



GEOMORPHIC RECLAMATION:  
APPROACHES AND LESSONS LEARNED

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Montana Mine Design, Operations, and Closure Conference



# Acknowledgments

- Montana DEQ
- Wyoming AML
- Iowa DALs
- Herrera Environmental Consultants
- AVI, PC
- BRS
- RESPEC

Rosebud Pit, WY - Before



# Presentation Overview

- Sustainable Reclamation
- Historical Reclamation Practices
- Software Discussion
- Case Studies
- Lessons Learned

Rosebud Pit, WY - After



# Sustainable Reclamation



Rosebud Pit, WY



Huh? What? Reclamation?

# Reclamation Progression: Early



Cherokee Peak Site, WY



Again: Huh? What? Reclamation?

# Reclamation Progression: 70's & 80's



Begin the age of 3:1!



Seminoe #1 Site (East Monument), WY

# Reclamation Progression: 80's & 90's



Cover Soil, Terraces and Down Drains!

# Reclamation Progression: 80's & 90's



Fixed this...



Still a possibility to get this!

Cover Soil, Terraces and Down Drains!

# Reclamation Progression: Current



Terraces and Down Drain still in use:  
Goff AML, IA - 2012

# Reclamation Progression: Current



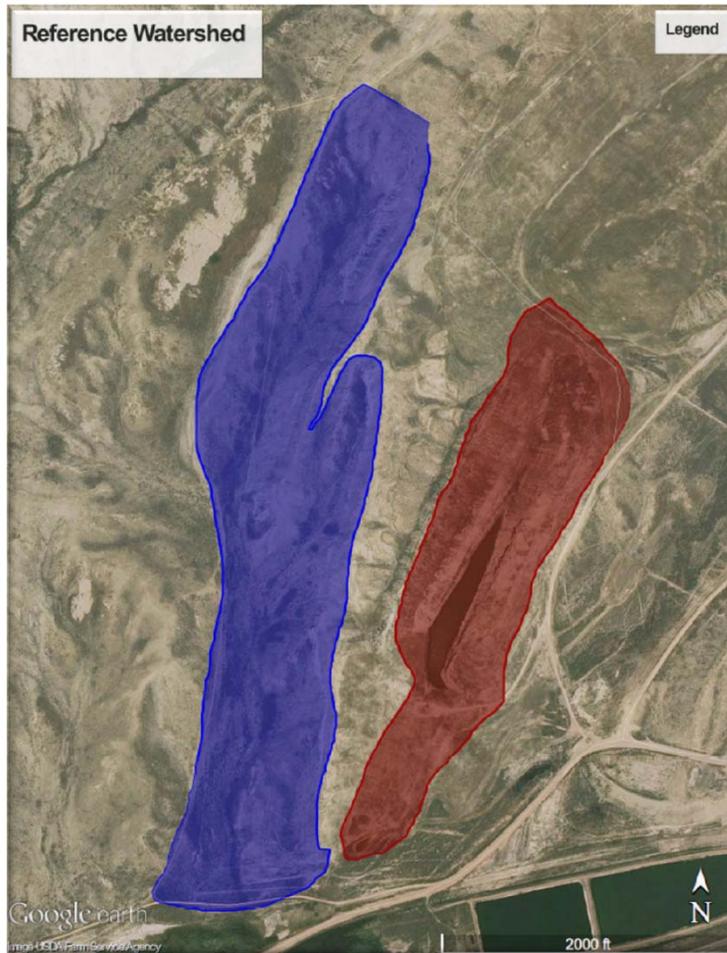
Wyoming's **first** NR site



Sub-watersheds – Rosebud Pit, WY

Natural Landform Grading

# Software Discussion



- Empirically Based
- Efficient Development of Designs
- Training
- Focus on collecting and using reference characteristics (Surveying, Google Earth)
- Several Iterations
- Substantial post processing/grading cleanup
- Requires thorough engineering review
- Incorporate additional engineering controls

