Geomorphic Reclamation of Abandoned Coal Mines near Raton, NM

The Swastika Mine and Dutchman Canyon Reclamation Project

- Design and Construction Oversight
- Reclamation and Revegetation

Presented By: Kenneth E. Carlson, CPSS.: Habitat Management, Inc. (HMI)

Additional Preparers:

Robin F. Bay, Senior Environmental Scientist, Habitat Management, Inc.

Richard Spotts, P.E., President, Water and Earth Technologies, Inc.

Zoe Isaacson, Hydrologist, New Mexico EMNRD AML Program

Habitat Management

Water & Earth TECHNOLOGIES
Water Resources and Environmental Consulting

New Mexico Abandoned Mine Land Program
EMNRD - MMD

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

Sept. 18, 2012

Environmental Permitting & Reclamation Planning

- EA & FONSI
- Wetland Delineation and Jurisdictional Determination
- ACOE 404 NW-27 Permit
- ACOE Mitigation and Monitoring Plan Approval
- Archaeology Survey and SHPO Mitigation Plan Approval
- Wetlands Preservation & Reclamation Planning

Wetlands Preservation

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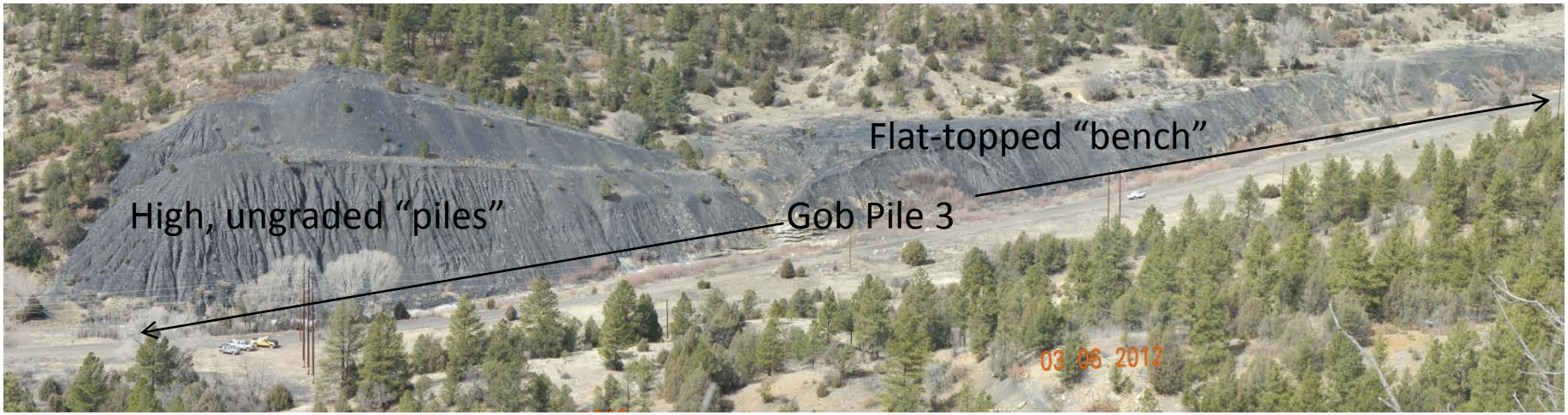
Wetlands Preservation

Abandoned Coal Waste at Swastika Mine



Site Characterization

- Gob Chemistry
- Borrow Soil Chemistry

Site Characterization

- Wetland Delineation
- Vegetation Survey
- T&E Species Survey

Reclamation Planning

- Borrow Soil Suitability & Volume
- Gob Mitigation

Gob Mitigation

Gob Pile	Depth (inches)	pH	EC (µS)	SAR	Potential Acidity (t/kt)
GP-5 Pre	0-6	4.4	0.39	0.73	2.2
GP-5 Pre	6-12	4.2	0.77	0.66	2.8
GP-5 Post	0-12	6.6	4.6	8.2	4.1
GP-3b Pre	0-12	7.4	2.0	15	1.4
GP-3b Post	0-12	7.8	2.7	11.5	6

