



Riley Pass Uranium Mine Site - Restoring the Hydrology

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acknowledgements:

Dustin Wasley TriHydro

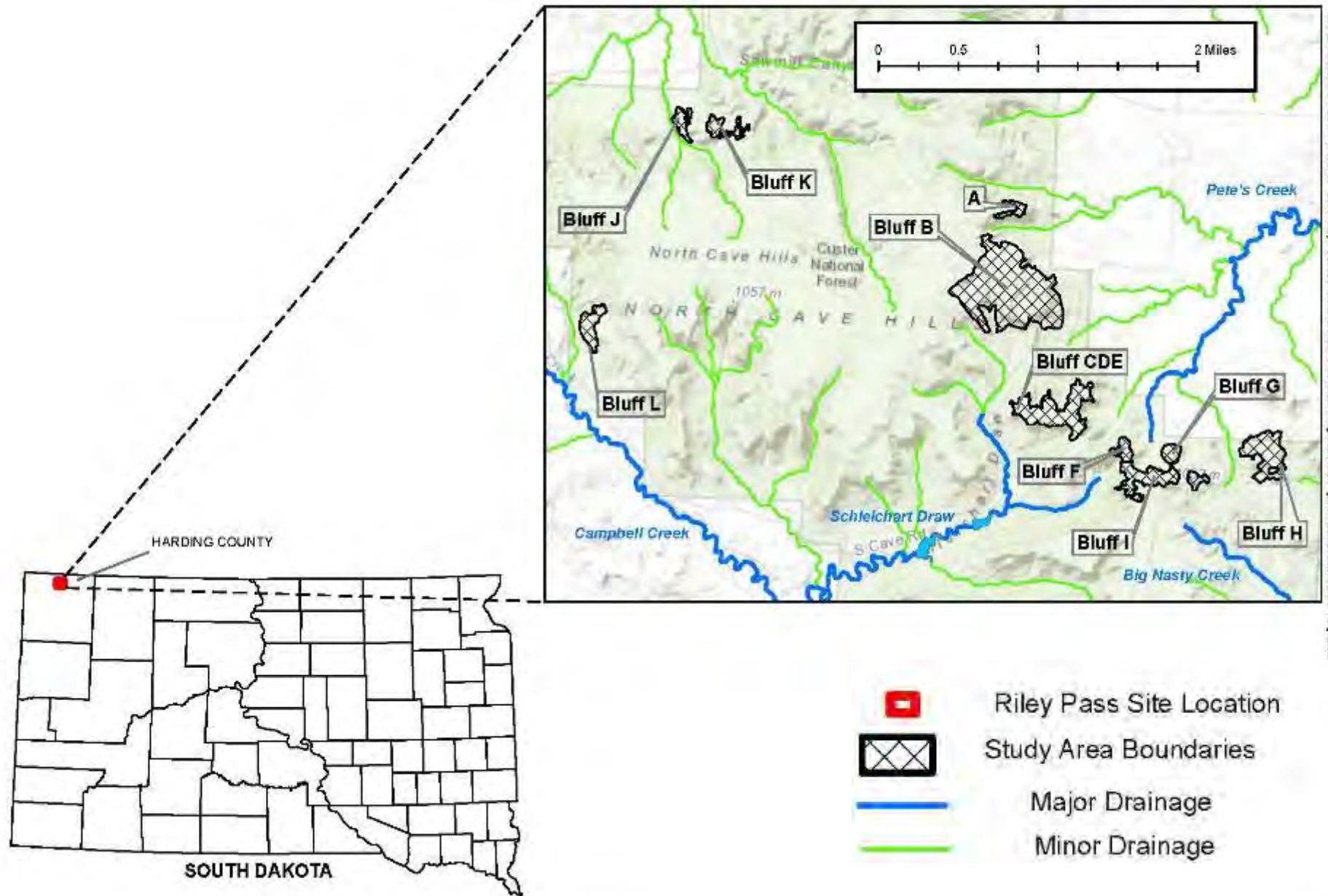
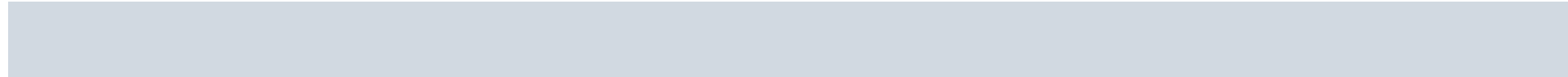
Harold Hutson BSR Engineering

Peter Werner USDA Forest Service

Larry Cawlfeld Tetra Tech

Aaron Orchewa Tetra Tech





W:201005.Tech.Draft.08/14/08.08.08 - 2010 Riley Pass Area Geomorphology - Revision 1 - Figure 1 - Riley Pass Site Location map August, 2010