# Case Studies: Rosebud Pit, WY



Existing Site

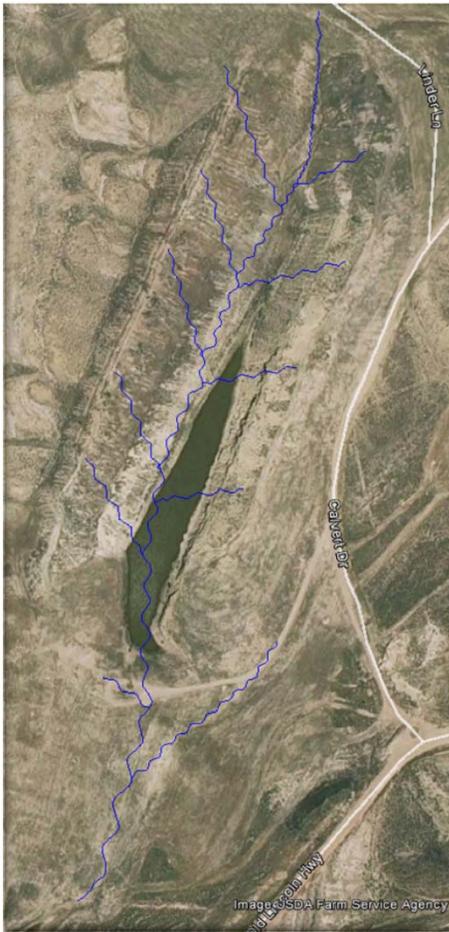


# Case Studies: Rosebud Pit, WY



Final Reclamation

# Case Studies: Rosebud Pit, WY



- Under-estimated competency of native sandstone
- More Test pitting
- Fill shrink factor
- Additional Information for Contractor
- Weather difficulties
- Vegetation Diversity



Lessons Learned

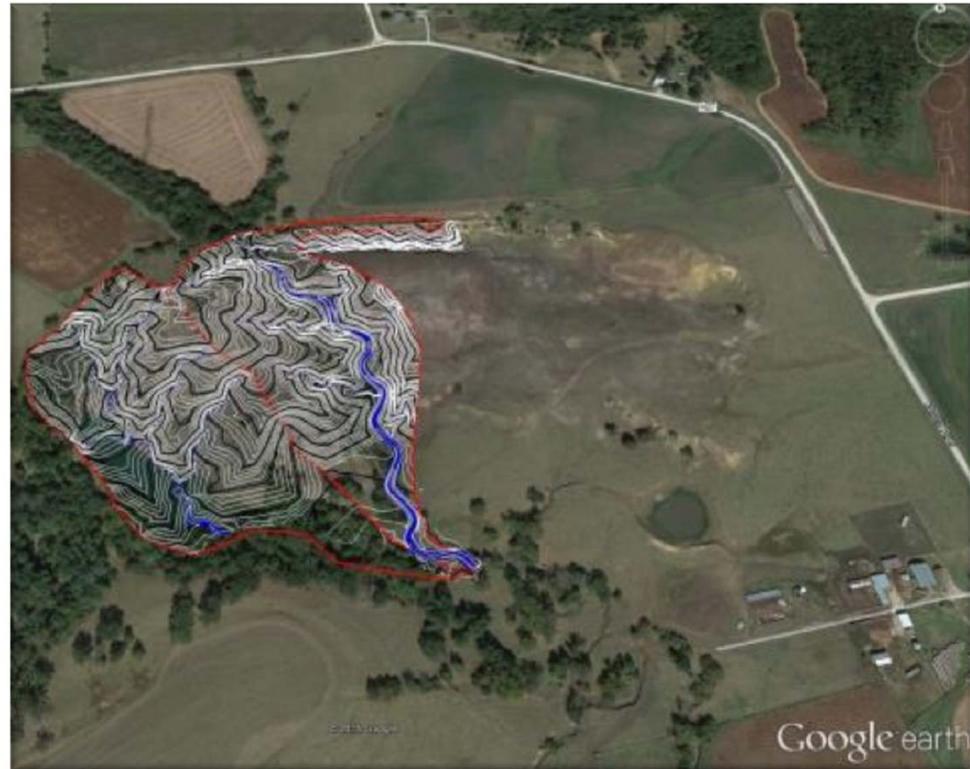
# Case Studies: Teach AML, IA



Existing Site

- New to Iowa AML Program
- NR Applicable?
  - Landowner Review
  - Land use
  - Acidic Spoils and AMD
  - Incorporate Wetlands
  - Quadruple the precipitation as Wyoming sites

