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June 12, 2016

Mr. James Hollen
New Mexico Energy, Minerals and Natural Resources Department
Mining and Minerals Division
Mining Act Reclamation Program
1220 South St. Francis Drive
Santa Fe, NM 87505

**RE: Request for Amendment to the *Closeout/Mitigation Plan, JJ No.1/L-Bar Mine* –
DRAFT - Methodology for the Determination of Revegetation Success for the JJ No. 1/L-Bar Mine
SOHIO Western Mining Company, Permit No. CI007RE**

Mr. Hollen,

On behalf of SOHIO Western Mining Company, INTERA is submitting this *DRAFT - Methodology for the Determination of Revegetation Success for the JJ No. 1/L-Bar Mine* Work Plan (Work Plan) to New Mexico Energy, Minerals and Natural Resources Department (EMNRD) Mining and Minerals Division (MMD) for review and comment. This Work Plan should be considered an amendment to the *Closeout/Mitigation Plan, JJ No.1/L-Bar Mine, Cibola County, New Mexico,* dated October 2008, which was approved by an amended Director's Order issued on May 29, 2009. This DRAFT Work Plan provides alternatives for the proposed methodology basis for determining if reclaimed areas at the site have met the revegetation standards needed for final closure. The three methodology options proposed in this Work Plan include: Option 1 - Background areas used as a reference area (if suitable), Option 2 - Technical standards established from relevant literature, or Option 3 - Soil-loss erosion calculations. In addition, the site-specific success standard development, potential maintenance activities, and a contingency plan and conditions for final bond release are presented in the Work Plan.

In addition to INTERA's request for review and comment of the Work Plan, we also propose that the revegetation areas that currently have adequate vegetation growth be considered, on an individual basis, for early release from the monitoring period. INTERA understands that the actual release will depend on the results of individual vegetation surveys within each area being proposed. However, we request approval to propose revegetation areas for final closure and release on an individual basis as opposed to waiting until all 13 areas are ready for release. Please provide any questions or comments you have on the Work Plan at your earliest convenience, and feel free to contact me by email (pjohnson@intera.com) or phone (505.235.6618) if you have any questions regarding the above information.

