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Mine Cleanup

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Hydraulic mining damage at Pioneer Pit

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Considering Cleanup Options

- Off-Site Disposal
- On-Site repository (above or below ground)
- Cover and stabilization
- All should include erosion controls and revegetation planning
- All may require treatment of acid mine drainage

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Off-Site Disposal

- Consider off-site impacts
- Consider impacts to air and climate resulting from off-site disposal
- Consider off-site disposal reg. requirements
- Consider impacts to site stability post-excavation
- Consider the future cleanup (long term O& M); what's next?

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Projected Air Impacts for off-site Disposal of U Mine Wastes

Emissions rates for Option A alone (based on estimated number of truck-days required, emission factors, and 1,100 mile roundtrip to nearest disposal facility).

Air contaminant	Quantity over trip duration
Nitrogen oxides (NO_x) :	354 tons
Carbon monoxide (CO):	34 tons
Volatile organic compounds (VOCs) :	6 tons
Particulate matter :	5 tons
Sulfur dioxide (SO_2) :	<1 ton
Carbon dioxide (CO_2) :	23,085 tons

Provided by ecology & environment, personal communication, March 2007.

KOBELCO
United Rentals

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On-Site Repository

- Consider liner and cap design
  - Drainage (materials may be moist)
- Apply substantial erosion controls
- Consider design life
  - Use RUSLE to determine appropriate thickness
- Examples of use include arsenic, mercury and radiologicals

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Tailings Pile at BV/Klau Mine

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Excavation and Rep. Construction

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Repository Drainage System

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Completed Repository

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In-Situ Stabilization

- Regrade and/or cover
- Attempt to cut-off exposure pathways
- Decrease mobility and leachability of contaminants
- Will the cover withstand erosion?

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Rinconada Mine

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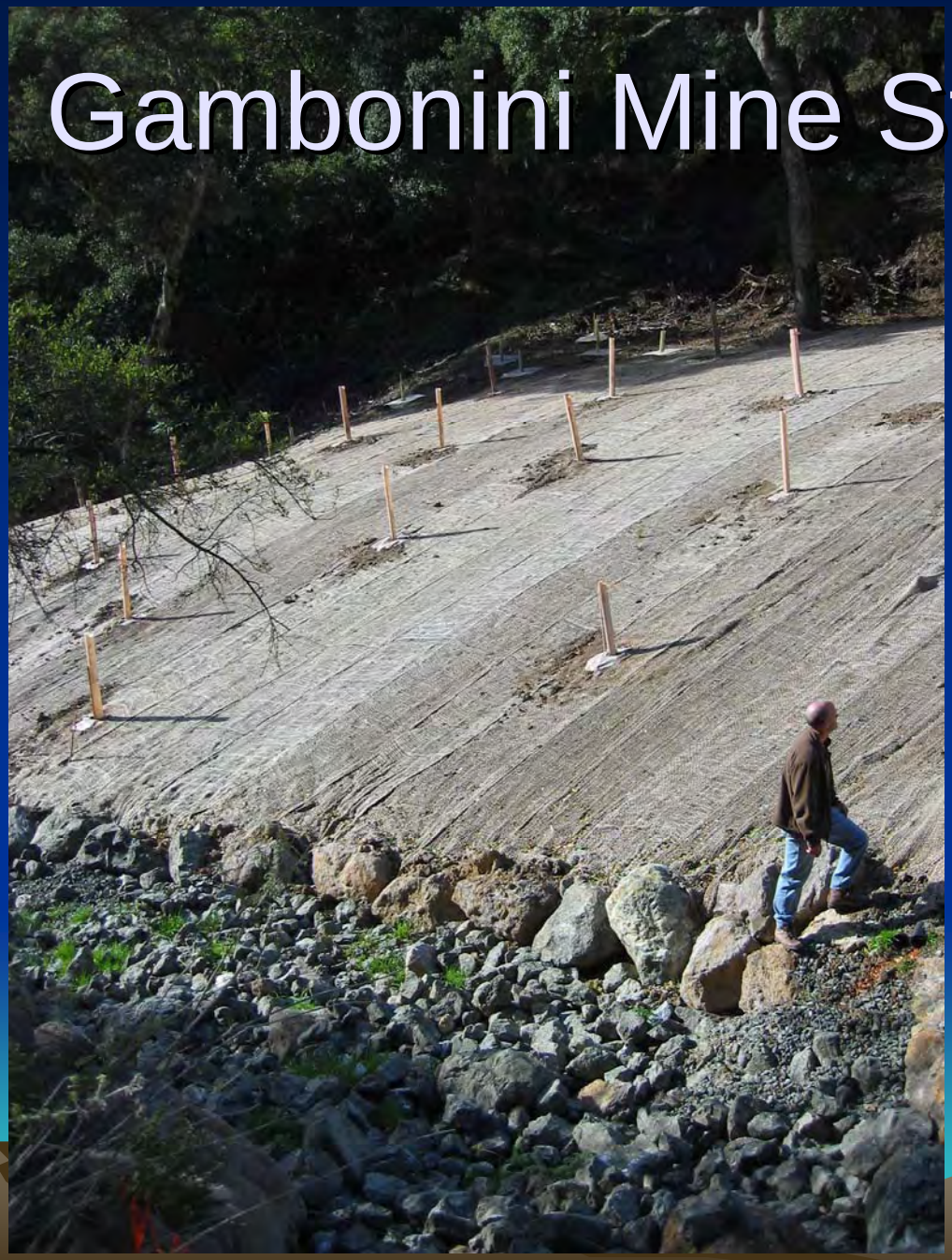
Gambonini Mine Stabilization



