

# Technical Memorandum

**To:** GCC Rio Grande, Inc  
**From:** Taylon Earl, Project Manager  
**Subject:** Request for Revision 26-1 Permit NO. BE001RE: 2022 Vegetation Monitoring  
**Date:** June 25, 2026  
**Project:** GCC Rio Grande Tijeras Mine and Mill Project

The Tijeras site is an active quarry operation located in Bernalillo County, New Mexico. Mining and reclamation activities have progressed to a stage where portions of the site are eligible for partial and final reclamation release, and a reference area is needed to support future reclamation evaluations. Barr Engineering Co. (Barr) biologists collected field data for the 2022 vegetation monitoring. The data were collected at the Tijeras Mine and Mill, which is owned and operated by GCC Rio Grande, Inc. (GCC Rio Grande). This memorandum summarizes the 2022 vegetation monitoring data and results, provided as an attachment to the GCC Rio Grande 2026 application to the New Mexico Energy, Minerals and Natural Resources Department, Mining and Minerals Division (NM MMD), to modify its Mining Act Permit No. BE001RE, pursuant to 19.10.12 NMAC.

In 2021, Ecosphere completed the Year 1 (YR 1) vegetation monitoring of the reference area and areas reclaimed in 1994, 2003, 2007, 2008, and 2011. This memorandum presents the YR 2 Vegetation Monitoring results from the 2022 monitoring efforts for the areas reclaimed in 2003, 2008, and 2022, and estimates of numerical sampling adequacy and statistical tests to demonstrate conformance with the approved October 2021 Reclamation Monitoring Plan (Ecosphere Environmental Services, Inc. 2021).

## 1 Methodology and Findings

Sampling and monitoring methods proposed in the October 2021 Reclamation Monitoring Plan were reviewed by the New Mexico Mining and Minerals Division (Ecosphere Environmental Services, Inc. 2021). The New Mexico Mining and Minerals Division ("MMD") received the *Reclamation Monitoring Plan* ("Plan") on October 8, 2021 for *Permit No. BE001RE* proposing the reference area and associated monitoring methods (November 10, 2021). Following the submittal of the Plan, the MMD Comments Letter dated November 10, 2021, requested that the results be provided for the first round of vegetative monitoring (2021 YR 1) and all subsequent monitoring results (2022 Year 2 (YR 2) be submitted to MMD upon Completion.

Therefore, data collected in 2022 were used to evaluate YR 2 vegetation monitoring cover, diversity, and woody plant and shrub density data for areas reclaimed in 2003, 2008, and 2011 and the reference area. All calculations, including cover, shrub density, diversity, sample adequacy, and test statistics, were performed in Microsoft Excel.

### 1.1 Parameter Estimates

On October 12, 13, 14, and 24, 2022, Barr biologists conducted vegetation monitoring at the Tijeras Quarry. Data for the reference area and areas reclaimed in 2003, 2008, and 2011 were collected in the established reclamation monitoring transects and respective azimuths, determined before the 2021 YR 1 monitoring efforts and field investigation using the "Random" tool in ArcGIS (Map 1). Vegetative cover was measured by the Line-Intercept Method (Cook and Bonham 1977). At each predetermined location, a

25-foot-long transect was established along the assigned azimuth. The plant species encountered at each 0.25-foot interval was recorded. Only those living plants or seedlings touched by the line or lying under or over it were considered. Bare ground and litter were also recorded.

Woody plant density was evaluated by moving down one side of the tape and returning along the other, counting the number of individual shrubs/woody species within a 3-foot area perpendicular to the tape, providing a 6-foot-wide by 25-foot-long sample area (150 square feet). Data are reported as the number of shrubs per acre.

The Simpson's index was used to estimate species diversity (Simpson 1949). Simpson's index emphasizes the dominant and abundant species rather than the rare species that vary in their occurrence from place to place (Barbour et al. 1987). The Simpson's index quantifies biodiversity by accounting for both richness and distribution and represents the probability that two individuals drawn at random from a community belong to different species.

$$C = \sum_{i=1}^s (p_i)^2$$

where:

$C$  is the index number,

$s$  is the total number of species in the sample, and

$p_i$  is the proportion of all individuals in the sample (plot, transect) that belong to species  $i$ .

