Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

LAND RECLAMATION, ABANDONED MINED LAND

CODE 543

(ac)

DEFINITION

Reclamation of land and water areas adversely affected by past mining activities.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Decrease erosion and sedimentation
- Improve offsite water quality
- Protect public health and safety

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to abandoned mined land with one or more problems that degrade the quality of the environment; prevent or interfere with the beneficial uses of soil, water, air, plant, or animal resources; or endanger human health and safety.

This practice also applies to nearby nonmined areas adversely affected by the past mining activities. Treat the source of the problem before or in conjunction with treatment of the nonmined areas.

CRITERIA

General Criteria Applicable to All Purposes

Assess the hazards and resource concerns onsite. These hazards and resource concerns may include, but are not limited to, highwalls, shafts or adits, toxic soils, contaminated runoff, excessive erosion or sedimentation, invasive or unwanted vegetation, and trash and garbage. Develop a reclamation plan that addresses the hazards and resource concerns identified for the site. The plan must be consistent with the site capability, the planned land use, and the landowner's conservation objectives. Include practices necessary to reclaim the mined area and areas adjacent to the mined area that are adversely affected by the mined area.

Public health and safety

Prior to beginning onsite investigations, identify possible hazards and implement appropriate safety precautions.

Erosion and sediment control

Control or treat runoff and sedimentation from treatment areas, soil material stockpiles, access roads, and permanent impoundments. Use sediment-trapping practices, such as filter strips, riparian forest buffers, contour buffer strips, silt fences, sediment basins, or similar practices. Include temporary practices necessary during earth moving activities and permanent practices necessary to stabilize the site and control runoff from the site after reclamation.

Control the generation of particulate matter and fugitive dust during removal and replacement of soil and other materials.

Site preparation
Identify areas for preservation during construction. Include areas containing desirable trees, shrubs, grasses, stream corridors, natural springs, historic structures, or other important features that will be protected during construction activities.

Remove trees, logs, brush, rubbish, and other debris that interfere with reclamation operations. Dispose of debris material in a way that does not create a resource problem or interfere with reclamation activities and the planned land use.

Storage of soil materials
Stockpile soil or fill materials until needed for reclamation. Protect stockpiles from wind and water erosion, dust generation, unnecessary compaction, and contamination by noxious weeds, invasive species, or other undesirable materials.

Highwall treatment
Slope rock walls to slopes that are 0.5:1 (horizontal to vertical) or flatter before placing backfill against the wall. Determine the thickness and density of lifts for fill material to limit the deep infiltration of precipitation and to limit settlement of the completed fill to acceptable levels, based on the available fill material and planned land use.

Shafts and adits
Use NRCS Conservation Practice Standard (CPS) Mine Shaft and Adit Closing (Code 457)to close/seal a shaft or adit. Divert runoff away from the shaft or adit.

Placement of surface material
Develop a grading plan that returns the site, including any offsite borrow areas, to contours that are suitable for the planned land use and control soil loss. Include the spreading of stockpiled topsoil material as the final layer. Treat graded areas to eliminate slippage surfaces and promote root penetration before spreading surface material. Spread surface soil without causing over-compaction.

Shape the land surface to provide adequate surface drainage and to blend into the surrounding topography. Use erosion control practices to reduce slope lengths where sheet and rill erosion exceeds acceptable levels. If settlement is likely to interfere with the planned land use, develop surface drainage or water disposal plans that compensate for the expected settlement.

If the subsurface material is not a source of contamination, improve soil permeability after placing backfill material by using deep ripping tools to decrease compaction, promote infiltration, and encourage root development. Do not plan practices that promote infiltration if seepage through cover materials has the potential to develop or exacerbate acid mine drainage loading or treatment.

Restoration of borrow material
If cover or fill material is taken from areas outside the reclamation site, stockpile the topsoil from the borrow area separately, and replace it on the borrow area after the area is restored for its intended purpose. Grade and shape the borrow area for proper drainage, and revegetate the site to control erosion.

Establishment of vegetation
Prepare a revegetation plan for the treated areas. Select plant materials suitable for the specified end land use according to local climate potential, site conditions, and local NRCS criteria. Use native species where possible. Avoid use of invasive species.

Use the criteria in NRCS CPS Critical Area Planting (Code 342)to establish grasses and forbs. Use NRCS CPS Tree-Shrub Establishment (Code 612) for the establishment of trees and shrubs. If vegetation cannot be established, use NRCS CPS Mulching (Code 484).

Control of toxic aqueous discharge
Identify and document water quality and quantity releases from seeps, overland, and mine shafts. Quantify water impacts such as low pH, arsenic, etc. Identify measures that may affect treatment such as dissolved oxygen, iron, aluminum, magnesium, manganese, etc.

Methods for treatment of toxic aqueous discharge depend upon the type and extent of the contamination. When control of toxic mine drainage is needed, use best management practices (BMPs) that comply with State regulatory requirements. Evaluate the consequences of each potential treatment method to avoid creating a secondary problem. Select a method that can adequately treat the water based on the quantity and chemistry of the mine water and that is suitable for the planned level of operation and maintenance. Size the treatment area and settling basin(s) to allow for the volume of flow and treatment rate. Include a plan for disposal of the precipitated metals and spent treatment material.

Reduce the volume of contaminated water by diverting clean water away from the contaminated area or by limiting the opportunity for water to contact contaminated soil materials. Install practices, such as diversions, underground outlets, lined waterways, or grade stabilization structures, to control surface runoff. To the extent possible, divert clean upslope runoff away from the treated area.

