REPORT

2018 Quantitative Vegetation and Erosion Monitoring

Little Rock Mine, United States Natural Resources (USNR) Test Plots

Submitted to:

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1.0 INTRODUCTION

The Little Rock Mine is permitted as an existing mine under Mining Act Permit No. GR007RE and Discharge Permit 1236 (DP-1236). The best available materials for reclamation at the Little Rock mine is overburden composed of Precambrian Granite. In early 2014, Freeport McMoRan Tyrone Inc. (Tyrone) proposed to build test plots on a portion of the United States National Resource (USNR) reclamation area to evaluate the use of Precambrian Granite from the Little Rock pit. The test plot was tentatively approved by the New Mexico Mining and Minerals Division (MMD) and the New Mexico Environment Department (NMED) prior to construction with the understanding that formal approval was pending further consideration.

In November 2014, Tyrone prepared a work plan for the USNR test plots to facilitate technical discussion with the MMD and NMED (FMI 2014). The Agencies requested that Tyrone modify the work plan to include enhanced erosion and vegetation monitoring and consider the application of amendments. The USNR test plot work plan was conditionally approved in conjunction with Modification 17-1 to Permit GR007RE, Condition 8.P.1 (a & b). The work plan also addressed the requirements of Condition 33 of Discharge Permit 1236 (DP-1236). The test plots construction started in late 2014 and they were seeded in the spring of 2015. The intent of this report is to document the results of the erosion and vegetation monitoring following the 2018 growing season.

1.1 Background

The Little Rock Test Plots were originally constructed on the 7A Stockpile at the Tyrone Mine using Precambrian Granite overburden from the Copper Mountain Pit. When the Little Rock Test Plot work plan was originally developed (2001 with major revisions in 2004) it was impractical to access the overburden from the Little Rock pit because mining had not started and the haul road to Tyrone was not constructed. Copper Mountain materials were used because of their similarity to the overburden from the Little Rock pit and the availability of materials and a test location (i.e., the 7A stockpile). Once mining at Little Rock commenced, it was possible to construct test plots using overburden from the Little Rock pit. The USNR reclamation area provided an opportunity to test the overburden material from the Little Rock pit and further refine and demonstrate material handling techniques and reclamation specifications.

1.2 Objectives

The primary goal for the USNR test plot program is to evaluate vegetation success and erosion for the Little Rock Precambrian granite. Tyrone hypothesized that multiple year delays in seeding the Precambrian Granite on the 7A test plots, combined with drought conditions, contributed to unacceptable vegetation establishment (Golder 2014). Thus, the major performance criterion to be assessed at the USNR test plots is vegetation performance. The test plots will further inform Tyrone about the implications of surface armoring on seedling establishment over time. The second objective of the test plots is to quantify erosion on the Precambrian Granite cover materials.

2.0 USNR TEST PLOT DESIGN AND REVEGETATION

Reclamation of the USNR Leach Stockpile area involved removal of the residual leached ore materials primarily from drainage areas, minor regrading of the site to tie into bedrock drainages, and installation of a nominal 3-foot thick cover of Precambrian Granite from the Little Rock pit. The construction and material handling methods were described in the as-built report (Golder 2017). The layout and design of the test plot treatments are discussed in Section 2.1. The revegetation techniques are summarized in Section 2.2.

2.1 Test Plot Layout and Design

The two-acre test plot included four treatments, which were approximately a half acre each. A control and three treatments were proposed for the USNR test plots. The major treatments involve changes in the seed mix and the timing of mulching. The treatments are described below:

- Control (conventional seed mix and mulching (CSMA))
- Mulch prior to seeding with conventional seed mix (CSMB)
- Conventional mulch with experimental seed mix (ESMA)
- Mulch prior to seeding with experimental seed mix (ESMB)

Figure 1 illustrates the layout and configuration of the USNR test plots. The finished slope gradients on the test plot ranged from about 3:1 to 4:1 with slope lengths ranging from about 150 to 180 feet. The cover thickness exceeded three feet on the test plot (Golder 2017).

2.2 Revegetation

The plots were revegetated in a manner consistent with requirements of Appendix C of Permit GR007RE, with some minor variations related to the seed mix and the timing of the mulching, which are described below. The revegetation operations were performed by the Freeport-McMoRan seeding crew on June 4 and 5, 2015. Operationally, the revegetation procedures included: 1) scarification and seedbed preparation, 2) seeding, and 3) mulching and crimping.

2.2.1 Scarification and Seeding

Scarification was performed on the contour at a depth of 8-12 inches. The seed was drilled and broadcast simultaneously using a modified rangeland drill with depth control bands, packer wheels, agitators and augers, and picker wheels. The light and fluffy seeds were allowed to fall freely behind the drill and were covered using chain drags pulled behind the drill. Denser seeds were drilled to promote proper seed placement.

2.2.2 Seed Mix

Two seed mixes were applied on USNR test plots. The conventional seed mix was modified slightly from the primary seed mix in Appendix C of the MMD permit modification 06-3 to accommodate the availability of seed and included 4 warm season grass, 5 cool season grass, 3 forb, and 4 shrub species (Table 1). An alternative seed mix deviated from the typical seed mix in Appendix C of Permit GR007RE to include a number of experimental species native to the Desert Southwest region. The alternative seed mix was comprised of 10 warm season grass, 6 cool season grass, 10 forb, and 6 shrub species (Table 2). For reference the number of seeds per square foot were similar for both seed mixes, but the experimental mix contained some species with larger seeds.

2.2.3 Mulching

Conventionally, Tyrone has applied mulch after seed placement. At the USNR, the timing of seeding and mulching varied among the test plot treatments. Mulch was applied prior to seeding on half the area and after seeding on the other half. Mulch was applied at a rate of approximately 2-tons/acre. The mulch was then crimped 3 to 4 inches into the cover using a disc harrow with straight coulter discs spaced approximately 6 to 8 inches apart. The crimping operation was performed on the contour.

2.3 Prevailing Climate Conditions

The amount and distribution of precipitation are important determinants for the progression of vegetation affecting cover levels on a year-to-year basis, with grasses and forbs showing the most immediate effects. The precipitation records from the Little Rock meteorological station are provided in this section. Table 3 lists the monthly and annual precipitation for 2015 to 2018. The daily distribution of precipitation is shown in Figure 2.

Cumulative annual precipitation in 2018 was 13.95 inches and was below the long-term average of 15.82 inches. The growing season precipitation in 2018 was 7.3 inches and was also below the long-term average of 10.0 inches. While the total annual precipitation at the Little Rock meteorological station was above the regional average of about 16 inches at Ft. Bayard (WRCC 2019) in 2016, it was below the regional average in 2015 and the last two years. From a growing season perspective, precipitation was slightly to well below average for three of the last four years with 2016 being above average (Figure 3). Thus, the prevailing precipitation in 2018 is considered dry from a regional perspective.

3.0 EROSION MONITORING

Erosion is the detachment and movement of soil by wind or water. Soil erosion rates vary temporally in response to several controlling factors. The major factors affecting erosion include the amount, duration, and intensity of rainfall, soil physical characteristics, nature of the soil surface, vegetation, litter, and rock cover, and the gradient, shape, and length of slope. Soil erosion at mine sites is typically predicted using models that incorporate these factors (Toy and Foster 1998). Because erosion is episodic, short-term measurements are typically poorly correlated to the long-term prediction provided by models (Weltz et al. 1998). For instance, erosion rates are expected to be highest during the vegetation establishment period and may not reflect long-term rates. Similarly, variations in weather events can strongly affect the erosion process. Because of the large size of the plots, sediment traps were considered impractical as a means to measure erosion. Soil erosion was measured using a portable erosion meter (McCool et al. 1981, Kincaid and Williams 1966). The erosion measurements were made using the portable erosion meter described in Golder (2009).

The erosion transects were installed and baseline monitoring was conducted in June 2016. Subsequent monitoring episodes were conducted after the summer rains in December 2016, and November 2017 and December 2018 to assess changes in surface topography. Figure 1 shows the location of the erosion monitoring stations. Photographs of the monitoring locations compared to the baseline conditions are included in Appendix A. Cross-section plots of the relative changes in the ground surface from the baseline measurements in 2016 are also included in Appendix A (Figures A-1 to A-2).

Changes in soil surface elevations were evaluated assuming each erosion station represents a separate sample. For each station, the average change in surface elevation from the initial baseline measurement was calculated using points that intersected soil, rock fragments, and litter. Negative changes in surface elevation indicate degradation and positive changes indicate aggradation. The four individual stations on each transect were averaged to determine the change in elevation for each transect. The two transects were averaged to estimate the change in surface elevation for the test plot as a whole considering that the vegetation was not substantively different among the mulching treatments.

3.1 Changes in Surface Elevation and Erosion

The relative changes in ground surface elevation were minimal considering that the test plots are still in the vegetation establishment phase. In 2018, the relative change in the ground surface from baseline was

1.0 millimeter (mm) on the north transect and 3.8 mm on the south transect (Table 4). Thus, the average change in elevation for the test plot transects in 2018 was 2.4 mm. Since 2016, the average surface elevation has increased about 2.0 mm (Table 5). The total estimated accumulation on the test plots is about 40.2 tons/acre for the past three years, averaging 13.0 tons per acre per year (Table 6).

Examination of the station cross-sections suggests that very minor rill erosion has occurred, primarily in mid-slope positions (Figures A-1 and A-2). These data also suggest some of the rills observed in 2016 have filled in and healed in 2017 and 2018. This is likely the reason for the estimated soil accumulation rather than erosion. The minimal evidence of erosion in 2018 is also related to the erosion resistance of these materials. The soil accumulation trend in the first three years since seeding may also be partly due to the lack of high-magnitude precipitation events at the site (Figure 2).

The erosion transects were constructed and baseline conditions were measured about 1 year after seeding and mulching. The amount of surface aggradation or degradation that occurred during the period between mulching and the baseline measurement (i.e., summer of 2015) is impossible to quantify. Thus, the erosion estimates provided in this section do not represent the entire period of reclamation.

4.0 VEGETATION STATUS

Qualitative vegetation inspections in 2016 and 2017 found all the treatments had high levels of seed germination and seedling establishment with average plant density exceeding 1 plant/square foot and increases in canopy cover levels year over year (Golder 2017 and 2018). Treatment effects (seed mixes and seeding before or after mulching) were not observed during the Year 1 and 2 inspections and species composition was generally similar for the experimental and conventional seed mix treatments.

Condition 8.P.1 (a) of Revision 17-1 to Permit GR007RE requires quantitative vegetation monitoring during the third (2018) and fifth (2020) years after seeding to determine if vegetation status is on a trajectory expected to meet reclamation vegetation standards. Vegetation attributes on the USNR test plots were evaluated quantitatively in 2018.

The quantitative vegetation monitoring methods are described in Section 4.1. The results of the vegetation monitoring for the USNR Test Plots are presented in Section 4.2.

4.1 Vegetation Monitoring Methods

Vegetation attributes on the USNR test plots were quantified using the following methods. Fieldwork was conducted at the end of the growing season, but prior to the first killing frost. The quantitative vegetation monitoring took place between September 17-19, 2018.

A systematic random sampling procedure employing a transect/quadrat system was used to select sample sites within the test plots. A 5-meter square (m^2) grid was imposed over each treatment to delineate vegetation sample plots, and random coordinates were used to select plots for vegetation sampling. Transects originated from the southeastern corner of the selected vegetation plot. Each transect was 10 meters (m) long in a dog leg pattern (Figure 4). Four 0.5 m^2 quadrats were located at pre-determined intervals along the transect for quantitative vegetation measurements. The locations of randomly selected vegetation plots are shown on Figure 5 for the USNR test plots. The quadrat data are included in Appendix B and photographs of the quadrats are in Appendix C.

For each quadrat, ocular estimates were made of total canopy, species canopy cover, basal cover, surface litter, surface rock fragments, and bare soil. Not all plant species are expected to occur in the sampling quadrats. Prior to and during formal sampling, each site was traversed on foot to inventory plants growing within the plots and across the reclaimed area.

4.1.1 Vegetation and Ground Cover

Relative and total canopy cover, basal cover, surface litter, rock fragments, and bare soil were visually estimated for each quadrat. Canopy cover estimates include the foliage and foliage interspaces of all individual plants rooted in the quadrat. For the monitoring effort, canopy cover is defined as the percentage of quadrat area included in the vertical projection of the canopy (Daubenmire 1968). The canopy cover estimates made on a species basis may exceed 100% in individual quadrats where the vegetation has multi-layered canopies. In contrast, the sum of the total canopy cover, surface litter, rock fragments, and bare soil does not exceed 100%.

Basal cover is defined as the proportion of the ground occupied by the crowns of grasses and rooting stems of forbs and shrubs. Basal cover estimates were also made for surface litter, rock fragments, and bare soil. Like the total cover estimates, the basal cover estimates do not exceed 100%. All cover estimates were made in 0.1% increments. Percent area cards were used to increase the accuracy and consistency of the cover estimates. Plant frequency also determined on a species-basis by counting the number of individual plants rooted in each quadrat.

4.1.2 Shrub Density

Shrub density, or the number of woody plants per square meter, was determined using the frequency count data from the quadrats and the belt transect method (Bonham 1989). Shrub density was calculated from the quadrat frequency data by dividing the total number of individual plants counted by the number of quadrats measured.

Shrub density was also determined using a belt transect method (Bonham 1989). Shrub density was determined from a 2-meter wide, 10-meter long belt transect situated along the perimeter of the dog-legged transect (Figure 4). Shrubs rooted in the belt transect were counted on a species basis.

4.1.3 Sample Adequacy

The number of samples required to characterize a particular vegetation attribute depends on the uniformity of the vegetation and the desired degree of certainty required for the analysis. Rigorous statistical guidelines are typically applied to bond release analyses. In contrast, interim monitoring activities do not need to have this level of statistical rigor. Often it is impractical to achieve sample adequacy in vegetation monitoring studies and a minimum sample number approach is taken. MMD recognizes this limitation and has provided minimum sample sizes for various quantitative methods (MMD 1996). With normally distributed data where sample adequacy cannot be met because of operational constraints or for other reasons, 40 samples are often considered adequate. The minimum of 40 samples is based on an estimate of the minimum number of samples needed for a t-test under a normal distribution (Sokal and Rohlf 1981). Schulz et al. (1961) have also demonstrated that this number remains robust for most cover and density measures with increased numbers of samples only slightly improving precision.

The number of samples necessary to meet sample adequacy was calculated for canopy cover, basal cover, and shrub density assuming the data were normally distributed using Snedecor and Cochran (1967).

$$N_{min} = \frac{t^2 s^2}{(\overline{x}D)^2}$$

Where N_{min} equals minimum number of samples required, *t* is the two-tailed t-distribution value based on a 90% level of confidence with n-1 degrees of freedom, *s* is the standard deviation of the sample data, $\overline{x}$ is the mean, and D is the desired level of accuracy, which is 10% of the mean. By rule the *t*-value for shrub density is based on an 80% level of confidence (α = 0.2) with n-1 degrees of freedom.

Although statistical adequacy is not required for interim vegetation monitoring at the USNR test plots, the number of samples necessary to meet sample adequacy are reported. Additionally, the 90% confidence interval (CI) of the sample mean (n=16) and the level of confidence that the sample mean is within 10% of the true mean are reported. The probability statistic is provided as a convenience to better understand the confidence level for the sample mean when sample adequacy is not achieved.

4.2 Quantitative Vegetation Monitoring Results

Condition 8.P.1 (a) of Revision 17-1 to Permit GR007RE requires quantitative vegetation monitoring during Year 3 (2018) and Year 5 (2020) after seeding to determine if vegetation status is on a trajectory expected to meet reclamation vegetation standards. Vegetation attributes on the USNR test plots were evaluated quantitatively in September 2018 to fulfill the Year 3 monitoring requirement. Results from the Year 3 quantitative monitoring are presented in Section 4.2.1 for the Conventional Seed Mix plots and Section 4.2.2 for the Experimental Seed Mix plots.

4.2.1 Conventional Seed Mix Plots

Mean total canopy cover levels were from 11.6 to 16.5% for the Conventional Seed Mix plots (Table 7) with individual quadrat values ranging from 2.8 to 46.2% (Tables B-1 and B-3). Mulching before or after seeding did not result in statistically different (based on a 90% CI overlap) canopy cover levels (Figure 6). The mean basal cover ranged from 0.7 to 1.3% for the Conventional Seed Mix plots with individual quadrat values ranging from 0.1 to 2.8%. Thirty-nine plant species were identified, and the plant community was dominated by perennials with no noxious weeds present. Thirteen plant species were from the seed mix and the other 26 are volunteer native plants from the surrounding vegetation communities. Shrub density ranged from 0.9 to 1.4 stems per square meter (stems/m^2), based on the belt transect method. These vegetation attributes indicate that the Conventional Seed Mix under both mulching treatments are progressing well and are consistent with the levels expected for the early establishment phase of reclamation in this region. Figure 9 provides a comparison of the CSMA and CSMB plots in 2017 and 2018. Monitoring results for the two mulching treatments are discussed in the subsections below.

4.2.1.1 Conventional Mulching

Mean total canopy cover (± 90% CI) for the CSMA plot was 11.6% ± 4.5% (Table 7). Canopy cover in the individual quadrats ranged from 2.8 to 46.2% (Table B-1). Canopy cover components for vegetation, litter, rock, and bare soil on the CSMA plot is illustrated in Figure 7. Mean basal cover was estimated at 0.7% ± 0.3%. The calculated N_{min} for canopy cover was 268 samples (Table 7).

