# PRODUCED WATER SPILLS SOIL RECLAMATION TREATMENT

Produce water spills may elevate the salt content of soils to a level that will be detrimental to vegetation, especially if the spill is 10 barrels or more. Soils with high clay naturally have a higher concentration of sodium and chloride and a lower permeability. Therefore, because of the higher clay content spilled salt water tends to accumulate resulting in greater impacts. Sandy soils on the other hand, tend to allow the salt water to disperse away from the spill and are more resistant to damage. Salts are a combination of cations (sodium, calcium, magnesium, etc.) and anions (chlorides, sulfates, bicarbonates, etc.).

## Damage Assessment

After a spill, a soil sample should be taken of the affected area and a background sample, in close proximity to the spill site, for comparison purposes. Saline soils are defined as having an electrical conductivity (EC) equal to or greater than 4 mmhos/cm and the exchangeable sodium percentage is less than 15 percent. Generally, these soils have a pH value below 8.5. Sodic soils contain excess sodium compared to other cations and have an exchangeable sodium percentage (ESP) greater than 15. Saline-sodic soils are soils which have characteristics of both saline and sodic conditions. If the soil testing indicates a saline, sodic or saline-sodic site reclamation of the site will be necessary.

## Remediation

Arid regions, such as the San Juan Basin, require active removal of salts. Soluble salts are quite easily removed from the saline soil if the salts can be leached with fresh water to a depth beyond the rooting zone. High levels of chloride are also easily removed by leaching. Chlorides ions are highly soluble and mobile in soil solutions and easily dispersed. To successfully leach salts beyond the rooting zone, adequate drainage is necessary to promote rapid downward flow of water. Generally, a minimum of one (1) inch of fresh water must be applied for each inch of soil depth to be reclaimed. The reclamation proceeds more rapidly if the fresh water is impounded rather than sprinkled. Repeated application may be necessary until soil test results approach background values.

Soils that impacted by high levels of sodium, called sodic soils, will physically and chemically change the soil condition. Clay particles will disperse and lower the permeability of soil to air and water. This dispersion also forms dense, impenetrable surface crusts that greatly hinder the emergence of seedlings. Sodic soils tend to have a high pH. A high pH, will causing no direct effect to plants, but will hinder the availability of nutrients such as iron, manganese, calcium, and magnesium. However, high sodium and chloride levels can be toxic to plants. High levels of Sodic soils are defined as having an exchangeable sodium percentage (ESP) greater than 15.

Sodic soils can be reclaimed by adding an amendment that supplies soluble calcium. The calcium replaces excess sodium in the soil and the sodium can be removed by leaching with fresh water. Gypsum is the most commonly and economically used amendment. Other commercial amendments are also available. The gypsum must be fine grained and

mixed thoroughly with the soil. Based on the level of contamination, sufficient amendment must be added to react with other soluble compounds in the soil that will compete with sodium for the calcium. Saline-sodic soils are soils which have both saline and sodic conditions present.

Excavation is suitable remediation option which can be implemented quickly and produce rapid result. Excavation will require disposal of the salt-impacted soil, replacement with suitable fill material, compaction or grading of the fill, and revegetation of the reclaimed site. However, rugged terrain may make excavation impracticable and active reclamation is the recommended option. Reclamation will proceed slowly and initial beneficial results will not be observed for 6 months to 1 year. Vegetation restoration may not be complete for 3 to 5 years.

**Conclusions**

Reclamation and excavation are the two options suitable to remediate produced water spill sites. Reclamation needs to be conducted promptly after soil conditions are determined to minimize deterioration of the soil structure. The recommended amendment is gypsum due to it availability and low cost, but other commercial amendments are available. A rate of seven (7) tons per acre of soil disked to one (1) foot is recommended for clay soils and four (4) to six (6) tons per acre for sandy soils. Leaching with fresh water should immediately follow the application of amendments. The amount of fresh water applied should equal the thickness of the soil profile present at the spill site up to maximum of 60 inches. The water needs to be applied in several stages as is practical to allow for impoundment over the spill area if topography suitable.

Excavation can be implemented quickly and produce rapid results, but will require disposal of salt impacted soil, replacement with suitable fill material, and may not be practical on rugged topography. An excavation program is most effective if it were implemented to remediate very small volumes of soil.

Spills that extend beyond areas that have previously been permitted, cleared or approve, will require operators to obtain: (1.) Temporary Use Permits if the action is related to oil and gas (Mineral Leasing Act) operations, (2.) Short Term Right-of-Way if related to pipeline and road (FLMPA) actions, and (3.) conducting all necessary clearances and approvals for cultural, paleontological, and biological resources.

[D. Wirth BLM Farmington]