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

Uranium Mining

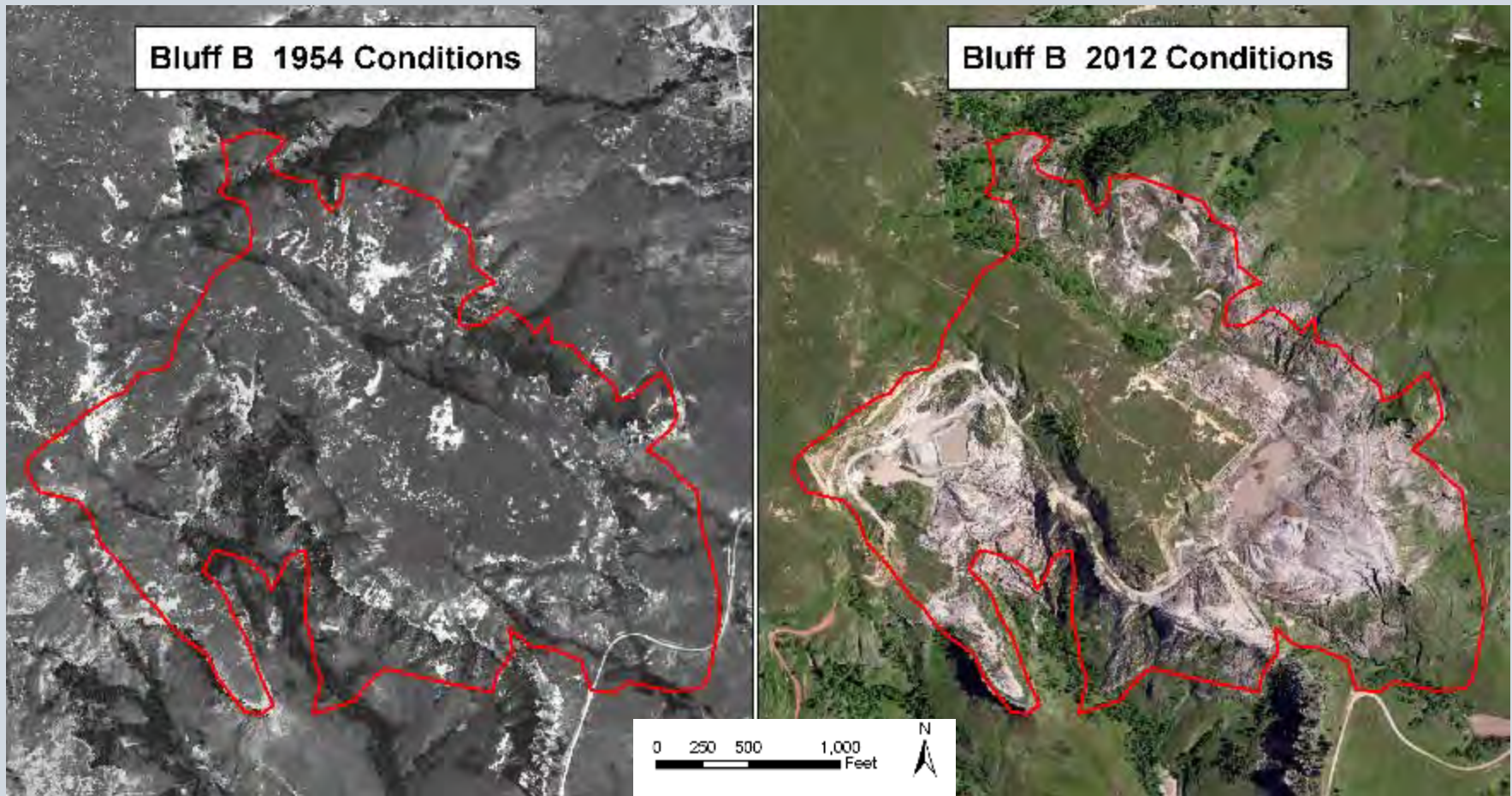
Riley Pass, North Cave Hills, 1962-1964






2870-2

Historical Imagery

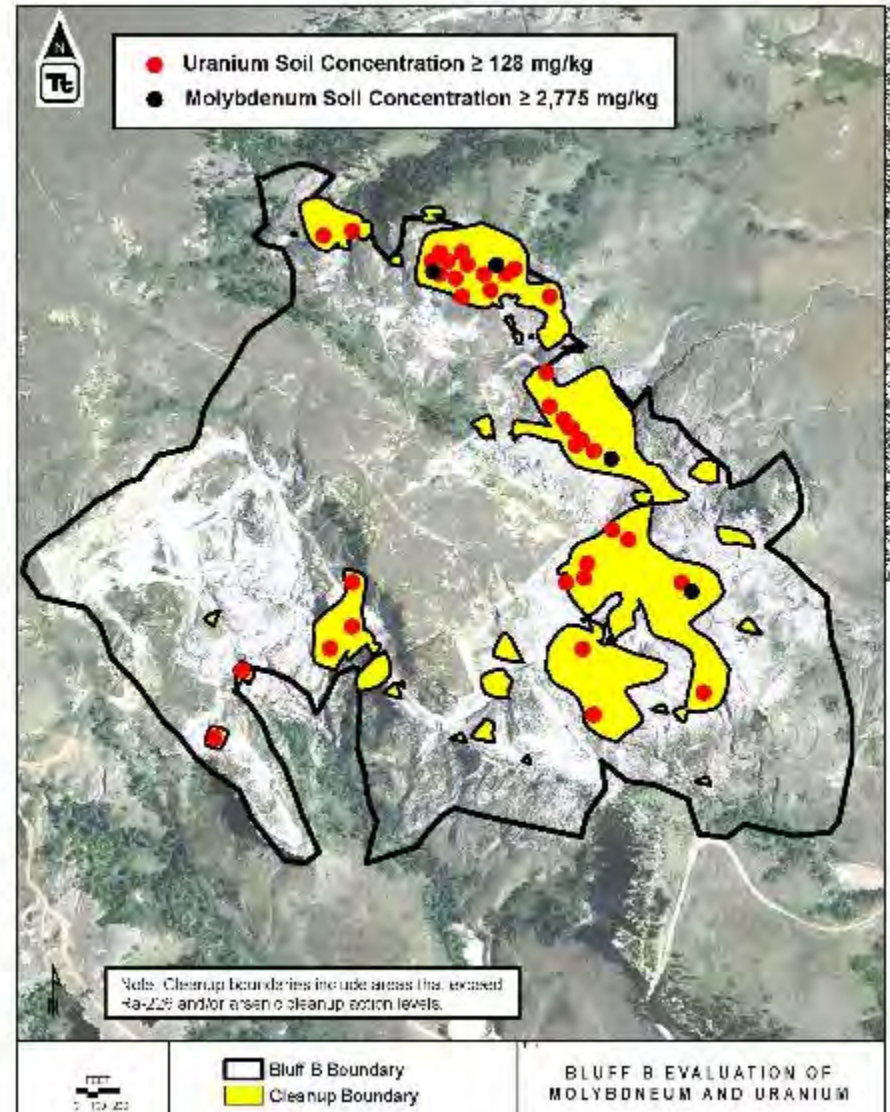


- 
- Exposed lignite ores and waste contain elevated contaminants
 - Arsenic
 - Molybdenum
 - Selenium
 - Uranium
 - Radium
 - Thorium