## 1.2 Sample Adequacy

All cover estimates were arcsine-square-root-transformed before analysis. Sample adequacy was determined using the Cochran (1977) formula:

$$n_{\min} = t^2 s^2 / (0.1\bar{x})^2$$

where:

$t$  is the tabular  $t$  value for a preliminary sample with  $n-1$  degrees of freedom and a two-tailed significance level of  $\alpha = 0.10$  ( $P = 0.90$ ),

$s$  is the standard deviation of the preliminary sample, and

$\bar{x}$  is the sample mean of the preliminary sample.

Sample adequacy is the minimum number of samples required to estimate the coverage with a 90% confidence that the sample mean for coverage represents the true population mean.

## 1.3 Statistical Testing

All cover estimates were arcsine-square-root-transformed, and shrub density estimates were log-transformed before analysis. Parameter estimates were compared to the reference area (technical standard in equation below) using the one-sample, one-sided  $t$ -test:

$$t^* = \frac{\bar{x} - 0.9(\text{technical standard})}{s/\sqrt{n}}$$

where:

$t^*$  is the calculated  $t$ -statistic,  
 $\bar{x}$  is the sample mean,  
 $s$  is the standard deviation of the sample, and  
 $n$  is the sample size.

The  $\alpha$ -level for vegetation cover is 0.10 by regulation, and 0.20 by regulation for shrub cover. The decision rules for testing the reverse null hypothesis are as follows:

- if  $t^* < t(1 - \alpha; n - 1)$  (critical  $t$ -value), conclude failure to meet the performance standard
- if  $t^* \geq t(1 - \alpha; n - 1)$  (critical  $t$ -value)), conclude that the performance standard was met

P-values represent the probability of the data given the null hypothesis to determine whether an observed sample likely reflects a true effect in the population, rather than random chance. P-values were calculated using the  $t$ -statistic and degrees of freedom for each site and compared to an  $\alpha$ -level of 0.10 by regulation for vegetation cover, and 0.20 by regulation for shrub cover.

- If  $P < \alpha$ , reject the null hypothesis; the result is statistically significant and likely to be a true representation of the sample.
- If  $P > \alpha$ , fail to reject the null hypothesis; the result is not statistically significant and likely is not a true representation of the population.

## 2 Reclamation Monitoring Results

### 2.1 Vegetation Cover

#### 2.1.1 Reclamation Areas

Table 2-1 provides the plant species identified during the 2022 monitoring of the Tijeras Mine and Mill reclamation area. Nomenclature and duration information were obtained from the Natural Resources Conservation Service PLANTS database (NRCS 2022).

**Table 2-1 Plant Species Observed at all Reclamation Areas**

| Scientific Name               | Common Name      | Duration  |
|-------------------------------|------------------|-----------|
| <b>Grasses</b>                |                  |           |
| <i>Achnatherum hymenoides</i> | Indian ricegrass | Perennial |
| <i>Andropogon gerardii</i>    | big Bluestem     | Perennial |
| <i>Aristida arizonica</i>     | Arizona threeawn | Perennial |
| <i>Andropogon hallii</i>      | sand bluestem    | Perennial |
| <i>Aristida purpurae</i>      | purple threeawn  | Perennial |
| <i>Bouteloua barbata</i>      | six-weeks grama  | Annual    |
| <i>Bouteloua curtipendula</i> | sideoats grama   | Perennial |
| <i>Bouteloua curtipendula</i> | sideoats grama   | Perennial |

