ROSEMONT COPPER

UNIVERSITY OF ARIZONA RECLAMATION TEST PLOTS

The purpose of the test plot project is to evaluate different reclamation techniques in order to establish successful reclamation methods. There have been two previous phases to the project that tested 29 different native species from the site and compiled into 4 seed mixes. The different seed mixes were tested in the University of Arizona greenhouses using 3 different rainfall scenarios, 3 soil types, and 3 amendments with 4 replications of each scenario. The test plots are the third phase of the project, which will evaluate the established native species seed mix and methods while exposed to the environmental conditions of the site. Two reclamation methods will be evaluated using three levels of straw mulch (no mulch, mulch placed on the soil surface, and mulch incorporated into the soil), and two levels of soil roughness (smooth surface and rough surface). A soil conditioner will be used when mulch is placed on the surface to prevent movement from wind or water. Research results will help land owners across Southern Arizona transform disturbed or degraded lands into properly functioning plant communities.

The objective of reclamation is to create a self-sustaining, self-repairing ecosystem. Re-establishing vegetation will create a positive feedback loop, which will help repair hydrological processes and site stability. There are two test plot sites located at two elevations; these elevations represent the lower and upper elevations of the future buttress, at approximately 4600 and 5400 feet above sea level. To mirror future reclamation of the outer buttress, one-foot of growth media consisting of two topsoil-types will be used: Gila and Arkose, which will be placed at both sites. The majority of the buttress will expose an east-facing slope with a gentle 3 to 3.5-to-1 slope. Heavy equipment traffic during the construction of the test plots will be limited to decrease compaction, which will increase infiltration and reduce soil erosion. Vegetation establishment will help to hold soil in place which will prevent soil erosion and loss and retain water quality. Roots will reach down into the soil and bind the soil beneath, while the plant cover helps to intercept the rainfall impact and to infiltrate into the soil. Successful revegetation will have many positive effects for a permanent, natural solution. Seedbed preparation is a key factor for successful revegetation.

Soil surface roughness can have a significant impact on seedling germination. A rough soil surface will reduce wind erosion, create micro-niches and will retain soil moisture better than a smooth surface. A rough surface may be scarified by using a tine ripper, chisel, drill, or disc to name a few. A smooth surface may be created by a land roller, or dragging a chain or blade and will provide more consistent soil-seed contact, but is subject to higher rates of evaporation. The test plots will use both methods with the combination of a mulch treatment; a smooth surface will allow better mulch contact to the soil surface.

Mulch can be made out of a variety of materials, including straw, hay, native grasses, wood chips, or gravel. Plant litter is nature's mulch and is composed of dead organic materials, such as leaves, bark, or branches. Mulch reduces soil moisture evaporation and soil erosion from wind and water, which can make a significant difference in when rebuilding an ecosystem. Mulch can

be applied to the surface or be incorporated into the soil and is a way to enhance the microtopography. If the mulch is applied to the surface, it is often crimped or used in conjunction with soil tackifier to keep the mulch protected from the wind and water. The light color of the straw will also help to reflect sunlight and allow it to aesthetically blend with the surrounding semi-desert grassland. Adding mulch can serve as a protective layer to seeds, shielding them from sunlight, heat, wind and predators, though different species require different conditions to germinate.

The seed mix currently being tested has six warm-season perennial grasses, one cool-season perennial grass, one annual forb, one perennial forb, and one shrub. These species are native to the Southeast Arizona and were chosen from the results of the University of Arizona greenhouse studies. The seed mix was allocated using the Natural Resource Conservation Service Ecological Site Description to represent the target functional group. The mix will produce similar productivity rates and biomass to the natural ecosystem, which will support future grazing and wildlife needs. Selecting native seeds will improve success rates, as the seeds are adapted to the arid Southeast Arizona region.

There are many different ways to spread seed in an area; this project is testing broadcast seeding for use across large areas, where a tractor spreads seed evenly. The seeding rate is slightly higher than other methods, like hydroseeding or drill seeding, since not all seeds will not end up at its optimal burying depth or have optimal seed-soil contact. Broadcast seeding with a rough soil surface is anticipated have favorable results due to small amounts of particle movement, which will bury the seeds naturally. Timing is an important factor when seeding; warm-season species must be seeded when soil temperatures are high and before monsoon rains begin in July and cool-season species before the winter rains begin in January. Seeds need a sufficient precipitation event to germinate the seeds, followed by additional events to establish the plants. Seeding too early may leave the seeds exposed to predators and unfavorable conditions that may terminate the seeds. If climatic conditions are not optimal during a season, most seeds will lie dormant and viable until the next opportunity comes for germination.

Continuous and repeated monitoring of each key element will be used to assess reclamation success. Vegetation can be measured using transects and quadrats to measure species composition, diversity, cover, and biomass. Hydrological processes will be measured by means of soil erosion, including soil topography, moisture content, infiltration, compaction and crusting. Precipitation, temperature and other climatic conditions will be examined in association to vegetation response with the various treatments. The seed mix, soil roughness and mulch treatments will then be evaluated to find the most successful techniques. The test plots were placed on private Rosemont Copper property, in areas that will not be disturbed in the future; additional, long-term tests may be conducted to ensure successful reclamation of the Project.

DEFINITIONS

Annual: A plant which germinates, flowers, and seeds in a single season (NRCS 2005).

Arkose: A topsoil material that is characterized predominantly by sandstone sediment.

Buttress: The perimeter structure composed of the waste rock and tailings, capped with topsoil and revegetated.

Compaction: When a force is applied to soil particles, like sand, silt or clay, and becomes denser and pores between soil particles become smaller, resulting in a hard soil layer.

Ecosystem: An ecological system or unit that includes living organisms and nonliving substances which interact to produce an exchange or cycling of nutrients.

Forb: Flowering annual, biennial, or perennial plant, with leaves and stem.

Gila: A topsoil material that is characterized predominantly by alluvial deposits of sediment grains and pebbles.

Infiltration: The process in which water enters the soil; factors such as soil crust, soil texture, compaction, organic matter, aggregation and structure, pores, temperature, and water content all affect infiltration (USDA, 1998).

Invasive Species: An alien species whose introduction is currently or is likely to cause economic or environmental harm or harm to human health.

Mulch: Protective cover typically placed over the soil to modify conditions for plant growth.

Quadrat: A measured square or rectangular unit that is used in ecology to sample an area.

Reclamation: The process designed to adapt a natural ecosystem to serve a utilitarian human purpose. It may put a natural ecosystem to a new or altered use, most often using introduced plants. It is often used to refer to processes that replace native ecosystems and convert them to agricultural, mining or urban uses (NRCS 2005).

Shrub: A woody perennial plant differing from a tree by its low stature and by generally producing several basal shoots instead of a single stem.

Topography: The study of the Earth’s surface shape and features.

3 to 3.5-to-1 slope: A raise of 1 foot for every 3 to 3.5 feet horizontal feet.

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