Borrow Soils

Site	Borrow Soil Horizon	Depth (inches)	pH	EC µS	SAR	Texture	OM (%)
Swastika Borrow	A	0-35	7.4	0.44	0.71	L	1.87
	Bt	35-54	7.4	0.77	0.79	SCL	1.63
	Bk	54-85	7.5	.73	0.79	SCL	1.13
Swastika Channel	A	0-19	7.5	0.6	0.5	SCL	2.32
	Bt	19-64	7.0	2.4	0.6	SCL	2.62
	Bk	64-105	7.5	1.2	0.5	SCL	2.71

Reclamation Planning: Seed Mixes

	Composition (# of species, %, PLS/SF)			
Seed Mix	Grasses	Forbs	Shrubs	Total PLS/SF
Upland	10, 75, 37.5	6, 22, 11	3, 3, 1.5	50
Wetland Swastika	10, 85, 42.5	4, 15, 7.5	0, 0, 0	50
Wetland Dutchman	8, 90, 45	1, 10, 5	0, 0, 0	50

Construction:

- Channel Realignment
- Soil Borrow & Gob Repository

Construction:

- Installation of BMPS
- Gob removal and reshaping
- Geomorphic grading

Reclamation: Amendments

- Lime, Gypsum and Fertilizer were amended at rates determined by the soil test results

- Lime: neutralize potential acidity and SAR
- Gypsum: neutralize SAR
- Fertilizer: Nitrogen to modify C:N ratio of compost

Reclamation: Compost

- Local source of composted sawmill waste
- C:N ration of 110:1
- Treated with N to 30:1
- Applied at 400 cy per acre

Reclamation: Compost

- Applied at 400 cy per acre over gob and poor cap soils

Reclamation: Ripping

- Ripping to incorporate amendments and alleviate compaction
- Two perpendicular passes
- Rip to 12” depth
- Final pass on the contour

Reclamation: Seeding & Mulching

- Broadcast seeding at 50 PLS/sf
- Seed size variability & steep slopes required hand seeding

Woodstraw™ Application Rates:

- 0-5%: 4,000 lbs/acre (40% cover)
- <33%: 7,500 lbs/acre (50% cover)
- >33%: 13,800 lbs/acre (70% cover)

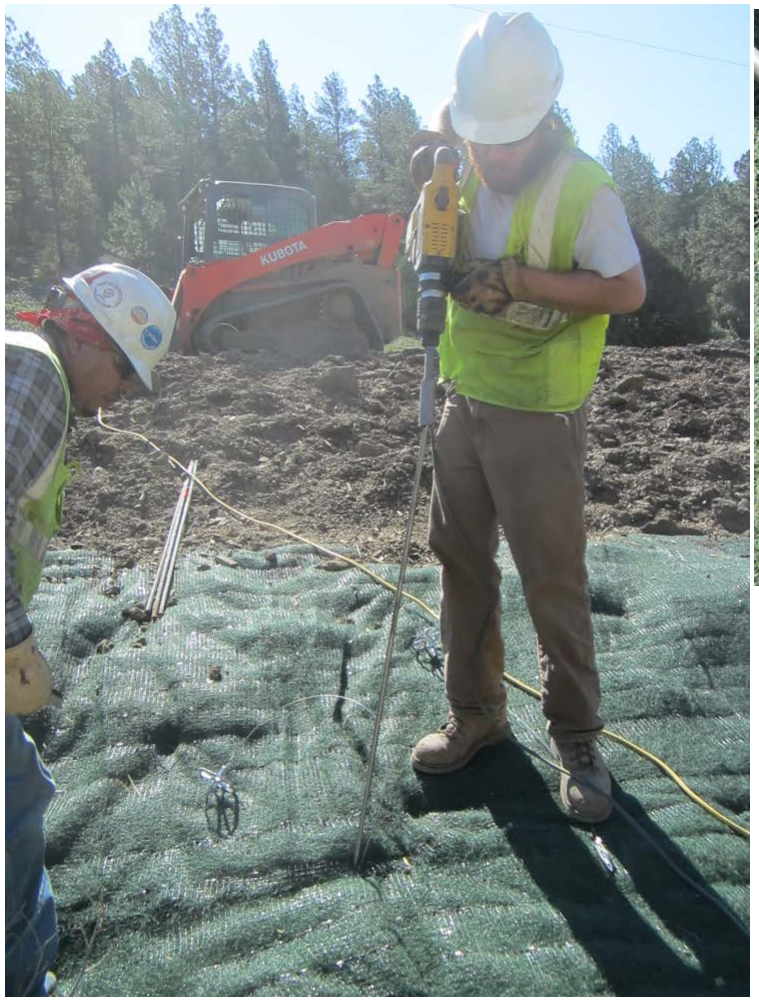
Reclamation: Turf Reinforcement Mat (TRM)

