

# Conceptual Model of Terrestrial Injury

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# Presentation Overview

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- ▶ Conceptual model
- ▶ Data sources
- ▶ Simplified injury concept
- ▶ Potential service loss approaches

# Conceptual Model

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1. Habitat-level injury
  - a. Riparian soils
  - b. Offsite soils receiving fugitive dust?
2. Injury to wildlife resources
  - a. Mine site soils/waste rock
  - b. Riparian
  - c. Tailings

# Key Data Sources Reviewed

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1. RI/FS and EcoRA data and presentations (eRoom database?)
2. RGC (1997-2000) Closure/Closeout documents
3. Kent (1995)
  - a. Expanded Site Inspection Report from NMED
4. NRCS (1990), Dreeson and Henson (?), NRCS (2000)
  - a. Plant heavy metal uptake
  - b. Establishment of vegetation after revegetation effort
5. SRK (1995) geochemical assessment of waste rock
6. Vail Engineering (1995) revegetation report

# Simplified Injury Approach

- ▶ Rely on risk-based screening levels (RBSLs) for site soils:

Analyte	Soil (mg/kg)	Analyte	Soil (mg/kg)
Aluminum	?? (pH < 5.5)	Iron	NA
Ammonia	5	Lead	15
Antimony	0.3	Manganese	152
Arsenic	31	Mercury	0.1
Barium	330	Molybdenum	2
Beryllium	30	Nickel	48
Boron	0.5	Selenium	1
Cadmium	0.4	Silver	2
Chromium	7.9	Thallium	1
Chromium VI	94	Titanium	1000
Cobalt	32	Vanadium	2
Copper	54	Zinc	120