The proportional or relative canopy cover for the plant classes (grasses, forbs, and shrubs) is illustrated in Figure 7 for the CSMA plot. Grasses represented 82% of the total relative canopy, with sideoats grama (*Bouteloua curtipendula*), intermediate wheatgrass (*Thinopyrum intermedium*), and Indian ricegrass (*Achnatherum hymenoides*), being the most prevalent (Table 8). Relative herbaceous forb cover was 8%, with annual pink buckwheat (*Eriogonum polycladon*) being the most prevalent. Relative shrub cover was 10% and included three shrub species, with desert willow (*Chilopsis linearis*) contributing the most canopy cover.

As of the fall of 2018, 33 species (12 from the seed mix) have been identified in the reclaimed plant community on the CSMA plot (Table 8). Thus, plant diversity is increasing with the recruitment of an additional 21 native species from the surrounding ecosystems. In 2018, 19 species were captured in the 16 individual quadrats on the CSMA plot.

Mean shrub density on the CSMA plot was 0.9 stems/m^2 using the belt transect method (Table 7). Two shrub species were encountered in the belt transects with California brickellbush (*Brickellia californica*) being the most frequently measured species (Table B-9). Based on the quadrat count (frequency) data, the mean total shrub density was 3.1 stems/m^2. Three of the 4 shrub species identified on the CSMA plot were captured in the quadrat data (Table 8).

4.2.1.2 Mulch Prior to Seeding

Mean total canopy cover for the CSMB plot was 16.5% ± 3.7% (Table 7). Canopy cover in the individual quadrats ranged from 6.0 to 32.1% (Table B-3). Canopy cover components for vegetation, litter, rock, and bare soil on the CSMB plot is illustrated in Figure 7. Mean basal cover was estimated at 1.3% ± 0.3%. The calculated minimum sample size for canopy cover was 92 samples (Table 7).

The proportional or relative canopy cover for the plant classes (grasses, forbs, and shrubs) is illustrated in Figure 7 for the CSMB plot. Grasses represented 84% of the total relative canopy, with sideoats grama, mountain brome (*Bromus marginatus*), and intermediate wheatgrass being the most prevalent (Table 9). Relative herbaceous forb cover was 9%, with annual pink buckwheat being the most prevalent. Relative shrub cover was 7% and included three shrub species, with rubber rabbitbrush (*Ericameria nauseosa*) contributing the most canopy cover.

As of the fall of 2018, 31 species (12 from the seed mix) have been identified in the reclaimed plant community on the CSMB plot (Table 9). Thus, plant diversity is increasing with the recruitment of an additional 19 native species from the surrounding ecosystems. In 2018, 15 species were captured in the 16 individual quadrats on the CSMB plot.

Mean shrub density on the CSMB plot was 1.4 stems/m^2 using the belt transect method (Table 7). Three shrub species were encountered in the belt transects with California brickellbush being the most frequently measured species (Table B-9). Based on the quadrat count (frequency) data, the mean total shrub density was 6.5 stems/m^2. Three of the 4 shrub species identified on the CSMB plot were captured in the quadrat data (Table 9).

4.2.2 Experimental Seed Mix Plots

Average total canopy cover levels were from 13.5 to 16.3% (Table 7) for the Experimental Seed Mix Plots with individual quadrat values ranging from 5.3 to 55.0% (Tables B-5 and B-7). Mulching before or after seeding did not result in statistically different (based on a 90% CI overlap) canopy cover levels (Figure 6). The mean basal cover ranged from 1.2 to 1.7% for the Experimental Seed Mix plots with individual quadrat values ranging from 0.3

to 11.5%. Thirty-five plant species were identified, and the plant community was dominated by perennials with no noxious weeds present. Sixteen (16) plant species were from the seed mix and the other 19 are volunteer native plants from the surrounding vegetation communities. Shrub density ranged from 2.5 to 3.7 stems/m^2, based on the belt transect method. These vegetation attributes indicate that the Experimental Seed Mix under both mulching treatments are progressing well and are consistent with the levels expected for the early establishment phase of reclamation in this region. Figure 10 provides a comparison of the ESMA and ESMB plots in 2017 and 2018. Monitoring results for the two mulching treatments are discussed in the following subsections.

4.2.2.1 Conventional Mulching

Mean total canopy cover for the ESMA plot was 16.3% ± 5.0% (Table 7). Canopy cover in the individual quadrats ranged from 6.2 to 55.0% (Table B-5). Canopy cover components for vegetation, litter, rock, and bare soil on the ESMA plot is illustrated in Figure 8. Mean basal cover was estimated at 1.7% ± 1.1%. The minimum sample size for N_{min} for canopy cover was 168 samples (Table 7).

The proportional or relative canopy cover for the plant classes (grasses, forbs, and shrubs) is illustrated in Figure 8 for the ESMA plot. Grasses represented 67% of the total relative canopy, with sideoats grama, intermediate wheatgrass, and purple threeawn (*Aristida purpurea*) being the most prevalent (Table 10). Relative herbaceous forb cover was 16%, with desert marigold (*Baileya multiradiata*) and Palmer's penstemon (*Penstemon palmeri*) being the most prevalent. Relative shrub cover was 17% and included five shrub species, with white sagebrush (*Artemisia ludoviciana*) and desert willow contributing the most canopy cover.

As of the fall of 2018, 31 species (16 from the seed mix) have been identified in the reclaimed plant community on the ESMA plot (Table 10). Thus, plant diversity is increasing with the recruitment of an additional 15 native species from the surrounding ecosystems. In 2018, 18 species were captured in the 16 individual quadrats on the ESMA plot.

Mean shrub density on the ESMA plot was 3.7 stems/m^2 using the belt transect method (Table 7). Six shrub species were encountered in the belt transects with white sagebrush and desert willow being the most frequently measured species (Table B-9). Based on the quadrat count (frequency) data, the mean total shrub density was 12.4 stems/m^2. Five of the 7 shrub species identified on the ESMA plot were captured in the quadrat data (Table 10).

4.2.2.2 Mulch Prior to Seeding

Mean total canopy cover for the ESMB plot was 13.5% ± 2.9% (Table 7). Canopy cover in the individual quadrats ranged from 5.3 to 26.6% (Table B-7). Relative mean canopy cover for vegetation, litter, rock, and bare soil on the ESMB plot is illustrated in Figure 8. Mean basal cover was estimated at 1.2% ± 0.3%. The calculated sample adequacy (N_{min}) for canopy cover was 83 samples (Table 7).

The proportional or relative canopy cover for the plant classes (grasses, forbs, and shrubs) is illustrated in Figure 8 for the ESMB plot. Grasses represented 89% of the total relative canopy, with sideoats grama, intermediate wheatgrass, and cane bluestem (*Bothriochloa barbinodis*) being the most prevalent (Table 11). Relative herbaceous forb cover was 3%, with desert marigold and Palmer's penstemon being the most prevalent. Relative shrub cover was 8% and included five shrub species, with white sagebrush contributing the most canopy cover.

As of the fall of 2018, 32 species (15 from the seed mix) have been identified in the reclaimed plant community on the ESMB plot (Table 11). Thus, plant diversity is increasing with the recruitment of an additional 17 native

species from the surrounding plant community. In 2018, 18 species were captured in the 16 individual quadrats on the ESMB plot.

Mean shrub density on the ESMB plot was 2.5 stems/m^2 using the belt transect method (Table 7). Six shrub species were encountered in the belt transects with white sagebrush and desert willow being the most frequently measured species (Appendix B-9). Based on the quadrat count (frequency) data, the mean total shrub density was 11.9 stems/m^2. Five of the 6 shrub species identified on the ESMB plot were captured in the quadrat data (Table 11**)**.

5.0 SUMMARY

The primary goal for the USNR test plot program is to evaluate vegetation success and erosion for the Little Rock Precambrian granite cover materials. These evaluations will inform Tyrone about the implications of surface armoring on seedling establishment over time, while quantifying erosion on the cover materials. Vegetation attributes on the USNR test plots were evaluated quantitatively in September 2018, fulfilling the third-year monitoring requirement.

Precipitation in 2018 at the Little Rock meteorological station was below normal from a regional perspective. Annual and seasonal precipitation has been slightly to well below average for 3 of the last 4 years with only 2016 being above average. The site has not seen any significant high-magnitude rainfall events that characterize the region's monsoonal precipitation patterns.

Cumulatively, erosion at the site since seeding has resulted in soil accumulation rather than degradation with average accumulation estimated at 10.6 tons per acre per year. While localized sheet and small-scale rill erosion is evident in mid-slope positions, deposition near the toe of the slopes and recent rill healing has led to aggradation. The soil accumulation trend in the first three years may be in part due to the lack of high-magnitude precipitation events at the site in combination with the armoring of the soil surface. Initial results for the USNR test plots indicated the erosional stability of the Precambrian granite is adequate, though long-term evaluations will offer greater insight into the cover materials' ability to resist erosion.

Despite the generally dry conditions since seeding, vegetation efforts on the USNR test plots are considered successful as all seeding and mulching treatments are performing well and are in line with expectations for this stage of reclamation. Average total canopy cover levels on the USNR test plots ranged from 11.6 to 16.5% and the seed mix and mulching treatments did not result in statistically different canopy cover levels based (Figure 6). Shrub density measured in belt transects ranged from 0.9 to 3.7 stems/m^2. Each plant community was dominated by perennials and no noxious weeds were present. Average perennial plant density exceeds 1 plant per square foot, indicating successful establishment based on Golder's experience with reclamation in the Southwestern U.S. The Year 3 results indicate that both seed mixes under the two mulch treatments are progressing well and are consistent with the levels expected for the early establishment phase of reclamation in this region. Photographic comparisons of the treatments also indicate positive vegetation progression between 2017 and 2018 (Figures 9 and 10).

Grass species are providing the most canopy cover in both experimental and conventional seed mix treatments. Sideoats grama is the dominate grass across the test plots, with good establishment of cane bluestem and Fendler threeawn in the experimental seed mix plots and some initial positive responses of several cool-season grasses including intermediate wheatgrass and Sandberg bluegrass. Several experimental shrubs have become established including desert willow, whitethorn acacia and white sagebrush and all the test plots have recruited California brickellbush. Diversity is increasing in all test plots with over 15 native plant species having been

recruited from adjacent undisturbed areas. A more complete evaluation of species response will be made during the quantitative vegetation study scheduled in 2020.

The 2018 monitoring events indicate the USNR test plots are establishing a self-sustaining vegetation community and the cover materials are stable. These initial results indicate the Precambrian granite is a suitable cover material with the ability to resist erosion and support vegetation under the adverse conditions that are characteristic of the region.

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Tables

Table 1: Conventional Seed Mix used at the USNR Test Plots

Scientific Name	Common Name	lbs/ac
Warm Season Grass		
Bothriochloa barbinodis	Cane bluestem	0.3
Bouteloua curtipendula	Sideoats gramma	1.25
Bouteloua gracilis	Blue grama	0.25
Leptochloa dubia	Green sprangletop	0.4
Cool Season Grass		
Achnatherum hymenoides	Indian ricegrass	1.5
Agropyron dasystachyum	Streambank wheatgrass	1
Elymus elymoides	Bottlebrush squirreltail	1.25
Koeleria macrantha	Prairie Junegrass	0.1
Sporobolus cryptandrus	Sand dropseed	0.05
Shrubs		
Atriplex canescens	Fourwing saltbush	0.75
Chilopsis Linearis	Desert willow	0.75
Ericameria nauseosa	Rubber rabbitbrush	0.3
Krascheninikovia lanata	Winterfat	0.5
Forbs		
Dalea candida	White prairie clover	0.4
Linum lewisii	Blue flax	0.12
Ratibida columnaris	Prairie coneflower	0.2
	PLS (lbs/acre)	**9.12**

Note: lbs/ac = pounds per acre, PLS = pure live seed

Table 2: Experimental Seed Mix used at the USNR Test Plots

Scientific Name	Common Name	lbs/ac
Warm Season Grass		
Aristida purpurea var. longiseta	Fendler threeawn	0.25
Bothriochloa barbinodis	Cane bluestem	0.1
Bouteloua curtipendula	Sideoats grama	1
Bouteloua rothrockii	Rothrock's grama	0.05
Eragrostis intermedia	Plains lovegrass	0.05
Heteropogon contortus	Tanglehead	0.25
Muhlenbergia montana	Mountain muhly	0.03
Schizachyrium scoparium	Little bluestem	0.9
Sporobolus airoides	Alkali sacaton	0.05
Sporobolus giganteus	Giant dropseed	0.05
Cool Season Grass		
Elymus elymoides	Bottlebrush squirreltail	1
Elymus glaucus	Blue wildrye	0.4
Hesperostipa neomexicana	New Mexico feathergrass	3
Poa secunda	Sandberg bluegrass	0.05
Sporobolus cryptandrus	Sand dropseed	0.02
Thinopyrum intermedium	Intermediate wheatgrass	1
Shrubs		
Acacia constricta	Whitethorn acacia	1
Acacia greggii	Catclaw acacia	2
Atriplex canescens	Fourwing saltbush	1.5
Encelia virginensis	Virgin River brittlebush	0.25
Ericameria nauseosa	Rubber rabbitbrush	0.2
Robinia neomexicana	New Mexico locust	2.5
Forbs		
Achillea millefolium var. occidentalis	Western yarrow	0.01
Artemisia ludoviciana	White sagebrush	0.05
Baileya multiradiata	Desert marigold	0.05
Erigeron speciosus	Aspen fleabane	0.05
Isocoma tenuisecta	Burroweed	0.05
Lotus rigidus	Deervetch	0.1
Oenothera pallida	Pale evening primrose	0.1
Penstemon palmeri	Palmer's penstemon	0.2
Senna covesii	Coues' cassia	0.25
Sphaeralcea coccinea	Scarlet globemallow	0.1
	PLS (lbs/acre)	**16.61**

Note: lbs/ac = pounds per acre, PLS = pure live seed

Table 3: Monthly and Annual Precipitation (inches) at the Little Rock Meteorological Station

	2015	2016	2017	2018	Ft Bayard[a]
January	2.22	1.03	3.22	0.00	0.88
February	0.44	0.31	1.54	2.14	0.85
March	0.82	0.00	0.17	0.16	0.68
April	0.31	0.54	0.03	0.01	0.38
May	0.52	0.15	0.07	0.00	0.47
June	1.14	0.61	0.98	0.18	0.82
July	2.40	2.43	3.29	1.25	3.32
August	2.57	5.53	1.85	3.95	3.30
September	1.14	3.34	0.16	1.89	2.06
October	0.25	0.27	0.26	2.10	1.24
November	1.15	0.26	0.07	0.28	0.75
December	1.44	2.54	0.30	1.99	1.05
Annual	**14.40**	**17.01**	**11.94**	**13.95**	**15.80**

Notes:

[a] Long-term averages for the Ft Bayard Station (293265) are from Western Regional Climate Center (2019).

Table 4: Average Change in Ground Surface Elevation of the USNR Erosion Transects

Year	Individual Transects		Test Plot
	North (mm)	South (mm)	(mm)
2016	0.9	1.7	1.3
2017	2.9	1.9	2.4
2018	1	3.8	2.4

Notes:

Negative values indicate an average loss of materials (degradation).

Positive values indicate average accumulation of materials (aggradation).

Table 5: Cumulative and Annual Average Change in Ground Surface Elevation

MARGINAL CHANGE IN ANNUAL AVERAGE GROUND SURFACE ELEVATION					
Transect	2016	2017	2018	Cumulative	Three-Year Average
	(mm)				(mm/yr)
North and South Average	1.3	2.4	2.4	6.1	2.0

Notes:
Negative values indicate an average loss of materials (degradation).
Positive values indicate average accumulation of materials (aggradation).

Table 6: Cumulative and Annual Average Soil Loss or Accumulation

ANNUAL AVERAGE SOIL LOSS OR ACCUMULATION					
Transect	2016	2017	2018	Cumulative	Three-Year Average
	(tons/acre)				(t/ac/yr)
North and South Average	-9.0	-15.6	-15.6	-40.2	-13.0

Notes:
Positive values indicate erosion; Negative values indicate accumulation.
Erosion values assume a 1 mm change in elevation = 6.5 tons/acre

Table 7: Summary Statistics for the USNR Test Plots

	CSMA	CSMB	ESMA	ESMB
Total Canopy (%)				
Mean	11.6	16.5	16.3	13.5
Standard Deviation	10.8	9.0	12.1	7.0
90% Confidence Interval	4.5	3.7	5.0	2.9
Nmin[1]	268	92	168	83
Confidence level of sample mean[2]	0.66	0.76	0.70	0.77
Basal Cover (%)				
Mean	0.7	1.3	1.7	1.2
Standard Deviation	0.7	0.6	2.7	0.8
90% Confidence Interval	0.3	0.3	1.1	0.3
Nmin[1]	260	71	765	153
Confidence level of sample mean[2]	0.67	0.79	0.60	0.71
Shrub Density (stems/m^2) from Quadrats				
Mean	3.1	6.5	12.4	11.9
Standard Deviation	2.4	4.6	15.5	9.0
90% Confidence Interval	1.0	1.9	6.4	3.7
Nmin[3]	108	90	281	104
Confidence level of sample mean[2]	0.69	0.71	0.62	0.70
Shrub Density (stems/m^2) from Belt Transect Data				
Mean	0.9	1.4	3.7	2.5
Standard Deviation	0.6	0.5	2.1	1.8
90% Confidence Interval	0.5	0.4	1.7	1.5
Nmin[3]	35	22	428	333
Confidence level of sample mean[2]	0.70	0.74	0.56	0.57

Notes:

[1] Minimum number of samples required at 90 percent level of confidence that the sample mean is within 10 percent of the population mean

[2] Estimated confidence level that the true mean is within 10 percent of the sample mean based on a one-sided student's t distribution.

