S2	*0.38*		*0.02*			*0.36*							
	BS	**0.37**	**0.05**	**0.14**			**0.18**							
	C-N	0.21		0.19		0.02								
	C-S	0.37	0.01	0.13		0.12	0.11							
	D-N	0.02		0.01			0.01							
	D-S1	*0.46*		*0.08*		*0.14*	*0.24*							
	D-S2	*0.28*	*0.02*	*0.26*										
	DS	**0.37**	**0.01**	**0.17**		**0.07**	**0.12**							
	E-N	0.21	0.02	0.13	0.01	0.01					0.04			
	E-S1	*0.22*	*0.02*	*0.18*							*0.02*			
	E-S2	*0.66*				*0.18*	*0.46*				*0.02*			
	ES	**0.44**	**0.01**	**0.09**		**0.09**	**0.23**				**0.02**			
	F-N	0.37		0.33	0.01	0.03								
	F-S	0.36		0.02	0.01	0.01	0.32							
	G-N	0.81	0.02	0.74		0.03	0.02							
	G-S	0.46		0.07	0.01	0.06	0.3			0.02				
	H-N	0.09	0.03	0.05	0.01									
	H-S	0.4	0.02	0.35		0.03								
	I-N	0.54	0.05	0.41	0.01	0.01	0.01				0.04	0.01		
	I-S	0.12	0.01	0.1							0.01			
	J-N	1.31	0.06	1.21	0.02						0.01		0.01	
	J-S	0.32		0.19	0.01		0.12							
	K-N	0.7		0.59	0.01	0.03					0.07			
	K-S1	*0.62*	*0.06*	*0.56*										
	K-S2	*0.42*		*0.36*		*0.02*	*0.04*							
	KS	**0.52**	**0.03**	**0.46**		**0.01**	**0.02**							
	L-N	0.35	0.03	0.24	0.07						0.01			
	L-S	0.13	0.05	0.08										
	M-N	1.02	0.02	0.99		0.01								

	TRANSECT	For Transect	*Larrea tridentata*	*Ambrosia dumosa*	*Hilaria rigida*	*Ambrosia salsola*	*Atriplex polycarpa*	*Aristida purpurea*	*Dicoria canscens*	*Encelia farinosa*	*Olneya tesota*	*Parkinsonia florida*	*Prosopis glandulosa*	*Ambrosia dumosa* Seedling
	M-S	0.19	0.04	0.14	0.01									
	N-N	0.2	0.01	0.08	0.11									
	N-S	0.07	0.01	0.04	0.02									
	0-S	0.06			0.06									
	P-N	0.21	0.07	0.02							0.12			
	P-S	0.07	0.02								0.05			
	Q-N	0.18	0.01	0.02							0.15			
	Q-S	0.14	0.01			0.03					0.1			
	TRANSECT	**For Transect**	***Larrea tridentata***	***Ambrosia dumosa***	***Hilaria rigida***	***Ambrosia salsola***	***Atriplex polycarpa***	***Aristida purpurea***	***Dicoria canscens***	***Encelia farinosa***	***Olneya tesota***	***Parkinsonia florida***	***Prosopis glandulosa***	***Ambrosia dumosa* Seedling**
Control	C-1	0.04	0.04											
	C-2													
	C-3	0.01	0.01											
	C-4	0.13	0.02	0.09	0.02									
	C-5	0.09	0.01	0.08										
	C-6	0.16	0.02	0.1	0.04									
	C-7	0.02	0.02											
	C-8	0.02	0.02											
	C-9	0.08	0.01	0.05	0.02									
	C-10													
	C-11	0.04	0.04											
	C-12	0.04	0.04											

Appendix 1c. Mean height (cm) for perennial shrubs and bunch grasses, by species and transect, on 2024 quantitative transects. Blank cells are zeros.