Sincerely,

INTERA Incorporated

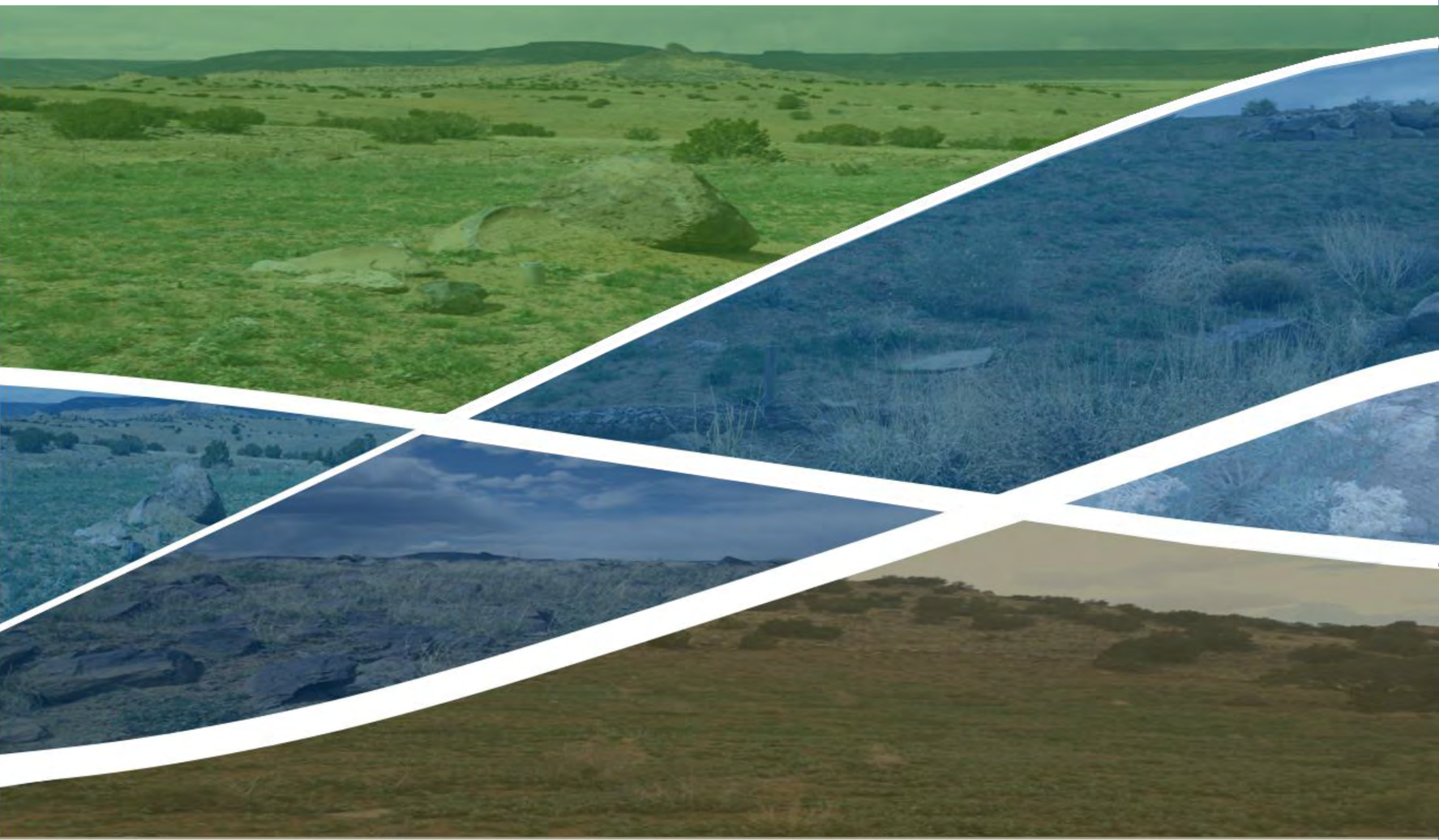
PJohnson

Patricia Johnson
Project Manager

Enclosure: Methodology for the Determination of Revegetation Success
cc: Dave Cline, RT, file

DRAFT –

Methodology for the Determination of Revegetation Success for the JJ No. 1/L-Bar Mine



Prepared For

SOHIO Western Mining Company (Rio Tinto)

Prepared By

INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

and

Cedar Creek Associates, Inc.

June 12, 2016

Methodology for the Determination of Revegetation Success
JJ No. 1/L-Bar Mine

1.0 INTRODUCTION

INTERA contracted Cedar Creek Associates, Inc. (Cedar Creek) in early 2016 to develop a methodology for determining revegetation success in accordance with the *Closeout/Mitigation Plan, JJ No. 1/L-Bar Mine* (INTERA, 2008) and *JJ No. 1/L-Bar Mine Closeout/Mitigation As-Built Report* (INTERA, 2011). This methodology defines procedures and protocols to be utilized for revegetation success evaluations pursuant to mandates of Title 19, Chapter 10, Part 5 of the Mining Act Rules set forth by the MMD (New Mexico Mining and Minerals Division). Reclamation and revegetation techniques were employed in 2010 to target the post-mining land use of livestock grazing with coincidental wildlife habitat. The purpose of this document is to facilitate a determination of a revegetated unit's ability to meet post-mining land use considerations. This document defines site-specific success standard development, protocols for monitoring, and eventual success evaluations to be used at the mine.

Revegetation success at the JJ. No. 1/L-Bar Mine (Site) will address perennial (and biennial) vegetative cover and woody plant density by comparison to background reference conditions and/or technical standards representative of the pre-existing vegetation communities and/or desirable ecological conditions. Evidence of success will be reflected by actual growth of plant species present in the approved (and planted) seed mix and will indicate whether the post mining land use (livestock grazing with coincidental wildlife habitat) has been established, and whether the vegetation is capable of being grazed at proper grazing intensity.

A background vegetation survey of adjacent undisturbed areas within fenced areas will be conducted concurrently with the 6-year monitoring event in late summer of 2016. A background vegetation survey differs from a baseline survey in that a baseline survey is conducted prior to disturbance, whereas, a background survey is conducted after disturbance and does not influence the liability period. The basis of success benchmarks will be developed from three sources:

1) Background areas used as a reference area (if suitable);

2) Technical standards established from relevant literature; or

3) Soil-loss erosion calculations.

The 2016 survey will also be used to confirm soil types and the ecological site(s) representative of pre-mine conditions, which will be used to guide the methods and determination of success.

2.0 BASIS FOR REVEGETATION STANDARDS

The three sources of information that will be used to determine the basis for revegetation success are described in detail below.

2.1 Reference Area Approach

According to the Natural Resource Conservation Service (NRCS) Soil Survey for Cibola Area, New Mexico, comprised of parts of Cibola, McKinley, and Valencia Counties, the predominant soil unit within the 2010 Site reclamation areas is the Poley-Pojoaque very cobbly loams, with 5 to 30 percent slopes (NRCS Soil Survey). The Ecological Site Description (ESD) associated with these soils is Foothills (R036XB131NM) (USDA-NRCS, 2013). The climax community described in the Foothills ESD consists of a mixed shrub-grassland component with scattered one-seed juniper and piñon pine trees. Blue grama, black grama, galleta, New Mexico feathergrass, little bluestem, sideoats grama, and bottlebrush squirreltail are common understory species.

Site observations indicate that current plant composition varies from the climax community due to the history of grazing activities in the area. In 2010, fencing was erected around the reclamation and revegetation areas to exclude grazing, and this fencing included small areas of native ground which, when combined, could possibly serve as a pre-mining reference area. These small areas are representative of pre-mining communities and fall under the same land management as the reclaimed areas (grazing excluded).