| Scientific Name                   | Common Name                       | Duration  |
|-----------------------------------|-----------------------------------|-----------|
| <i>Bouteloua gracilis</i>         | blue grama                        | Perennial |
| <i>Bouteloua hirsuta</i>          | hairy grama                       | Perennial |
| <i>Bromus tectorum</i>            | cheatgrass                        | Annual    |
| <i>Elymus elymoides</i>           | squirreltail                      | Perennial |
| <i>Elymus trachycaulus</i>        | slender wheatgrass                | Perennial |
| <i>Muhlenbergia porteri</i>       | Bunchgrassring muhly              | Perennial |
| <i>Pascopyrum smithii</i>         | western wheatgrass                | Perennial |
| <i>Pleuraphis jamesii</i>         | galleta grass                     | Perennial |
| <i>Pseudoroegneria spicata</i>    | bluebunch wheatgrass              | Perennial |
| <i>Sporobolus cryptandrus</i>     | sand dropseed                     | Perennial |
| <b>Forbs</b>                      |                                   |           |
| <i>Achillea millefolium</i>       | common yarrow                     | Perennial |
| <i>Amaranthus acanthochiton</i>   | greenstripe                       | Annual    |
| <i>Arenaria eastwoodiae</i>       | Eastwood's Sandwort               | Perennial |
| <i>Astragalus sp.</i>             | milkvetch, locoweed, goat's-thorn | Annual    |
| <i>Bassia scoparia</i>            | burningbush                       | Annual    |
| <i>Centaurea stoebe</i>           | spotted knapweed                  | Perennial |
| <i>Erodium cicutarium</i>         | common stork's-bill or pinweed    | Annual    |
| <i>Euphorbia davidii</i>          | David's Spurge                    | Annual    |
| <i>Euphorbia sp.</i>              | Spurge                            | Annual    |
| <i>Helianthus annuus</i>          | common sunflower                  | Annual    |
| <i>Heliomeris multiflora</i>      | showy goldeneye                   | Perennial |
| <i>Heterotheca villosa</i>        | hairy goldenaster                 | Perennial |
| <i>Machaeranthera canescens</i>   | hoary tansyaster                  | Annual    |
| <i>Machaeranthera pinnatifida</i> | cutleaf tansyaster                | Perennial |
| <i>Marrubium vulgare</i>          | white horehound                   | Perennial |
| <i>Melilotus albus</i>            | white sweet clover                | Perennial |
| <i>Melilotus officinalis</i>      | sweet yellow clover               | Annual    |
| <i>Mentzelia sp.</i>              | blazingstar                       | Perennial |
| <i>Mertensia oblongifolia</i>     | oblongleaf or sagebrush bluebells | Perennial |
| <i>Penstemon angustifolius</i>    | broadbeard beardtongue            | Perennial |

| Scientific Name                    | Common Name                   | Duration  |
|------------------------------------|-------------------------------|-----------|
| <i>Portulaca oleracea</i>          | common purslane               | Annual    |
| <i>Salsola tragus</i>              | Russian thistle               | Annual    |
| <i>Sphaeralcea coccinea</i>        | scarlet globemallow           | Perennial |
| <i>Tragia nepetifolia</i>          | catnip noseburn               | Perennial |
| <i>Trifolium repens</i>            | white clover                  | Annual    |
| <i>Verbena bracteata</i>           | bigbract Verbena              | Perennial |
| <i>Verbesina encelioides</i>       | golden crownbeard             | Annual    |
| <b>Shrubs/Trees</b>                |                               |           |
| <i>Artemisia frigida</i>           | fringed sagebrush             | Perennial |
| <i>Atriplex canescens</i>          | four-wing saltbush            | Perennial |
| <i>Cercocarpus montanus</i>        | mountain-mahogany             | Perennial |
| <i>Chrysothamnus viscidiflorus</i> | yellow (or green) rabbitbrush | Perennial |
| <i>Ericameria nauseosa</i>         | rubber rabbitbrushchamisa     | Perennial |
| <i>Fallugia paradoxa</i>           | Apache plume                  | Perennial |
| <i>Gutierrezia sarothrae</i>       | broom snakeweed               | Perennial |
| <i>Juniperus monosperma</i>        | New Mexico juniper            | Perennial |
| <i>Krascheninnikovia lanata</i>    | winterfat                     | Perennial |
| <i>Purshia tridentata</i>          | antelope bitterbrush          | Perennial |
| <i>Quercus gambelii</i>            | Gambel oak                    | Perennial |
| <i>Rhus aromatica</i>              | fragrant sumac                | Perennial |
| <i>Rhus trilobata</i>              | skunkbush sumac               | Perennial |
| <i>Ulmus pumila</i>                | Siberian Elm                  | Perennial |
| <i>Vachellia constricta</i>        | whitethorn acaicia            | Perennial |
| <b>Cacti, Yucca</b>                |                               |           |
| <i>Cylindropuntia imbricata</i>    | tree cholla                   | Perennial |
| <i>Opuntia phaeacantha</i>         | desert prickly pear           | Perennial |
| <i>Opuntia polyacantha</i>         | plains prickly pear           | Perennial |

Table 2-2 presents cover estimates, the most frequently observed species, and that species' average cover for each reclamation year.