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



Sandstone Cliffs, Fort Union Formation





Fractures in Basal Sandstone



Bluff E

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

TRADITIONAL MINE RECLAMATION

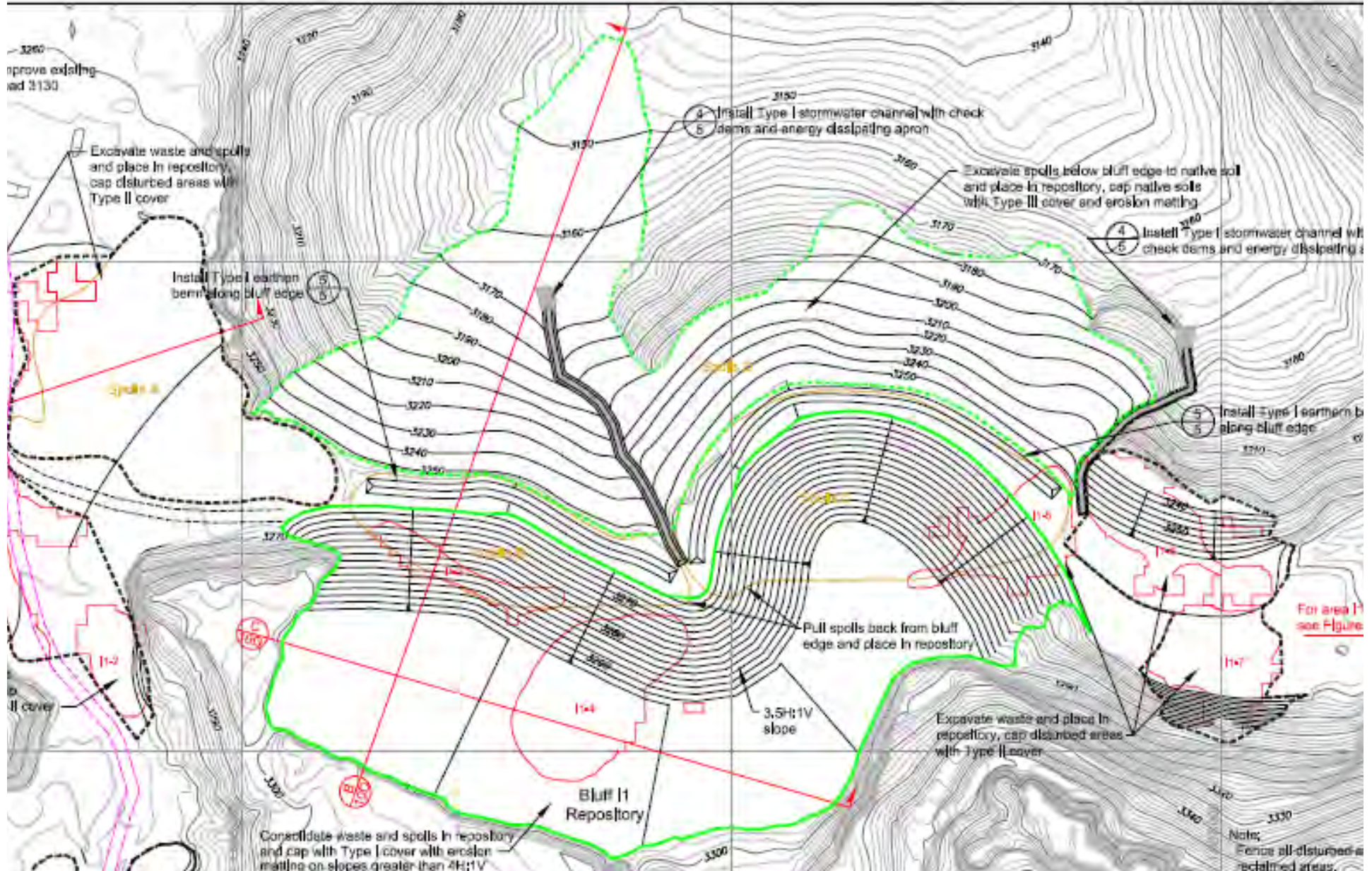
- ❖ Constant uniform slopes
- ❖ Rock lined ditches
- ❖ Terraces
- ❖ Erosion Control structures, such as rock basins and check dams

