INTEGRATING GEOMORPHIC RECLAMATION WITH UNDISTURBED AND PREVIOUSLY RECLAIMED AREAS USING A MULTI-PROGRAM COMPUTERIZED DESIGN APPROACH AT McKINLEY MINE

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McKINLEY MINE

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HISTORY:

- McKinley Mine Opened In 1962
- 1st Large Scale Surface Coal Mine in New Mexico
- Employed 600 people in its peak
- 175,000,000 tons over 50 years
Overview of the McKinley Coal Mine

The project area is located due North of Gallup NM
• PROJECT STATS:

• FINAL PIT HIGHWALLS - 11,850 LF

• UNGRADED SPOIL – 793 AC

• CONVENTIONAL RECLAMATION AREA – 211 AC

• CONTRIBUTING UNDISTURBED WATERSHED – 891 AC
SPECIFIC PROJECT CHALLENGES:

- Handle the interface between existing conventional reclamation & proposed geomorphic reclamation
- Incorporate run on from large upgradient watersheds
- Achieve an earth balance
- Evaluate constructability
Conventionally reclaimed areas
INTEGRATED GEOMORPHIC APPROACH

Hydrology
• Rainfall Parameters
• Runoff Characteristics

Geomorphologic Characteristics
• Drainage Density
• Ridge to Head Of Channel
• Concave Slopes
• Slope Lengths
• Channel Sinuosity

Hydraulics
• Channel Capacity
• Velocities
• Shear Stress
• Channel Protection
GEOMORPHIC APPROACH

Evaluate Undisturbed Stable Landforms
Determine Appropriate Modeling Tools
Design Watershed Network
Address Further Permit Stipulations
MULTI-TOOL APPROACH:

OSTM T.I.P.S. Toolbox

1. **NATURAL REGRADE™ With GeoFluv**
2. **ARC GIS**
3. **SEDCAD**
4. **HEC-RAS**
5. **RUSLE**

**OSM = Office of Surface Mining**

**T.I.P.S. = Technical Innovation and Professional Services**
Rainfall/Runoff Parameters

New NOAA Atlas 14 for New Mexico
- 2-yr, 1-hr (bankfull)
- 50-yr, 6-hr (floodprone)
- 100-yr, 24-hr (if required by permit)

Rainfall Distribution Curves
- Type II 70 distribution
- United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS)

Runoff Characteristics
- NRCS Curve Numbers (Disturbed/Undisturbed)
Drainage Density = \[ \frac{\text{Length Of Channel}}{\text{Watershed Area}} \]

Target Drainage Density = 154 ft/acre

Length = 420 ft
Watershed Area = 2.9 ac
Drainage Density = 145 ft/ac
Ridge to Head of Channel Distance
Determine Watershed Configuration

- Sub-Watershed Boundary
- Drainage
- Undisturbed Area
Complete a Geomorphic Design for Stable Landforms using Natural Regrade™

- Subwatershed Boundary
- Channel
- Ridge
- Valley
- 5’ Contour

Cut-Fill balance is achieved
Importance of Sub-Ridges and Sub-Valleys
As part of the comprehensive approach, additional analysis on the geomorphic design surface was completed to show that erosion rates and specified design flows would meet permit criteria.
Additional Analysis Completed

- A 100-yr, 6-hr peak flow analysis was completed for designed watersheds with contributing area greater than 1 mile.
- A 50-yr, 6-hr peak flow analysis was completed for designed watersheds with contributing area less than 1 square mile.
- A soil loss analysis was completed on the worst case slope in each watershed. The condition needed to be better than or equal to soil loss for pre-mining conditions.
- A channel stability analysis was completed to determine if additional channel protection would be necessary.
Channel Protection

- Riprap Lining
- Loose Rock Check Dams
Time Lapse – 2005 - 2011
Construction
Bulldozer rough grades watershed geometry by pushing horizontally from the channel bottom to the ridge tops.
Final Product
Benefits of Integrated Geomorphic Reclamation

- Stable Landform
- Flexibility for integrating with existing reclamation
- Ability to handle large flows
- Topographic Diversity
- Low Maintenance
- Aesthetically pleasing
Questions