EXCEL CC4
LandLok TRM 450

Reclamation: TRM

Duckbill anchors used to secure TRM at edges

Reclamation: TRM



- Duckbills inserted 3 feet into the ground with an impact hammer
- Friction disk hold fabric in place up to 300 psi

Reclamation: TRM

- TRM EXCEL CC-4 transitions between lower velocity point bars and straight reaches
- Landlok 450 is placed at approaches to cut banks

Reclamation: Wetland Transplant Plugs

- Wetland plugs dug from channel before backfilling
- Held in 1 gallon pots until new channel was constructed

Reclamation: Wetland Transplant Plugs

- Local provenance of wetland plugs
- Many species are not commercially available

- Wetland plugs established and spread quickly

Reclamation: Riparian Transplants

- Willows and Cottonwoods harvested with 32” tree spade from channel before backfilling
- Placed in wire baskets for storage

- Cottonwoods were fenced for protection from grazing by elk

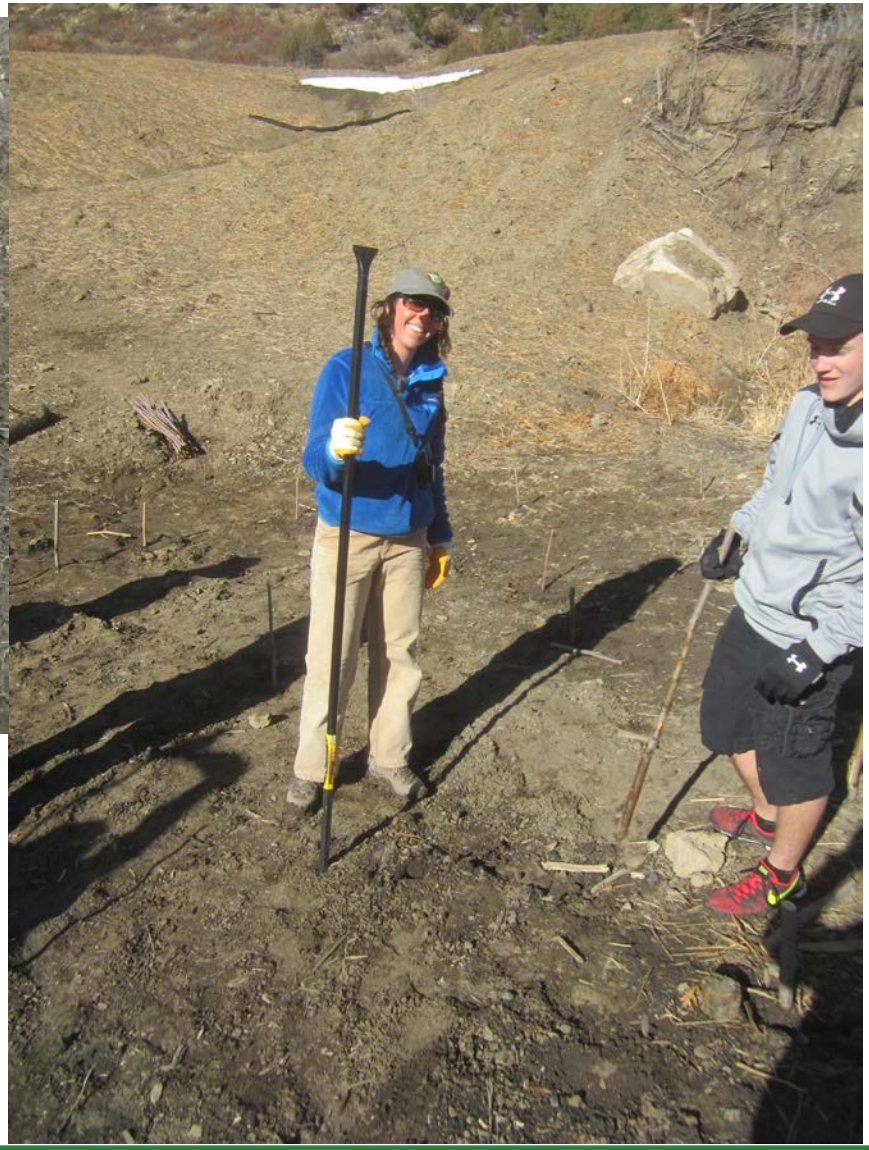
Reclamation: Riparian Transplants

- Willows planted next to channel in wet soils
- Cottonwoods planted up gradient into mesic soils

Reclamation: Riparian Transplants

- Transplants moved from digging areas to nursery holding yard

Reclamation: Riparian Willow Staking



- Willow stakes cut in Spring 2013
- Planted by Raton area student volunteers

Reclamation: Riparian Cottonwood Pole Planting

- Cottonwood poles were cut, limbed and planted
- Hole depth to ground water table

Reclamation: Upland Transplants

- Upland species including oak, chokecherry, rabbitbrush and currant were transplanted

Reclamation: Dutchman Compensatory Wetlands

- ACOE 0.6 acre mitigation wetland
- Further finish saline/sodic historic mine adit drainage

Reclamation: Dutchman Compensatory Wetlands