NATURAL LANDFORM RECLAMATION

- ❖ Natural channel morphology
- ❖ Small drainage basins
- ❖ Increased diversity of slope aspects and habitat
- ❖ Stable configuration of slopes

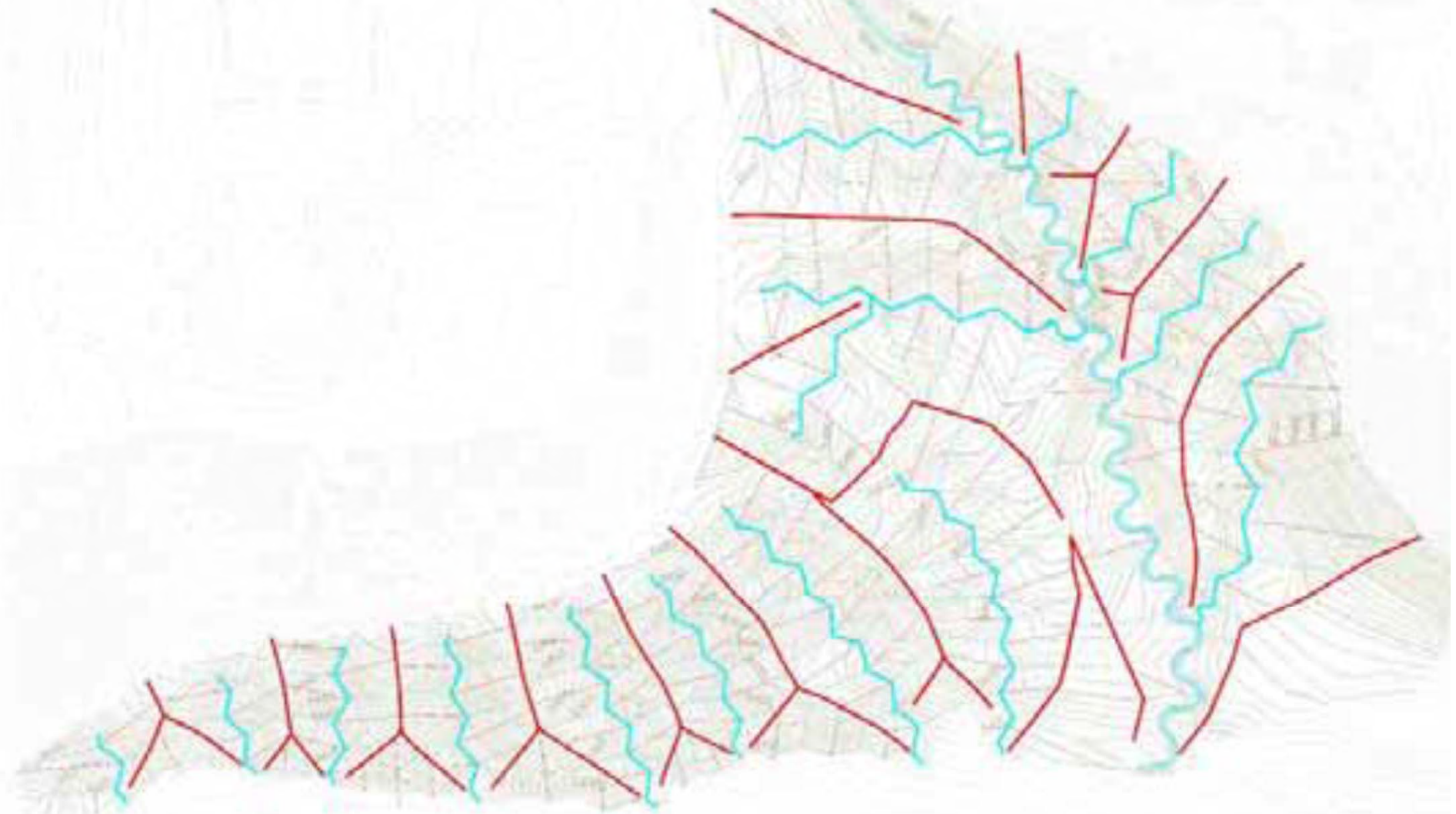