Sloping, cover and revegetation

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Blue Ledge Stabilization

Sedimentation basin construction

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Create a "reactive cover" by Decreasing Bioavailability *in-situ*

- Various substances can be used to decrease bioavailability (and therefore toxicity) *in-situ*
  - Biosolids and Water Treatment Residuals (other OM)
  - Amendments
    - Limestone, use for arsenic, lead, zinc, cadmium
    - Phosphate, use for lead sites
  - Basis provided by bioavailability & ecotoxicity tests
- See the new white paper *Amendments for Ecological Restoration*

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McCleur Tailings Site

- The McCleur Tailings Site is an abandoned mine with high arsenic and lead concentrations in soil
  - Estimated bioavailability before and after treatment with biosolids, limestone and phosphate.
  - Demonstrated a reduction in bioavailability and leachability
  - Demonstrated that the site could be revegetated for erosion control

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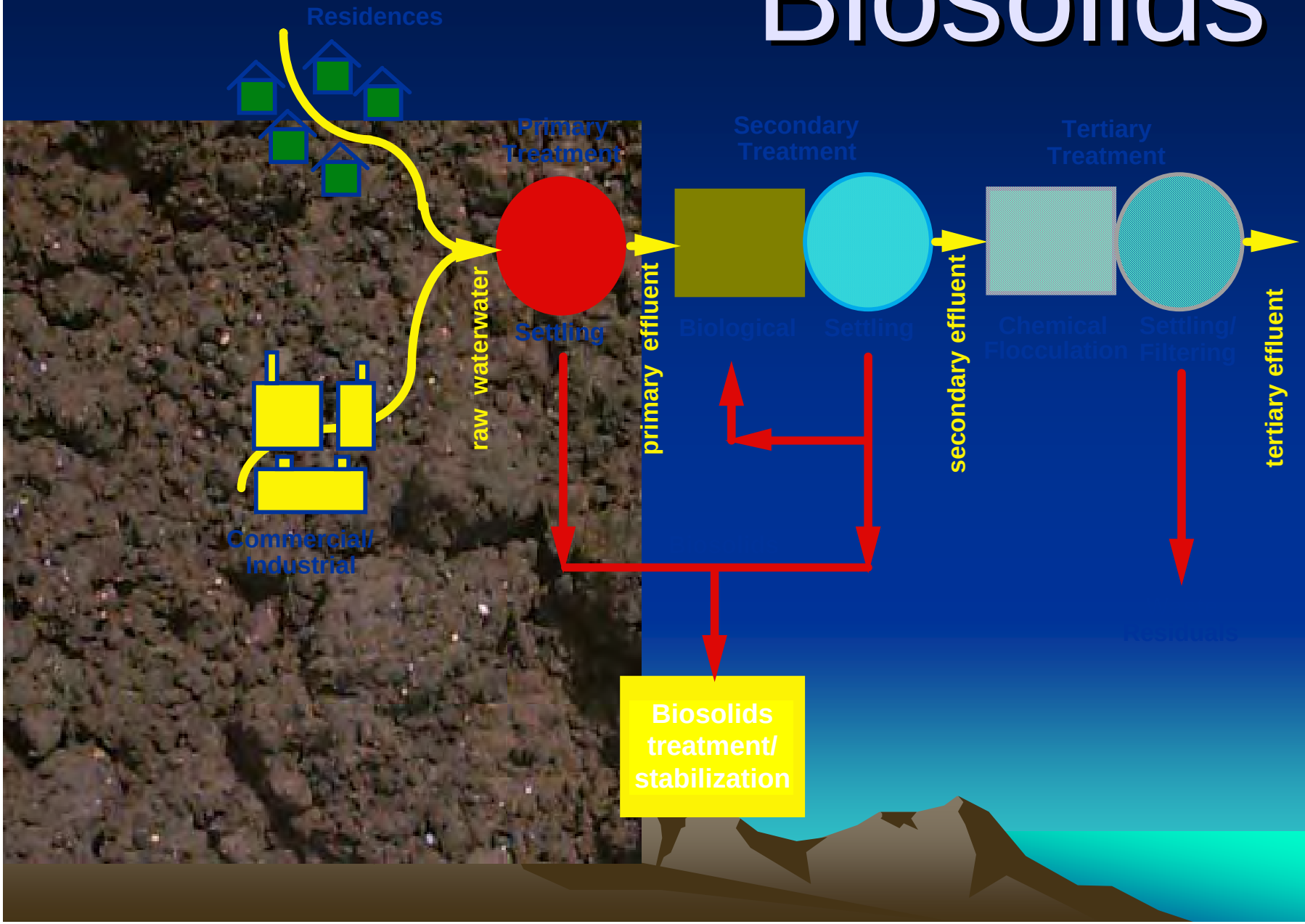
Biosolids