[3]Minimum number of samples required at 80 percent level of confidence that the sample mean is within 10 percent of the population mean

CSMA = Conventional seed mix, mulch applied after seeding

CSMB = Conventional seed mix, mulch applied before seeding

ESMA = Experimental seed mix, mulch applied after seeding

ESMB = Experimental seed mix, mulch applied before seeding

Table 8: Comprehensive Plant List, Vegetation Cover and Density for USNR Test Plot CSMA

Scientific Name	Common Name	Code	Mean Cover (%)		Mean Density (stems/m²)	Source
			Basal	Canopy		
Grasses						
Achnatherum hymenoides	Indian ricegrass	ACHY	<0.1	0.3	0.6	S
Agropyron dasystachyum	Streambank wheatgrass	AGDA	<0.1	<0.1	0.1	S
Aristida purpurea	Purple threeawn	ARPU	<0.1	<0.1	0.1	V
Bothriochloa barbinodis	Cane bluestem	BOBA3	<0.1	<0.1	0.1	S
Bouteloua curtipendula	Sideoats grama	BOCU	0.6	8.2	14.3	S
Bouteloua gracilis	Blue grama	BOGR	<0.1	0.1	1.4	S
Dasyochloa pulchella	Low woollygrass	DAPU7	--	--	--	V
Elymus elymoides	Bottlebrush squirreltail	ELEL	--	--	--	S
Elymus glaucus	Blue wildrye	ELGL	--	--	--	V
Thinopyrum intermedium	Intermediate wheatgrass	THIN6	<0.1	0.8	0.5	V
Forbs						
Achillea millefolium	Common yarrow	ACMI2	--	--	--	V
Baileya multiradiata	Desert marigold	BAMU	<0.1	<0.1	0.1	V
Chaenactis stevioides	False yarrow	CHST	<0.1	<0.1	0.1	V
Dalea candida	White prairie clover	DACA	<0.1	0.1	0.1	S
Eriogonum pharnaceoides	Wirestem buckwheat	ERPH2	<0.1	<0.1	0.1	V
Eriogonum polycladon	Annual pink buckwheat	ERPO	<0.1	0.9	21.3	V
Eriogonum wrightii	Bastardsage	ERWR	--	--	--	V
Heliomeris longifolia	Long-leaf goldeneye	HELO	--	--	--	V
Heliomeris multiflora	Showy goldeneye	HEMU3	--	--	--	V
Heterotheca subaxillaris	Telegraph plant	HESU	--	--	--	V
Linum lewisii	Blue flax	LILE	--	--	--	S
Machaeranthera canescens	Purple aster	MACA	--	--	--	V
Machaeranthera gracilis	Slender goldenweed	MAGR	<0.1	<0.1	0.4	V
Penstemon palmeri	Palmer's penstemon	PEPA8	--	--	--	V
Psoralidium lanceolatum	Lemon scurfpea	PSLA3	--	--	--	V
Ratibida columnifera	Prairie coneflower	RACO3	<0.1	<0.1	0.1	S
Salsola tragus	Russian thistle	SATR	<0.1	<0.1	0.4	V
Sanvitalia abertii	Abert's creeping zinnia	SAAB	--	--	--	V
Undifferentiated forb species		UNKF	<0.1	<0.1	0.1	V
Shrubs						
Atriplex canescens	Four-wing saltbush	ATCA	--	--	--	S
Brickellia californica	California brickellbush	BRCA	<0.1	0.2	2.9	V
Chilopsis linearis	Desert willow	CHLI2	<0.1	0.9	0.1	S
Ericameria nauseosa	Rubber rabbitbrush	ERNA	<0.1	<0.1	0.1	S

Notes:
S=seeded; V=volunteer
-- observed on this plot

Table 9: Comprehensive Plant List, Vegetation Cover and Density for USNR Test Plot CSMB

Scientific Name	Common Name	Code	Mean Cover (%)		Mean Density (stems/m²)	Source
			Basal	Canopy		
Grasses						
Achnatherum hymenoides	Indian ricegrass	ACHY	<0.1	0.1	0.9	S
Agropyron dasystachyum	Streambank wheatgrass	AGDA	<0.1	<0.1	0.6	S
Aristida purpurea	Purple threeawn	ARPU	--	--	--	V
Bouteloua curtipendula	Sideoats grama	BOCU	1.1	10.6	19.8	S
Bouteloua gracilis	Blue grama	BOGR	0.1	0.2	1.9	S
Bromus marginatus	Mountain brome	BRMA4	<0.1	0.8	0.1	V
Elymus elymoides	Bottlebrush squirreltail	ELEL	<0.1	0.6	1.0	S
Elymus glaucus	Blue wildrye	ELGL	--	--	--	V
Leptochloa dubia	Green sprangletop	LEDU	--	--	--	S
Thinopyrum intermedium	Intermediate wheatgrass	THIN6	<0.1	0.6	0.6	V
Forbs						
Achillea millefolium	Common yarrow	ACMI2	--	--	--	V
Baileya multiradiata	Desert marigold	BAMU	--	--	--	V
Chaenactis stevioides	False yarrow	CHST	<0.1	<0.1	0.4	V
Cirsium spp.	Undifferentiated thistle species	CIRSI	--	--	--	V
Dalea candida	White prairie clover	DACA	<0.1	0.1	0.6	S
Eriogonum pharnaceoides	Wirestem buckwheat	ERPH2	--	--	--	V
Eriogonum polycladon	Annual pink buckwheat	ERPO	0.1	1.1	26.5	V
Ipomopsis multiflora	Many-flowered ipomopsis	IPMU	--	--	--	V
Linum lewisii	Blue flax	LILE	<0.1	<0.1	0.5	S
Machaeranthera gracilis	Slender goldenweed	MAGR	--	--	--	V
Melilotus officinalis	Yellow sweetclover	MEOF	<0.1	0.2	0.1	V
Penstemon palmeri	Palmer's penstemon	PEPA8	--	--	--	V
Ratibida columnifera	Prairie coneflower	RACO3	--	--	--	S
Rhynchosia senna	Rosary bean	RHSE	--	--	--	V
Salsola tragus	Russian thistle	SATR	--	--	--	V
Sphaeralcea coccinea	Scarlet globemallow	SPCO	--	--	--	V
Tragopogon dubius	Yellow salsify	TRDU	--	--	--	V
Shrubs						
Atriplex canescens	Four-wing saltbush	ATCA	--	--	--	S
Brickellia californica	California brickellbush	BRCA	<0.1	0.1	6.0	V
Chilopsis linearis	Desert willow	CHLI2	<0.1	0.1	0.4	S
Ericameria nauseosa	Rubber rabbitbrush	ERNA	<0.1	0.9	0.1	S

Notes:
S=seeded; V=volunteer
-- observed on this plot

Table 10: Comprehensive Plant List, Vegetation Cover and Density for USNR Test Plot ESMA

Scientific Name	Common Name	Code	Mean Cover (%)		Mean Density (stems/m²)	Source
			Basal	Canopy		
Grasses						
Aristida purpurea	Purple threeawn	ARPU	<0.1	0.1	1.3	S
Bothriochloa barbinodis	Cane bluestem	BOBA3	<0.1	<0.1	1.3	S
Bouteloua curtipendula	Sideoats grama	BOCU	0.8	9.7	45.8	S
Dasyochloa pulchella	Low woollygrass	DAPU7	--	--	--	V
Elymus elymoides	Bottlebrush squirreltail	ELEL	<0.1	0.1	0.3	S
Elymus glaucus	Blue wildrye	ELGL	--	--	--	S
Panicum capillare	Witchgrass	PACA6	--	--	--	V
Poa secunda	Sandberg bluegrass	POSE	<0.1	<0.1	1.8	S
Schizachyrium scoparium	Little bluestem	SCSC	<0.1	<0.1	0.3	S
Thinopyrum intermedium	Intermediate wheatgrass	THIN6	0.1	0.5	1.4	S
Forbs						
Achillea millefolium	Common yarrow	ACMI2	--	--	--	S
Baileya multiradiata	Desert marigold	BAMU	<0.1	1.3	0.4	S
Chaenactis stevioides	False yarrow	CHST	<0.1	<0.1	0.4	V
Dalea candida	White prairie clover	DACA	--	--	--	V
Eriogonum pharnaceoides	Wirestem buckwheat	ERPH2	--	--	--	V
Eriogonum polycladon	Annual pink buckwheat	ERPO	<0.1	<0.1	2.5	V
Heliomeris longifolia	Long-leaf goldeneye	HELO	--	--	--	V
Heterotheca subaxillaris	Telegraph plant	HESU	--	--	--	V
Machaeranthera gracilis	Slender goldenweed	MAGR	<0.1	<0.1	0.5	V
Penstemon palmeri	Palmer's penstemon	PEPA8	0.1	1.1	0.9	S
Psoralidium lanceolatum	Lemon scurfpea	PSLA3	--	--	--	V
Rhynchosia senna	Rosary bean	RHSE	--	--	--	V
Salsola tragus	Russian thistle	SATR	<0.1	<0.1	0.1	V
Stephanomeria pauciflora	Skeleton weed	STPA4	--	--	--	V
Shrubs						
Artemisia ludoviciana	White sagebrush	ARLU	0.6	2.2	6.8	S
Atriplex canescens	Four-wing saltbush	ATCA	--	--	--	S
Brickellia californica	California brickellbush	BRCA	<0.1	<0.1	2.8	V
Chilopsis linearis	Desert willow	CHLI2	<0.1	0.4	1.9	V
Ericameria nauseosa	Rubber rabbitbrush	ERNA	--	--	--	S
Senegalia greggii	Catclaw acacia	SEGR4	<0.1	<0.1	0.3	S
Vachellia constricta	Whitethorn acacia	VACO9	<0.1	0.1	0.8	S

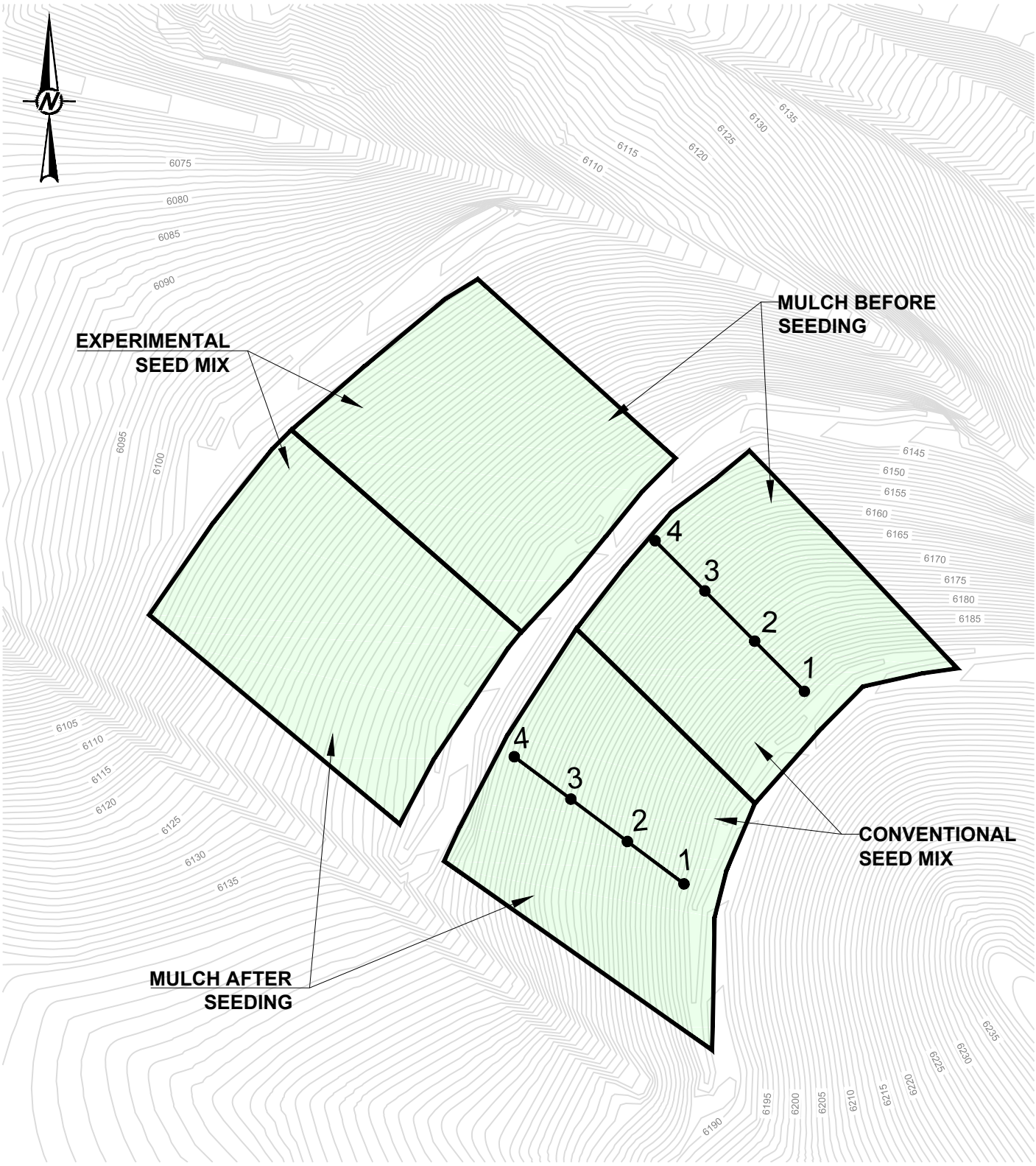
Notes:
S=seeded; V=volunteer
-- observed on this plot

Table 11: Comprehensive Plant List, Vegetation Cover and Density for USNR Test Plot ESMB

Scientific Name	Common Name	Code	Mean Cover (%)		Mean Density (stems/m²)	Source
			Basal	Canopy		
Grasses						
Aristida purpurea	Purple threeawn	ARPU	0.1	0.2	2.0	S
Bothriochloa barbinodis	Cane bluestem	BOBA3	<0.1	0.3	3.4	S
Bouteloua curtipendula	Sideoats grama	BOCU	0.7	9.0	36.1	S
Elymus elymoides	Bottlebrush squirreltail	ELEL	<0.1	0.2	1.0	S
Elymus glaucus	Blue wildrye	ELGL	<0.1	0.1	1.0	S
Panicum capillare	Witchgrass	PACA6	--	--	--	V
Poa secunda	Sandberg bluegrass	POSE	<0.1	0.1	1.9	S
Schizachyrium scoparium	Little bluestem	SCSC	--	--	--	S
Thinopyrum intermedium	Intermediate wheatgrass	THIN6	0.3	2.3	5.0	S
Forbs						
Achillea millefolium	Common yarrow	ACMI2	--	--	--	S
Baileya multiradiata	Desert marigold	BAMU	0.1	0.3	1.0	S
Chaenactis stevioides	False yarrow	CHST	--	--	--	V
Dalea candida	White prairie clover	DACA	--	--	--	V
Eriogonum pharnaceoides	Wirestem buckwheat	ERPH2	--	--	--	V
Eriogonum polycladon	Annual pink buckwheat	ERPO	<0.1	0.01	2.3	V
Eriogonum wrightii	Bastardsage	ERWR	--	--	--	V
Heliomeris longifolia	Long-leaf goldeneye	HELO	--	--	--	V
Linum lewisii	Blue flax	LILE	<0.1	<0.1	0.1	V
Machaeranthera canescens	Purple aster	MACA	--	--	--	V
Machaeranthera gracilis	Slender goldenweed	MAGR	--	--	--	V
Penstemon palmeri	Palmer's penstemon	PEPA8	<0.1	0.1	0.4	S
Psoralidium lanceolatum	Lemon scurfpea	PSLA3	--	--	--	V
Ratibida columnifera	Prairie coneflower	RACO3	--	--	--	V
Rhynchosia senna	Rosary bean	RHSE	<0.1	<0.1	0.3	V
Salsola tragus	Russian thistle	SATR	<0.1	<0.1	0.9	V
Stephanomeria pauciflora	Skeleton weed	STPA4	--	--	--	V
Shrubs						
Artemisia ludoviciana	White sagebrush	ARLU	0.1	0.8	4.6	S
Brickellia californica	California brickellbush	BRCA	<0.1	0.1	4.5	V
Chilopsis linearis	Desert willow	CHLI2	<0.1	0.2	2.5	V
Ericameria nauseosa	Rubber rabbitbrush	ERNA	<0.1	<0.1	0.1	S
Senegalia greggii	Catclaw acacia	SEGR4	--	--	--	S
Vachellia constricta	Whitethorn acacia	VACO9	<0.1	<0.1	0.1	S

Notes:
S=seeded; V=volunteer
-- observed on this plot

Figures



LEGEND

4 3 2 1

TEST PLOT BOUNDARY

TRANSECT LOCATION WITH STATIONS AT 40 FEET APART, STATION 1 AT 10 FEET FROM CREST OF SLOPE.

REFERENCE(S)

TOPOGRAPHY PROVIDED BY FREEPORT McMoRAN TYRONE INC.

