OIL AND GAS RECLAMATION IN ARID SOILS

Aimee Davison
EOG Resources, Inc.

EOG Resources, Inc., in cooperation with surface management agencies, has pursued numerous methods to help minimize potential adverse environmental impacts and to improve reclamation of well locations, access roads, and pipeline routes. Among the primary issues when considering the location of well pads, roads, and pipelines are slopes, drainage patterns, and vegetation. An attempt is made to utilize existing pads, roads, and pipeline corridors whenever possible to minimize additional disturbance and also to provide the opportunity for improved reclamation of old, inadequately reclaimed disturbances. Location sites with slopes greater than **24%** and access roads that would require slopes greater than 10% are avoided. Every effort is made to eliminate the need for severe cuts, which inevitably leave unsightly topographic scars and potentially result in severe erosion on the slope face. It was not unusual in the past to lose significant amounts of soil from these cut areas. In addition, areas that would create unmanageable watershed issues or create excessive damage to critical winter range vegetation are also avoided.

Once the site selection process has been completed, construction proceeds with the goal of meeting the needs of the project while minimizing disturbance and reclamation requirements. Reclamation considerations include reserve pit siting, optimization of cut and fill, and placement of topsoil and spoil. Typically, approximately 6" of topsoil is removed from a location and placed to decrease the possibility of any loss of material to off location areas. Efforts are made to replace the topsoil within six months, which helps to alleviate the loss of organic matter, microorganisms, and soil structure. Reserve pits are located away from fill areas in order to eliminate the potential leakage of drilling fluids into these soft, unconsolidated soils. Access roads are crowned and ditched as opposed to flat blading. In addition, most roads are graveled to prevent excessive soil movement off the road surface and shoulders. Culverts and wing ditches are placed to optimize the control of water erosion and minimize the movement of topsoil. Topsoil removed during road construction is later returned to the shoulders and seeded. Whenever practical, pipelines are placed parallel to the access road and are reseeded in conjunction with the reseeding of the road shoulders. The practice of building berms over the pipeline has been discontinued to help eliminate the unnatural flow of water and subsequent erosion on the pipeline corridor. Pipeline corridors are now constructed to conform to the natural lay of the land.

Following the drilling, completion, and facility installation phases, the disturbed areas that are not required for continuing operations are reclaimed to conform as closely as possible to the original contour of the affected land. The rehabilitated areas are scarified to a depth of 18" with 8" spacing between rows. Even though the tight spacing of the rows significantly increases reseeding costs, the practice aids in reducing weed encroachment, accelerates vegetative recovery, and decreases erosion tendencies. The scaritied area is planted with a mixture of seed that is representative of the natural vegetation in the vicinity. Seeding concentrations are determined on a case by case basis. Where the terrain is relatively steep, reseeding is done by hand and the slope is then raked. Seed mixes have been revised to include grasses that are more nutritious for wildlife that utilize the reclaimed area for grazing in the spring. The ultimate goal **of** EOG Resources is to attain stability of the disturbed acreage by providing sufficient vegetative cover and litter to prevent future degradation of the affected surfaces. Mulch is often used as a protective cover in areas that have poor topsoil composition and high erosion potential. The mulch increases filtration, reduces wind erosion, lessens rainfall impact and the effect of surface runoff. In areas where relatively heavy grazing may be an issue, reclaimed acreage is often enclosed by an electric fence to prevent spring feeding on new growth. The fencing is typically removed after two growing seasons if the vegetation has been adequately established. These areas normally host a more abundant plot of grasses and forbs than surrounding areas.

Successional changes begin after the disturbance is returned back to its original topography, accompanied by soil building. Many annuals and some less desirable plants occupy most of the disturbed area the first season, with perennial grasses beginning to be established. Noxious weeds are controlled through herbicide applications. Translocated, selective herbicides are used to eradicate these undesired species. The second growth season is more of a transition into a perennial mix of grasses and forbs. As competition for space, light, and nutrients becomes tighter, fewer annuals occupy the area. Translocation of seed from the wind, animals and other reclaimed areas also aids in the establishment of ground cover. Through native vegetation encroachment, seed establishment and microenvironmental soil changes, the area begins to resemble nearby undamaged ecosystems.

Winter range habitat has been enhanced through the establishment of critical shrubs used by browsers. Shrubs have been extremely difficult to cultivate from seed. EOG Resources, Inc. has experimented with multiple ways of propagating various shrubs. Some success has been achieved through planting shrub seed in small islands. This is planted as a monoculture, excluding grasses and other plants that would compete with delicate seed. Vesicular-arbuscular mycorrhizae (VAM), which is found in a majority of rangeland plants (Newman et al 1986), is often a depleted or missing factor in the regrowth process. VAM is responsible for enhancing water transport in plant material and increasing phosphorous, nitrogen and mineral absorption. It also incorporates the cycling of these minerals and the energy flow process. When soil is disturbed, VAM is reduced and in some cases lost due to the amount of time topsoil is stored. Some plant nurseries offer seedlings that have been cultured in mycorrhizea environments, which may aid in the establishment process. Browsers target individual shrubs that are of nutrients value. To ensure that the shrubs do not get overbrowsed before the are fully established, cages are installed over delicate seedlings. Even then climatic conditions, including precipitation levels, most often dictate the amount of success that is experienced.

Once the well is no longer used to produce natural resources, the entire location and access road is reclaimed. All gravel is removed from the access road and spread on existing roads where needed. The culverts are removed and drainages are reinstated. If there is excessive till material over the culverts, it is spread over the roadbed. Cattle guards are removed and wire fence gates are installed to replace them. Vegetation and topsoil from the road and borrow ditches are bladed out to the apex of the borrow ditch. Borrow ditches are bladed in and topsoil is replaced once the area is brought back to its natural form. Water bars are installed on slopes steeper than 4%. This helps to reduce the velocity of runoff water, reducing erosion.

Well sites are completely reclaimed to their previous state. The contour of the land is completed, and all available topsoil is spread. Drainages are put back to their original slope as nearly as possible. Rock dams will be installed in the drainages that have down slopes greater than **4%.**

Lastly, bonds are released once the plant success is diverse and self sustaining, developing a plant ecosystem. As managers of the land, we must remind ourselves that we are simply in the natural process of ecosystem succession towards societal goals (Heady and Child 1994). We influence the vegetative success that produces forage for wildlife and domestic animals, providing habitat for wildlife and enhancing the esthetic values of the site (Laycock 1980).

LITERATURE CITED

Heady **H.** F., R. D. Child. 1994. Rangeland ecology and management. pp 435-451. *In:* Reclamation of damaged rangeland. Westveiw Press, Inc., Boulder Colorado.

Laycock, W. A. 1980. What is successful reclamation?—a **look** at concepts of adaptability, productivity, cover, and diversity of seeded species. pp 1-17. *In:* Northwest Colorado land reclamation seminar II Proc. Steamboat Springs, Colorado.

McFarland, M. L., D. N. Ueckert and S. Hartman. 1987. Revegetation of oil well reserve pits in west Texas. J. Range Mgmt. 40:122-127

Newman, E. F., R. D. Child and C. M. Patric. 1986. Mycorrhizal infection in grasses of Kenyan savanna. Jour. Of Ecol. 74(4). December 1986.