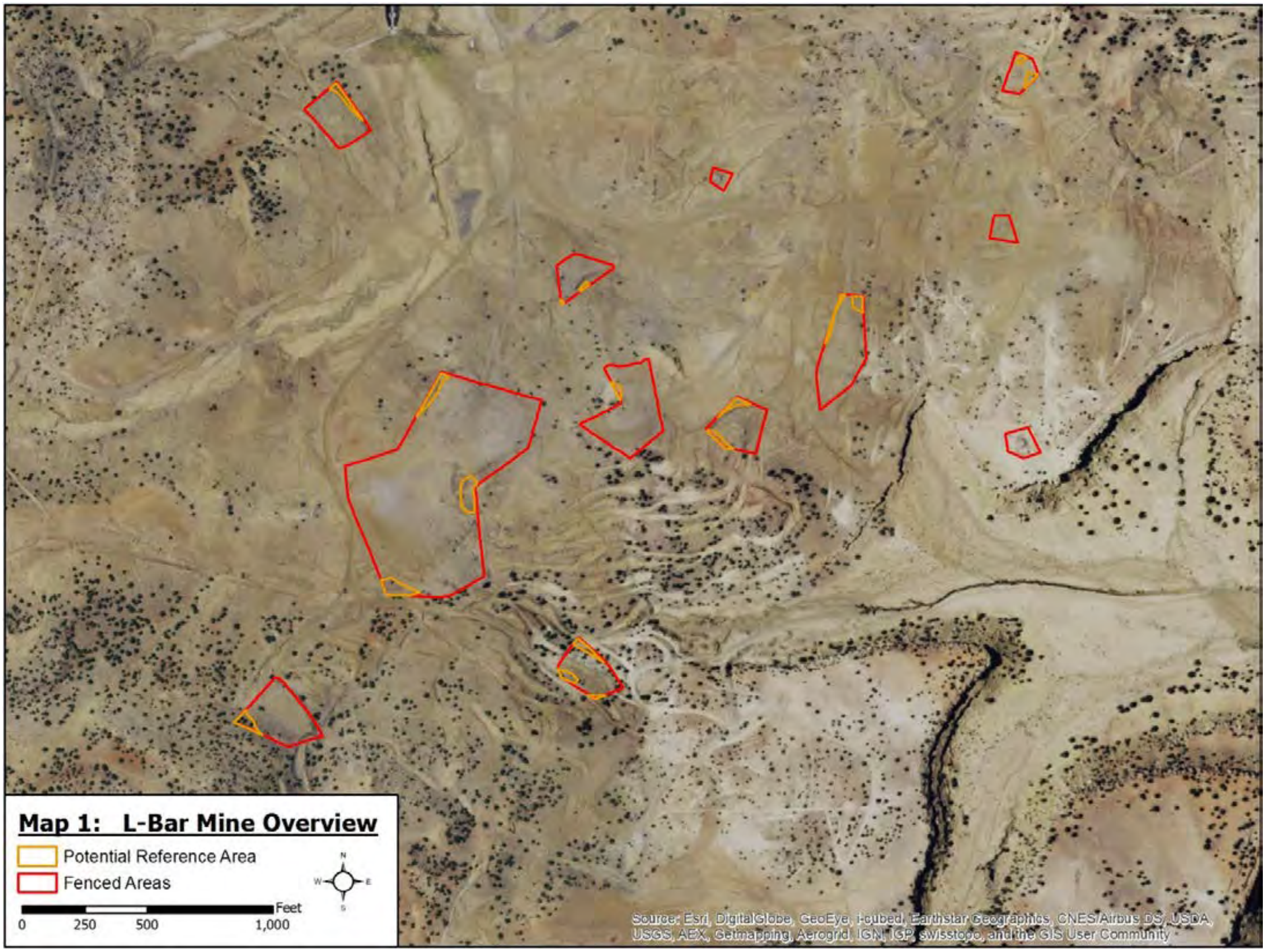
As displayed on **Map 1**, the potential fenced reference areas, even when combined, are still quite small (0.91 acres). Though small, these areas may be combined with any areas external to fencing that are in reasonable range condition to serve as a reference area.

2.2 Determination of Literature-Based Technical Standards

Review of relevant scientific articles and/or success criteria established for other local mine sites yielded options for the determination of revegetation success at the Site. The following sections present the most suitable of these criteria for vegetative ground cover and woody plant density.

Vegetative Ground Cover Standard. The NRCS develops ESDs of vegetation communities as they relate to soils. As stated previously, the ESD of the Site area is most likely Foothills (R036XB131NM) (USDA-NRCS, 2013). However, in order to verify the ESD, soils within the vicinity of the Site will first be confirmed to demonstrate that this ESD is appropriate for application to the site. The Foothills ESD climax community consists of a mixed shrub-grassland aspect with scattered one-seed juniper and piñon pine trees. As presented in Section 2.1, blue grama, black grama, galleta, New Mexico feathergrass, little bluestem, sideoats grama, and bottlebrush squirreltail are common understory species. Described vegetative cover values by lifeform for this community are 20% tree cover, 20% shrubs and sub-shrub cover, and 12% herbaceous cover (total of 52%). Because the production for all life forms of this community is described to vary 30 to 50% from average for favorable and unfavorable precipitation years, it is reasonable to conclude that vegetative cover varies in a similar manner. Therefore, a conservative estimate of the low-end cover value for this climax community would be 40% below the average of 52% vegetative cover (or 31.2% vegetative cover). Considering the nature of young revegetation, 70% of the 31.2% reference value should be considered the success criterion; this value would equal 21.8% vegetative cover**.**

Woody Plant Density Standard. Hoenes and Bender (2012) measured native shrub density in Juniper Scrub and Grassland communities of central New Mexico and found them to exhibit approximately 200 shrubs per acre on average. Although Hoenes and Bender define relevant shrub species more narrowly than the sampling protocol at the Site, this count should be adequate for the early seral (a changing plant community after disturbance) revegetation evaluation. In addition, similar woody plant density standards for grazing areas have been accepted by the MMD for surrounding mines. Therefore, 200 shrubs per acre would be the success criterion for the revegetation areas on Site.



