Riley Pass Uranium Mine Site -
Restoring the Hydrology

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acknowledgements:
Dustin Wasley TriHydro
Harold Hutson BSR Engineering
Peter Werner USDA Forest Service
Larry Cawlfield Tetra Tech
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RILEY PASS URANIUM MINES

Prospecting Activities – as early as 1950

Uranium mining operations in 1962

Mining ceased in 1965

Overburden pushed off the outer edges of the pits, highwalls and spoils material with exposed radioactive material
Historical Imagery

Bluff B 1954 Conditions

Bluff B 2012 Conditions
• Exposed lignite ores and waste contain elevated contaminants
  • Arsenic
  • Molybdenum
  • Selenium
  • Uranium
  • Radium
  • Thorium
Risk-based Cleanup Levels

Arsenic and Radium-226 soil cleanup levels are used as surrogate for other contaminants of concern.

Determined that removal of Arsenic and Radium-226 soils will also remove other contaminants.
Risk-based Cleanup Levels

Arsenic risk-based cleanup level
142 mg/kg

Radium-226 risk-based cleanup level
30 pCi/g
EROSION

- the physical characteristics of the soils,
- the relatively steep terrain they occupy, and
- regional climate conditions

Primary transport of contaminants is erosion – both wind and water
Northeast Drainage Channel – Bluff B
Soil piping throughout spoils material
Bluff G – During Mining - 1964
Bluff G – Post Mining - 2012
Sediment Control Work

1. Channel Check Dams
2. Bluff Top Sediment Control
3. Sediment Ponds
Check Dam Installation
Check Dam looking upstream
Bluff Top Drainage Control
Five Sediment Ponds at Bluff B
Site Geology

• Fort Union Formation — Tertiary Age (63-50 MYA)
• Principal rock formation throughout the North Cave Hills, including Riley Pass site
• Fort Union is highly permeable and readily transmits groundwater
• Fort Union contains the lignite coal beds, host rock for uranium ore
Fractures in Basal Sandstone
Hydrology

- No surface water at site, except runoff during snowmelt and rain events
- Springs and seeps surface at the base of the sandstone
Riley Pass Reclamation Approach

- Isolate the waste

- Reclaim using natural landform mine reclamation techniques
  Such as Natural Regrade™ GeoFluv
What are the Natural Landforms at Riley Pass?
North Cave Hills Landscape
## Reclamation Approach

<table>
<thead>
<tr>
<th>TRADITIONAL MINE RECLAMATION</th>
<th>NATURAL LANDFORM RECLAMATION</th>
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</thead>
<tbody>
<tr>
<td>❖ Constant uniform slopes</td>
<td>❖ Natural channel morphology</td>
</tr>
<tr>
<td>❖ Rock lined ditches</td>
<td>❖ Small drainage basins</td>
</tr>
<tr>
<td>❖ Terraces</td>
<td>❖ Increased diversity of slope aspects and habitat</td>
</tr>
<tr>
<td>❖ Erosion Control structures, such as rock basins and check dams</td>
<td>❖ Stable configuration of slopes</td>
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Traditional Reclamation Design
Natural Regrade™ Reclamation
Natural Regrade™ Reclamation
Natural Landform Reclamation at Riley Pass Mine Site

• Starting with Natural Regrade™ on bluff tops and slopes
• Placement of large rocks and tree and shrub planting
• Reclamation approach will evolve as we observe surface runoff and gain experience with Natural Regrade™
• Isolation of waste, sandstone bluff edges and groundwater flow will likely present challenges
Any Questions?
QUESTIONS?
Tronox Settlement Funds

- BANKRUPTCY CLAIMS SETTLED ABOUT 2012
- FRAUDULENT CONVEYANCE SETTLEMENT – JANUARY 2015
- DEPARTMENT OF AGRICULTURE HAS RECEIVED $194 MILLION
  - For three mine site on National Forest System lands
  - Riley Pass is the largest Site of the three mines
**Bluff B Watershed Delineation**

North (Pete’s Creek)  
East (Pete’s Creek)  
Central (Sediment Pond “SP1”)
Southeast (Sediment Pond “SP2”)

<table>
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<tr>
<th>Watershed ID</th>
<th>Drainage Area</th>
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<tbody>
<tr>
<td></td>
<td>(mi²)</td>
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<tr>
<td>North</td>
<td>0.067</td>
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<tr>
<td>East</td>
<td>0.113</td>
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<tr>
<td>Southeast</td>
<td>0.025</td>
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<tr>
<td>Central</td>
<td>0.039</td>
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<tr>
<td>South</td>
<td>0.147</td>
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Bluff B
Bluff B

ARSENIC

RADIUM-226
Radium-226 Mapping

Bluff B Ra-226 Continuous Map

Ra-226 Soil Concentration (pCi/g)
- < 1
- 1-10
- 10-75
- 75-150
- 150-300
- > 300
Arsenic Mapping