- Flood irrigation onto compensatory wetland site
- Seeded with Dutchman wetland mix
- Willow staking

Project Constraints:

Unidentified Cultural Resources

Project Constraints:

- Steep Slopes
- Groundwater

Project Constraints

- In-stream Construction
- Sediment Control
- Diversions

Project Constraints

- Wildlife

Project Constraints

Detailed Geomorphic Grading Plan

Project Constraints

- Steep and short transition from up gradient project boundary and channel
- Narrow work area due to cultural resources
- 2012-2013 drought

Geomorphic Channel Realignment and Restoration

- TRM will stabilize channel banks until vegetation is well established

- Transplanting native vegetation resulted in a quick establishment
- Rapid channel stabilization

THE NEW MEXICO MINING AND MINERALS DIVISION PRESENTED A 2012 EXCELLENCE IN RECLAMATION AWARD TO THE PROJECT TEAM

Water and Earth Technologies Inc., and Habitat Management Inc., Kiewit New Mexico Company and 814 Solutions LLC, were honored for their work at the Swastika Mine and Dutchman Canyon Reclamation Project at the Vermejo Park Ranch where the focus was innovative abandoned coal mine reclamation and geomorphic landforming.

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The Swastika Mine and Dutchman Canyon Reclamation Project

Habitat Management, and **Water & Earth Technologies** express our appreciation for the assistance and dedication of the following individuals and companies in making this award winning project a success:

Zoe Isaacson, Mike Thompson and John Kretzmann-New Mexico EMNRD AML Program; Gus Holm-Vermejo Park Ranch; Peter Kiewit New Mexico and 814 Solutions

ANY QUESTIONS?

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