2.3 Soil-Loss Erosion Calculations Approach

The vegetative cover technical standard can also be developed in reverse by calculating how much vegetation cover is required to control erosion to an acceptable rate. This approach may be necessary at the Site due to diminished soil properties in the revegetation areas. Even when using topsoil for reclamation, as was done in this case, disturbance of the soil profile can lead to diminished potential for vegetation growth. Many of the reclaimed areas of the Site show evidence of a lack of topsoil. Disruption of soil structure in borrowed materials can lead to increased wind and water erosion rates, and an increase in biological activity can quickly volatilize and deplete organic matter and nutrients, particularly in warm and dry climates where fertility can be limiting. In addition, the mixing of subsurface accumulations of carbonates and salts with topsoil, or using only subsoil as a growth media, often results in diminished germination and plant vigor when compared to undisturbed reference areas. The subsoil used for reclamation at the Site refers to the soil between parent material (bedrock) and the topsoil.

When comparing reclamation with a subsoil as growth media to a reference area that is native (topsoil), expectations must be adjusted. Decreased fertility, susceptibility to erosion, unfavorable soil-water characteristics, and poor structure are a few of the issues confronted when reclaiming land with subsoil and diminished quality growth media. These soils in their native, undisturbed state regularly support excellent vegetation, but it is the excavation and mixing of the deleterious subsurface accumulations with the topsoil that can result in diminished revegetation results. Unrealistic and often unattainable (regardless of cost) standards are often set when comparing native areas to reclamation with subsoil growth media. When setting standards for revegetation success, the availability and quality of growth media and the use of subsoil must be taken into account to set scientifically attainable goals and standards. The vegetative cover technical standard can be developed in reverse based on the threshold value for acceptable erosion rates. It can be determined, using the Revised Universal Soil Loss Equation (RUSLE) equation, how much vegetation cover would be necessary to facilitate control of erosion to an acceptable rate, in tons per acre per year. The erosion rate will be established after additional field work is conducted.

Efforts to predict soil erosion from croplands mathematically were initiated approximately 60 years ago. A variety of factors were considered in attempting to develop prediction equations. All of these earlier equations were essentially state or regional in nature and were applicable only under limited climatic/edaphic (soil characteristics) conditions. These equations were considered useful, however, and an effort was subsequently initiated to develop an equation that would be applicable nationally under a variety of site conditions. Work on this was begun in the mid-1950's by the Agricultural Research Service. From this work the Universal Soil Loss Equation (USLE) was developed and refined during the 1960's and 1970's. Continued refinements were made to the equation and the associated parameters based on site-specific research and general use by the public. Additional data were continually gathered in an effort to update the equation and make it more useful (Renard et al., 1992).

Based on this additional data and refinement, the RUSLE equation was developed. Though still influenced by basic agronomic values in some instances, and using the same overall parameters as the USLE, the RUSLE equation is considered to be a significant step forward in more accurately predicting the potential for erosion under a variety of conditions. Where the original USLE arrived at a potential soil erosion value through simple multiplication of selected parameter values, the RUSLE employs a computer-based model which involves sub-routines for various parameters to ultimately predict potential soil erosion. Revisions and improvements in assessing values for the parameters which are used in RUSLE have also been made which render the model more useful. Once believed applicable only to agronomic situations, RUSLE is now considered to be applicable to construction sites as well. The term "construction sites" also includes mine sites if appropriate care is taken in applying this erosion prediction model (Renard et al., 1992).

Though a reasonably advanced tool, it should be noted that there are limits with respect to the applicability of the model. This model predicts erosion potential as a result of sheet and rill erosion. Gully erosion is not a part of the predicative capability of RUSLE. Where gullying may occur, the bearing that this type of erosion would have on soil stability must be judged independently. RUSLE also does not, in and of itself, predict potential sedimentation. Soil loss is predicted, but not the eventual fate of the eroded material. RUSLE is a predictive model and must be used as such in the comparative sense against values which exhibit the same level of potential accuracy. This is the intent of the application of this model as a part of the overall revegetation success protocol discussed in this document.

The RUSLE model is based on six parameters utilized to estimate or quantify the factors which affect the potential for soil erosion. The RUSLE model is as follows (Renard et al., 1992):

A (soil loss in tons/acre/year) **= R•K•L•S•C•P**

"**R**" represents the rainfall-runoff erosivity factor. The effects that climate, in terms of amount of incident precipitation, storm intensity, etc. have on erosion are accounted for by this factor. Values for this factor are taken directly from soil surveys and related documents developed for and within the State of New Mexico by the NRCS (formerly Soil Conservation Service).

The "**K**", or soil erodibility, factor is related to the integrated effect of rainfall, runoff, and infiltration on soil loss. It is typically considered to be the soil loss rate/unit for a specified soil as measured on a standard plot experimentally. K-factors to be used for this protocol may be taken from a standard nomograph developed for this purpose (NRCS 1992) since the surface growth medium may not directly correspond to any recognized soil series. The factors to be considered in developing the appropriate K-factor are texture, percent organic matter, soil structure, and permeability. Alternately, average values for K-factors for growth medium textures occurring in the area to be evaluated may be used if considered appropriate; especially given that topsoil was obtained from borrow areas in the vicinity.