0 40 80

1" = 80' FEET

CLIENT

FREEPORT-MCMORAN, TYRONE AND LITTLE ROCK MINES
GRANT COUNTY, NEW MEXICO

PROJECT

2018 USNR TEST PLOT
QUANTITATIVE VEGETATION AND EROSION MONITORING

CONSULTANT

GOLDER

YYYY-MM-DD	2017-02-22
DESIGNED	LM
PREPARED	CM
REVIEWED	LM
APPROVED	LM

TITLE

CONFIGURATION OF THE USNR TEST PLOTS AND EROSION TRANSECT LOCATIONS

PROJECT NO.	PHASE	REV.	FIGURE
123-80014	--	--	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

0 1 in

Path: \\albuquerque\Cad\2012 Projects\123800141\USNR Test Plots\Production\ | File Name: 123800144A0004.dwg

Figure 2: Daily Precipitation at the Little Rock Meteorological Station, 2015-2018

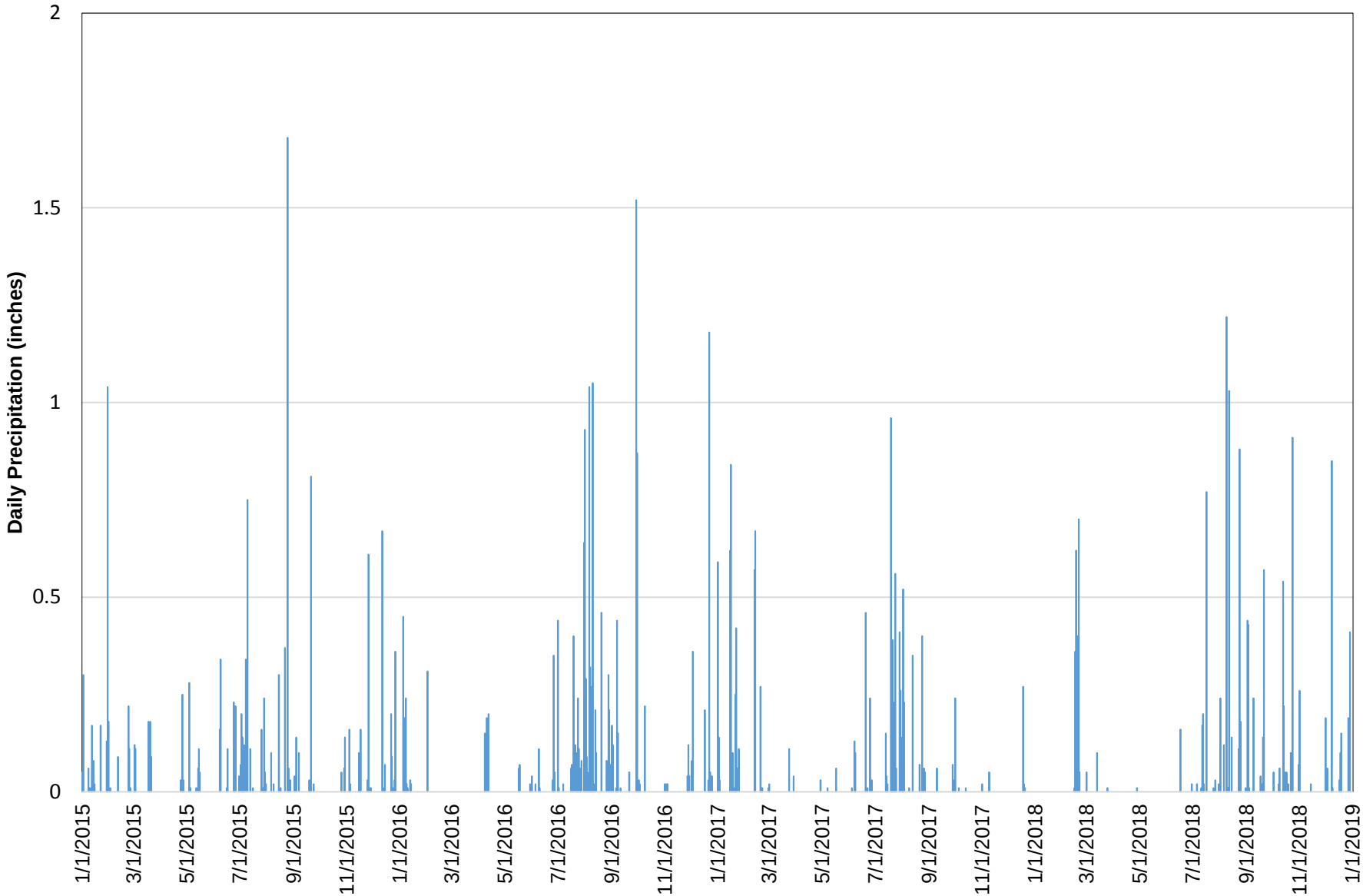
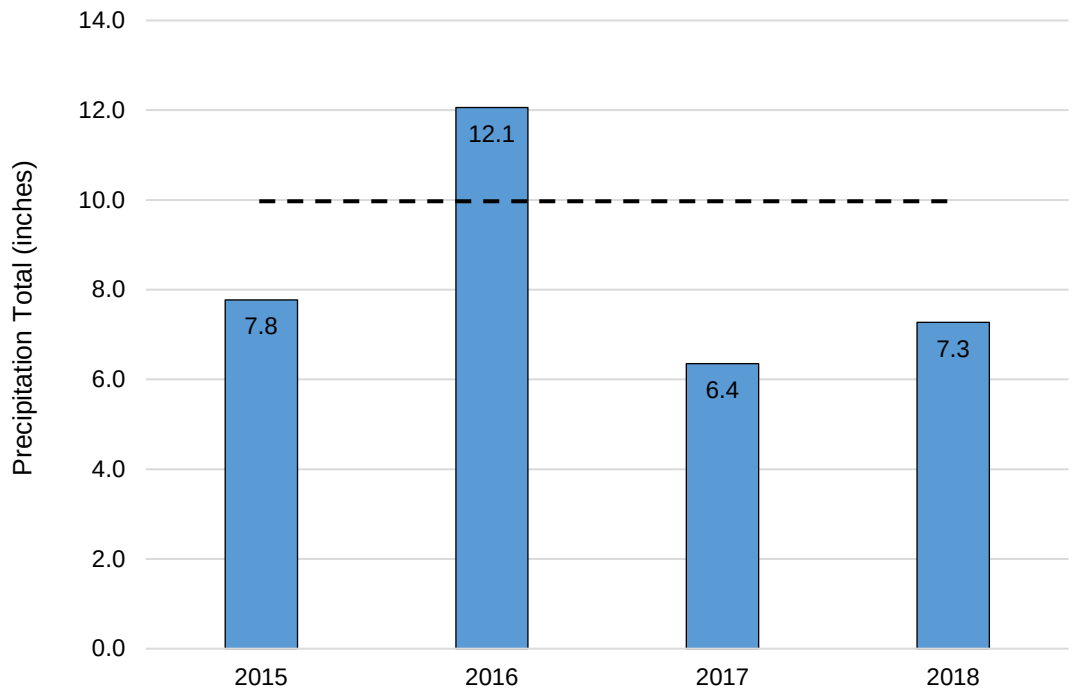


Figure 3: Growing Season Precipitation at the Little Rock Meteorological Station, 2015-2018

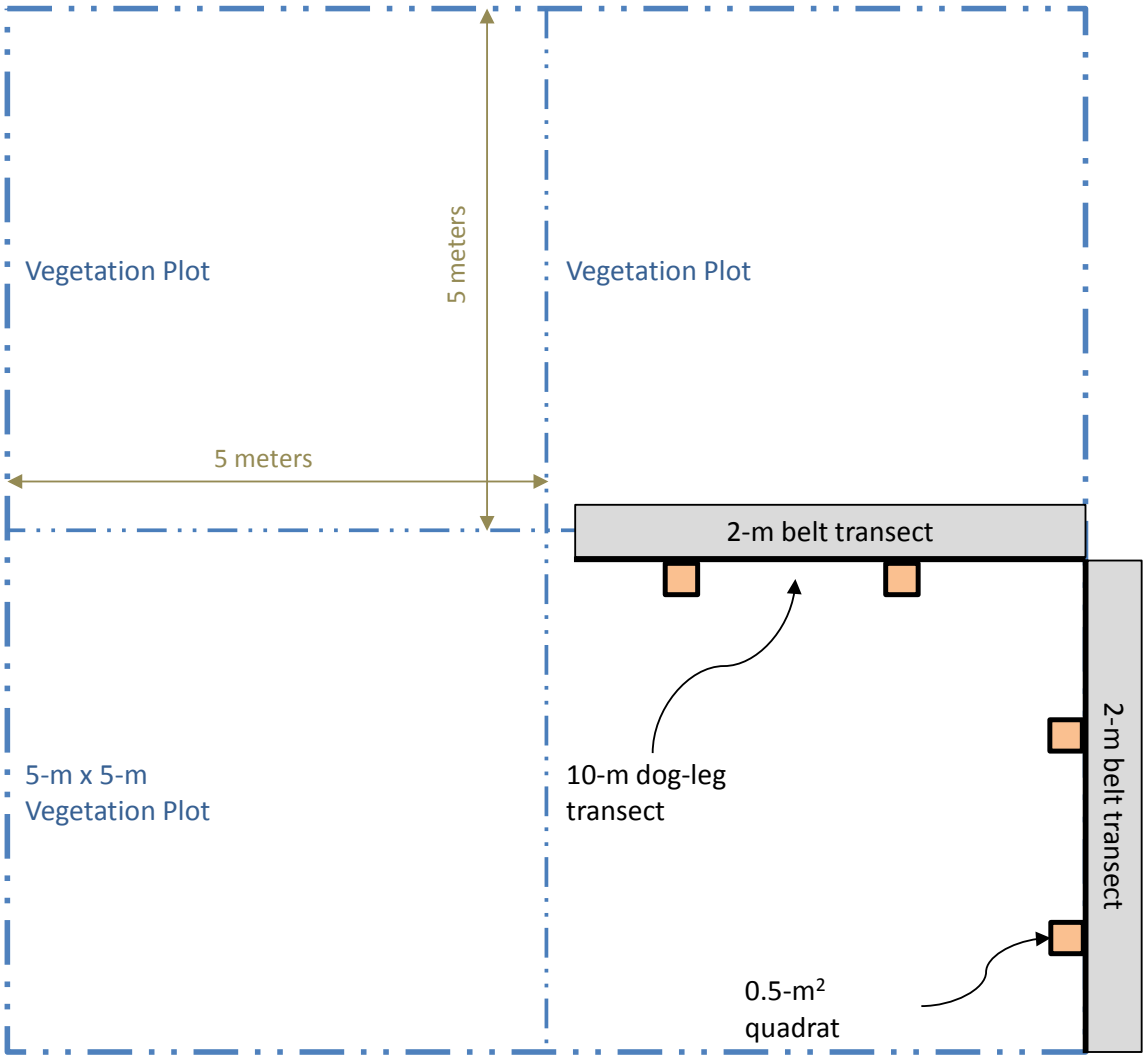


Notes:

[a] The long-term average (1897-2011) is from the Ft Bayard Station (293265), Western Regional Climate Center (2019).

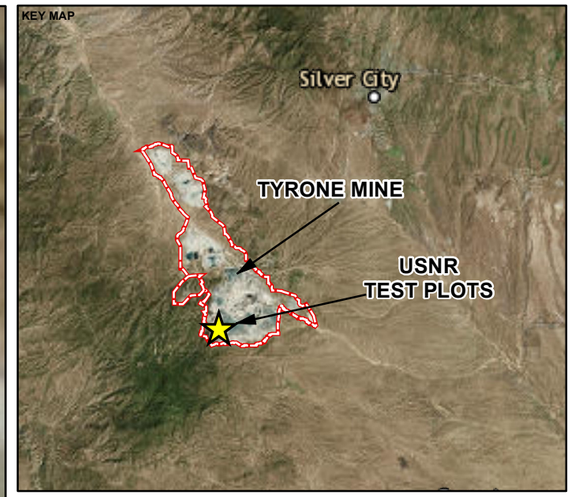
[b] Growing season precipitation totals are for May through September.

Figure 4: Vegetation Plot, Transect, and Quadrat Layout



not to scale

KEY MAP



LEGEND

- Transect Locations, 2018
- Conventional Seed Mix, Mulch After Seeding
- Conventional Seed Mix, Mulch Before Seeding
- Experimental Seed Mix, Mulch After Seeding
- Experimental Seed Mix, Mulch Before Seeding

0 50 100
Feet

NOTE(S)

1. CS = CONVENTIONAL SEED MIX
2. ES = EXPERIMENTAL SEED MIX
3. MB = MULCH BEFORE SEEDING
4. MA = MULCH AFTER SEEDING
5. KEY MAP IS NOT TO SCALE

REFERENCE(S)

1. COORDINATE SYSTEM: UTM ZONE 13N
2. IMAGERY SOURCE: DIGITALGLOBE, MARCH 2016

CLIENT
FREEPORT-MCMORAN, TYRONE AND LITTLE ROCK MINES
GRANT COUNTY, NEW MEXICO

PROJECT
2018 USNR TEST PLOT
QUANTITATIVE VEGETATION AND EROSION MONITORING

TITLE
VEGETATION TRANSECT LOCATIONS, 2018

CONSULTANT
GOLDER

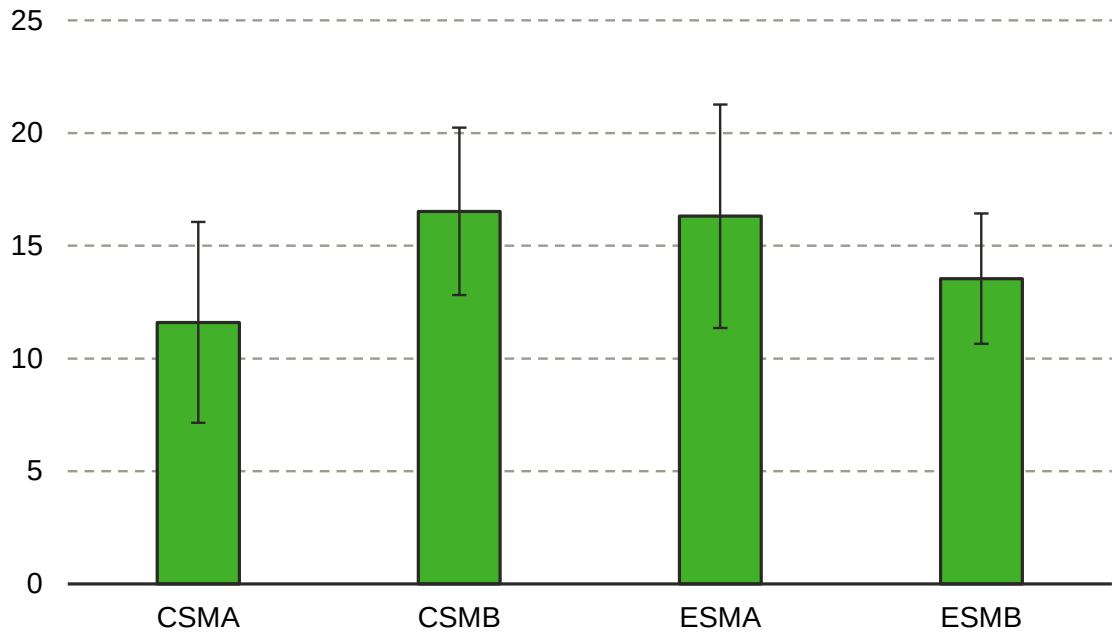
YYYY-MM-DD	2019-04-08
DESIGNED	DW
PREPARED	DW
REVIEWED	DR
APPROVED	DR

PROJECT NO.	CONTROL	REV.	FIGURE
123-80014	--	--	5

PATH: W:\2018\123-80014_USNR\MXDs\123-80014_USNR-TPs_TransectLocations.mxd PRINTED ON: 2019-04-08 AT: 12:03:46 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Figure 6: Canopy Cover for USNR Test Plots Treatments



Notes:

Error bars are the 90% confidence interval about the mean (Table 7)

CSMA = Conventional seed mix, mulch applied after seeding

CSMB = Conventional seed mix, mulch applied before seeding

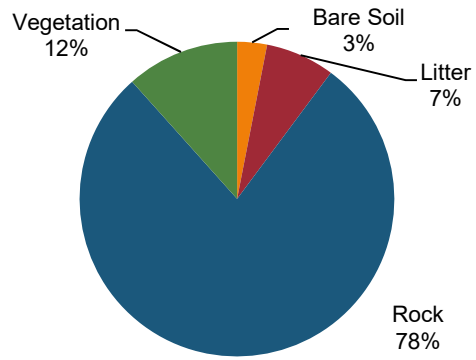
ESMA = Experimental seed mix, mulch applied after seeding

ESMB = Experimental seed mix, mulch applied before seeding

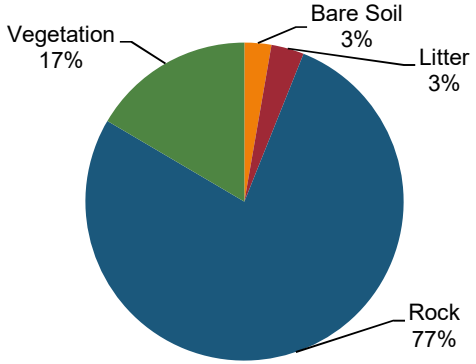
Figure 7: Ground Cover Components and Proportional Canopy Cover by Plant Class for Conventional Seed Mix Plots

