

# RESOURCE NOTES

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## *Mine Revegetation in Nevada: The State of the Art in the Arid Zone*

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### Background

Revegetation of mined lands, including cyanide leach heaps, is an evolving technique in the arid intermountain west. At the Bureau of Land Management (BLM) Salt Desert Shrub Symposium in 1966, noted desert plant ecologist A. P. Plummer commented that the success rate of revegetation efforts where annual precipitation was under ten inches was less than one percent. Now, thirty years later, successful vegetation is the norm in even the driest and hottest parts of Nevada. There is no area where perennial native species have not been re-established after mining disturbance at cover and density equal to or far exceeding that of undisturbed areas. Areas which have not been intentionally revegetated are uniformly dominated by exotic annuals.

### Discussion

The keys to successful revegetation are site preparation, species choice, and timing. Site preparation consists of reduction in slopes to 2.5 or 3:1, application of suitable growth medium and creation of a roughened seeding surface. Because extremely arid soils rarely have significant A and B horizons, topsoil may be either unavailable or too salty and/or silty to be useful.

Most mines move ample supplies of Tertiary or Quaternary alluvial overburden material in the process of accessing the ore bodies. This can be salvaged as growth medium. Because the nutritional requirements of native plants are rarely known, and because the growth medium is assembled one truckload at a time, soil chemical testing is not indicated unless problems with excessive salt or boron are anticipated. It is only necessary to assure that the medium contains a mix of coarse and fine material that will allow creation of an uneven surface with adequate safe sites for seedling establishment.

Upon application of the material to a depth of 18 inches or more, the surface should be shallowly ripped with heavy equipment to roughen it. Numerous observers have concluded that smooth surfaces are the leading cause of failed revegetation efforts on mined sites in Nevada (This is consistent with much experience with desert seeds that suggests that safe sites which provide a good microclimate and ensure seed-to-soil contact and perhaps water harvest are vital to germination). A diverse mix of site-adapted native shrubs, forbs, and grasses is then broadcast at a rate of 20 - 30 seeds per square foot. The mix should include at least three or four species from each of the three plant forms. Where the use of non-native species is required, the documentation of their need is required by BLM policy. Observation of the surrounding terrain may suggest suitable species, although fire and grazing regimes may have degraded these areas so severely that they are dominated by annuals or undesired perennial. In such cases, consultation with local managers and observations of past successful

revegetation efforts can guide species choice. It is important that seeding be done in late fall or early winter to take advantage of seasonal precipitation — summer seedings are rarely successful in Nevada except at higher elevations. After seeding, the surface should be immediately dragged with some device to cover the seed. A piece of chainlink fence weighted with scrap iron or large tires is often used.

Joint state and federal guidelines for release of revegetated disturbances on public lands in Nevada allow evaluation of efforts after three or more growing seasons have elapsed. Evaluation consists of comparison with a reference area or standard, usually an adjacent undisturbed area. Ecological Site Indices, test plots, or other reference standards may also be used. Comparison is by aerial cover of vegetation, usually measured by the line intercept methods described in Sampling Vegetation Attributes (Interagency Technical Reference BLM/RS/ST-96/002+1730, 1996, BLM National Science and Technology Center, Denver, Colorado) or other vegetation analysis references. Nevada guidelines require that the cover be as close as possible to that of the reference site, with evidence of site stability, species reproduction, and no noxious weeds.

Sampling must be adequate to provide 80% assurance that the samples are within 20% of the true mean cover of both the reference and revegetated sites. This typically requires 7 to 10 intercept transects on each site. A simple equation for determination of sample adequacy is included below:

$$N = (T)^2 \times (S)^2 / (\text{mean} \times 0.2)^2$$



where, N = minimum number of samples required to give 80% probability of being within 20% of the true mean

T = two tailed t value at (n-1) degrees of freedom and alpha=0.80 (from a standard table)

S = standard deviation of preliminary samples

Typically six intercepts comprise a satisfactory preliminary sample. If fewer are used, the equation will provide an incorrectly high number of required samples to achieve the required adequacy.

### Conclusion

Hundreds of examples of successful revegetation at diverse elevations, site conditions, and locations have proven that there are few if any

arid sites in the intermountain west which cannot be simply and economically revegetated. In most cases, the species choice results in a far more productive post mining land use than was present on degraded sites before the mining disturbance. However, the use of vegetation to intercept meteoric water before it can penetrate cyanide leach heaps should be approached very cautiously. Most proposals for this to date have incorporated serious flaws. These include uncertainty about rooting depth of planted or invading species, no acknowledgement of the fact that grazing or fire may remove the vegetation at undetermined times, and general ignorance of the fact that in many areas the precipitation occurs in winter when

plants are not actively transpiring significant amounts of water. Enthusiasm for the potential of revegetation success should not lead to inappropriate applications of the technology or uncritical application of modelling techniques developed in other regions.

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Reclaimed haul road: The green, grassy area is a 120 foot-wide haul road three years after reclamation. This is an extremely harsh site where temperatures range from well below zero to over 100F, while the saline soils receive approximately 4 inches of precipitation annually.

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