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Biosolids

- Produced by all municipalities
- Use regulated under 40 CFR 503
- 70% of biosolids are now land applied
- Cost - "subsidized" by municipality

Courtesy of H. Compton, EPA & Dr. S. Brown, U. Wash.

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In-vitro bioavailability

- Physiologically Based Extraction Test (PBET) & others
- Correlated to past *in-vivo* bioavailability studies

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Soil Characteristics Tailings

- Tailings A
- Total Lead 3%,
- 30,000 ppm
- Total Arsenic 300 ppm
- pH 2.3

- Tailings B
- Total Lead 0.2%,
- 2,000 ppm
- Total Arsenic 200 ppm
- pH 2.7

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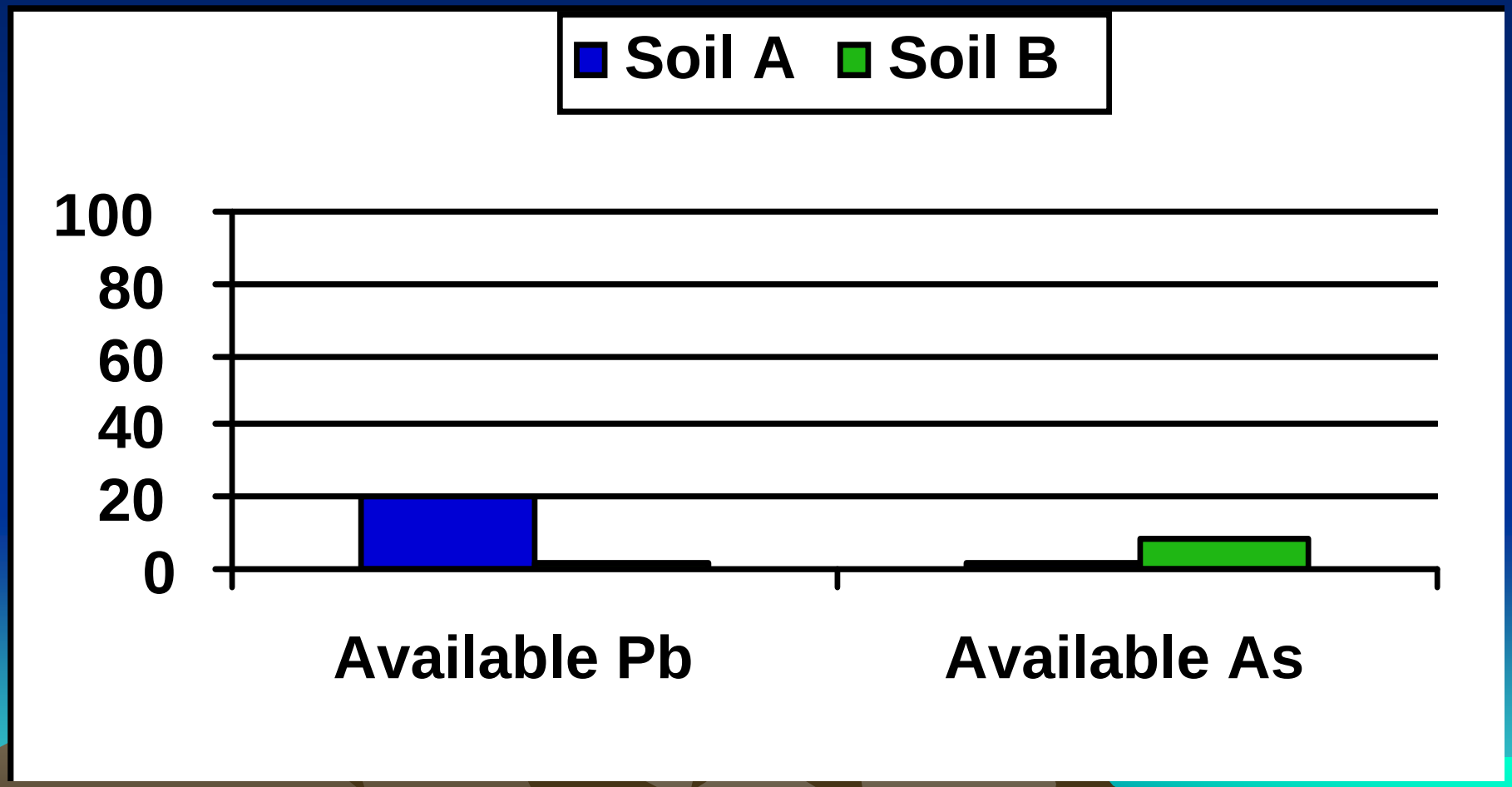
PBET Extractable



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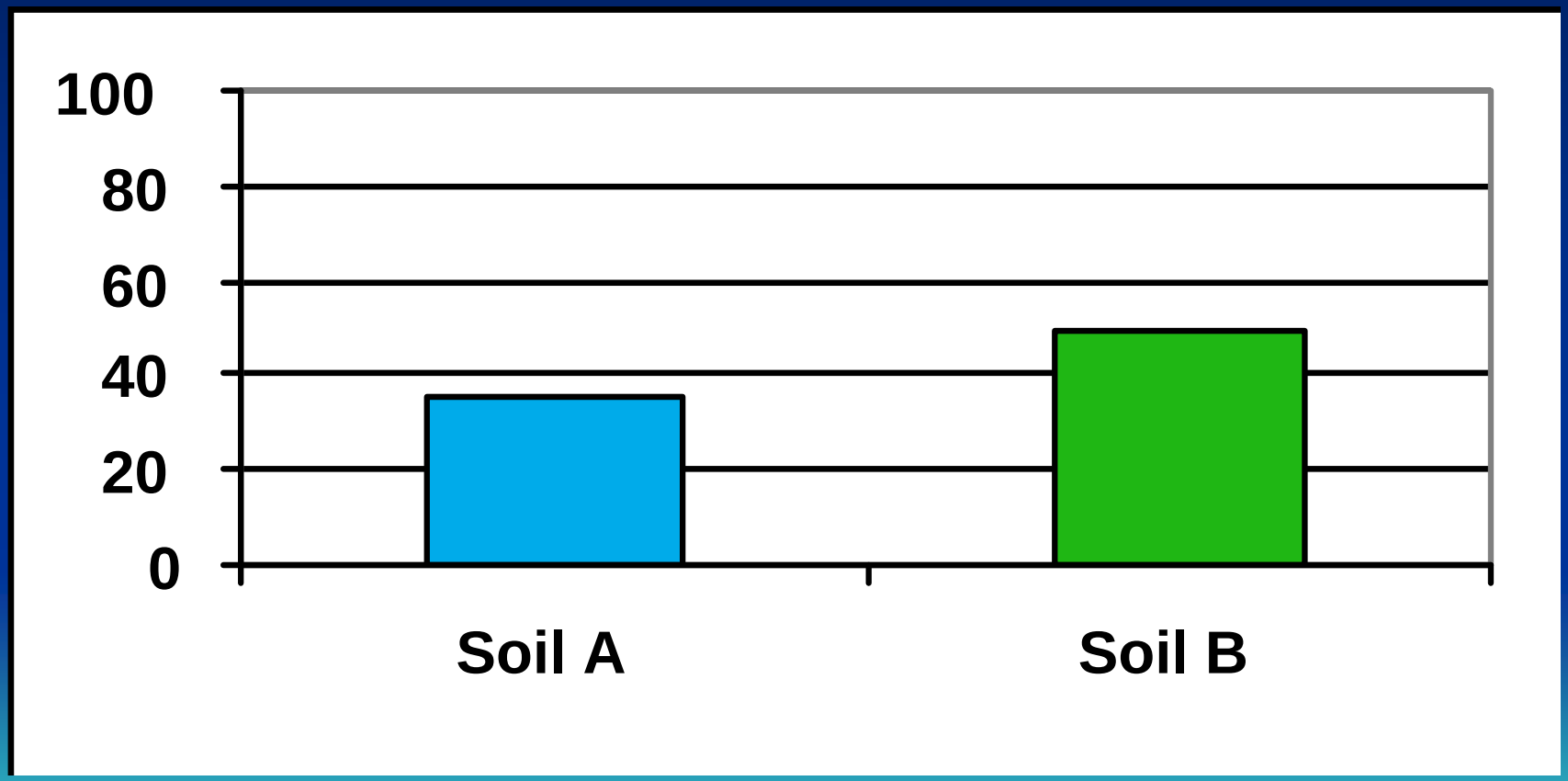
High Iron Compost Addition Reduction in Lead Availability