	TRANSECT	*Larrea tridentata*	*Ambrosia dumosa*	*Hilaria rigida*	*Ambrosia salsola*	*Atriplex polycarpa*	*Aristida purpurea*	*Dicoria canscens*	*Encelia farinosa*	*Olneya tesota*	*Parkinsonia florida*	*Prosopis glandulosa*	*Echinocactus polycephalus*
Road Shoulder	A-N	104.00	16.92	55.00									
	A-S	92.80	38.86	71.25	70.67								
	B-N	175.50	62.17										
	B-S1	*118.25*	*37.54*		*86.00*								
	B-S2		*53.00*			*53.46*							
	BS	**118.25**	**38.64**		**86.00**	**53.46**							
	C-N		47.13		83.60	76.00							
	C-S	124.00	44.57		68.88	56.83							
	D-N		22.50			45.50							
	D-S1		*35.50*		*72.83*	*67.70*							
	D-S2	*71.00*	*31.14*										
	DS	**71.00**	**31.69**		**72.83**	**67.70**							
	E-N	97.4	38	59	44						247.50		
	E-S1		*36.67*										
	E-S2		*23.50*		*89.33*	*69.87*				*55.00*			
	ES		**33.38**		**89.33**	**69.87**				**55.00**			
	F-N		41.48		90.00								
	F-S		20.33		67.00	46.45							
	G-N	158.60	35.55		80.50	29.50							
	G-S	87.50	27.50		56.00	55.67			52.00				
	H-N	156.67											
	H-S	111.00	33.95		68.50								
	I-N	147.60	52.83	78.00		54.00				195.00	225.00		
	I-S	95.00	31.57										
	J-N	125.50	34.90	70.00	68.00							220.00	1.70
	J-S		38.27			49.11							
	K-N	32.00	40.76	58.00	71.00								
	K-S1	*93.00*	*26.45*										
	K-S2		*32.14*		*94.00*								
	KS	**93.00**	**28.67**		**94.00**								
	L-N	145.00	52.25	74.71									
	L-S	99.71	32.00										
	M-N	144.50	38.45										

	TRANSECT	*Larrea tridentata*	*Ambrosia dumosa*	*Hilaria rigida*	*Ambrosia salsola*	*Atriplex polycarpa*	*Aristida purpurea*	*Dicoria canscens*	*Encelia farinosa*	*Olneya tesota*	*Parkinsonia florida*	*Prosopis glandulosa*	*Echinocactus polycephalus*
	M-S	106.67	35.80	72.00									
	N-N	157.00	31.78	73.50									
	N-S	179.00	27.50	44.50	65.00								
	O-S		42.00	66.00									
	P-N	105.43								79.67			
	P-S	84.50								53.00			
	Q-N	140.00	26.33							46.00			
	Q-S	74.00	36.00	44.00	59.00					44.50			
	TRANSECT	***Larrea tridentata***	***Ambrosia dumosa***	***Hilaria rigida***	***Ambrosia salsola***	***Atriplex polycarpa***	***Aristida purpurea***	***Dicoria canscens***	***Encelia farinosa***	***Olneya tesota***	***Parkinsonia florida***	***Prosopis glandulosa***	***Echinocactus polycephalus***
Control	C-1	126.67											
	C-2	124.00											
	C-3	119.00											
	C-4	152.75	30.00	45.00									
	C-5		43.00	97.00									
	C-6	156.00	37.71	68.25									
	C-7	166.33											
	C-8	119.50											
	C-9	163.00	57.50	91.00									
	C-10	208.00	51.00										
	C-11	182.00											
	C-12	108.60											

Appendix 1d. Mean percent cover for annuals and herbaceous perennials, by species and transect, on 2024 quantitative transects. Blank cells are zeros.

Sent as separate file.

Appendix 1e. Ant mounds and rodent holes on 2024 quantitative transects. Blank cells are zeros.