# Case Studies: Teach AML, IA



Conceptual Reclamation

# Case Studies: Teach AML, IA



# Case Studies: Teach AML, IA



Lessons Learned

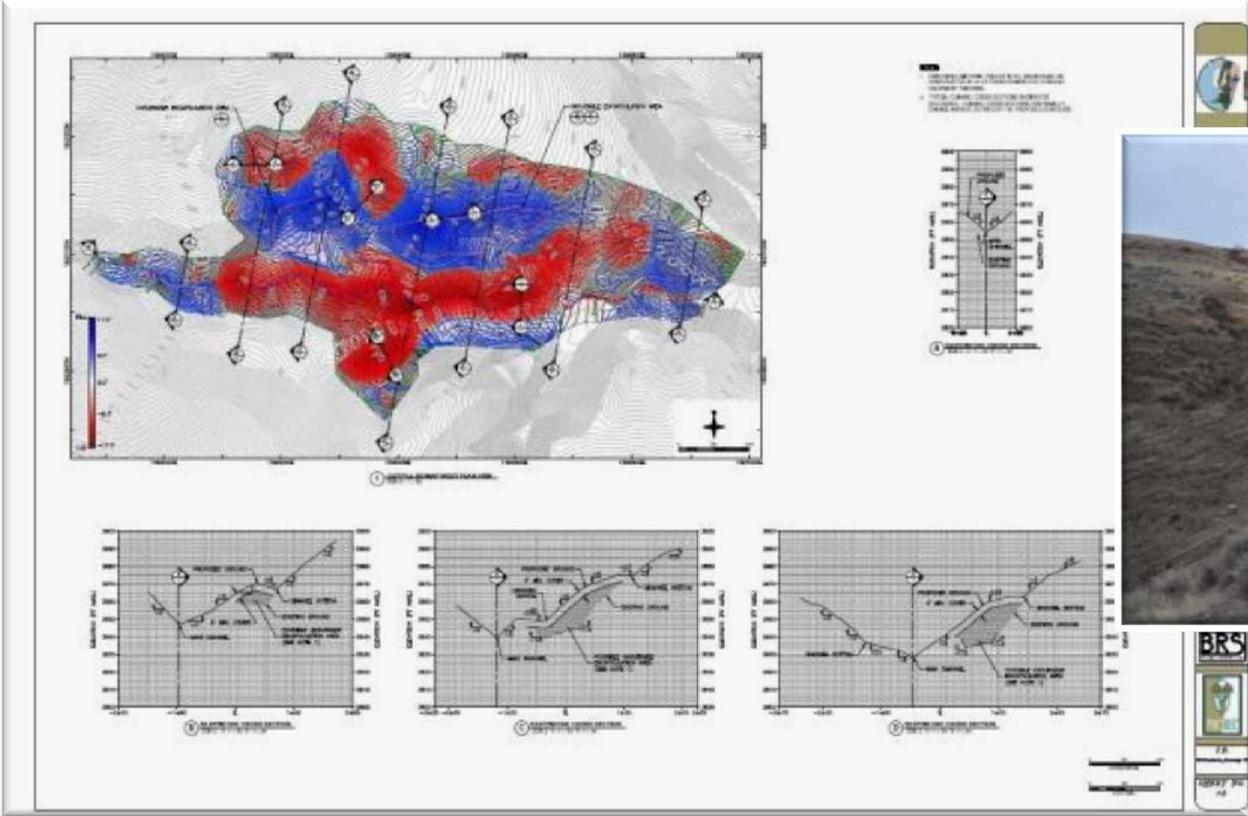
- Acid mine drainage issues continue along main channel
- Able to create a NR design to tie in with original channel
- Able to create NR design that suits landowner
- Held up well in heavy rain w/o vegetation
- Incorporated Wetlands/Ponds into design

# Case Studies: Custer/Armstrong



Existing Site

# Case Studies: Custer/Armstrong



Final Reclamation



# Case Studies: Custer/Armstrong



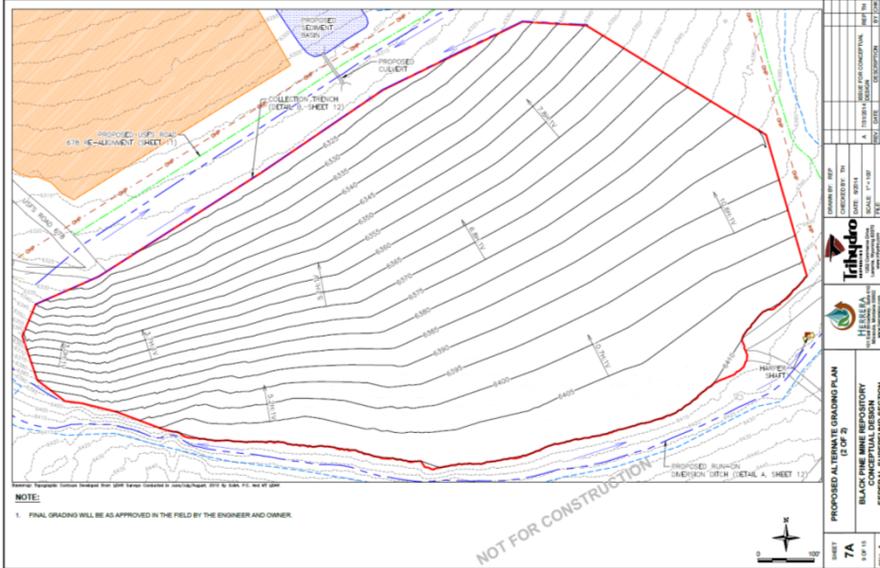
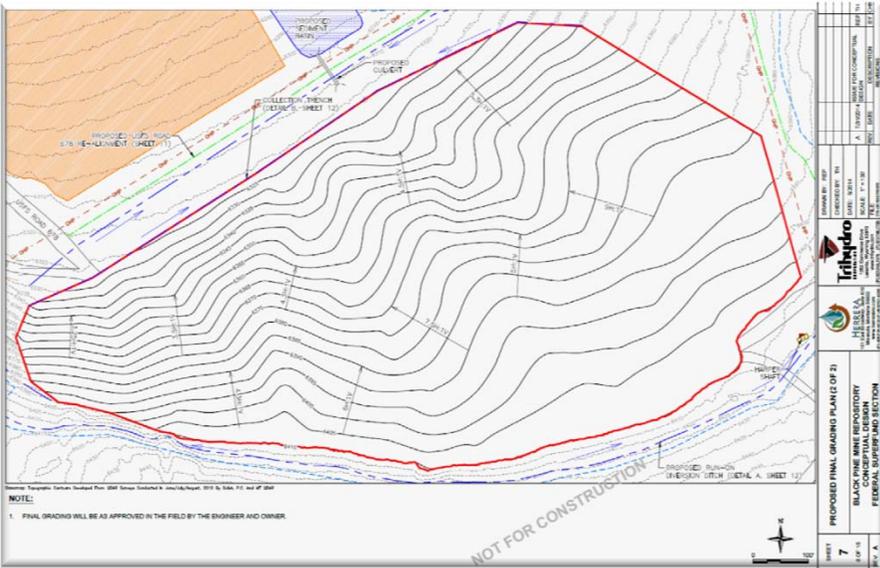
Lessons Learned