Canopy Cover Components

CSMA

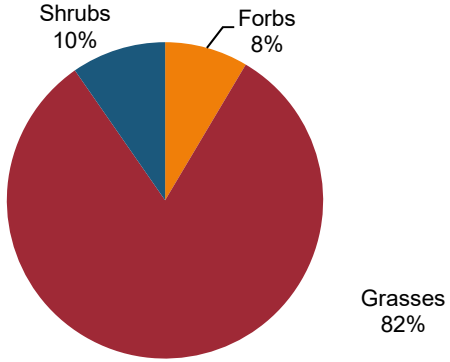


CSMB



Proportional Canopy Cover by Plant Class

CSMA



CSMB

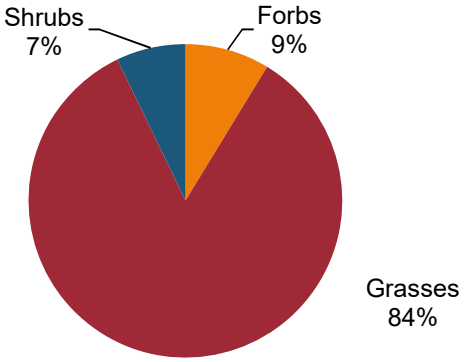
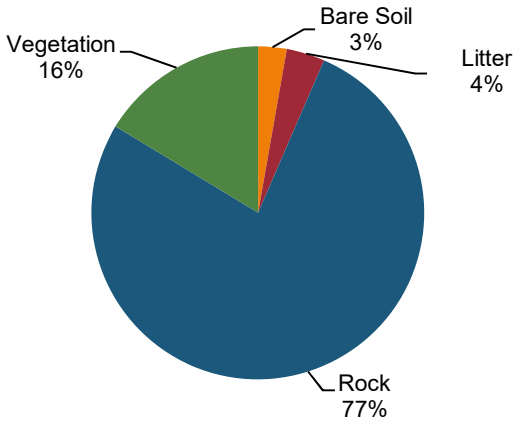


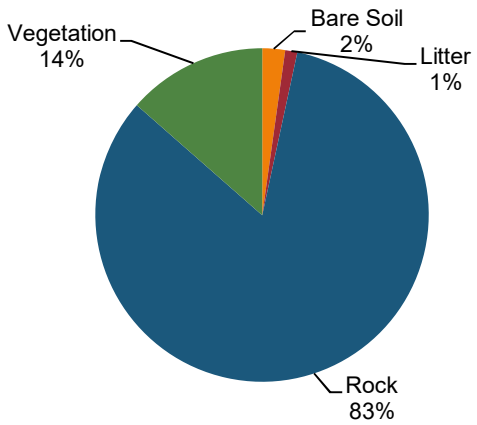
Figure 8: Ground Cover Components and Proportional Canopy Cover by Plant Class for Experimental Seed Mix Plots

Canopy Cover Components

ESMA

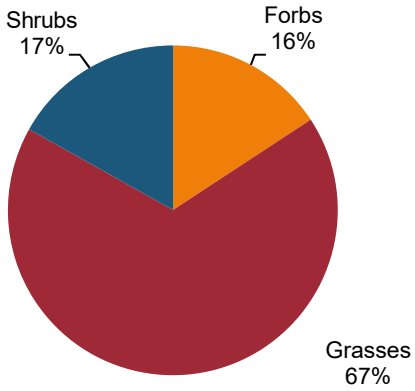


ESMB



Proportional Canopy Cover by Plant Class

ESMA



ESMB

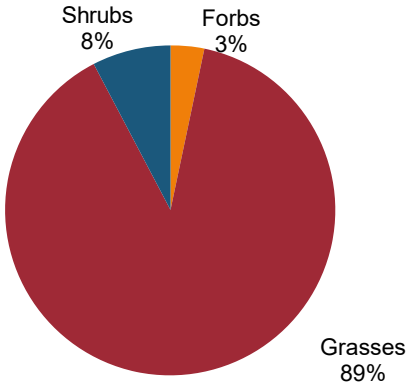


Figure 9: Conventional Seed Mix Plots, Photograph Comparisons

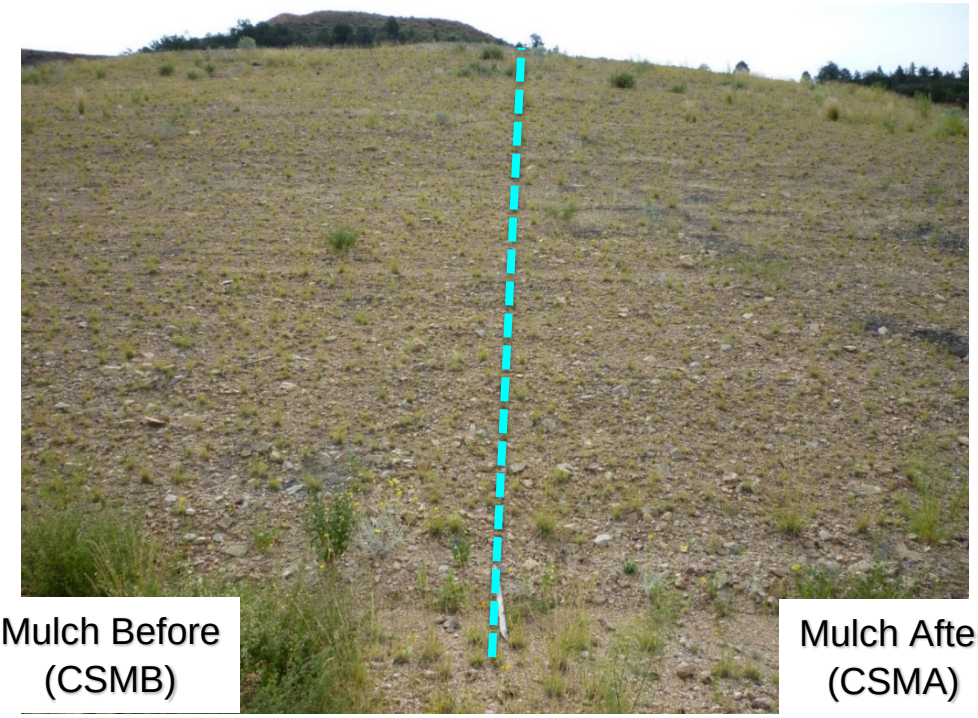


Figure 9a: September 2018

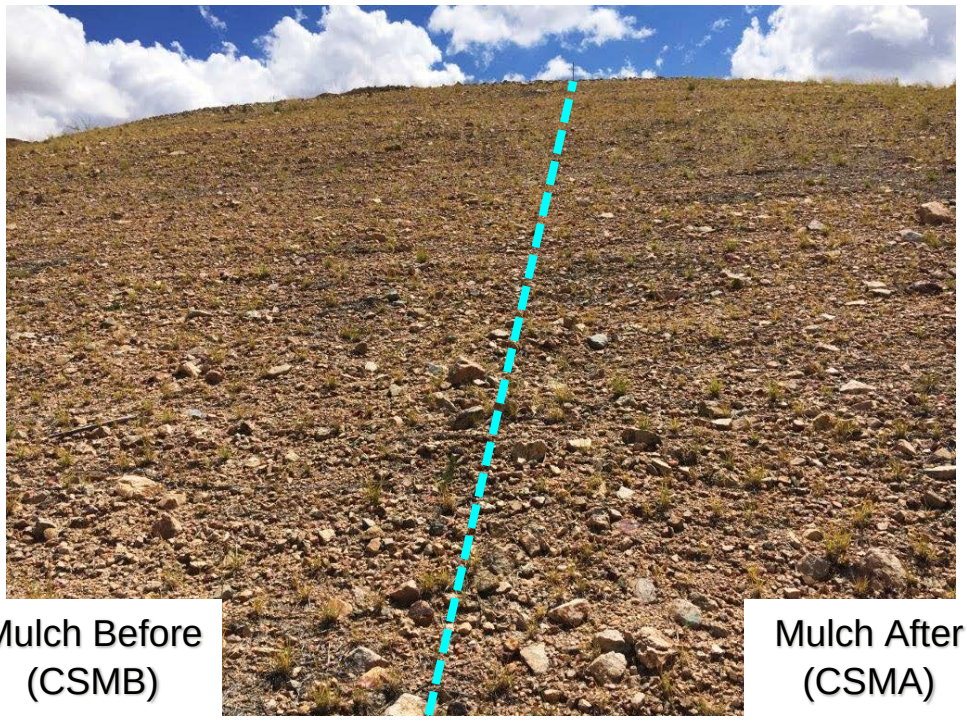


Figure 9b: September 2017

Figure 10: Experimental Seed Mix Plots, Photograph Comparisons

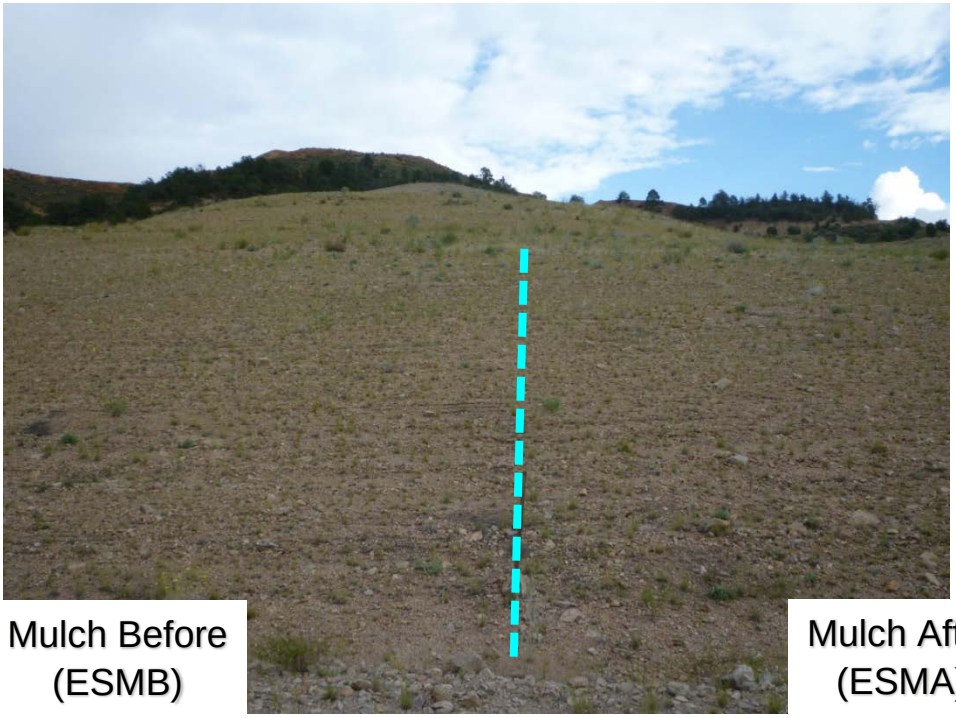


Figure 10a: September 2018

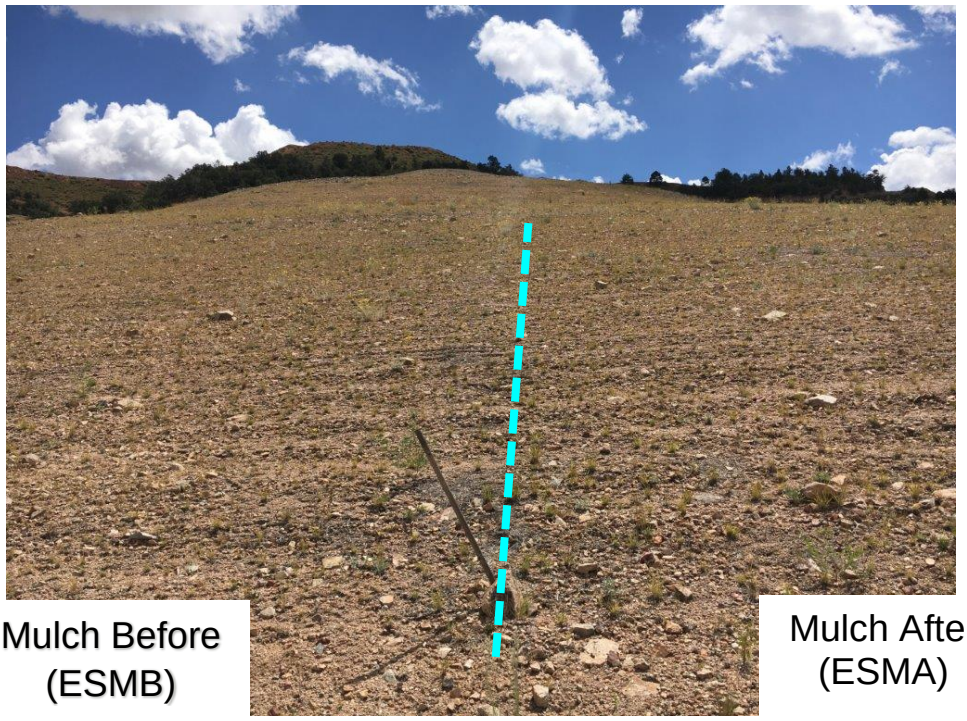


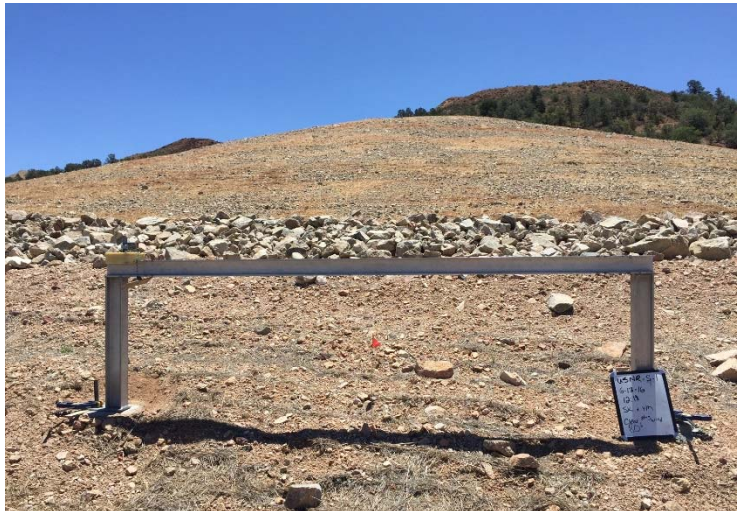
Figure 10b: September 2017

APPENDIX A

Erosion Transect Graphs and Photographs

	
Transect Location: USNR-N-1 Date: 6/13/16	**Transect Location:** USNR-N-1 Date: 12/15/18
	
Transect Location: USNR-N-2 Date: 6/13/16	**Transect Location:** USNR-N-2 Date: 12/15/18

	
Transect Location: USNR-N-3 Date: 6/13/16	**Transect Location:** USNR-N-3 Date: 12/15/18
	
Transect Location: USNR-N-4 Date: 6/13/16	**Transect Location:** USNR-N-4 Date: 12/15/18

	
Transect Location: USNR-S-1 Date: 6/13/16	**Transect Location:** USNR-S-1 Date: 12/15/18
	
Transect Location: USNR-S-2 Date: 6/13/16	**Transect Location:** USNR-S-2 Date: 12/15/18

	
Transect Location: USNR-S-3 Date: 6/13/16	**Transect Location:** USNR-S-3 Date: 12/15/18
	
Transect Location: USNR-S-4 Date: 6/13/16	**Transect Location:** USNR-S-4 Date: 12/15/18