Slope length (**L**) and gradient (**S**) will be combined into one factor using charts developed for this purpose. Data have shown that this method offers the best means of integrating the effects of these two factors into the equation. Slope length accounts for the effect topography has on erosion potential. Lengths will be measured in the field to supply the correct data for the L-factor and compound slopes will be defined if existing. Slope steepness, or gradient, is a representation of the percent slope and will also typically be determined in the field to supply the most relevant data.

The cover-management factor (**C**) reflects the effect of vegetation and related management practices on erosion rates. This factor will be based largely on site-specific data collected from, or which is estimated to be relevant to, each area for which revegetation success is being evaluated. The type of vegetation currently existing on site, estimated soil roughness, measured soil surface percent cover (vegetation, coarse fragments, litter, other non-erodible material) and height, measured plant canopy cover, and estimated above- and below-ground plant biomass factors will all be used to develop the C-factor using a computer program sub-routine run. This factor may be the most influential factor in determining potential erosion from a site.

The "**P**", or support practice, factor takes into account the effects of mechanical practices applied to the surface of the growth medium to increase infiltration, reduce runoff, and decrease erosion. Such practices include ripping, pitting, and contour furrowing and result in a parameter value of less than 1.0. A value of 1.0 may be appropriate where no support practices have been employed on the reclaimed area. The effects that basic tillage or fertility practices have on erosion potential are included in the cover management factor of the equation.

At the Site, the R factor will be established from the NRCS soil survey and site collected data will be used to establish the K, LS, and P factors. Therefore, once R, K, LS, and P factors are defined along with an acceptable erosion rate (A), it is possible to calculate the C factor (ground cover) necessary to achieve an acceptable erosion rate (A). A success criterion for vegetative ground cover can be established from the calculated C factor.

3.0 REVEGETATION MONITORING

The proposed monitoring schedule and procedures associated with evaluating the revegetation success at the Site are detailed below.

3.1 Revegetation Monitoring Schedule

Revegetation success will be monitored through periodic detailed vegetation surveys (sampling) of revegetated units. Sampling will occur in accordance with the monitoring schedule below. All areas will be monitored during the interim years 6 and 9 and will undergo final evaluation in years 11 and 12. In addition to year 6 monitoring, data will be concurrently collected from background reference areas for the intended use as a direct comparison for the revegetation or the development of technical standards.

Table 1. Revegetation Monitoring Schedule

Year	Action
2016	Year Six Monitoring and Success Standard Sampling
2017	-
2018	-
2019	Year Nine Monitoring
2020	-
2021	Year 11 Bond Release Evaluation
2022	Year 12 Bond Release Evaluation and Test

INTERA and Cedar Creek will be available throughout the responsibility period to attend regularly scheduled meetings with MMD representatives to review sampling results and progress toward achievement of revegetation success criteria.

3.2 Revegetation Monitoring Procedures

Monitoring and eventual success testing will involve sampling of ground cover and woody plant density within each revegetated unit and reference area (if suitable) with consideration for bond release standards. Sampling for ground cover will be accomplished utilizing the point-intercept procedure using modern instrumentation (e.g. lasers or optics) along transects of 100 intercepts each. Long belt transects or near total population enumeration will be used for woody plant density determination.

The first step of the vegetation protocol will be to obtain samples of the ground cover and woody plant density from the revegetated unit to be evaluated. A revegetated unit consists of a defined area based on managerial criteria (e.g., an area with common revegetation procedures and initiation times, common post-mining land use, and common pre-mining vegetation communities). Based on these criteria, all of the fenced areas can be considered the same revegetated unit at the Site. Ground cover and woody plant density samples will be obtained from the background reference area. Sampling will occur during the peak biomass period of the year (late summer) and sampling locations will be determined utilizing a systematic (bias-free) method with a random start.[1] This systematic procedure also provides proportionate representation from across each reclaimed unit for such characteristics as aspect.

1 Systematic sampling is superior to other sample distribution procedures because it forces representation from across the reclaimed unit. It accounts better for heterogeneous expressions of multiple seedings or revegetation conditions by

Sample Site Location. The systematic procedure for sample location in both the revegetated unit and the reference area will occur in the following stepwise manner. First, a fixed point of reference will be selected for the area to facilitate location of the systematic grid in the field. Second, a systematic grid of appropriate dimensions will be selected to provide a reasonable number (e.g., 20) of coordinate intersections which could be used for the initial set of sample sites. Third, a scaled representation of the grid will be overlain on field maps of the target unit extending along north/south and east/west lines. Fourth, the initial placement of this grid will be implemented by selection of two random numbers (an X and Y distance) to be used for locating the first coordinate from the fixed point of reference, thereby making the effort unbiased. Fifth, where an excess number of potential sample points (grid intersections) is indicated by overlain maps, the excess will be randomly chosen for elimination (unless it is later determined that additional samples are necessary for meeting sampling adequacy). Sixth, utilizing a GPS, the sample points will be located in the field.