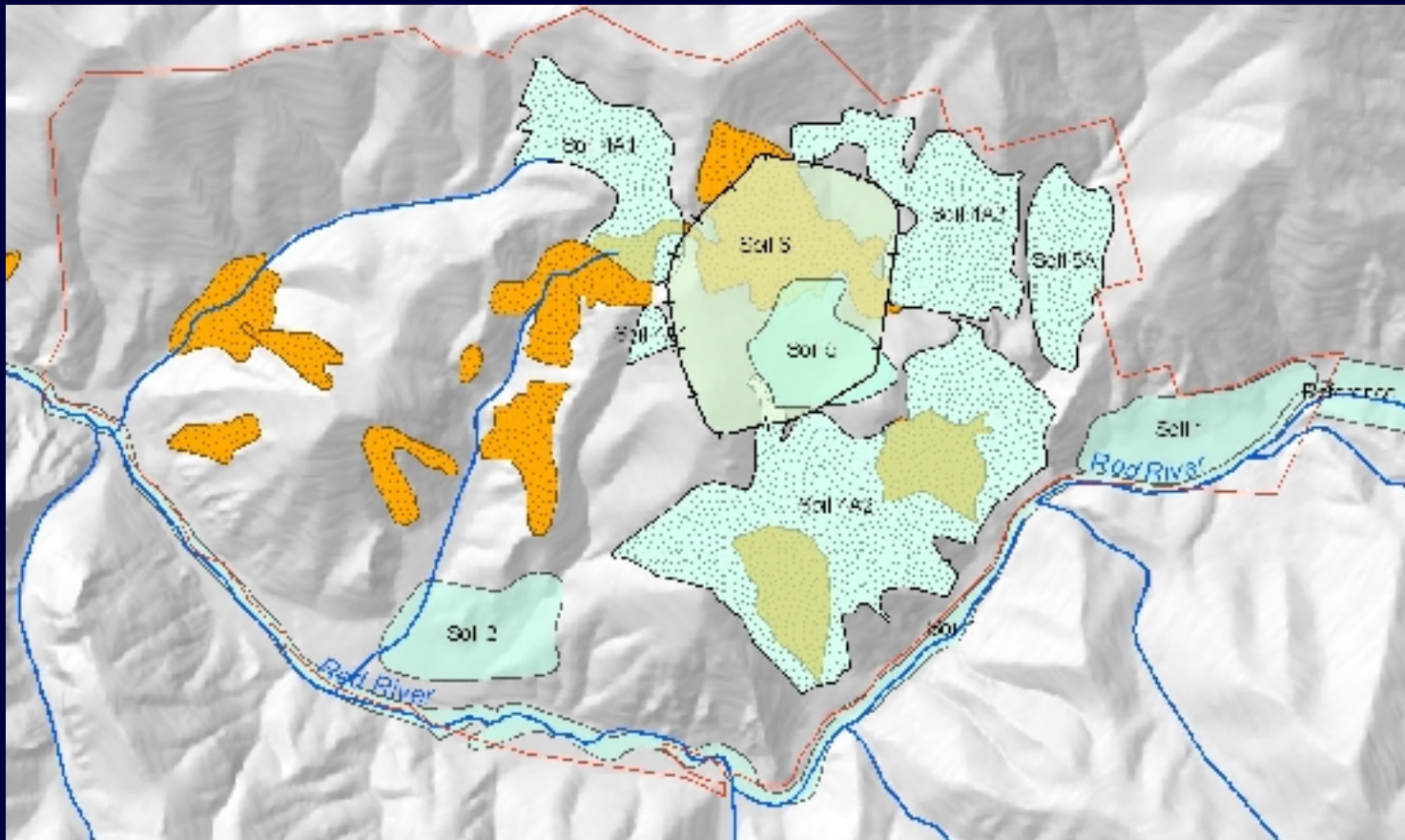
# Injury: Mine Site

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- ▶ Soil metal concentrations exceed RBSLs and exceed concentrations at reference sites:
  - Mill (Soil Area 1)
  - Admin/Electrical (Soil Area 2)
  - Capulin, Goathill N, South piles (Soil 4A1)
  - Sugar Shack S and W, Middle, Sulphur Gulch piles (Soil 4A2)
  - Sulphur Gulch N, Blind Gulch toes (Soil 4A3)
  - Spring Gulch and Truck Stop (Soil Area 5)
  - Open Pit (Soil Area 6)

# Injury Determination

- ▶ Mine Site Areas



# RBSL Exceedences: Mine Site

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## ▶ Copper

- [Cu] < RBSL in reference areas
- Mean [Cu] > RBSL: Areas 1, 2, 4A2, 4A3, 5, 6

## ▶ Manganese

- [Mn] > RBSL in reference areas
- Mean [Mn] > Ref Soils: Areas 1, 2, 4A1, 4A3, 5, 6

## ▶ Molybdenum

- [Mo] > RBSL in reference areas
- Mean [Mo] >> Ref Soils: Areas 1, 2, 4A2, 4A3, 5, 6