FIGURE A-1:
EROSION TRANSECTS
USNR-N1, N2, N3, N4

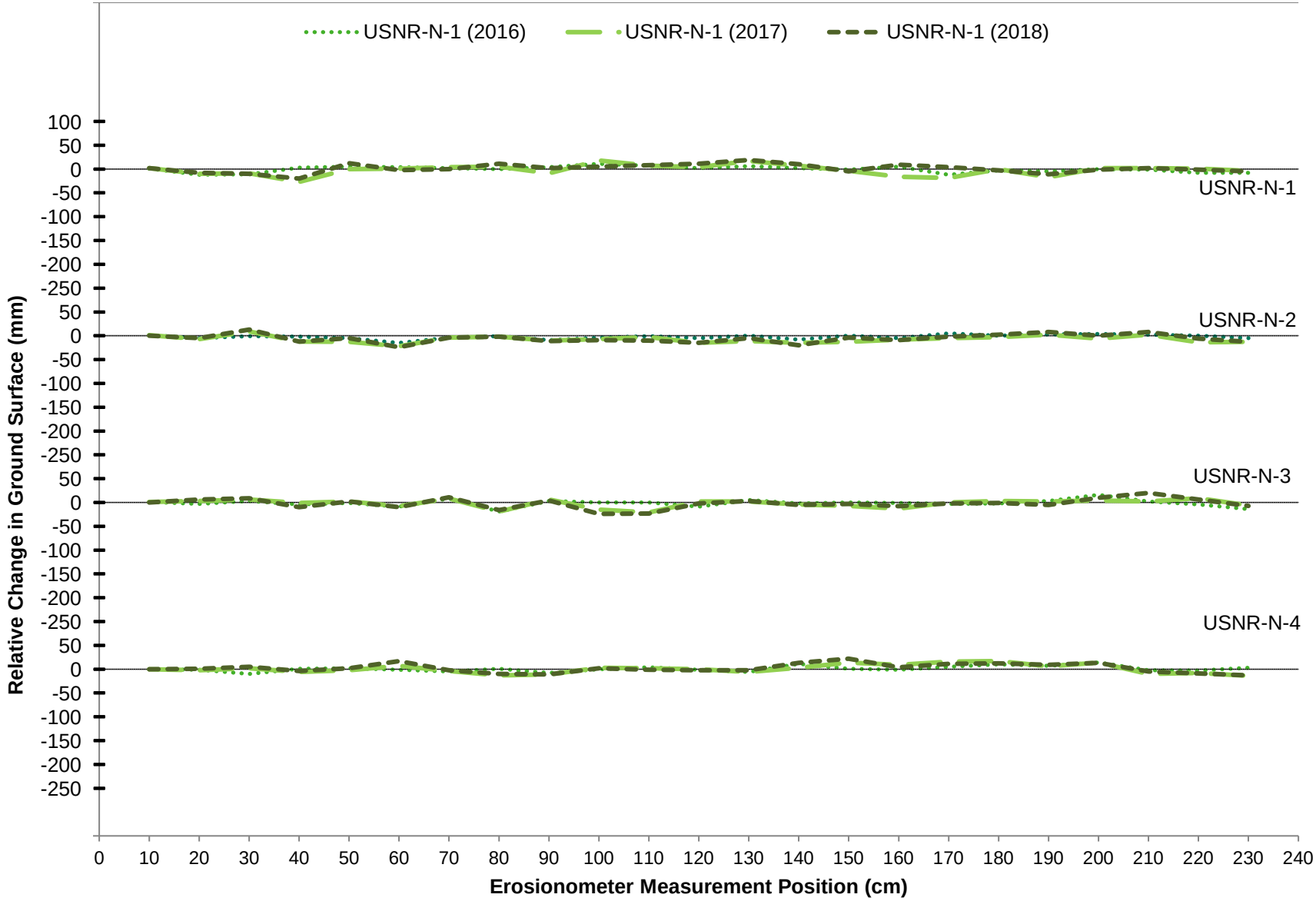
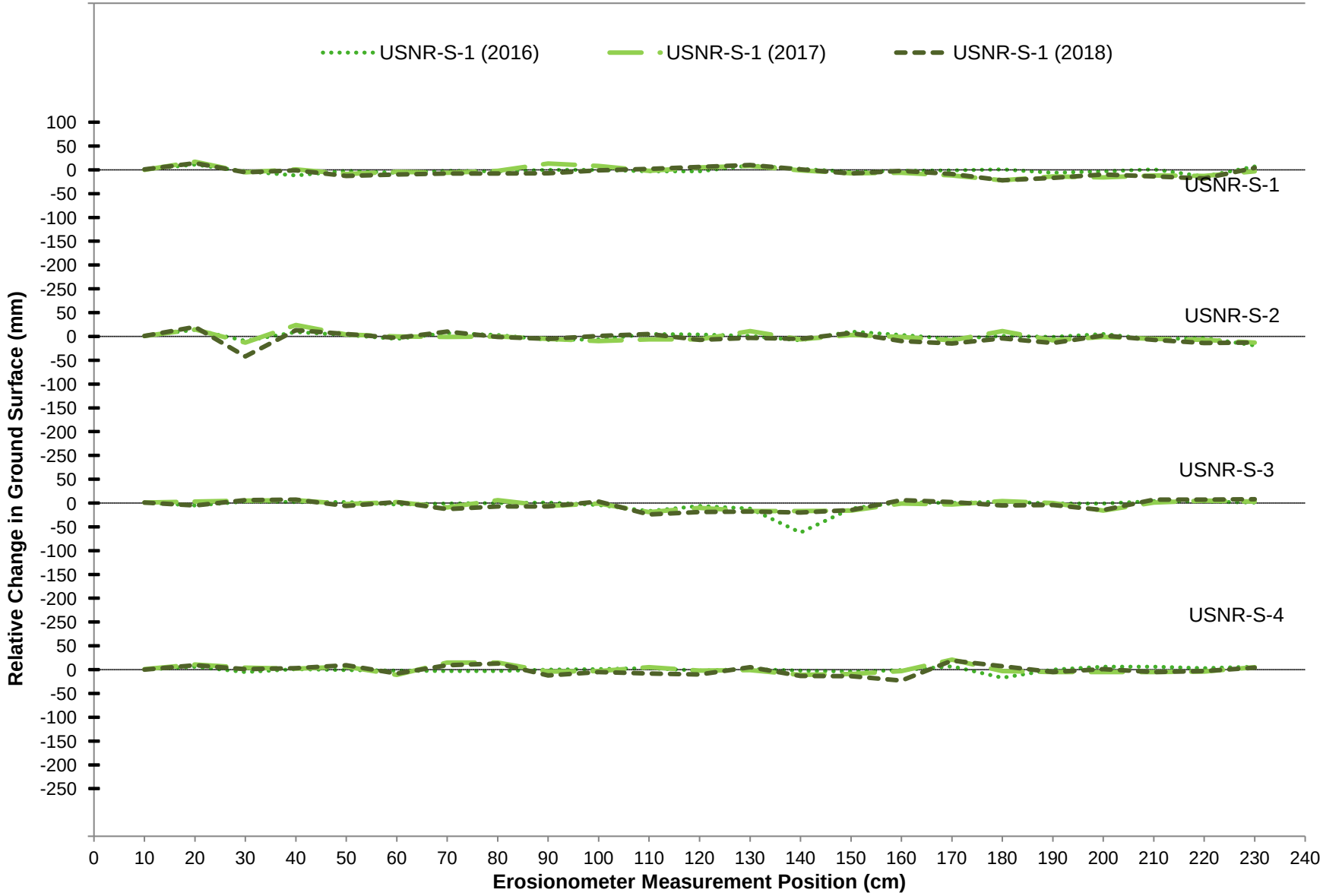


FIGURE A-2
EROSION TRANSECTS
USNR-S1, S2, S3, S4



APPENDIX B

Vegetation Transect Data

Table B-1: USNR Plot CSMA Canopy Cover (%)

Transect	1				2				3				5			
Quadrat	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Forbs																
BAMU	--	--	--	--	--	0.20	--	--	--	--	--	--	--	--	--	--
CHST	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--
DACA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.20
ERPH2	--	--	--	--	--	--	--	0.05	--	--	--	--	--	--	--	--
ERPO	9.70	T	--	--	T	0.20	0.05	0.10	2.45	0.10	0.40	0.90	T	--	T	--
MAGR	--	--	--	--	--	--	--	--	--	--	--	--	0.20	--	--	--
RACO	--	--	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--
SATR	--	--	--	--	--	T	--	--	--	--	T	--	--	--	--	--
UND FORB	--	--	--	--	--	--	--	--	--	--	--	0.05	--	--	--	--
Grasses																
ACHY	0.10	--	0.05	--	--	4.00	--	0.10	--	--	0.70	--	--	--	--	--
AGDA	--	--	--	--	--	--	--	--	--	--	0.30	--	--	--	--	--
ARPU	--	--	--	--	--	1.30	--	--	--	--	--	--	--	--	--	--
BOBA3	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--
BOCU	1.10	8.50	13.70	10.00	6.50	4.50	1.75	2.45	0.20	0.80	4.20	3.60	16.00	9.20	31.60	17.40
BOGR	0.20	--	0.25	0.25	0.20	--	--	--	0.05	0.10	--	--	--	--	--	--
THIN6	--	--	--	--	--	--	3.50	--	--	2.10	--	--	7.50	--	--	--
Shrubs																
BRCA	--	T	0.15	T	0.20	0.30	--	0.20	0.10	2.00	T	0.05	--	--	--	T
CHLI2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14.60	--
ERNA	0.20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Totals																
BARE	5.5	4.0	1.8	4.0	4.0	0.5	2.5	2.0	2.0	5.0	1.0	2.4	5.0	2.0	3.0	4.4
LITTER	7.0	2.0	7.3	1.0	13.0	4.5	5.7	5.5	14.0	30.0	0.5	9.0	7.0	4.5	1.4	1.6
ROCK	76.2	85.5	76.7	84.8	76.1	84.5	86.5	89.6	81.2	59.9	92.9	84.0	64.3	84.3	49.4	75.4
TOTAL	11.3	8.5	14.2	10.3	6.9	10.5	5.3	2.9	2.8	5.1	5.6	4.6	23.7	9.2	46.2	18.6

Notes:

Species codes defined in Table 8

T = Trace: less than or equal to 0.05%.

Table B-2: USNR Plot CSMA Basal Cover (%)

Transect	1				2				3				5			
Quadrat	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Forbs																
BAMU	--	--	--	--	--	--	--	--	--	T	--	--	--	--	--	--
CHST	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--
DACA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T
ERPH2	--	--	--	--	--	--	--	--	--	--	--	T	--	--	--	--
ERPO	0.10	T	--	--	0.10	T	T	0.05	T	T	T	T	T	--	T	--
MAGR	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--	--
RACO	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--
SATR	--	--	--	--	--	--	T	--	--	T	--	--	--	--	--	--
UND FORB	--	--	--	--	--	--	--	T	--	--	--	--	--	--	--	--
Grasses																
ACHY	T	--	T	--	--	--	0.10	--	--	0.10	--	T	--	--	--	--
AGDA	--	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--
ARPU	--	--	--	--	--	--	--	--	--	0.30	--	--	--	--	--	--
BOBA3	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--
BOCU	0.10	0.70	1.05	0.70	T	0.10	0.40	0.20	0.50	0.40	0.10	0.20	1.00	0.80	2.75	1.00
BOGR	T	--	0.05	0.10	T	T	--	--	T	--	--	--	--	--	--	--
THIN6	--	--	--	--	--	0.20	--	--	--	--	0.10	--	0.40	--	--	--
Shrubs																
BRCA	--	T	T	T	T	T	T	T	T	T	--	T	--	--	--	T
CHLI2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	--
ERNA	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Totals																
BARE	6.5	4.2	2.2	4.2	2.1	5.2	1.1	2.5	4.0	0.6	2.8	2.2	5.6	2.0	4.0	4.8
LITTER	9.5	3.2	8.3	1.5	14.8	33.0	0.7	9.8	13.7	5.0	6.5	5.9	8.0	4.8	4.2	2.0
ROCK	83.8	91.9	88.4	93.5	83.0	61.5	97.7	87.5	81.8	93.6	90.5	91.7	85.0	92.4	89.0	92.2
TOTAL	0.2	0.7	1.1	0.8	0.1	0.3	0.5	0.3	0.5	0.8	0.2	0.2	1.4	0.8	2.8	1.0

Notes:

Species codes defined in Table 8

T = Trace: less than or equal to 0.05%.

Table B-3: USNR Plot CSMB Canopy Cover (%)

Transect	1				3				4				6			
Quadrat	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Forbs																
CHST	--	T	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--
DACA	--	0.10	--	--	0.20	--	--	--	--	0.50	--	--	0.70	--	--	--
ERPO	0.20	--	T	T	T	T	0.15	T	1.20	--	0.05	1.00	0.10	T	0.10	14.00
LILE	--	--	--	--	--	T	--	T	T	--	--	--	--	--	--	--
MEOF	2.70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Grasses																
ACHY	--	--	0.20	0.80	--	--	--	T	--	--	--	0.30	--	--	--	--
AGDA	T	--	--	--	--	--	--	--	0.60	--	--	--	--	--	--	--
BOCU	13.10	13.00	11.45	7.95	7.10	7.70	16.85	4.80	8.70	26.00	21.00	4.60	15.80	3.00	8.05	0.05
BOGR	0.30	0.90	--	--	0.40	--	T	0.70	--	0.30	--	--	0.10	0.70	--	--
BRMA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12.00
ELEL	--	--	0.15	0.45	--	--	--	0.80	--	--	--	--	--	1.20	7.00	--
THIN6	--	2.50	--	--	1.80	--	--	--	--	--	--	--	--	--	--	6.00
Shrubs																
BRCA	0.30	--	0.25	0.10	0.10	T	0.10	0.10	0.30	T	--	0.20	0.10	--	0.15	--
CHLI2	--	--	--	0.70	--	--	--	--	--	1.00	--	--	--	--	--	--
ERNA	--	--	--	--	--	--	--	--	--	--	14.05	--	--	--	--	--
Totals																
BARE	3.6	2.8	2.5	3.0	1.5	1.0	3.3	1.0	3.7	3.0	3.2	3.7	2.7	2.5	3.0	3.0
LITTER	2.7	2.5	2.1	1.6	4.0	4.0	2.5	4.0	4.2	1.2	1.6	9.3	0.7	3.0	7.5	2.5
ROCK	77.1	78.2	83.4	85.4	84.9	88.6	77.1	88.6	81.2	68.0	66.1	81.0	79.8	62.6	74.2	62.5
TOTAL	16.6	16.5	12.0	10.0	9.6	6.4	17.1	6.4	10.9	27.8	29.1	6.0	16.8	31.9	15.3	32.1

Notes:

Species codes defined in Table 9

T = Trace: less than or equal to 0.05%.

Table B-4: USNR Plot CSMB Basal Cover (%)

Transect	1				3				4				6			
Quadrat	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Forbs																
CHST	--	T	T	--	--	--	--	--	--	--	--	--	--	--	--	--
DACA	--	T	--	--	T	--	--	--	--	T	--	--	T	--	--	--
ERPO	T	--	T	T	T	T	T	T	0.20	--	T	0.05	T	T	T	0.20
LILE	--	--	--	--	--	T	--	T	T	--	--	--	--	--	--	--
MEOF	0.10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Grasses																
ACHY	--	--	T	0.20	--	--	--	T	--	--	--	T	--	--	--	--
AGDA	T	--	--	--	--	--	--	--	T	--	--	--	--	--	--	--
BOCU	1.20	0.80	1.40	0.55	0.90	0.60	2.10	0.50	1.10	1.60	2.50	0.30	1.70	1.70	0.50	T
BOGR	T	0.30	--	--	0.10	--	T	0.10	--	0.20	--	--	T	0.20	--	--
BRMA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.50
ELEL	--	--	T	0.05	--	--	--	0.10	--	--	--	--	--	0.20	0.20	--
THIN6	--	0.20	--	--	0.10	--	--	--	--	--	--	--	--	--	--	0.15
Shrubs																
BRCA	T	--	T	T	T	T	T	T	T	T	--	T	T	--	T	--
CHLI2	--	--	--	T	--	--	--	--	--	T	--	--	--	--	--	--
ERNA	--	--	--	--	--	--	--	--	--	--	T	--	--	--	--	--
Totals																
BARE	3.9	4.0	2.8	3.4	1.7	0.9	3.7	1.1	3.9	4.0	4.2	4.2	2.9	3.0	3.8	3.2
LITTER	3.3	4.0	3.0	2.4	5.0	0.6	3.5	4.2	4.5	3.2	3.4	10.0	1.3	5.0	10.4	3.1
ROCK	91.5	90.7	92.8	93.4	92.2	97.9	90.7	94.0	90.3	91.0	89.9	85.5	94.1	89.9	85.1	92.9
TOTAL	1.3	1.3	1.4	0.8	1.1	0.6	2.1	0.7	1.3	1.8	2.5	0.4	1.7	2.1	0.7	0.9

Notes:

Species codes defined in Table 9

T = Trace: less than or equal to 0.05%.

Table B-5: USNR Plot ESMA Canopy Cover (%)

Transect	1				2				3				5			
Quadrat	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Forbs																
BAMU	--	--	--	--	--	--	20.00	0.25	--	--	--	--	--	--	--	--
CHST	--	--	--	--	--	T	--	T	0.20	--	--	--	--	--	--	--
ERPO	T	T	T	T	--	T	--	T	--	T	T	0.05	0.05	T	--	--
MAGR	--	--	T	--	--	--	--	--	--	--	--	T	--	T	--	--
PEPA	0.25	--	--	0.10	--	--	--	--	11.00	--	--	--	--	--	0.10	6.50
SATR	--	--	--	--	--	--	--	--	--	T	--	--	--	--	--	--
Grasses																
ARPU	--	--	--	--	0.40	T	0.30	--	--	0.70	--	0.10	0.50	--	T	--
BOBA3	--	--	--	--	--	--	--	--	--	0.30	--	0.15	--	0.10	T	--
BOCU	8.25	6.00	7.00	9.00	17.00	5.80	6.80	18.00	8.20	11.00	14.50	8.60	4.80	12.00	7.00	11.00
ELEL	--	--	--	--	--	--	--	--	--	0.30	--	--	--	--	0.80	--
POSE	0.05	--	T	T	--	--	0.10	--	--	0.10	--	0.05	--	--	0.10	--
SCSC	--	--	--	--	--	T	--	--	--	--	--	--	--	--	0.50	--
THIN6	--	--	--	--	0.50	0.70	--	4.00	--	0.10	--	--	--	1.00	1.00	--
Shrubs																
ARLU	0.10	T	T	0.10	T	--	0.05	0.05	--	--	--	T	0.05	--	--	35.00
BRCA	0.05	T	T	T	--	T	T	--	--	T	T	0.05	T	--	T	--
CHLI2	--	0.10	4.00	0.60	--	--	0.10	--	--	T	0.05	--	0.65	--	--	0.10
SEGR4	--	--	--	--	--	--	--	0.20	--	--	--	--	--	T	--	--
VACO9	--	0.40	--	0.05	--	--	--	0.50	--	--	--	--	0.10	--	0.10	0.20
Totals																
BARE	2.5	3.0	3.0	1.0	5.0	5.0	2.3	1.0	2.4	3.0	1.5	2.5	4.0	1.5	4.5	3.0
LITTER	2.5	2.0	2.0	8.5	2.2	4.0	2.4	1.3	2.0	2.0	2.0	2.2	2.9	14.5	8.5	0.2
ROCK	86.3	88.5	84.0	79.7	74.9	84.5	68.0	74.7	76.2	82.5	82.0	86.3	87.0	70.9	67.5	41.8
TOTAL	8.7	6.5	11.0	10.9	17.9	6.5	27.4	23.0	19.4	12.5	14.5	9.0	6.2	13.1	19.5	55.0

Notes:

Species codes defined in Table 10

T = Trace: less than or equal to 0.05%.