Ground Cover Determination. Ground cover at each sampling site will be determined utilizing the point-intercept methodology (Bonham, 1989) as illustrated on **Figure 1**. This methodology has been utilized for range studies for over eighty (80) years and will occur as follows: First, a transect of 10 meters in length or longer will be extended from the starting point of each sample site toward the direction of the next site to be sampled. Then, at each one-meter interval along the transect, a laser point bar or optical point bar will be situated vertically above the ground surface, and a set

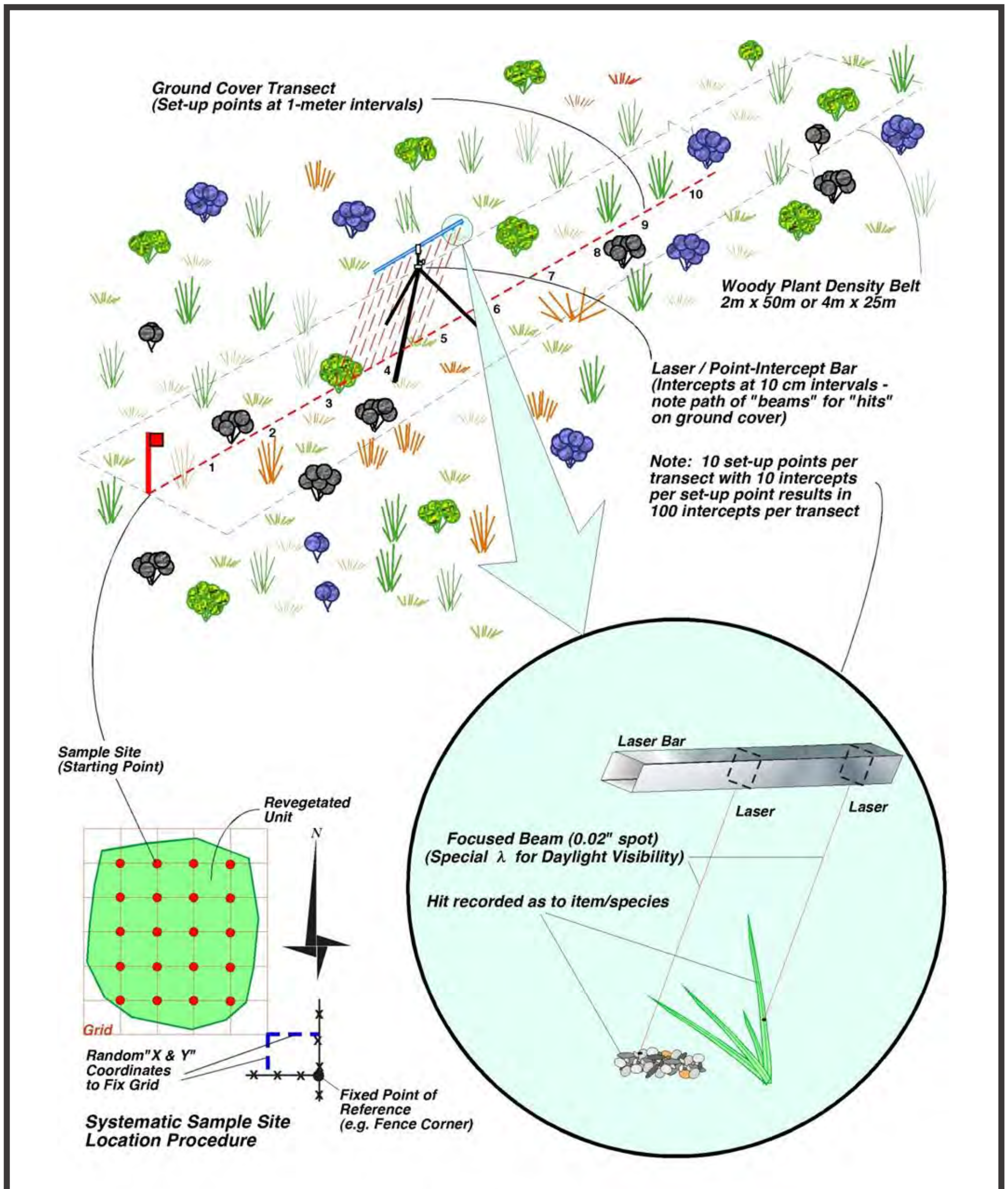


Figure 1

Sampling Procedure at a Systematic Sample Site Location

forcing a patterned distribution of samples. This method thus minimizes the risk that significant pockets will be either entirely missed or overemphasized.

of 10 readings recorded as to hits on vegetation (by species), litter, rock, or bare soil. Hits will be determined at each meter interval by activating a battery of 10 specialized lasers situated along the bar at 10 centimeter intervals and recording the variable intercepted by each of the narrow (0.02”) focused beams (see Figure 1). If an optical point bar is used, intercepts will be recorded by fine crosshairs situated at standard intervals. In either situation, a total of 100 intercepts per transect will be recorded resulting in 1 percent cover per intercept. This methodology and instrumentation facilitates the collection of the most unbiased, repeatable, precise, and cost-effective ground cover data possible. Furthermore, the point-intercept procedure has been widely accepted in the scientific community, especially the mining industry, as the protocol of choice for vegetation monitoring and bond release determination.