Traditional Reclamation Design





Natural Regrade™ Reclamation

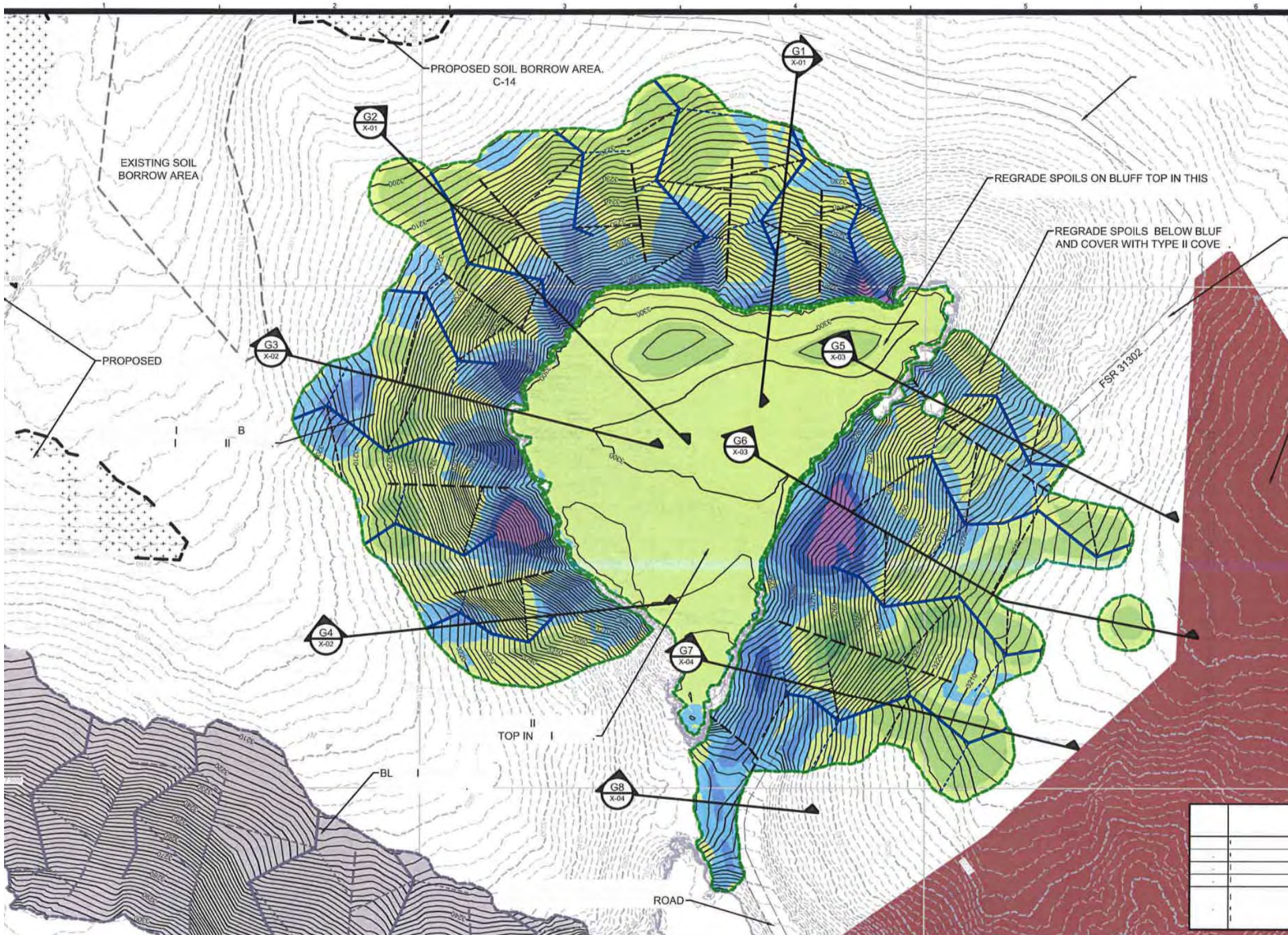


Natural Regrade™ Reclamation









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?