DEERE

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Achievements

- After removal of tailings and waste rock from the stream bed, amendments were used to bind heavy metals and create a growth media for plants
  - Achieved stability of the pile and stream channel, limited runoff and erosion
  - Achieved decrease in toxicity to a protective level

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Options Analysis

Options	Consistency with RBCG	Consistency with Land-Use	Feasibility & Special Considerations	Costs & Duration
Option A: Disposal off-site	Consistent with achieving the cleanup goal b/c waste will be disposed off-site	No risk of re-exposure to small areas due to human or animal perturbation	It may be physically impossible to remove some contamination. These areas will likely require cover (true of all options).	Costs and duration of cleanup are extremely high b/c of transportation and disposal *Estimated $37,127,000 to $44,552,000 (inc. 20% contingency)* *Minimum 3 seasons* Large uncertainty

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Option B

Option B: Disposition in an on-site repository	Consistent with the cleanup goal b/c waste will be encapsulated on-site Highest level material may be difficult to stabilize/shield	Low to medium risk of re-exposure due to human or animal perturbation May create a small area of restricted use land (temporarily)	May be difficult to manage long-term stability of cover (requires design & monitoring)	Costs and duration of cleanup are moderate Moderate uncertainty – best estimate approx. $10,000,000 Approx. 1 construction season Moderate uncertainty

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Option C

Option C: Regrading & covering *in-situ*	Consistent with achieving the cleanup goal b/c waste will be covered with clean material	Medium risk of re-exposure due to human or animal perturbation May require larger areas of restricted use land compared to Opt. B (temporarily)	May be difficult to manage long-term stability of cover (requires design & pot. monitoring). Requires significantly more material than Opt. B.	Costs and duration of cleanup are moderate to high -importation of fill for cover will have substantial costs which will depend upon the proximity of the borrow source. No Cost estimate made Large uncertainty

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Erosion Controls

- Erosion controls and revegetation planning
- Channel design
  - HDSC
  - Channel Worksheet.xls
  - Stream Corridor Restoration Guide
  - Channel Pro
- Revegetation
  - Seek University or local Conservation Corps assistance
  - Use native plant guides

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Erosion Control – blankets, bales, slope

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Confirmation Sampling

- Traditional sampling w/ reversed assumptions
- Radiologicals require scanning & sampling
- Others?

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Happy Campers!

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Questions?

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