Woody Plant Density Determination. Woody plant density will be determined in one of two manners depending upon a visual evaluation of the variability of the expressed population by an experienced field ecologist. If the population of woody plants appears to be sufficiently homogenous across the revegetated unit, density will be determined through a systematic sampling protocol utilizing large quadrats, or belts, co-located with the cover transects. If the population appears to be too heterogeneous, enumeration of the entire population, or nearly the entire population, may be the only reliable means available to determine density of woody plants. Newly establishing woody plant communities are often so inherently variable that no sampling protocols presently known to the scientific community are practical or cost-effective to obtain a viable estimate of the population’s parameters.

If it is determined that belt sampling can be used, belts will be sized to absorb as much of the between-sample variability as possible, and then fixed at this size for the duration of the sampling effort. Typical belt dimensions might be 2 meters X 50 meters, however, it is possible that 4 meter X 100 meter belts could be utilized. All shrubs, trees, and woody cacti rooted within the boundaries of these belts will be counted and classified according to species[2]. Seedlings (one-year old plants) will not be counted toward the total as this age class has extraordinarily high mortality rates.

If near-total population enumeration is deemed most appropriate, then the following protocol would be initiated. First, the various stands of woody plants within a revegetated unit would be delineated and their respective acreages determined. Then beginning with the largest stands and working down to the smallest, each will be subjected to total count procedures until a large percent of the area (e.g., 90%) has been counted. This procedure maximizes use of personnel and resources, and the vast majority of the population will be entirely enumerated with the worst possible error equivalent to the uncounted portion of the population (e.g., 10%).

Counting procedures would occur as follows. Once a stand of woody plants is delineated, it would be subdivided into long manageable strips using hip chain thread or similar means, and observers would progress slowly across each strip, shoulder to shoulder, recording each plant by species and age class. Use of hand-held tally meters facilitate uninterrupted viewing of the subject area and appropriate communication among the observers will preclude gaps in the field of coverage or duplication of effort (overlapping fields of view).

Sample Adequacy. A minimum sample size of fifteen (15) samples will be collected from each discrete unit for both vegetative cover and woody plant density. For monitoring purposes, sample adequacy is not required. Adequacy of sampling will be achieved when, for each discrete unit, the number of samples actually collected (n) provides

2 “Woody cacti” primarily refers to *Opuntia spinosior* and morphologically similar species. Succulent / non-woody cacti and lesser sub-shrubs will not be included in woody plant density counts (e.g. *Echinocereus melanocanthus, Opuntia polyacantha, Mammillaria* spp., *Escobaria* spp., and *Guttierrezia* spp.). These latter species are dissimilar to other shrubs and lack value as wildlife cover, forage, and/or perennial raindrop protection provided.

a level of precision within 10% of the true mean with 90% confidence (n_{min}), i.e., when $n_{min} \leq n$. Then n_{min} is calculated as follows:

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

where:

n = the number of actual samples collected with a minimum of 15 in each unit;

t = the value from the *t* distribution for 90% confidence with n-1 degrees of freedom;

s^2 = the variance of the estimate as calculated from the initial samples;

$\bar{x}$ = the mean of the estimate as calculated from the initial samples.

As indicated above, this formula provides an estimate of the sample mean to within 10% of the true population mean (μ) with 90% confidence. Calculations of the mean and variance will be based on total vegetation ground cover exclusive of litter. For bond release evaluations, if the initial 15 samples do not provide an adequate estimate of the mean (e.g., the inequality above is false), additional samples will be collected until a maximum of 40 samples has been achieved. Since sampling adequacy is not required (nor recommended) for woody plant density, one density belt will be co-located with each ground cover transect, but adequacy shall not be tested for this variable. Resulting data can then be considered reasonable for the evaluation purposes intended.

4.0 REVEGETATION SUCCESS DEMONSTRATIONS

Revegetation success of the revegetated unit(s) will be assessed against performance standards for (1) vegetative ground cover and (2) woody plant density. Specific standards for vegetative ground cover and woody plant density can be established from reference areas or technical standards. In evaluation years, any of the approaches presented below are deemed suitable. Revegetation efforts will be considered successful when standards have been met at the end of the 12-year responsibility period.

1. Vegetative Ground Cover Standard

The total perennial (and biennial) vegetative ground cover (exclusive of noxious species) in the revegetated unit equals or exceeds <u>50 percent</u> of the approved reference area's perennial vegetative ground cover (exclusive of noxious species). Due to the diminished soil properties at the Site, as discussed in Section 2.3 above, the vegetative ground cover standard has been adjusted to achieve realistic and attainable regrowth standards.

OR

The total perennial (and biennial) vegetative ground cover (exclusive of noxious species) in the revegetated unit equals or exceeds the success criterion[3] established from the literature (21.8%).

2. Woody Plant Density Standard

The density of live shrubs, trees, and woody cacti[4] rooted within the boundaries of the revegetated unit equals or exceeds <u>60 percent</u> of the approved reference area's density of live shrubs, trees, and woody cacti.

OR

The density of live shrubs, trees, and woody cacti rooted within the boundaries of the revegetated unit equals or exceeds a success criterion of <u>200 plants per acre</u>.

4.1 Ground Cover Comparison Testing

If sample adequacy is achieved on both the revegetated site and reference area, a direct mathematical comparison may be used to evaluate success in comparison with the reference area or technical standard. The ground cover standard will be met if the revegetated area mean meets or exceeds <u>50 percent</u> of the reference area's mean or if the revegetated area mean meets or exceeds the established success criterion from literature or erosion calculation.

