Top Down Process for Mine Closure Planning

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Top Down Process

1. Identify all possible closure methods
2. Identify factors by which methods will be evaluated
3. Try to evaluate methods using available information only
4. Make decisions where results are clear
5. Initiate investigations only where not clear
6. Re-evaluate & stop when decisions are clear

Ronneburg District – East Germany

14 Waste Rock piles
250 M tonnes
600 hectares

Absetzerhalde
150 M tonnes

Nordhalde
60 M tonnes

pH 2.7
SO_4 10,000 mg/L

1. Identify possible methods

- "Representative options":
  - Perpetual water treatment (only)
  - Cover waste rock in place
  - Relocate waste rock to pit

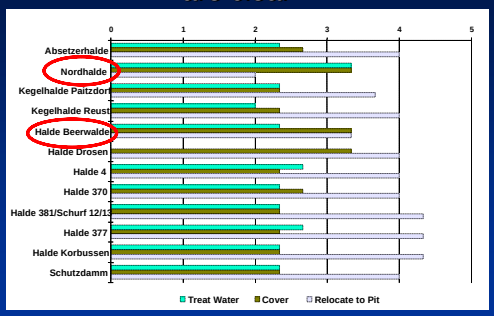
2. Identify evaluation factors

- Cost
  - Capital costs
  - Long-term water treatment costs
- Risk
  - Human and ecological
  - Radiological to workers
- Acceptance
  - Regulations and commitments
  - Local public

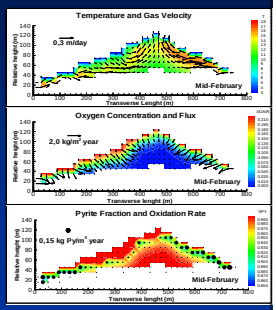
3. Use available information (only) to evaluate options

- Cost estimates based on conceptual designs only
- Human health risk assessments based on available data and comparison to other cases
- Assessed acceptance based on review of regulations, effect on land values, and feedback from public meetings

4. Make decisions when results are clear



5. Investigate only the uncertainties that prevent decisions



6. Re-evaluate and stop investigations when decision is clear

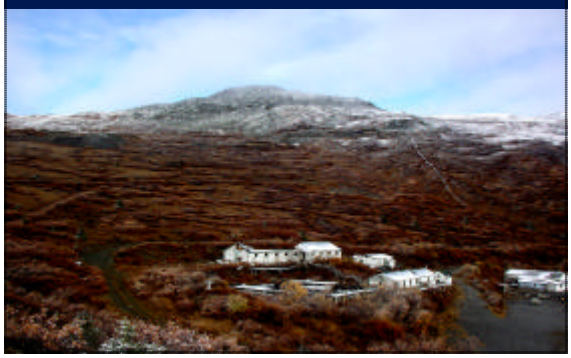
In situ measures unlikely to improve water quality

Decision: Relocate to pit

Refinements since 1994

- North American mine closure
  - More transparency
  - Broader consultation
  - Particularly when publicly funded
- Use of workshops at key points in project
  - Technical workshops – identification of options
  - Stakeholder workshops – evaluation factors
  - Joint workshops – decision making and identification of critical uncertainties

25 Abandoned Yukon Mines 1996-98



Arctic Gold & Silver, Yukon, 1998-99

Giant Mine Arsenic Trioxide 2001-03

Colomac Mine, NWT, 2001-2004

Island Copper Mine, BC, 2002-2004

Faro Mine, Yukon, 2003-Present

San Manuel Mine, Arizona, 2001-04

Flin Flon Metallurgical Complex, 2005

Red Dog Mine, Alaska, 2004-Present

Conclusions

- Mine closure is about making decisions
- The top down process applies a decision analysis framework:
  - Transparent and replicable
  - Defensible choices
  - Effective management of technical inputs