	TRANSECT	**Lizards**			**RODENT HOLES**			**ANT COLONIES**		
		Uta stansburiana	***Callisaurus draconoides***	***Aspidoscelis tigris***	**Active**	**Inactive**	**Active + Inactive**	**Active**	**Inactive**	**Active + Inactive**
Road Shoulder	A-N					0.4	0.4	0.005	0.01	0.015
	A-S					0.005	0.005	0.02	0.02	0.04
	B-N		0.0025		0.045	0.065	0.11	0.01	0.03	0.04
	B-S1	*0.01*			*0.02*	*0.05*	*0.07*	*0.01*	*0.04*	*0.05*
	B-S2				*0.02*	*0.27*	*0.29*		*0.01*	*0.01*
	BS	**0.005**			**0.02**	**0.16**	0.18	**0.005**	**0.025**	**0.03**
	C-N					0.01	0.01	0.12	0.03	0.15
	C-S	0.0025			0.005	0.02	0.025	0.005	0.03	0.035
	D-N					0.025	0.025	0.045	0.075	0.12
	D-S1			*0.015*	*0.01*	*0.1*	*0.11*			
	D-S2			*0*	*0.01*	*0.01*	*0.02*	*0.01*	*0.01*	*0.02*
	DS			**0.0075**	**0.01**	**0.055**	0.065	**0.005**	**0.005**	0.01
	E-N			0.0025		0.015	0.015	0.07	0.02	0.09
	E-S1			*0.01*				*0.04*	*0.1*	*0.14*
	E-S2				*0.09*	*0.01*	*0.1*	*0.05*	*0.01*	*0.06*
	ES			**0.005**	**0.045**	**0.005**	0.05	**0.045**	**0.055**	**0.1**
	F-N				0.025	0.03	0.055	0.03	0.035	0.065
	F-S				0.05	0.01	0.06	0.025	0.015	0.04
	G-N							0.005	0.01	0.015
	G-S				0.005	0.025	0.03	0.03		0.03
	H-N							0.005		0.005
	H-S			0.0025				0.045		0.045
	I-N					0.015	0.015	0.03	0.035	0.065
	I-S							0.05	0.06	0.11
	J-N					0.015	0.015			
	J-S								0.01	0.01
	K-N					0.005	0.005	0.025	0.005	0.03
	K-S1							*0.01*		*0.01*
	K-S2								*0.06*	*0.06*

	TRANSECT	Lizards			RODENT HOLES			ANT COLONIES		
		Uta stansburiana	*Callisaurus draconoides*	*Aspidoscelis tigris*	Active	Inactive	Active + Inactive	Active	Inactive	Active + Inactive
	KS							**0.005**	**0.03**	0.035
	L-N					0.015	0.015		0.005	0.005
	L-S							0.005	0.005	0.01
	M-N					0.005	0.005			
	M-S									
	N-N					0.005	0.005			
	N-S									
	0-S					0.02	0.02		0.005	0.005
	P-N				0.005	0.01	0.015	0.01		0.01
	P-S		0.0025					0.005	0.005	0.01
	Q-N				0.005	0.005	0.01	0.005		0.005
	Q-S							0.005		0.005
Number per m2		0.0125	0.005	0.03	0.29	1.14	1.43	0.67	0.635	1.305
Total # of Individuals		5	2	12	58	228	286	134	127	261

	TRANSECT	LIZARDS				RODENT HOLES			ANT COLONIES		
		Diososaurus dorsalis	*Uta stansburiana*	*Callisaurus draconoides*	*Aspidoscelis tigris*	Active	Inactive	Active + Inactive	Active	Inactive	Active + Inactive
Control	C-1	0.0025	0.0025			0.005	0.005	0.01	0.02	0.005	0.025
	C-2						0.04	0.04	0.01	0.015	0.025
	C-3					0.01	0.015	0.025	0.025	0.03	0.055
	C-4					0.015	0.015	0.03	0.005		0.005
	C-5					0.005		0.005			
	C-6					0.005	0.005	0.01			
	C-7					0.01	0.01	0.02	0.01	0.005	0.015
	C-8						0.025	0.025			
	C-9						0.005	0.005			
	C-10						0.02	0.02	0.005		0.005
	C-11					0.01	0.005	0.015	0.01		0.01