**Table 2-2. Dominant Species Cover Estimates for 2003, 2008, and 2011 Reclamation Areas**

| Area                | Cover (%) | <i>s</i> | <i>n</i> | Most Frequent Species; Associated Percent Cover                      |
|---------------------|-----------|----------|----------|----------------------------------------------------------------------|
| 2003                | 77.01     | 0.116    | 20       | western (red-joint) wheatgrass ( <i>Pascopyrum smithii</i> ); 21.42% |
| 2008                | 73.09     | 0.081    | 15       | James' gallata ( <i>Pleuraphis jamesii</i> ); 13.00%                 |
| 2011                | 58.97     | 0.094    | 9        | Indian ricegrass ( <i>Achnatherum hymenoides</i> ); 27.14%           |
| Reference Area 90 % | 59.57     | 0.077    | 9        | Blue gramma ( <i>Bouteloua gracilis</i> ); 29.34%                    |
| Reference Area 80 % | 52.95     | 0.069    | 9        | Blue gramma ( <i>Bouteloua gracilis</i> ); 29.34%                    |

Note: *s* = standard deviation; *n* = number of transects sampled.

### 2.1.2 Reference Area

Table 2-3 lists the plant species identified during the 2022 monitoring of the Tijeras Mine and Mill reference area.

**Table 2-3 Plant Species Observed at the Reference Area**

| Scientific Name               | Common Name              | Duration  |
|-------------------------------|--------------------------|-----------|
| <b>Grasses</b>                |                          |           |
| <i>Bouteloua curtipendula</i> | sideoats grama           | Perennial |
| <i>Bouteloua gracilis</i>     | blue grama               | Perennial |
| <i>Elymus elymoides</i>       | bottlebrush squirreltail | perennial |
| <i>Eragrostis sp.</i>         | lovegrass                | annual    |
| <i>Monroa squarrosa</i>       | false buffalograss       | perennial |
| <i>Pleuraphis jamesii</i>     | galleta grass            | Perennial |
| <b>Forbs</b>                  |                          |           |
| <i>Chenopodium fremontii</i>  | Fremont's goosefoot      | annual    |
| <i>Chenopodium sp.</i>        | goosefoot                | annual    |
| <i>Gutierrezia sarothrae</i>  | broom snakeweed          | perennial |
| <i>Portulaca oleracea</i>     | purslane                 | annual    |
| <i>Salsola tragus</i>         | Russian thistle          | perennial |
| <i>Zinnia acerosa</i>         | desert zinnia            | perennial |
| <b>Shrubs/Trees</b>           |                          |           |
| <i>Artemisia frigida</i>      | fringed sagebrush        | Perennial |

| Scientific Name                    | Common Name                  | Duration  |
|------------------------------------|------------------------------|-----------|
| <i>Atriplex canescens</i>          | four-wing saltbush           | Perennial |
| <i>Cercocarpus montanus</i>        | alder-leaf mountain-mahogany | Perennial |
| <i>Chrysothamnus viscidiflorus</i> | yellow or green rabbitbrush  | Perennial |
| <i>Ericameria nauseosa</i>         | rubber rabbitbrush           | Perennial |
| <i>Fallugia paradoxa</i>           | apache plume                 | Perennial |
| <i>Gutierrezia sarothrae</i>       | broom snakeweed              | Perennial |
| <i>Juniperus monosperma</i>        | New Mexico juniper           | Perennial |
| <i>Krascheninnikovia lanata</i>    | winterfat                    | Perennial |
| <i>Pinus edulis</i>                | pinyon pine                  | Perennial |
| <i>Purshia tridentata</i>          | antelope bitterbrush         | Perennial |
| <i>Rhus trilobata</i>              | skunkbush sumac              | Perennial |
| <i>Ulmus pumila</i>                | Siberian Elm                 | Perennial |
| <b>Cacti, Yucca</b>                |                              |           |
| <i>Cylindropuntia sp.imbricata</i> | tree cholla                  | Perennial |
| <i>Opuntia phaeacantha</i>         | desert prickly pear          | perennial |
| <i>Opuntia polyacantha</i>         | plains prickly pear          | Perennial |
| <i>Yucca glauca</i>                | small soapweed               | Perennial |
| <i>Yucca baccatasp.</i>            | banana yucca                 | Perennial |

In 2022, vegetation cover averaged 59.14%, blue grama grass contributed the highest cover of any species (29.34%), herbaceous litter made up 3.57%, and woody litter was 3.18% of the cover (Table 2-4).