## Case Studies: Black Pine Mine, MT (pending)



Existing Site

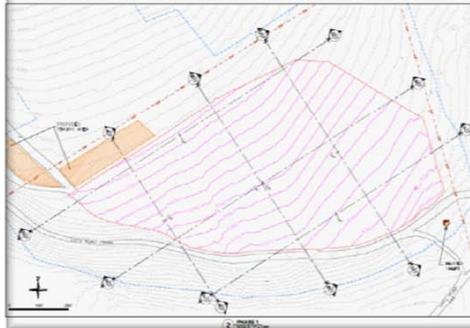
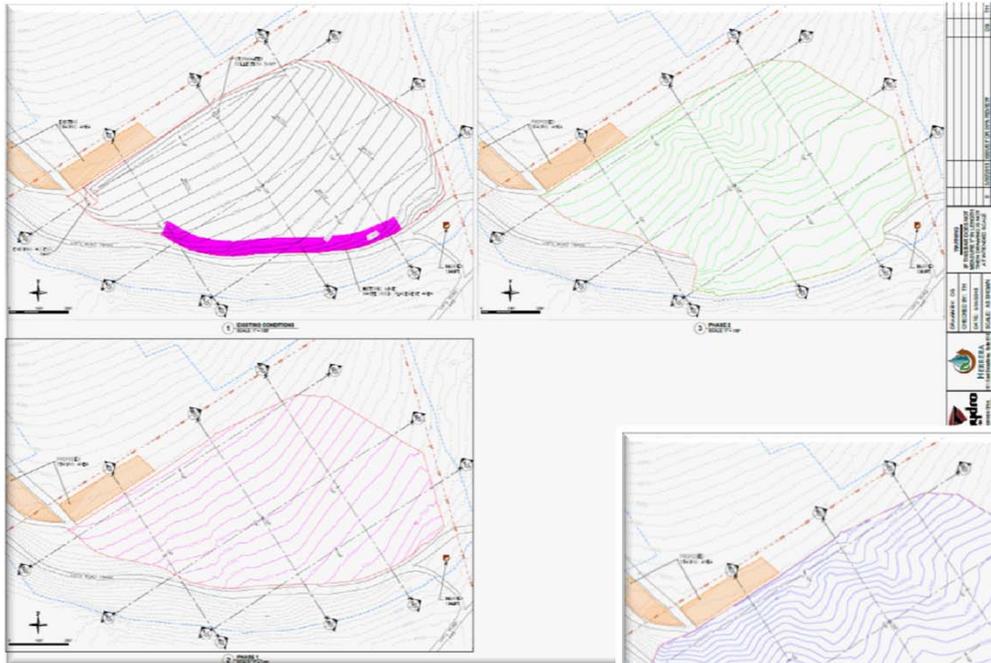
# Case Studies: Black Pine Mine, MT (pending)



Conceptual Designs



# Case Studies: Black Pine Mine, MT (pending)



Primary Design:  
Lessons Learned

- Capacity
- Filling Plan
- Liner System

# Conclusions

- Another tool to increase success and value of reclamation
- Pleased with the results on majority of projects
- Applicable to a wide range of sites
- Decreased maintenance
- Software Packages should be applied with care
- Wider availability of GPS equipment/constructible by variety of contractors
- Takes time to get comfortable with this approach/interpret grading plans/increased information for contractors

# Questions?

WHAT

WHY

WHERE

WHEN

WHO

HOW