	TRANSECT	LIZARDS				RODENT HOLES			ANT COLONIES		
		Diososaurus dorsalis	***Uta stansburiana***	***Callisaurus draconoides***	***Aspidoscelis tigris***	**Active**	**Inactive**	**Active + Inactive**	**Active**	**Inactive**	**Active + Inactive**
	C-12						0.015	0.015	0.015		0.015
Number per m2		0.0025	0.0025			0.06	0.16	0.22	0.1	0.055	0.155
Total # of Individuals		1	1			12	32	44	20	11	31

Appendix 2. Year 2017 Mean Percent Cover of the 10 Most Common Herbaceous Species, by Transect and in Total

Appendix 2. Year 2017 mean percent cover of the 10 most common herbaceous species, by transect and in total.

Restored Road Shoulder	Transect	Total	Biocrust	*Bouteloua* spp.	*Kallstroemia californica*	*Cryptantha* spp.	*Pectis papposa*	*Boerhavia* spp.	*Chamaesyce* spp.	*Allionia incana*	*Plantago ovata*	*Tiquilia plicata*	*Aristida* spp.
	A-S	11.45	0	4.6	2.06	0.4	0.1	0	0.42	0	1.3	0.95	0.05
	A-N	11	0	1.9	4.51	0.95	0.11	0	2.25	0	1.18	0.1	0
	B-S	21.1	0	3.1	9.55	1.75	0.25	0	1.5	0	4.8	0.01	0
	B-N	46.9	0	6.35	20.6	4.4	0.75	0	2.75	0	4.45	0	0
	C-S	31.4	0	9.7	3.65	7.7	3.11	2.4	0.4	4.65	0.2	0	0.3
	C-N	38.1	0	22.2	6.2	4.1	2.75	0.65	1.1	0.05	0.06	0	0.55
	D-S	22.5	0	11.2	5.4	0.85	0.7	0.2	0.6	0.05	0.67	3.4	0
	D-N	41.5	0	12.7	13.2	2.65	1.95	2.9	0.46	3.6	0.1	0	0.45
	E-S	21.6	0	9.4	1.6	5.65	1.2	2.9	0.65	0.01	0.01	0	0
	E-N	38.4	0	20.7	5.8	4.46	4	3.7	0.2	0.4	0	0	0
	F-S	24.75	0	8.25	6.8	5.3	1.15	3.55	0.1	0	0	0	0
	F-N	41.6	0	13.6	3.21	7	1.95	13.45	2.16	0	0	0	0
	G-S	19.7	0	7.1	5.7	6.31	0.85	0	0.11	0	0	0	0
	G-N	22.4	0	12.6	2.71	5.4	0.95	0	0.65	0.05	0	0	0.2
	H-S	12.6	0	8.1	1.31	2	0.31	0	0.27	0	0.26	0	0.15
	H-N	6.75	0	4.35	0.6	1.2	0.1	0.05	0.42	0	0.42	0	0
	I-S	9.55	0	4.6	0.4	0.05	0.2	0.05	0.5	2.35	0	0	0
	I-N	33	0	22.3	1.55	3.22	2.2	0.6	0.86	1.71	0.1	0	0.2
	J-S	15.2	0	8.5	0.11	2.6	1.46	0	0.21	1.25	0	0	0.8
	J-N	38.8	0	25.5	0	3.4	0.6	0.1	8.01	0.3	0.02	0	0.45
	K-S	14.7	0	8.05	0.6	2.15	0.6	0.3	0.06	3.11	0.1	0	0
	K-N	27.75	0	21.25	1.65	2.3	0.7	0.35	0.97	0.75	0	0	0
	L-S	13.5	0	9	2.75	1.35	0.23	0	0.56	0	0.25	0	0
	L-N	18.41	0	13.3	1.25	1.66	0.41	0	0.71	0.2	0.2	1.15	0
	M-S	7.1	0	5.05	1.4	0.55	0.17	0	0.18	0	0.28	0.1	0
	M-N	10.8	0	9.5	0	0.38	0.17	0	0.13	0	0.24	0	0
	N-S	32.8	0	4.65	21.7	4.95	0.81	0	0.17	0	0	0	0
	N-N	34.66	0	8.45	19.45	2.75	3.22	1.6	0.63	0	0	0	0
	O-S	43.6	0	5.05	37.3	1.85	0.76	0	0.2	0	0.05	0	0.1
	P-S	35.4	0	6.05	22.3	6.65	0.15	0	0	0	0.3	0	0
	P-N	56.8	0	24.6	30.8	1.35	0.95	0	0	0	0	0	0
	Q-S	44.7	0	13.8	25.9	5.1	0.8	0	0.15	0	0	0	0
	Q-N	39.7	0	15.6	18.7	2.1	2	0.1	1	0	0	0	0
	MEAN	**26.92**	**0.00**	**10.94**	**8.45**	**3.11**	**1.08**	**1.00**	**0.86**	**0.56**	**0.45**	**0.17**	**0.10**