**Table 2-4 Cover Estimates for the Reference Area**

| Scientific Name               | Common Name         | Cover (%) | s     |
|-------------------------------|---------------------|-----------|-------|
| <i>Artemisia frigida</i>      | fringed sagebrush   | 0.32      | 0.009 |
| <i>Bouteloua curtipendula</i> | sideoats grama      | 0.20      | 0.006 |
| <i>Bouteloua gracilis</i>     | blue grama          | 29.34     | 0.206 |
| <i>Chenopodium fremontii</i>  | Fremont's goosefoot | 0.62      | 0.019 |
| <i>Chenopodium sp.</i>        | Goosefoot           | 6.01      | 0.066 |
| <i>Cylindropuntia sp.</i>     | cholla              | 0.56      | 0.017 |

| Scientific Name              | Common Name                      | Cover (%) | s     |
|------------------------------|----------------------------------|-----------|-------|
| <i>Elymus elymoides</i>      | bottlebrush squirreltail         | 0.44      | 0.013 |
| <i>Eragrostis sp.</i>        | lovegrass                        | 1.36      | 0.032 |
| <i>Gutierrezia sarothrae</i> | broom snakeweed                  | 1.20      | 0.036 |
| <i>Juniperus monosperma</i>  | New Mexico juniper               | 5.23      | 0.048 |
| <i>Monroa squarrosa</i>      | false buffalograss               | 4.21      | 0.041 |
| <i>Opuntia phaeacantha</i>   | desert prickly pear              | 1.41      | 0.022 |
| <i>Opuntia polyacantha</i>   | plains pricklypear               | 2.19      | 0.027 |
| <i>Pinus edulis</i>          | pinyon pine                      | 3.00      | 0.045 |
| <i>Pleuraphis jamesii</i>    | James' galleta                   | 1.24      | 0.022 |
| <i>Portulaca oleracea</i>    | purslane                         | 0.20      | 0.006 |
| <i>Salsola tragus</i>        | russian thistle                  | 1.28      | 0.026 |
| <i>Yucca sp.</i>             | Adam's needle or Spanish-bayonet | 0.25      | 0.008 |
| <i>Zinnia acerosa</i>        | desert zinnia                    | 0.39      | 0.012 |
|                              | Herbaceous Litter, Litter        | 3.57      | 0.044 |
|                              | Woody Litter                     | 3.18      | 0.034 |
|                              | Rock                             | 6.89      | 0.073 |
|                              | Loose Erodible Soil, Bare ground | 26.92     | 0.093 |
|                              | Total Vegetation Cover           | 59.44     | 0.120 |
|                              | Total Cover                      | 66.19     | 0.086 |

## 2.2 Shrub Density

### 2.2.1 Reclamation Areas

Thirteen shrub species were observed in the reclamation areas during 2022 monitoring (Table 2-1). Table 2-5 presents shrub densities for each reclamation year and reference area at 80% and 90%. Shrubs per acre were higher in all 2003, 2008, and 2011 than in the reference area.

**Table 2-5 2022 Shrub Density Estimates for 2003, 2008, and 2011 Reclamation Areas**

| Area          | Shrubs per acre | <i>s</i> | <i>n</i> |
|---------------|-----------------|----------|----------|
| 2003          | 4.123           | 0.235    | 20       |
| 2008          | 3.895           | 0.227    | 15       |
| 2011          | 3.899           | 0.339    | 9        |
| Reference 90% | 3.737           | 0.178    | 9        |
| Reference 80% | 3.322           | 0.162    | 9        |

### 2.2.2 Reference Area

Nine shrub species were observed in the reference area during 2022 monitoring (Table 2-4). Shrub density was 4,260 total for the reference area; plains prickly pear (*Opuntia polyacantha*) had the highest density at 1,774.6 total (Table 2-6).

**Table 2-6 2021 Shrub Density Estimates for the Reference Area**

| Species                     | Common Name         | Shrub Density |
|-----------------------------|---------------------|---------------|
| <i>Cylindropuntia</i> sp.   | cholla              | 516.2         |
| <i>Juniperus monosperma</i> | New Mexico juniper  | 776.0         |
| <i>Opuntia phaeacantha</i>  | desert prickly pear | 387.2         |
| <i>Opuntia polyacantha</i>  | plains prickly pear | 1,774.6       |
| <i>Pinus edulis</i>         | pinyon pine         | 613.0         |
| <i>Rhus trilobata</i>       | skunkbush sumac     | 64.5          |
| <i>Yucca</i> sp.            | Spanish-bayonet     | 129.1         |
|                             | <b>Total</b>        | 4,260.8       |

## 2.3 Diversity

Species diversity, as estimated by Simpson's index, was highest in the 2003 Reclamation Area. Species richness was highest in the 2003 Reclamation Area, which also had the highest total number of individual plants and exhibited the highest diversity of all reclamation areas (Table 2-7).