Contaminated soil materials
Remove, bury, or treat soil materials that adversely affect or have the potential to adversely affect water quality or plant growth. Bury materials containing heavy metals below the root zone, add suitable soil amendments, or both, to minimize the negative effect of this material. Separate soils with high electrical conductivity, calcium carbonate, sodium, or other restrictive properties, and treat, if practicable.

Add a layer of compacted clay or a landfill cover over the contaminated material to deter infiltration. Place an earthfill blanket over the compacted clay to support plant growth. For each layer, identify the lift thickness and density needed to limit deep infiltration of precipitation and excessive settlement of the completed fill.

Mine sealing
If clean water is entering a mine opening, divert the water away. If contaminated water is exiting the mine, it may be necessary to seal the mine to prevent water movement. Use NRCS CPS Mine Shaft and Adit Closing (Code 457)to design the mine seal. Divert surface water away from the mine seal.

Neutralization and precipitation
Precipitate toxic metals and neutralize acidity in mine drainage using chemical or biological treatment. Select a method that can adequately treat the water based on the quantity and chemistry of the mine water and that is suitable for the planned level of operation and maintenance. Size the treatment area and settling basin(s) to allow for the volume of flow and treatment rate. Include a plan for disposal of the precipitated metals and spent treatment material.

CONSIDERATIONS

The key to a successful restoration is often dependent upon the proper placement of soils that will best support vegetation. One means to do this is to develop a detailed soil survey for the project and proposed borrow areas. Use the soil survey to identify the types and extent of soil materials and those that will best support vegetation.

Maintenance activities need to be done on a regular basis after the initial reclamation to ensure success. The construction of stabilized access roads allow access to the site for maintenance without causing erosion problems.

Reclaimed mine areas can provide important wildlife habitat. Improve the potential for wildlife habitat by establishing diverse vegetation types, including water in the reclaimed landscape, increasing edge effect, and diverse landforms. Avoid monocultures of vegetation. Use native, noninvasive vegetative species where possible.

Reclaimed soils are often low in organic matter. The use of organic soil amendments such as manure, compost, mulch, or sewage sludge can contribute to the success of vegetative establishment by increasing soil organic matter. Use deep-rooted perennial grasses and trees to further increase the long-term buildup of organic matter in the soil.

Consider the visual appearance of the completed site to ensure compatibility with nearby land uses.

Consider the complexity of the operation and maintenance needed for each potential solution during planning. Select treatments that are compatible with the desired level of maintenance.

PLANS AND SPECIFICATIONS

Prepare plans and specifications that describe the requirements for applying this practice to achieve the intended purpose or purposes.

At a minimum, include—

- A preliminary site report that describes the safety requirements for the investigation.
- A site investigation report that documents—
  - Risks to life, environment, and property associated with the mine.
  - Purpose of reclamation, including both onsite and offsite, as needed.
  - Access conditions on site.
  - Geology and ground water conditions at the site.
  - Amount of trash and debris onsite.
  - Presence of hazardous gases or acid mine drainage.
  - Inventory of the existing soil conditions, including the chemical and physical properties.
  - Water quality and quantity from seeps, runoff, and mine shafts.
  - Soil tests for pH and nutrients levels.
  - Mine history, including mine plan, if available.
  - Inventory of plant or animal species present onsite.
- Potential effects of changes to hydrology of site.
- Plan view of site with the location of structures, water features, etc.
- Plans showing the final grading to take place on the reclamation area. Identify lift thickness and compaction requirements.
- Profiles and cross-sections, as needed.
- Borrow and spoil requirements, including material types and quantities needed.
- Disposal plans for material removed from site.
- The location of topsoil and fill stockpiles.
- Erosion and sediment control practices.
- Dust control practices.
- Soil amendments to be applied to the site.
- Detailed information on the species and arrangement of plant materials to be planted on the site. Include the criteria for successful establishment of vegetation such as minimum percent ground and canopy cover, percent survival, or stand density.
- Site monumentation requirements.
- Active or passive treatment features such as dosing, Successive Alkalinity Producing System , Open Limestone Channel (OLC), and Anoxic Limestone Drain (ALD).
- Permanent features to be constructed on site such as fences, diversions, etc.
- Construction specifications.

- Safety requirements for construction.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for the site and review with the landowner prior to construction. At a minimum, include—

- Periodically check the site for areas where settlement may adversely affect drainage and land use. Perform needed repairs promptly.
- Periodically check the site for bare spots, eroded areas, areas of excessive settlement, and other areas where initial attempts to establish vegetation were not successful. Use soil testing to identify soil amendments needed to facilitate revegetation.
- Periodic soil testing and checking of vegetation to determine if additional soil amendments are needed.
- Periodically check the site for noxious weeds and invasive species. Treat, as appropriate.
- Inspection of passive treatments for clogging and damage.
- Operation requirements for active treatments.
- Maintenance of access roads.
- Maintenance of drainage structures and channels.
- Control of vehicular traffic to minimize disturbance to reclaimed areas.
- Periodically check structural measures and fencing. Repair or replace, as needed.
- Regular checking and maintenance of water treatment facilities, if applicable.

REFERENCES

USDA NRCS. 1983 (rev. July 2010). Landscape Architecture Note 1 (Title 210). Landscape Design in Mined Land Reclamation. Washington, D.C. https://directives.sc.egov.usda.gov/.

Fripp, J., P.F. Ziemkiewicz, and H. Charkavorki. 1999. Acid Mine Drainage Treatment – An Overview, TN SR-99. U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.