Control													
	C1	5.05	0	0.2	0.6	0.31	0	0	0.1	0	2	0.7	0
	C2	25.9	0	8.95	7.9	5.4	3.2	0	0.1	0	0.6	0	0
	C3	25.15	0	3.31	10.5	3.06	0	0	1.35	0	4.3	2	0
	C4	14.9	0	3.15	3.85	4.05	3.3	0	0.4	0	0.25	0	0
	C5	7.1	0	2.55	1.1	2.8	0.35	0	0.31	0	0.55	0	0.05
	C6	18.15	0	8.8	3.7	2.1	3.82	0.2	0.26	0	0	0	0.05
	C7	5	0	0.5	0.9	0.61	0.55	0	0.07	0.15	0.02	0	0
	C8	7	0	6.2	0.25	0.05	0.06	0	0.3	0	0.55	0	0.05
	C9	18.2	0	0.5	10.8	1.36	3.1	0	0.41	0	0.16	0	0
	C10	18.9	0	2.35	12.95	0.66	1.65	0	0.06	0	1.01	0	0.2
	C11	15.3	0	5.41	1.15	0.68	2.01	0	0.75	0	5.5	0	0
	C12	7.1	0	0.2	6.45	0.1	0.16	0	0.16		0.15	0	
	MEAN	**13.98**	**0.00**	**3.51**	**5.01**	**1.77**	**1.52**	**0.02**	**0.36**	**0.01**	**1.26**	**0.23**	**0.03**

Appendix 3. Photographs of Quantitative Transects, March 2024

3a. Road Shoulder Transects
3b. Control Transects

Appendix 3. Photographs of Quantitative Transects, March 2024

Appendix 3a. Road Shoulder Transects

Transect AN

Transect AS

Transect B**N**

Transect BS1

Transect BS2

Transect CN

Transect CS

Transect DN

Transect DS1

Transect DS2

Transect EN

Transect ES1

Transect ES2

Transect FN

Transect FS

Transect GN

Transect GS

Transect HN

Transect HS

Transect IN

Transect IS

Transect JN

Transect JS

Transect KN

Transect KS1

Transect KS2.