**Table 2-7 2021 Species Diversity in Areas Reclaimed in 2003, 2008, and 2011 and Reference Area**

| Area      | Simpson's Index | Simpson's Index/ Dominance | Species Richness | Total Individuals |
|-----------|-----------------|----------------------------|------------------|-------------------|
| 2003      | 0.881           | 0.1186                     | 39               | 6653              |
| 2008      | 0.859           | 0.1407                     | 30               | 4572              |
| 2011      | 0.702           | 0.2983                     | 14               | 2131              |
| Reference | 0.773           | 0.2273                     | 19               | 1604              |

## 2.4 Sampling Adequacy

Table 2-8 presents the sample adequacy calculations for cover and shrub density estimates of the 2022 monitoring effort in the areas reclaimed in 2003, 2008, and 2011, compared with the 2022 reference area data. Within this analysis, the cover in the areas reclaimed in 2003 and 2011 was equal to or greater than the reference area; however, the cover was less than the reference area for the area reclaimed in 2008. Shrub density was less than the reference area for the area reclaimed in 2011.

**Table 2-8 Cochran's  $n_{min}$  for Cover and Shrub Density Estimates**

| Area      | n  | Cochran's $n_{min}$ |               |
|-----------|----|---------------------|---------------|
|           |    | Cover               | Shrub Density |
| 2003      | 20 | 5.756               | 1.445         |
| 2008      | 15 | 2.497               | 1.077         |
| 2011      | 9  | 4.597               | 0.514         |
| Reference | 5  | 3.085               | 0.963         |

## 2.5 Statistical Testing

### 2.5.1 Cover Estimates

The Student's  $t$ -test of the transformed data indicated that the mean percent vegetation cover was not significantly less than 0.9x of the cover in the reference area in the area reclaimed in 2011, when the cover success criteria is set at 90% cover as compared to the reference area cover. Areas reclaimed in 2008 and 2011 reached less than 0.9x of the cover at the 90% cover threshold (i.e.,  $t_{calculated} > t_{critical}$ ; Table 2-9). When the success criteria is at 80% cover as compared to the Reference Area all 2003, 2008, and 2011 Reclamation Areas meet this standard (Table 2-10).

**Table 2-9 Student's *t*-Statistics (One-tailed *t*-test,  $\alpha=0.1$ ) for Transformed Vegetation Cover for Reclaimed Areas vs. Reference Area at GCC Tijeras Mine and Mill with 90% Cover Threshold**

| Area          | Cover (%) | <i>s</i> | <i>n</i> | <i>T-calculated</i> | <i>T-critical</i> | <i>T</i> ≤ <i>t</i> | <i>P</i> | <i>P</i> ≤0.1 |
|---------------|-----------|----------|----------|---------------------|-------------------|---------------------|----------|---------------|
| 2003          | 108.56    | 0.151    | 20       | 4.254               | 1.314             | yes                 | 0.006    | yes           |
| 2008          | 102.95    | 0.092    | 15       | 4.655               | 1.3212            | yes                 | 0.000    | yes           |
| 2011          | 87.80     | 0.101    | 9        | 0.4867              | 1.3368            | no                  | 0.317    | no            |
| Reference 90% | 85.72     | 0.081    | 5        |                     |                   |                     |          |               |

**Table 2-10 Student's *t*-Statistics (One-tailed *t*-test,  $\alpha=0.1$ ) for Transformed Vegetation Cover for Reclaimed Areas vs. Reference Area at GCC Tijeras Mine and Mill with 80% Cover Threshold**

| Area          | Cover (%) | <i>s</i> | <i>n</i> | <i>T-calculated</i> | <i>T-critical</i> | <i>T</i> ≤ <i>t</i> | <i>P</i>   | <i>P</i> ≤0.1 |
|---------------|-----------|----------|----------|---------------------|-------------------|---------------------|------------|---------------|
| 2003          | 108.56    | 0.151    | 20       | 6.0819              | 1.3137            | yes                 | 0.00000085 | yes           |
| 2008          | 102.95    | 0.092    | 15       | 7.456               | 1.3212            | yes                 | 0.00000009 | yes           |
| 2011          | 87.80     | 0.101    | 9        | 2.8069              | 1.3368            | yes                 | 0.00632992 | yes           |
| Reference 80% | 76.20     | 0.072    | 5        |                     |                   |                     |            |               |