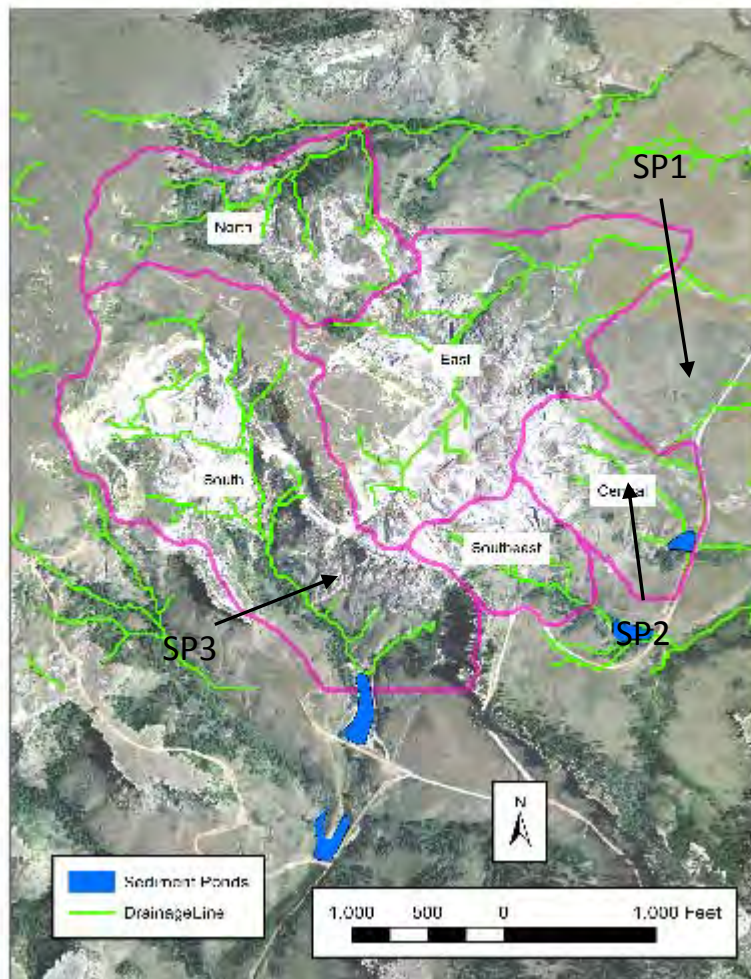
Tronox Settlement Funds

- 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")

Watershed ID	Drainage Area		
	(mi ²)	(km ²)	[acres]
North	0.067	0.17	42.6
East	0.113	0.29	72.2
Southeast	0.025	0.07	16.2
Central	0.039	0.10	25.0
South	0.147	0.38	94.0

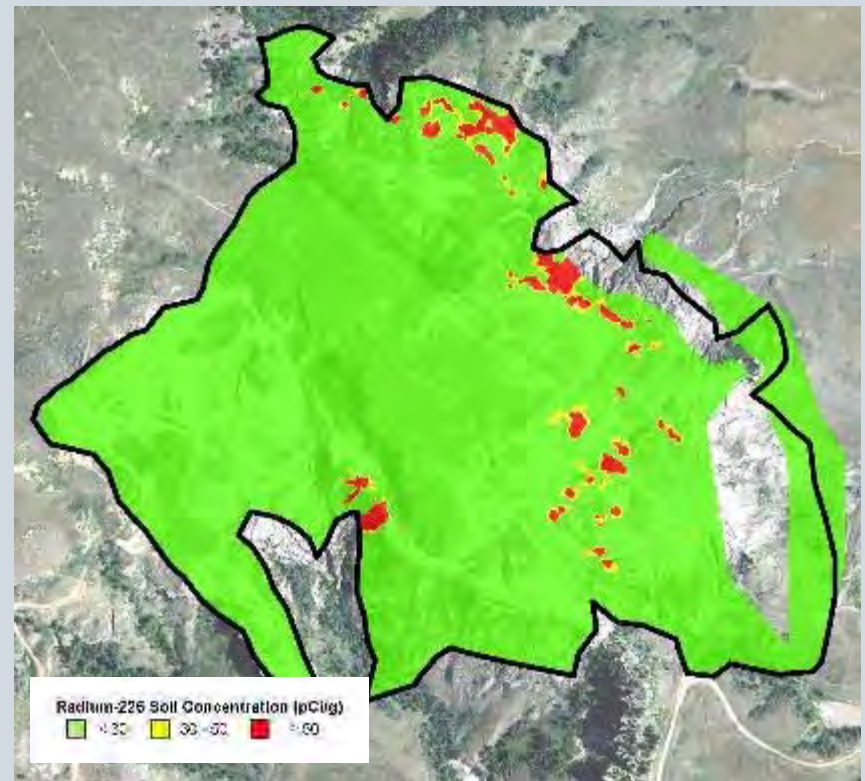
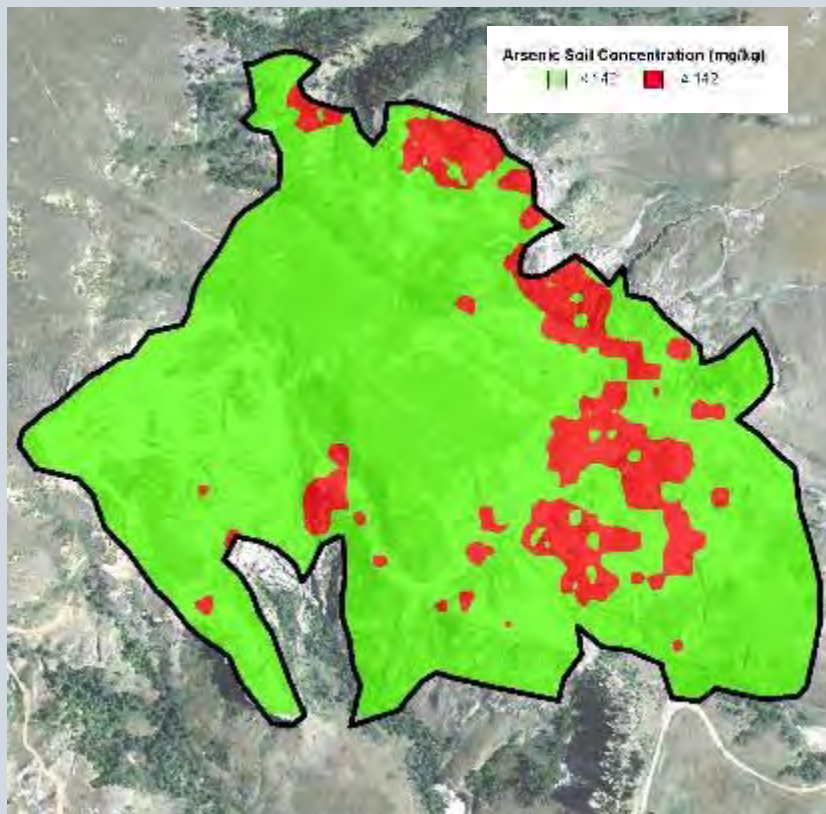
Bluff B