Transect LN

Transect LS

Transect MN

Transect MS

Transect NN

Transect NS

Transect OS

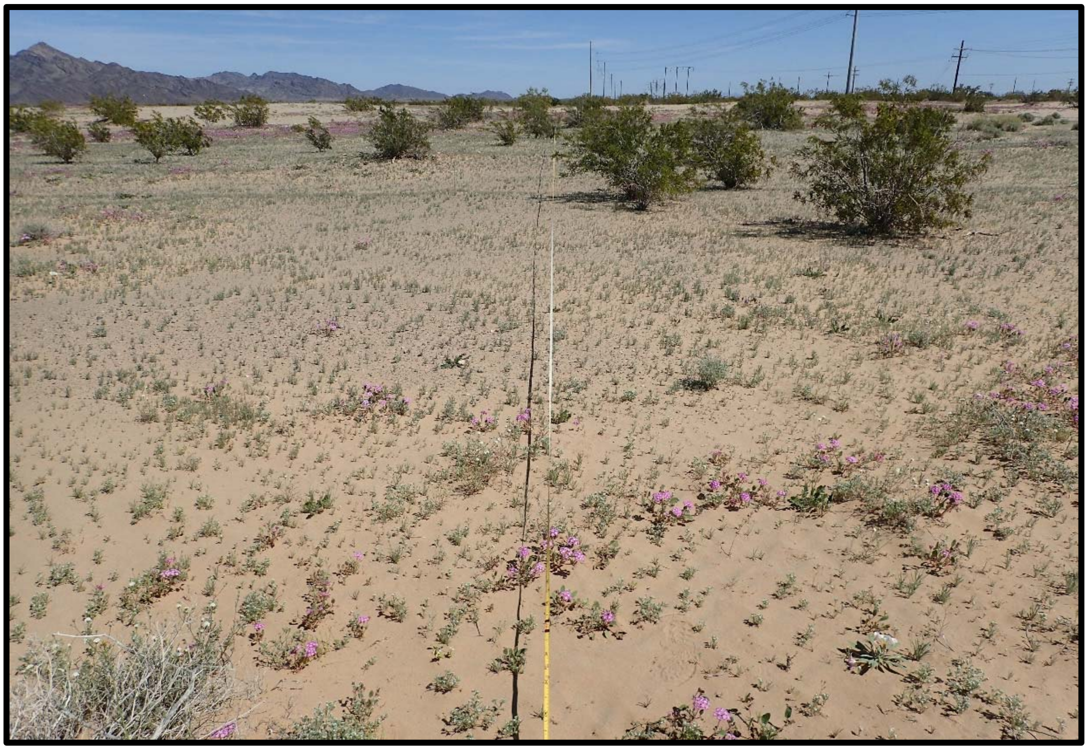
Transect PN

Transect PS