## 2.5.2 Shrub Density Estimates

The Student's *t*-test of the transformed data indicated mean shrub density was less than 0.8x of shrub density in the reference area with a success criteria threshold of 90% cover (3.74 shrubs per acre) in all areas reclaimed in 2003, 2008, and 2011 (i.e.,  $t_{\text{calculated}} > t_{\text{critical}}$ ; Table 2-11).

**Table 2-11 Student's *t*-Statistics (One-tailed *t*-test,  $\alpha=0.2$ ) for Transformed Shrub Density for Reclaimed Areas vs. Reference Area at GCC Tijeras Mine and Mill**

| Area          | Shrubs per acre | <i>s</i> | <i>n</i> | <i>T-calculated</i> | <i>T-critical</i> | <i>T</i> ≤ <i>t</i> | <i>P</i>   | <i>P</i> ≤0.2 |
|---------------|-----------------|----------|----------|---------------------|-------------------|---------------------|------------|---------------|
| 2003          | 4.12            | 0.24     | 20       | 4.3771              | 0.8551            | yes                 | 0.0008109  | yes           |
| 2008          | 3.90            | 0.23     | 15       | 1.7741              | 0.8583            | yes                 | 0.04494462 | yes           |
| 2011          | 3.90            | 0.34     | 9        | 1.2639              | 0.8726            | yes                 | 0.11698611 | yes           |
| Reference 90% | 3.74            | 0.18     | 9        |                     |                   |                     |            |               |

### **3 Conclusion**

Estimates of percent cover and shrubs per acre were equal to or greater than the reference area in all reclamation areas reclaimed in 2003, 2008, and 2011 (Table 2-9 through Table 2-11). Species diversity in all reclamation areas was equal to or greater than the reference area. Table 2-8 presents the sample adequacy calculations for cover and shrub density estimates of the 2022 monitoring effort in the areas reclaimed in 2003, 2008, and 2011, compared to the 2022 reference area data. In this analysis, the 2011 cover was equal to or greater than the reference area; however, the shrub density was less than the reference area. When the success criteria are at 80% cover as compared to the reference area, all areas reclaimed in 2003, 2008, and 2011 meet this standard as shown in Table 2-10.

GCC requests full reclamation release for approximately 74 acres of fully reclaimed land within the Tijeras Site. These areas have completed all required reclamation activities and have met applicable performance standards.

#### **3.1 Reclamation Performance**

Based on available reclamation records and field verification:

- Reclaimed surfaces are stable and resistant to erosion.
- Drainage patterns are functioning as intended.
- Vegetation has been established consistent with site conditions and post-mining land use.
- The areas appear to support self-sustaining vegetation communities.