Bluff B

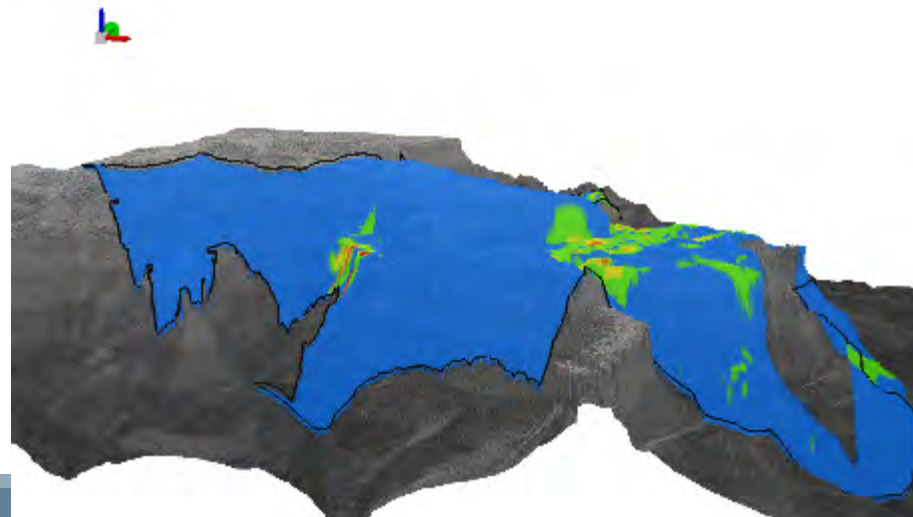
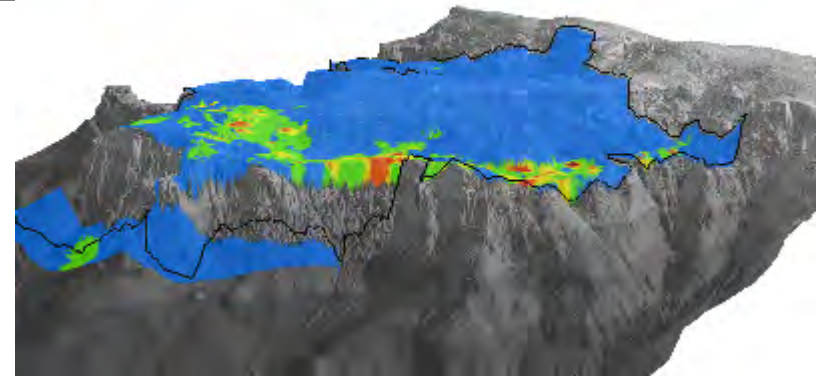
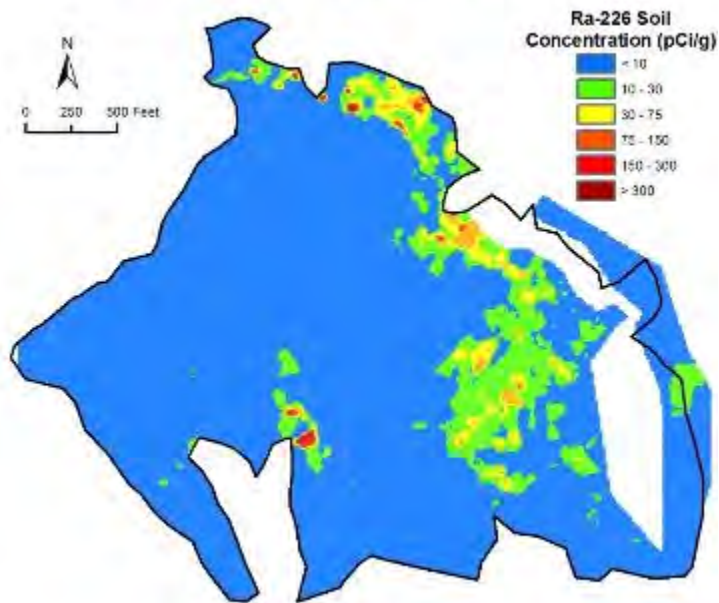
ARSENIC