Table B-6: USNR Plot ESMA Basal Cover (%)

Transect	1				2				3				5			
Quadrat	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Forbs																
BAMU	--	--	--	--	--	--	--	--	--	--	0.50	T	--	--	--	--
CHST	--	--	--	--	T	--	--	--	--	T	--	T	--	--	--	--
ERPO	T	T	T	T	--	T	T	T	--	T	--	T	T	T	--	--
MAGR	--	--	T	--	--	--	--	T	--	--	--	--	--	T	--	--
PEPA	T	--	--	T	0.25	--	--	--	--	--	--	--	--	--	1.00	0.70
SATR	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--
Grasses																
ARPU	--	--	--	--	--	0.10	--	T	T	T	T	--	T	--	T	--
BOBA3	--	--	--	--	--	T	--	T	--	--	--	--	--	T	T	--
BOCU	0.50	0.60	0.50	0.90	0.55	0.90	1.10	0.60	1.50	0.60	0.30	2.50	0.40	0.80	0.70	0.80
ELEL	--	--	--	--	--	T	--	--	--	--	--	--	--	--	0.10	--
POSE	T	--	T	T	--	T	--	T	--	--	T	--	--	--	T	--
SCSC	--	--	--	--	--	--	--	--	--	T	--	--	--	--	T	--
THIN6	--	--	--	--	--	T	--	--	0.05	0.10	--	1.00	--	0.20	0.20	--
Shrubs																
ARLU	T	T	T	T	--	--	--	T	T	--	T	T	T	--	--	10.00
BRCA	T	T	T	T	--	T	T	T	--	T	T	--	T	--	T	--
CHLI2	--	T	0.10	T	--	T	T	--	--	--	T	--	T	--	--	T
SEGR4	--	--	--	--	--	--	--	--	--	--	--	T	--	T	--	--
VACO9	--	T	--	T	--	--	--	--	--	--	--	T	T	--	T	T
Totals																
BARE	3.0	3.5	3.0	1.1	2.8	3.5	1.9	2.7	5.5	5.5	2.8	1.5	4.3	1.8	5.0	3.2
LITTER	3.2	2.5	2.5	12.0	3.0	2.5	3.0	3.0	3.5	4.5	3.5	2.5	4.5	15.5	9.5	4.0
ROCK	93.3	93.4	93.9	86.0	93.4	93.0	94.0	93.7	89.5	89.3	92.9	92.5	90.8	81.7	83.5	81.3
TOTAL	0.5	0.6	0.6	0.9	0.8	1.0	1.1	0.6	1.6	0.7	0.8	3.5	0.4	1.0	2.0	11.5

Notes:

Species codes defined in Table 10

T = Trace: less than or equal to 0.05%.

Table B-7: USNR Plot ESMB Canopy Cover (%)

Transect	1				2				3				4			
Quadrat	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Forbs																
BAMU	--	--	--	0.30	2.50	--	--	--	--	--	--	2.00	T	T	--	--
ERPO	--	T	--	T	--	--	T	--	T	--	T	--	--	T	--	--
LILE	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--	--
PEPA	--	--	--	--	--	--	--	--	0.10	--	--	--	0.20	1.30	--	--
RHSE	0.20	--	--	--	--	--	0.10	--	--	--	--	--	--	--	--	--
SATR	--	--	--	--	--	0.05	--	--	--	--	T	--	--	0.10	--	--
Grasses																
ARPU	0.10	--	0.50	0.05	2.00	0.15	0.20	0.10	--	--	--	--	--	0.20	0.30	--
BOBA3	0.50	1.30	--	--	0.20	--	T	--	0.30	0.80	1.50	0.20	--	--	--	0.10
BOCU	6.30	13.50	4.20	4.80	9.00	4.10	3.20	12.00	21.00	10.00	6.50	17.00	15.00	3.20	8.20	6.00
ELEL	--	--	--	--	--	--	0.40	--	--	0.70	--	1.50	--	0.40	--	--
ELGL	--	--	0.80	0.10	--	--	--	--	--	--	--	--	--	--	--	--
POSE	0.50	--	0.20	--	--	--	T	--	--	--	T	--	--	--	0.20	--
THIN6	--	4.50	0.20	--	--	3.80	0.40	2.00	4.80	--	0.50	--	11.00	1.20	--	8.00
Shrubs																
ARLU	0.20	--	0.20	--	T	0.05	--	0.10	--	4.00	7.50	--	--	T	0.05	T
BRCA	--	T	0.30	0.05	T	T	T	--	0.05	T	T	T	0.05	0.10	T	T
CHLI2	0.10	--	0.10	--	T	0.55	1.10	1.10	0.05	--	--	--	0.35	--	0.15	--
ERNA	--	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--
VACO9	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--
Totals																
BARE	2.5	0.7	0.5	4.5	4.0	3.5	2.0	2.0	2.0	3.0	1.5	2.5	1.2	1.2	3.0	1.2
LITTER	1.6	0.9	0.2	2.9	0.7	0.8	1.5	0.7	0.6	1.5	2.5	2.5	1.2	0.5	0.4	1.0
ROCK	88.0	79.1	92.8	87.3	81.6	87.0	91.1	82.0	71.1	80.0	80.0	74.3	71.0	91.8	87.7	83.7
TOTAL	7.9	19.3	6.5	5.3	13.7	8.7	5.4	15.3	26.3	15.5	16.0	20.7	26.6	6.5	8.9	14.1

Notes:

Species codes defined in Table 11

T = Trace: less than or equal to 0.05%.

Table B-8: USNR Plot ESMB Basal Cover (%)

Transect	1				2				3				4			
Quadrat	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Forbs																
BAMU	--	--	--	T	--	--	--	1.00	T	T	--	--	T	--	--	--
ERPO	--	T	--	T	T	--	T	--	--	T	--	--	--	--	T	--
LILE	--	--	--	--	--	--	--	--	T	--	--	--	--	--	--	--
PEPA	--	--	--	--	T	--	--	--	T	T	--	--	--	--	--	--
RHSE	T	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--
SATR	--	--	--	--	--	--	T	--	--	T	--	--	--	T	--	--
Grasses																
ARPU	T	--	0.10	T	--	--	--	--	--	T	0.10	--	1.00	T	T	T
BOBA3	T	0.15	--	--	T	0.10	0.30	0.05	--	--	--	T	0.05	--	T	--
BOCU	0.45	0.70	0.40	0.40	1.40	0.80	0.50	1.10	1.50	0.30	0.40	0.50	0.80	0.10	0.20	1.10
ELEL	--	--	--	--	--	T	--	0.20	--	T	--	--	--	--	T	--
ELGL	--	--	T	T	--	--	--	--	--	--	--	--	--	--	--	--
POSE	T	--	0.10	--	--	--	T	--	--	--	T	--	--	--	T	--
THIN6	--	0.15	T	--	0.90	--	T	--	1.40	0.20	--	1.00	--	0.20	T	0.10
Shrubs																
ARLU	0.05	--	T	--	--	0.20	0.50	--	--	T	T	T	T	T	--	T
BRCA	--	T	T	T	T	T	T	T	T	T	T	T	T	T	T	--
CHLI2	T	--	T	--	T	--	--	--	T	--	T	--	T	T	0.10	T
ERNA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--
VACO9	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--	--
Totals																
BARE	3.0	1.0	0.7	4.8	2.5	3.1	1.5	2.7	1.5	1.5	3.2	1.3	4.2	3.9	2.0	2.2
LITTER	2.2	2.2	1.0	3.3	1.7	1.9	3.5	3.8	4.5	1.0	2.4	2.5	2.5	1.5	1.7	1.8
ROCK	94.3	95.8	97.7	91.5	93.5	93.9	93.7	91.2	91.1	97.0	93.9	94.7	91.5	94.3	96.0	94.8
TOTAL	0.5	1.0	0.6	0.4	2.3	1.1	1.3	2.4	2.9	0.5	0.5	1.5	1.9	0.3	0.3	1.2

Notes:

Species codes defined in Table 11

T = Trace: less than or equal to 0.05%.

Table B-9: USNR Test Plots, Belt Transect Data for Shrubs

	ARLU	ATCA	BRCA	CHLI2	ERNA	SEGR4	VACO9
CSMA							
T-1			21				
T-2			8				
T-3			33				
T-5			6	3			
CSMB							
T-1			15	4			
T-3			29		1		
T-4			21	2	1		
T-6			41				
ESMA							
T-1	15			49		1	6
T-2	15		7	31			6
T-3	9	1		17		3	2
T-5	82		2	23			23
ESMB							
T-1	5		2	13		1	
T-2	1		6	13			1
T-3	75		5	11		1	4
T-4	27		14	19	1	3	

Notes:

Shrub species code definitions

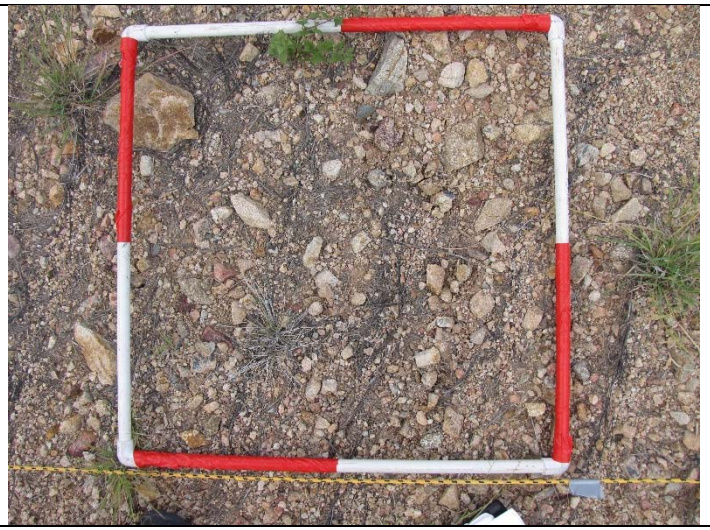
ARLU	White sagebrush	*Artemisia ludoviciana*
ATCA	Fourwing saltbush	*Atriplex canescens*
BRCA	California brickellbush	*Brickellia californica*
CHLI2	Desert willow	*Chilopsis linearis*
ERNA	Rubber rabbitbrush	*Ericameria nauseosa*
SEGR4	Catclaw acacia	*Senegalia greggii*
VACO9	Whitethorn acacia	*Vachellia constricta*

APPENDIX C

Vegetation Quadrat Photos

Conventional Seed Mix, Mulch Applied After Seeding

CSMA-T1-Q1



CSMA-T1-Q2

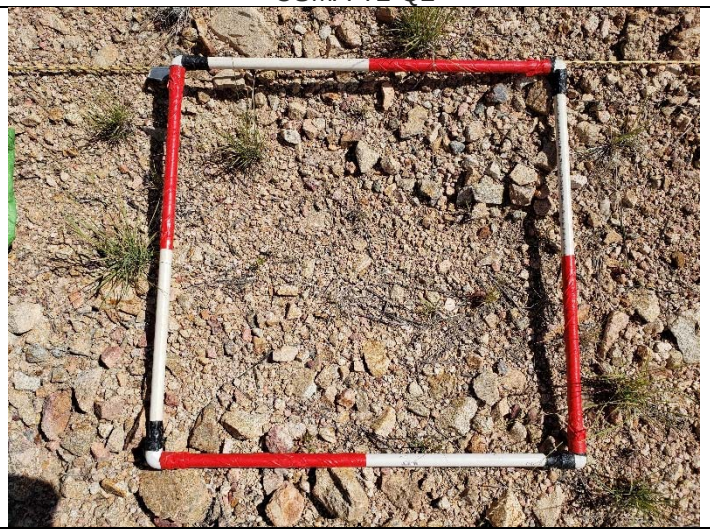
CSMA-T1-Q3

CSMA-T1-Q4

CSMA-T2-Q1

CSMA-T2-Q2

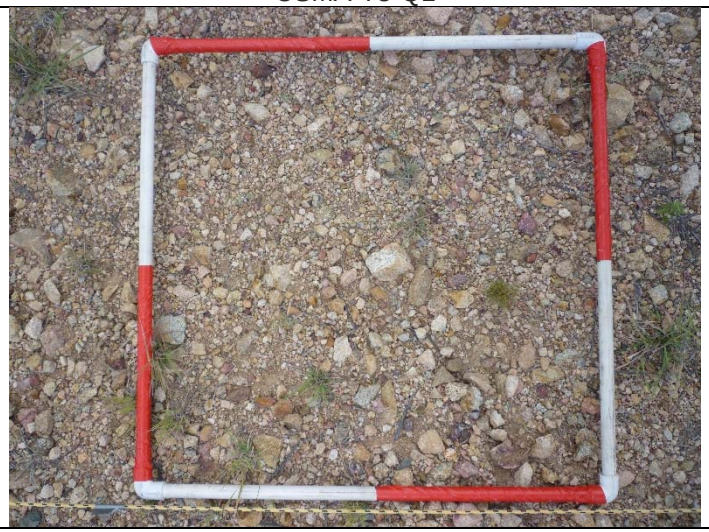
CSMA-T2-Q3



CSMA-T2-Q4

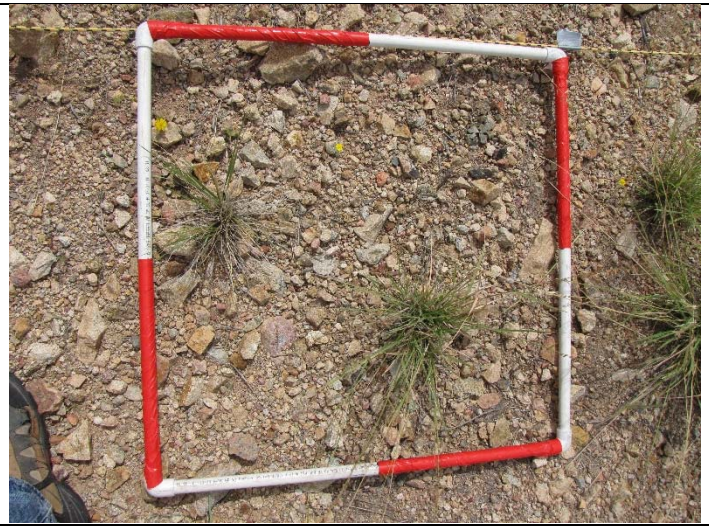
CSMA-T3-Q1

CSMA-T3-Q2



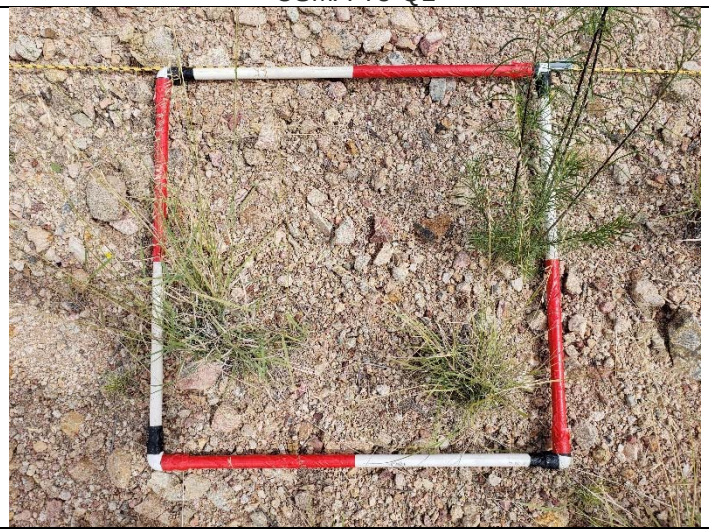
CSMA-T3-Q3

CSMA-T3-Q4

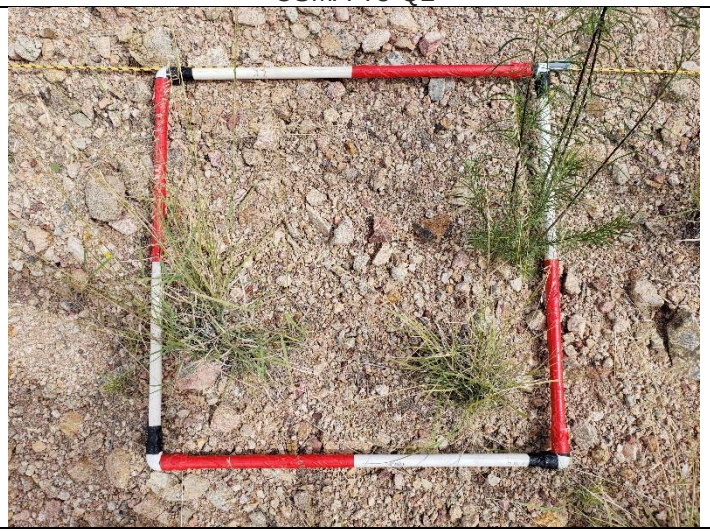


CSMA-T5-Q1

CSMA-T5-Q2



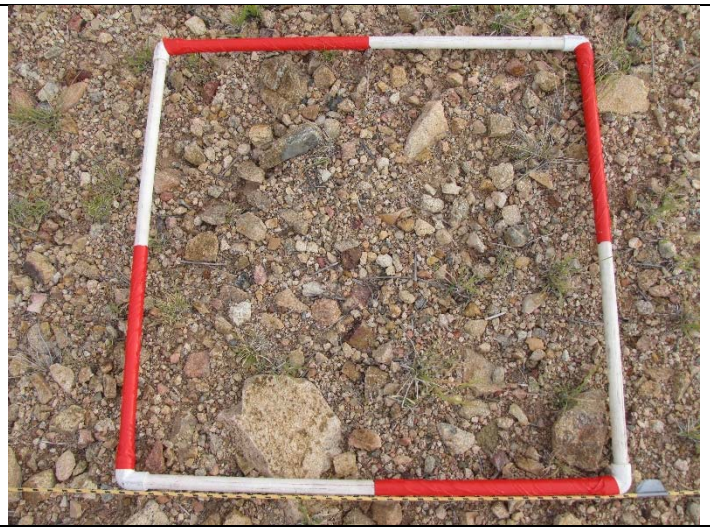
CSMA-T5-Q3



CSMA-T5-Q4

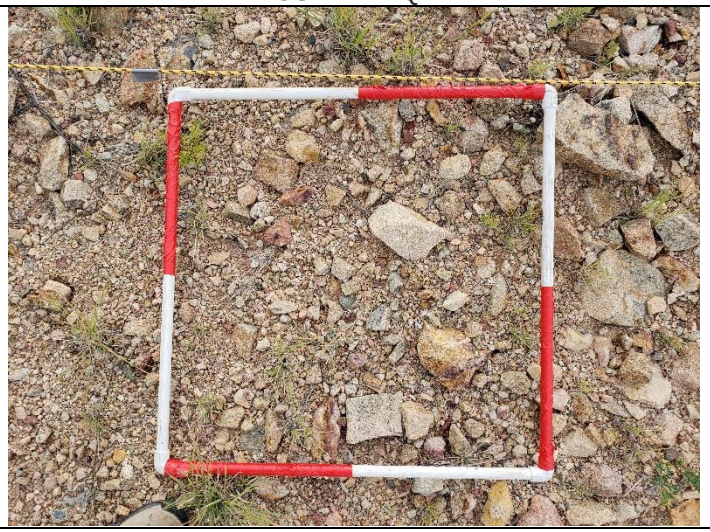
Conventional Seed Mix, Mulch Applied Before Seeding