If sample adequacy is not achieved after 40 samples are collected, a reverse null approach will be used to demonstrate success. The demonstration of success will utilize the central limit theorem which assumes approximate normality when a sufficiently large number of samples are collected (>30). A one-sided, one-sample, reverse–null t-test is considered appropriate and the decision rules for this test are as follows:

If $t^* < t_{(1-\alpha;n-1)}$, conclude failure to meet the performance standard, and

If $t^* \geq t_{(1-\alpha;\, n-1)}$, conclude that the performance standard was met (for $\alpha = 0.1$).

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3 A success criterion represents the actual value to demonstrate success and should not be discounted (e.g. 70%).

4 "Woody cacti" primarily refers to *Opuntia spinosior* and morphologically similar species. Succulent / non-woody cacti and lesser sub-shrubs will not be included in woody plant density counts (e.g. *Echinocereus melanocanthus, Opuntia polyacantha, Mammillaria* spp.*, Escobaria* spp., and *Guttierrezia* spp.). These species are dissimilar to other shrubs in the type of wildlife cover, forage, and perennial raindrop protection provided.

4.2 Woody Plant Density Testing

The woody plant density standard will be met if either the sample mean (regardless of adequacy) or the population mean (if the majority of the population is counted rather than sampled) meets or exceeds 60 percent of the reference area's mean or meets or exceeds established success criterion (200 woody plants per acre). A simple mathematical comparison will be utilized because the variability of woody plant density routinely exhibits excessive variation to the point that parametric comparison statistics cannot be employed.

5.0 MAINTENANCE AND CONTINGENCY CONSIDERATIONS

Maintenance activities are planned to repair and improve the Site Best Management Practices (BMPs) in the reclaimed areas. The role of revegetation as part of the maintenance activities are summarized below, along with contingency plans and conditions for final bond release.

5.1 Maintenance Activities

Any areas that have the potential to exhibit future erosion features will be repaired/re-graded and reseeded as part of maintenance activities. Inter-seeding may be implemented in areas to augment establishing revegetation. If necessary, noxious weed infestations will be treated in a timely manner with appropriate methods. Due to the continued land use around the reclamation areas, noxious weed management will only be conducted within the fenced areas. In addition, weed management will be implemented if noxious weeds identified within the fenced areas present an obstacle to achieving performance criteria. Noxious weed control is species-dependent and both method and timing will vary from species to species. All of these activities are considered routine maintenance and will not restart the bond responsibility period.

5.2 Contingency Plan and Conditions for Final Bond Release

If at any time during or after Monitoring Year six (2016), monitoring indicates significant potential for failure to meet any of the foregoing revegetation performance standards (e.g. significant observable erosion, noxious weed infestation, failing vegetation); on behalf of SOHIO, INTERA will document such findings in a report to MMD. The report will describe the area of concern, the perceived problem, and the probable causes. INTERA will submit a corrective action plan, with an implementation schedule, to MMD for review and approval. Following MMD approval, the corrective action plan will be implemented.

If a revegetated unit fails to meet a performance standard following Year 11 evaluation, INTERA may request a revision of the performance standards for any revegetated unit(s) on the grounds where the following conditions apply:

(a) a revised performance standard is appropriate under 19 NMAC 10.2 Subpart 5, § 507.A (the permit area will be reclaimed to a condition that allows for re-establishment of a self-sustaining ecosystem appropriate for the life zone of the surrounding areas); or

(b) the Operator qualifies for a waiver under 19 NMAC 10.2 Subpart 5, § 506.C (the unit will meet all applicable federal and state laws, regulations and standards for air, surface water and ground water protection and will not pose a current or future hazard to public health or safety); or

(c) the Operator qualifies for a variance under 19 NMAC Subpart 10 (the standard imposes undue economic burden, and the variance will not result in a significant threat to human health, safety, or the environment).

Once all applicable revegetation performance standards have been met for a revegetated unit, and all other permit-related reclamation requirements for that unit have been satisfied, then conditions for final bond release and release from future responsibility will also be met and sureties covering that respective unit will be released.

6.0 REFERENCES

Bonham, Charles D. 1989. Measurements for Terrestrial Vegetation. John Wiley & Sons. 338 pp.

Hoenes, B. D. and L. C. Bender. 2012. Factors influencing foraging habitats of mule deer (Odocoileus hemionus) in the San Andres Mountains, New Mexico. The Southwestern Naturalist, Vol. 57, No. 4 pp. 370-379.

Renard, K. G., G. R. Foster, G. A. Weesies, D. K. McCool, and D. C. Yoder (Coordinators). 1992. Predicting soil erosion by water: a guide to conservation planning with the revised universal soil loss equation (RUSLE). U. S. Department of Agriculture. Washington, D C. 400 pp. + appendices.

USDA-NRCS. 1993. National soils handbook. Superintendent of Documents. U. S. Government Printing Office. Washington, D. C. Various pages.

USDA-NRCS. 2011. Ecological Site Information System (ESIS) Database - ESD User Guide.

USDA-NRCS. December 26, 2013. Soil Survey Geographic (SSURGO) database for Cibola Area, New Mexico, Parts of Cibola, McKinley, and Valencia Counties. Fort Worth, Texas. http://websoilsurvey.nrcs.usda.gov

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