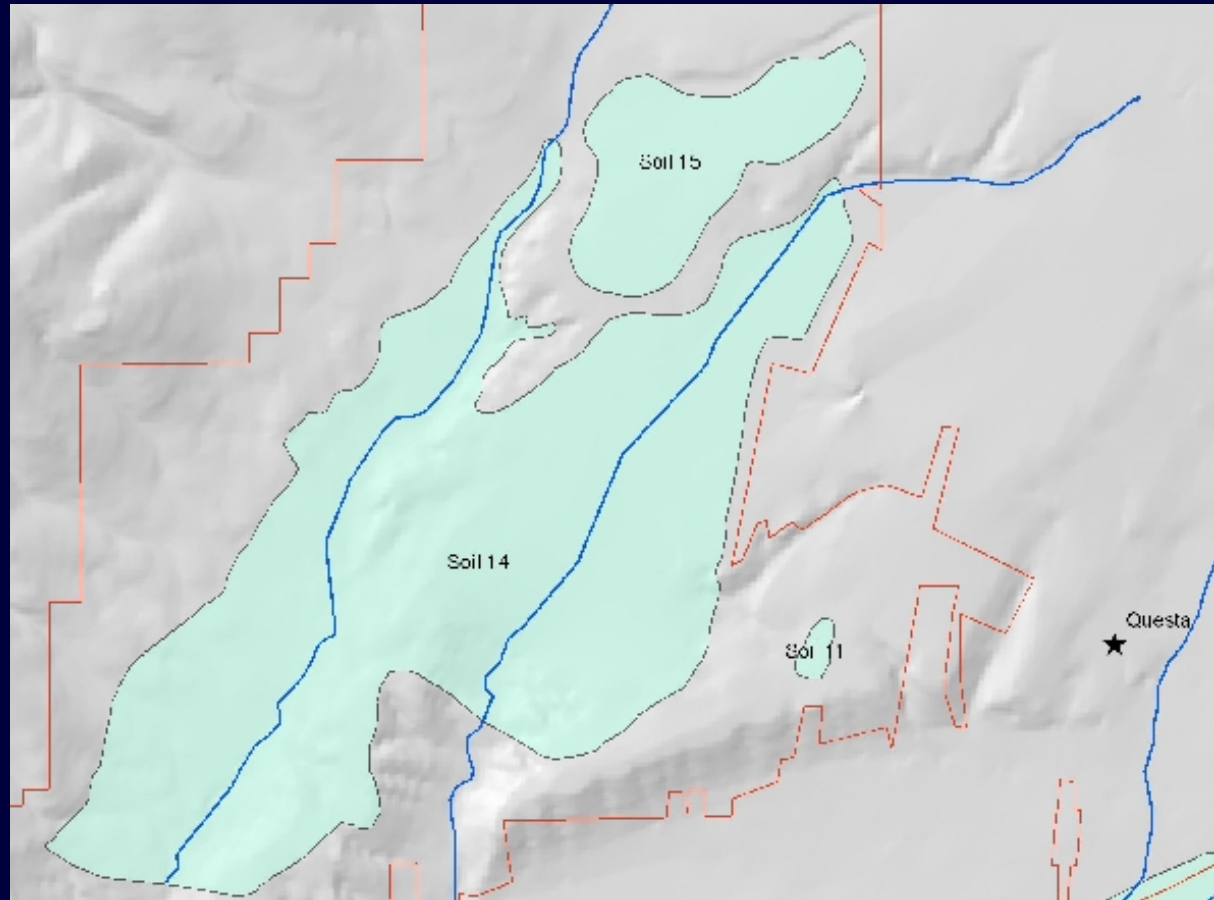


# Potential Areal Coverage of Injury at the Mine Site

- ▶ URS kriging data indicate potential RBSL exceedences throughout the entire mine site area
- ▶ Example coverage of specific mine waste areas, minus the areas that were originally alteration scars

Site	Coverage (Acres)
Soil Area 1	~100
Soil Area 2	99
Soil Area 4A1	111
Soil Area 4A2	335
Soil Area 4A3	155
Soil Area 5	73
Soil Area 6	115

# Injury: Tailings Area



# Example Exceedences: Tailings Area

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- ▶ Molybdenum RBSL = 2 mg/kg
- ▶ Tailings near Questa (Soil Area 14)
  - [Mo]: 36 samples in 1998, 2003
    - Range: 102 – 352 mg/kg
    - 2003 Avg [Mo]: 189 mg/kg
- ▶ Soils downwind of tailings (Soil Area 15)
  - Some Mo hits > 30 mg/kg

# Potential Areal Coverage of Injury at the Tailings Area

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Site	Coverage (Acres)
Soil Area 14	744
Soil Area 15	112

# Other Evidence of Potential Exposure at the Questa Tailings

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- ▶ Metals in aboveground plant tissue: plants in the upland tailings
  - Mo
    - Up to 250 mg/kg dry wt in forbs
    - May exceed Eisler (1989) criterion for molybdenosis in mule deer
  - Cu
    - Tailings forbs, shrubs contain 2X more Cu than reference plants

# Other Data

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- ▶ Metals in earthworms
  - Earthworm metal concentrations appear to show correlation between soil metals and earthworm body metals
    - Cu, Mn, Mo
    - Particularly evident in both mine site and tailings riparian areas

# Riparian Areas

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- ▶ Identify locations of tailings spills
- ▶ Metals residues? Area?

# Spatial Extent

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- ▶ Surface area (acres) of mine areas and riparian areas with metals exceeding injury threshold
  - Account for scars, developed areas



# Summary of Approach to Quantifying Service Loss

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- ▶ Use of risk-based exceedences in RWCS
  - Assigning % service loss
- ▶ Areal extent
  - Footprint of RBSL exceedences – (scar areas) – (developed areas)
- ▶ Assigning credit for revegetation?
- ▶ Recovery curve in future?