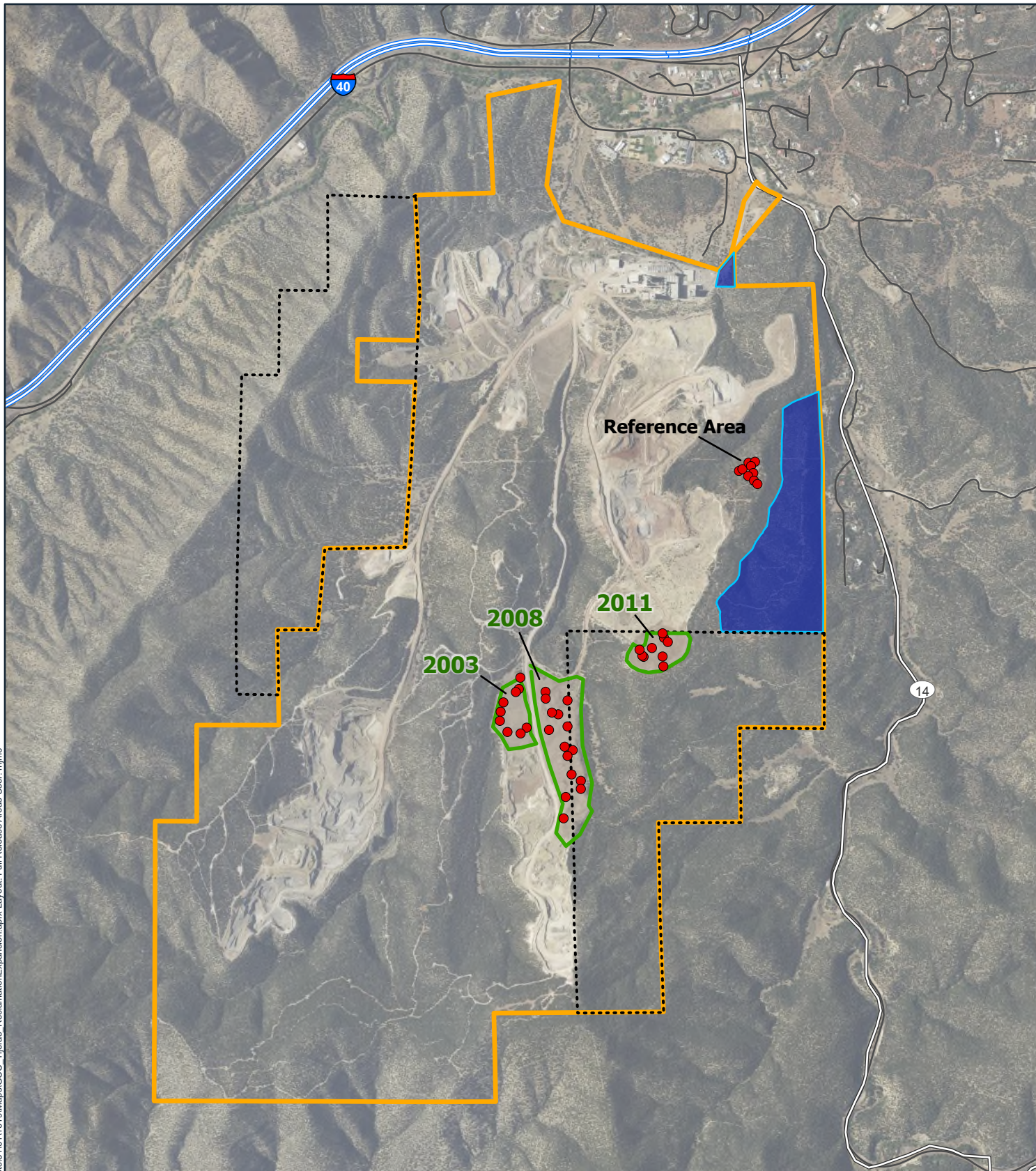
#### **3.2 Basis for Final Release**

Based on the standards in the mine closeout plan, the vegetation success criteria below from Section 22-1 provided by Tijeras Mine and Mill in June of 2026, the areas reclaimed in 2003, 2008, and 2011 have satisfied the requirements for final reclamation release, including the applicable liability period and demonstration of long-term stability and revegetation success (Barr Engineering Co. 2026).

- This Permit Modification establishes the following success criteria at the time of Financial Assurance ("FA") release when evaluating reclaimed areas within the Permit Boundary.
  - Reclamation success for a self-sustaining ecosystem shall be determined through the comparison of ground cover, shrub density, and diversity of the reclaimed area to the approved reference area, with monitoring for the purpose of FA release being done in the same year.
  - Foliage or basal cover of native living plants of the revegetated area shall be established equal to 90 percent of the reference area to within a 90 percent statistical confidence.
  - Shrub Density of native woody plant species shall be established to the approved density with an 80-percent chance statistical confidence.

## References

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- Ecosphere Environmental Services, Inc. 2021. Reclamation Monitoring Plan: Tijeras Mine & Mill
- Natural Resources Conservation Service (NRCS). 2019. The PLANTS Database. Available online at: <http://plants.usda.gov>. National Plant Data Team, Greensboro, North Carolina 27401-4901. Accessed January 11, 2022.
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|-------------------------|---------------|
| ● Transect Points       | — Interstate  |
| — Limit Permit          | — State Route |
| - - - Tijeras Claims    | — Road        |
| — Reclamation Areas     |               |
| ■ Quarry Expansion Area |               |



Sources: GCC, Barr, Esri

Tijeras Mine and Mill  
GCC  
Map 1  
2022 Vegetation Monitoring  
Transect Locations for the  
Reference Area and Areas  
Reclaimed in 2003, 2008, 2011