CSMB-T1-Q1

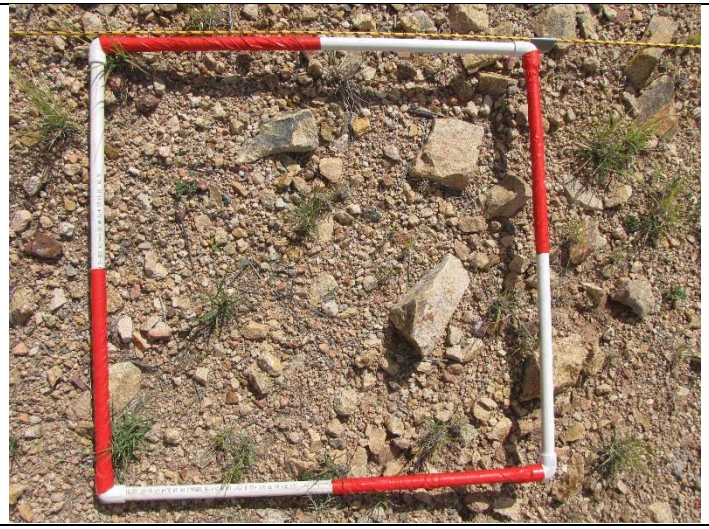


CSMB-T1-Q2

CSMB-T1-Q3



CSMB-T1-Q4

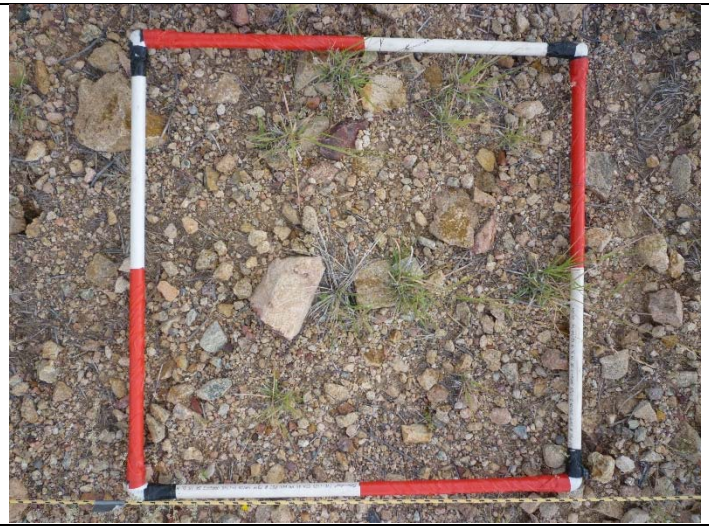


CSMB-T3-Q1

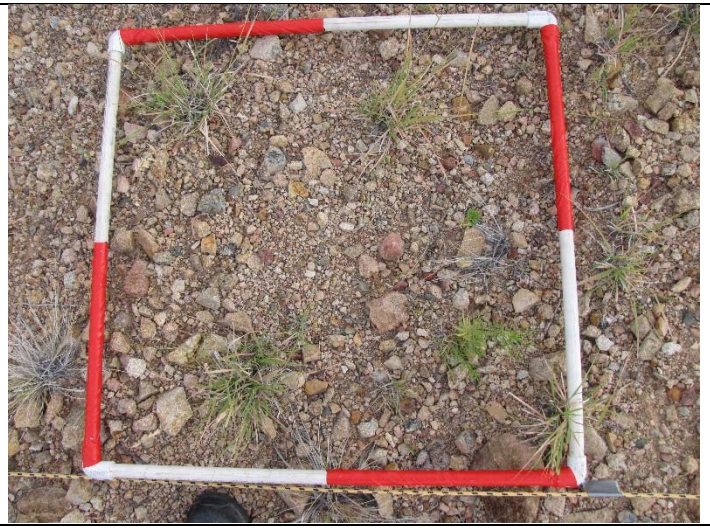
CSMB-T3-Q2

CSMB-T3-Q3

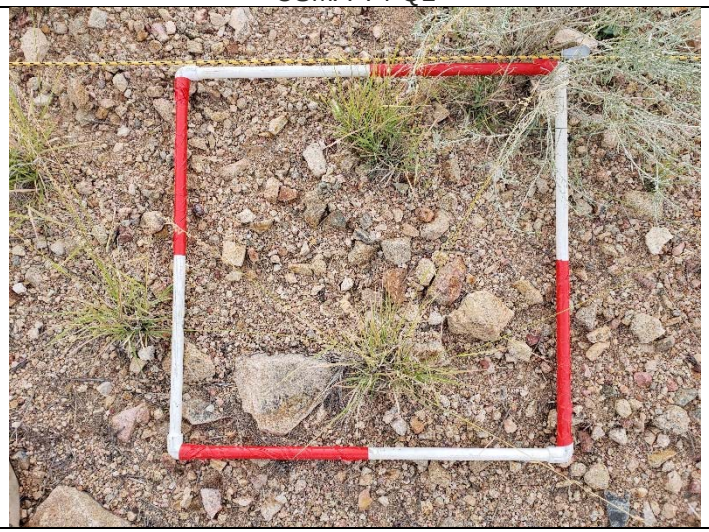
CSMB-T3-Q4



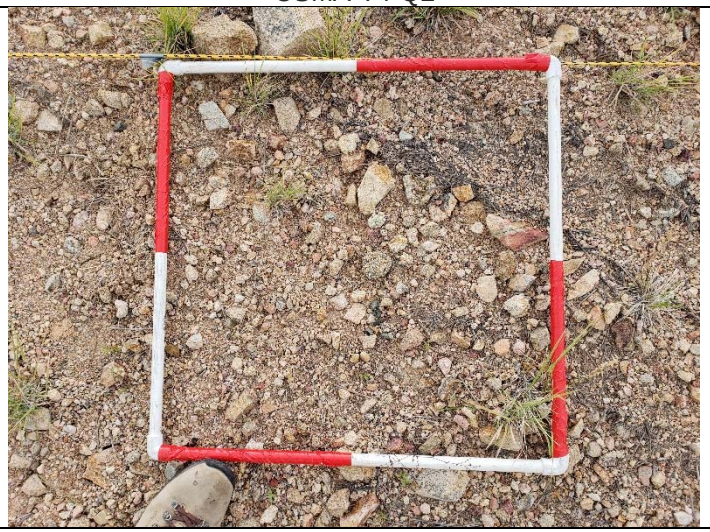
CSMA-T4-Q1



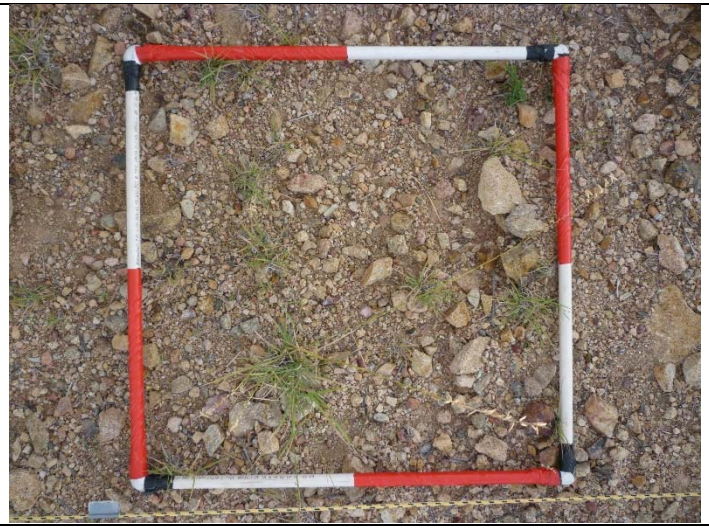
CSMA-T4-Q2



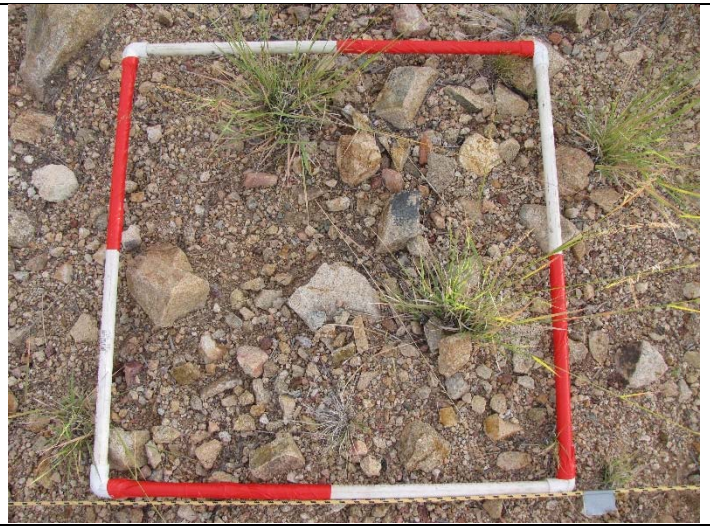
CSMB-T4-Q3



CSMB-T4-Q4



CSMB-T6-Q1



CSMB-T6-Q2

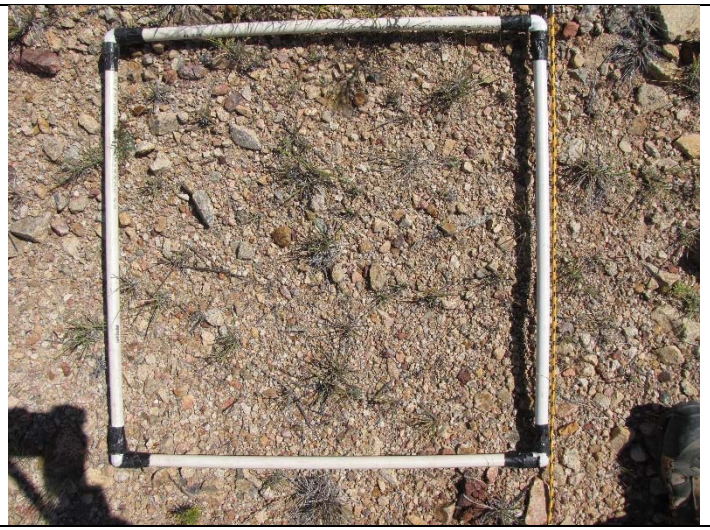
NO PHOTO AVAILABLE

CSMB-T6-Q3

CSMB-T6-Q4

Experimental Seed Mix, Mulch Applied After Seeding

ESMA-T1-Q1



ESMA-T1-Q2

ESMA-T1-Q3

ESMA-T1-Q4

ESMA-T2-Q1

ESMA-T2-Q2

ESMA-T2-Q3

ESMA-T2-Q4

ESMA-T3-Q1

ESMA-T3-Q2

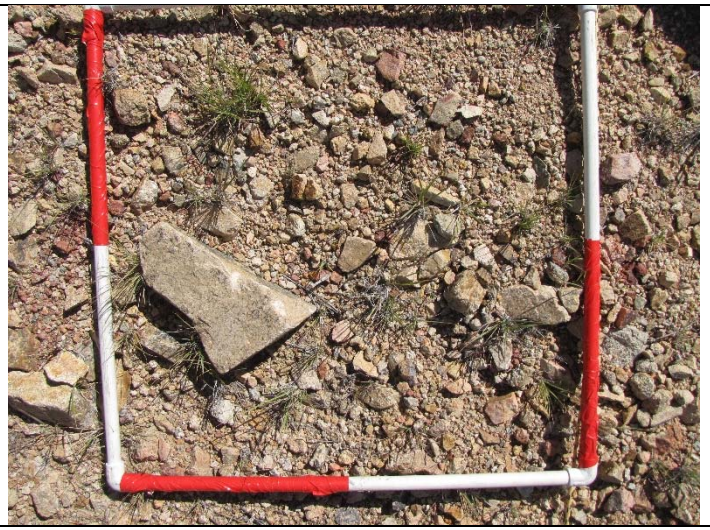
ESMA-T3-Q3

ESMA-T3-Q4

	NO PHOTO AVAILABLE
ESMA-T5-Q1	ESMA-T5-Q2
NO PHOTO AVAILABLE	
ESMA-T5-Q3	ESMA-T5-Q4

Experimental Seed Mix, Mulch Applied Before Seeding

ESMB-T1-Q1

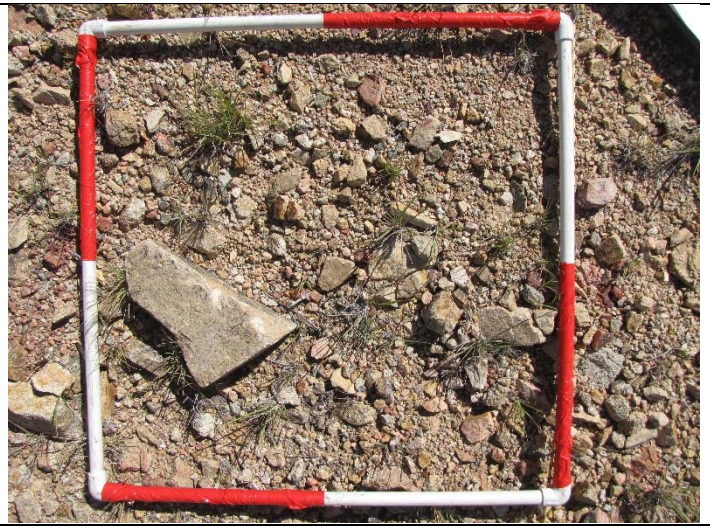


ESMB-T1-Q2

ESMB-T1-Q3

ESMB-T1-Q4

ESMB-T2-Q1



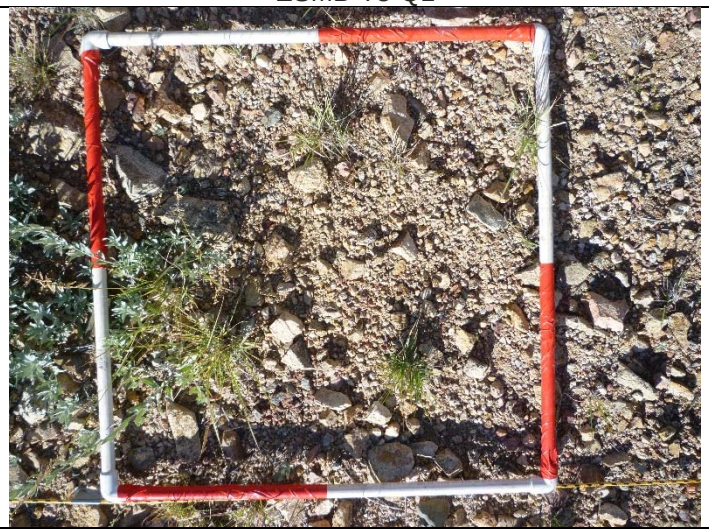
ESMB-T2-Q2

ESMB-T2-Q3

ESMB-T2-Q4

ESMB-T3-Q1

ESMB-T3-Q2



ESMB-T3-Q3

ESMB-T3-Q4

ESMB-T4-Q1

ESMB-T4-Q2

ESMB-T4-Q3

ESMB-T4-Q4

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