The Swastika Mine and Dutchman Canyon Reclamation Project

- Design and Construction Oversight

Completed Geomorphic Reclamation of Dillon Canyon at the Swastika Abandoned Coal Mine Site

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The Swastika Mine and Dutchman Canyon Reclamation Project

• Design and Construction Oversight
• Reclamation and Revegetation
Geomorphic Reclamation of Abandoned Coal Mines near Raton, NM

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Historic Mining in the Raton Coal Field near Raton, NM

Swastika Mine, 1917-1953

Swastika Mine Camp, courtesy of the Raton Historical Museum

Abandoned Mines in Dillon Canyon
Abandoned Coal Waste at Swastika Mine

- High, ungraded “piles”
- Flat-topped “bench”
- Pile 3
- Pile 5
- Pile 2
Environmental Detriments Associated with Abandoned Coal Waste

- Unstable coal waste slopes collapsing into the stream
- Infiltration leaching contaminants from the coal waste pile and conveying them to the stream channel
- Coal waste eroding into the stream during runoff events
Environmental Detriments Associated with Abandoned Coal Waste

In those locations where runoff from the mountainside above the waste pile crossed the pile, very deep gullies eroded through the coal waste.
Environmental Detriments Associated with Abandoned Coal Waste

The “Dillon Canyon Stream” is an ephemeral tributary, with scattered perennial pools.
Environmental Detriments Associated with Stream Channelization

- The stream was straightened to accommodate coal handling facilities.
- Channelization reduces stream gradient and increases flow velocities.
- High flow velocities erode the channel bed and banks, destabilizing the stream.
Environmental Detriments Associated with Stream Channelization

- Channel bed degradation propagates from the disturbed reach.

- Bank erosion works towards the return to a meandering stream alignment.

- However, bank erosion is undesirable because it undercuts the coal waste pile and the road.
Environmental Detriments Associated with Stream Channelization

The large capacity channel conveys flood flows in-channel, without the benefits of floodplain inundation:

- Zones of shallow, slow overbank flood flow and deposition
- Bank storage
- Flood peak attenuation
- Riparian habitat benefits
Traditional Reclamation on Vermejo Park Ranch

Koehler Mine near Raton, NM

- Terraced Landforms with Downdrains
- Channels Armored with Rip Rap
Geomorphic Design: Mimic Stable Natural Stream and Landform Characteristics Created by Natural Processes

- Reduce Maintenance
- Improve Aesthetic and Habitat Values
Design Challenges

- Determining the design volume of coal waste to be reclaimed, given uncertainties about the underlying “native” landform obscured by the pile

- Determining appropriate slopes and slope lengths for reclaimed landforms that will have no underlying geologic structure
Design Challenges

• Conveying runoff from the undisturbed hillside across the reclaimed landform and into the channel

• Preserving a row of archaeological features lying at the base of the hillside behind the bench of coal waste.
Design Challenges

- Scattered archaeological features
- Power poles (during the design phase), and power lines (during construction)
- Scattered resources including mature trees and wetlands
Project Approach: Stream and Road Realignment

- Reshape the coal waste “bench” into a landform with stable slopes
- Return the channel to a restored, meandering alignment in the center of the valley
- Return the road to the abandoned road alignment on the east side of the valley, with road and drainage improvements
Project Approach: Partial Removal of Coal Waste

Remove enough material to accommodate the remaining coal waste volume in geomorphic landforms with stable slopes.
Project Approach: Combination Soil Borrow/Coal Waste Repository Landforms

- Provide borrow soil for capping coal waste landforms
- Provide excavated volume and additional volume above the natural ground surface for backfill by coal waste
- Minimize disturbance area
Combination Soil Borrow/Coal Waste Repository Landforms

- Borrow Stockpile
- Excavated Repository
  - Receiving Coal Waste Material
- Removal of Material from Coal Waste Pile

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Combination Soil Borrow/Coal Waste Repository Landforms

South Combination Soil Borrow/Coal Waste Repository with wood straw mulch

May 3, 2013
Completed Geomorphic Landform at Pile 3

Geomorphic Landform and Integrated Drainage Channel

March 7, 2013
GPS Machine-Control Landform Construction
Plan View of Project Cut/Fill Balance

- Preventing Disturbance to Archaeological and other Avoidance Zones
- Cut/Fill Balance for Coal Waste, Clean Fill and Capping Soil
- Minimizing Double- and Triple-Handling of Materials while Minimizing Disturbance Area
Dillon Canyon Coal Waste Landforms Before, During, After Geomorphic Reshaping
Dillon Canyon Stream Channel Before, During, and After Geomorphic Realignment and Restoration

Pile 2
Template Stream Reaches

- Low gradient, sinuous channel
- Low flow channel armored with small rocks
- Wide, shallow channel cross section with moderate, vegetated banks
- High flows inundate a functional, vegetated floodplain with shallow, low velocity flow
Geomorphic Channel Realignment and Restoration

Typical channel cross section geometry, transitioning from steeper to flatter side slopes depending upon the location in the meander pattern.

Steeper slopes on the outside of meanders are protected with a heavier TRM product (green) in the completed restoration.
Geomorphic Channel Realignment and Restoration

A berm of clear fill prevents coal waste material from backfilling the straightened channel below the maximum groundwater elevation.

Coal waste was excluded from the fill within the “Meander Belt” of the channel as a precaution against its exposure as the channel migrates over time.
Geomorphic Channel Realignment and Restoration
Reclaimed Valley
Compatibility with Undisturbed Features of the Valley

Questions?