RADIUM-226



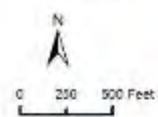
Radium-226 Map

Bluff B Ra-226 Continuous Map

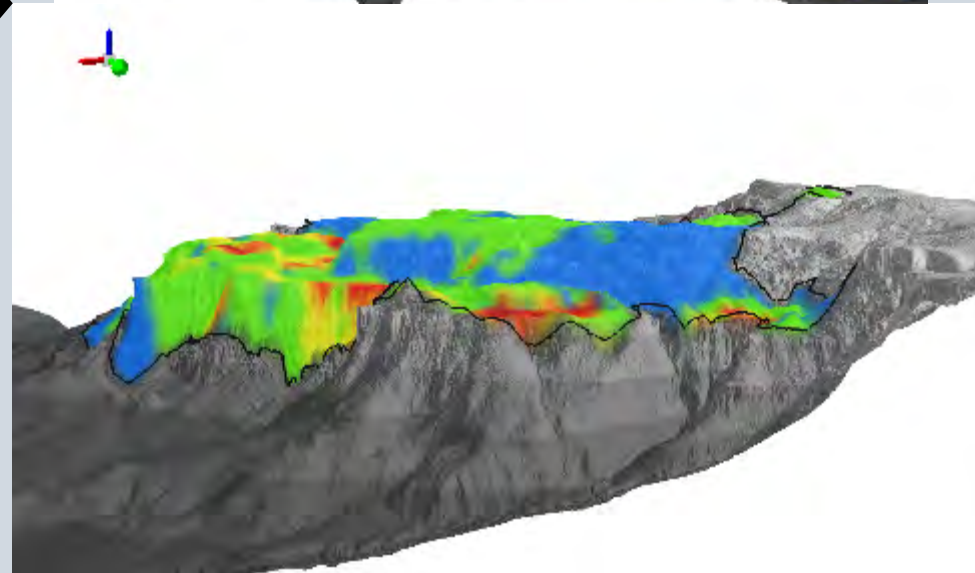
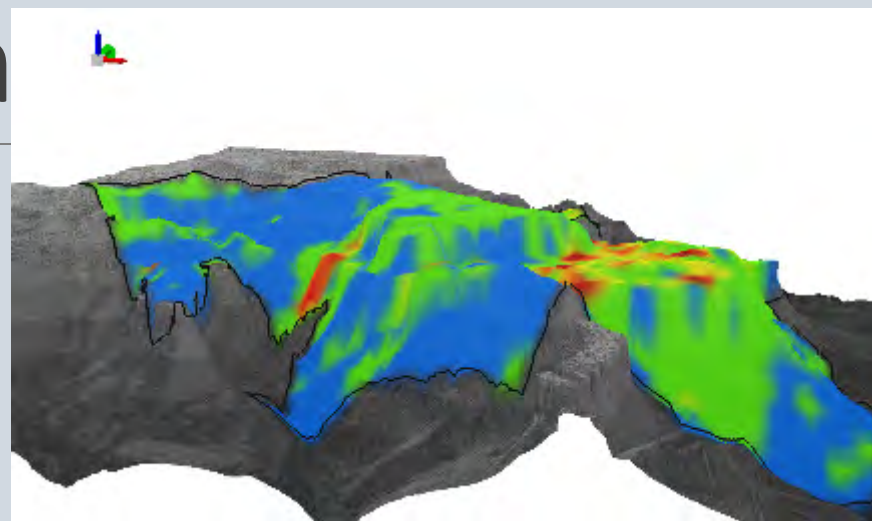
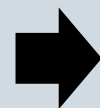
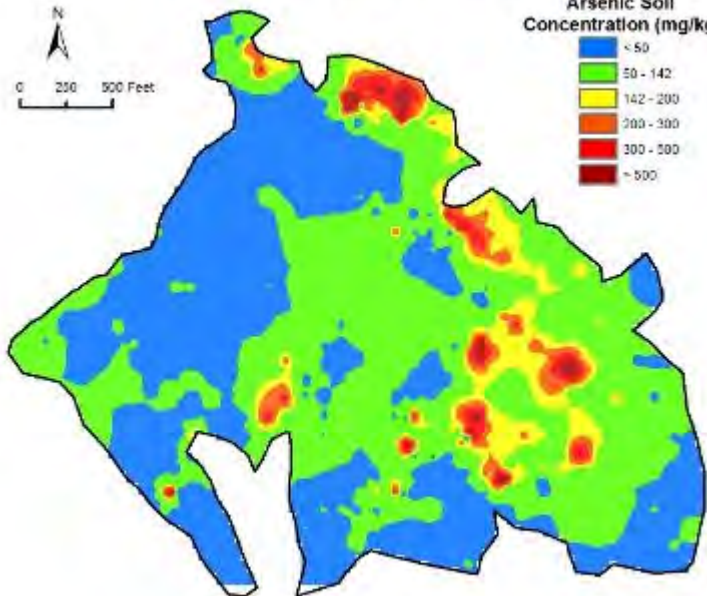
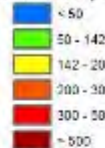


Arsenic Mapping

Bluff B Arsenic Continuous Map



Arsenic Soil Concentration (mg/kg)



Regional Geology and Uranium Transportation Model