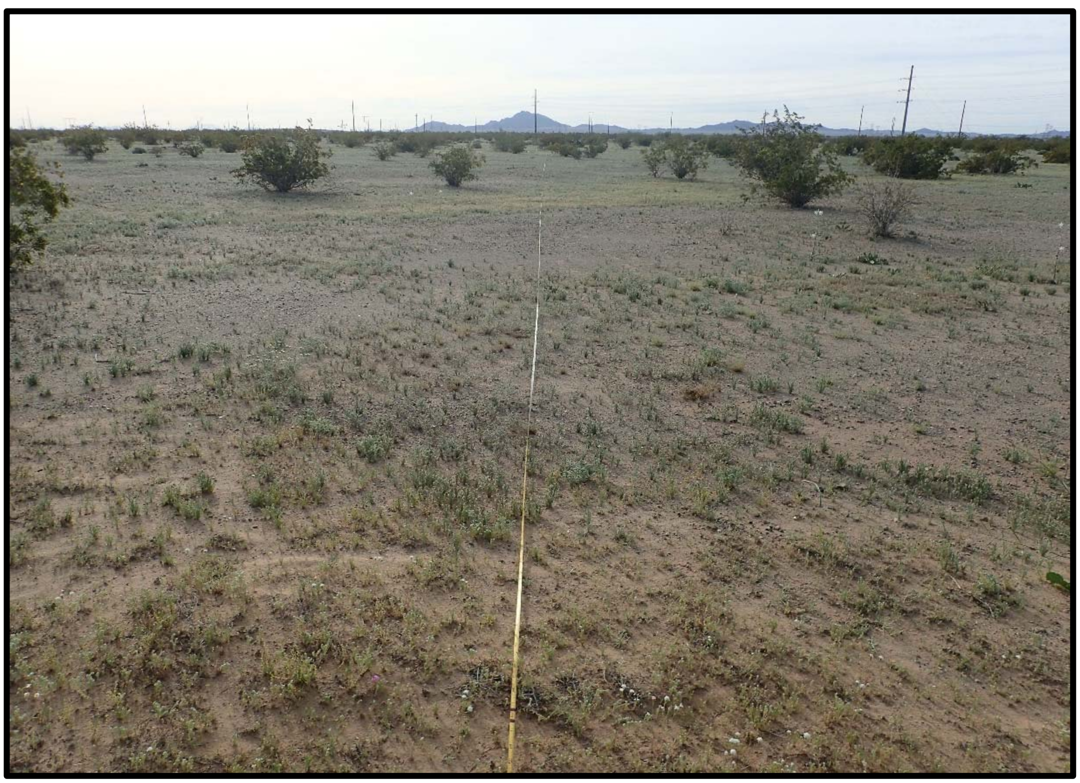
Transect QN

Transect QS

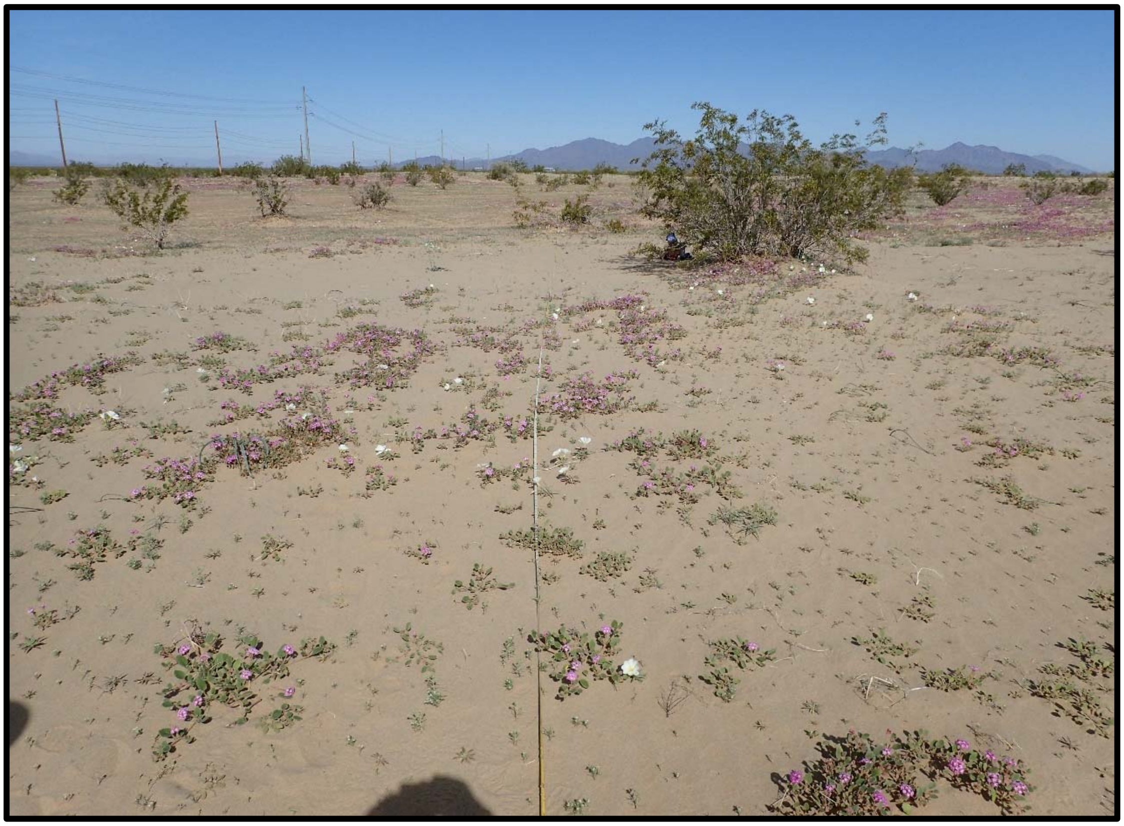
Appendix 3b. Control Transects



Transect C1

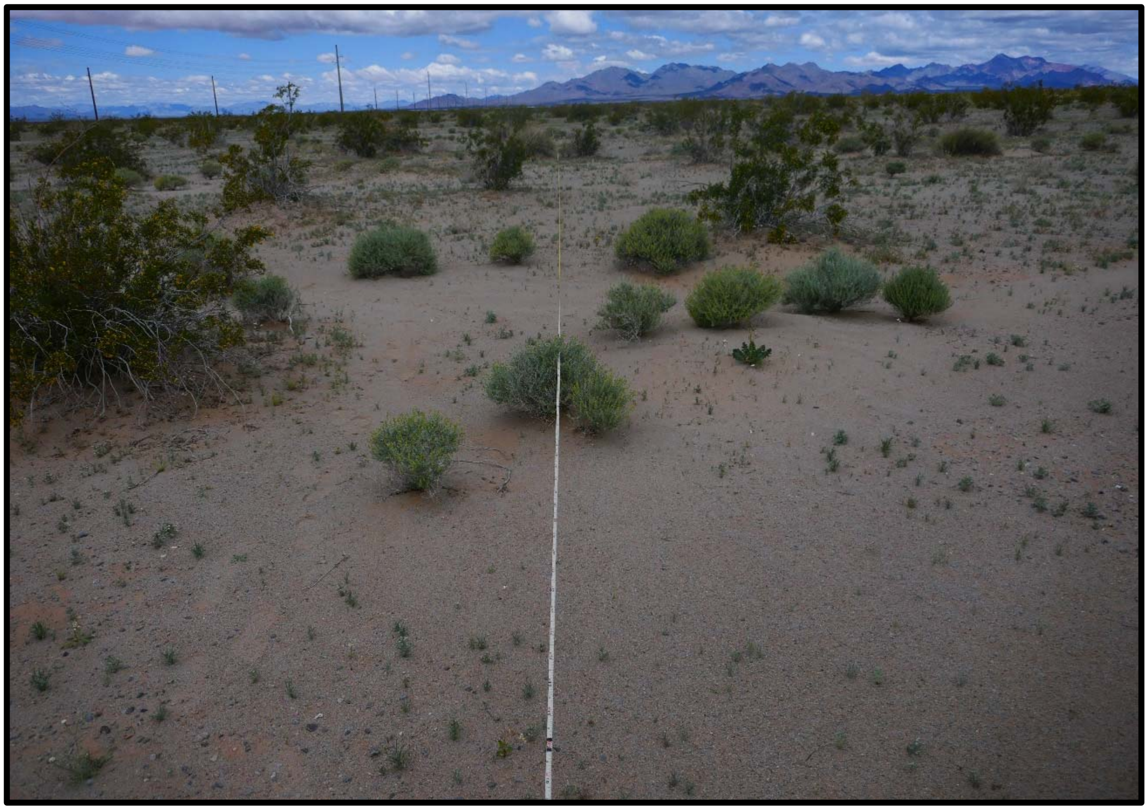


Transect C2



Transect C3

Transect C4



Transect C5

Transect C6

Transect C7

Transect C8

Transect C9

Transect C10

Transect C11

Transect C12