Managing Mining Legacies Forum

Site Identification and Prioritization in British Columbia

Brisbane, Australia
July 17, 2012
Overview of Presentation

- Prioritization Process
- Coarse and Fine Filters
- Management Actions
Process to Identify and Prioritize Sites
Cross-government site identification and prioritization by the Provincial Contaminated Sites Committee and coarse filter tool.

Site information compilation followed by Ministry of Justice input and initial on-site investigation and sample collection.

Apply Coarse Filter Criteria to identify candidate sites

Determine land ownership and responsibility for contamination - Crown responsibility?

Establish annual list of candidate sites

Conduct modified Preliminary Site Investigation (PSI)

Evaluate and rank each site using the Risk Ranking Methodology (RRM)

High priority site?

Conduct Supplemental and Detailed Site Investigation (DSI) or other management actions

Re-evaluate priority using RRM

High priority site?

Additional investigation required?

Complete site remediation (risk management strategy or numeric standards)

Establish long-term monitoring plan, if applicable
Cross-government site identification and prioritization by the Provincial Contaminated Sites Committee and coarse filter tool

Site information compilation followed by Ministry of Justice input and initial on-site investigation and sample collection

Apply Coarse Filter Criteria to identify candidate sites

Determine land ownership and responsibility for contamination — Crown responsibility?

NO FURTHER ACTION

Y

Establish annual list of candidate sites

Conduct modified Preliminary Site Investigation (PSI)
Historic Mines Atlas
Province Wide Databases

- Mine database “MINFILE”: location, size and type
- Population density and distribution
- Road network
- Points of water diversion and water wells
- Hydrology, community watersheds
- Fish species information “FISS”
- Listed species, wildlife habitat areas
Digital Road Atlas
Community Watersheds
Hydrology; Fish Species by Watershed
Historic Mines Atlas Calculations

**MINE**
- ARD = DEP_Class * LN_tonnage
- ARD_cum = Sum (ARD in 5 kms area)
- ARD_score = ARD + if (ARD>20%*ARD_cum, then ARD_cum, else 0)

**ECOLOGICAL**
- Terr_Eco_Score = max(BIOm_tally, BION_tally, WHA) * ARD
- FishScore = BlueFish*1 + RedFish*2 + # Fish
- Aqu_Eco_Score = FishScore*ARD_score
- Eco_Score = max(Terr_Eco_Score, Aqu_Eco_Score)

**HUMAN HEALTH**
- Aqu_HH_Score = max(COM_tally, DIV_tally, LIC_tally, WELL_tally) * ARD_score
- Terr_HH_Score = roads_5K/ TOWN_DIST * ARD_score
- HH_Score = max(Aqu_HH_Score, Terr_HH_Score)

*Atlas calculates ranks for each of these measures*
Cross-government site identification and prioritization by the Provincial Contaminated Sites Committee and coarse filter tool

Site information compilation followed by Ministry of Justice input and initial on-site investigation and sample collection

Apply Coarse Filter Criteria to identify candidate sites

Determine land ownership and responsibility for contamination – Crown responsibility?

Establish annual list of candidate sites

Conduct modified Preliminary Site Investigation (PSI)
Fieldwork
Preliminary Site Investigation
We needed a better method to prioritize sites

- The existing Federal ranking tool did not adequately differentiate between sites; we also reviewed methods in other jurisdictions

- We required a method for government to rank sites that was:
  - Systematic, transparent, based on technical information
  - Unbiased and risk-based
  - Could be used to support management decisions for the expenditure of public funds

- Result was the development of a Risk Ranking Methodology
Assessment of risks to human health and the environment using information and data collected from field investigations.

Determination of priority based on risk, using the RRM.

Evaluate and rank each site using the Risk Ranking Methodology (RRM).

High priority site?

Y?

Conduct Supplemental and Detailed Site Investigation (DSI) or other management actions.

Re-evaluate priority using RRM.

High priority site?

N

NO FURTHER ACTION AT THIS TIME

Re-evaluate risk.

NO FURTHER ACTION AT THIS TIME
Risk Ranking Methodology (RRM)

Goal: “to develop a scientifically based, defensible and systematic methodology for the evaluation and ranking of priority Crown contaminated sites based on potential risk to human health and the environment.”
Categorization and hierarchical design are key
Provide a direct link to decision-making
Data-driven; minimize use of subjective criteria
Avoid complexity
Use spatial information → cumulative impacts
Explicit consideration of uncertainty
RRM: Design

RRM in a two-step process:

1. **Risk Ranking Support Tool** (XL and underlying documentation) uses site-specific data and information to generate information about potential risks.

2. **Annual Workshop** is an expert-based process that builds on Tool’s outputs to recommend management actions at contaminated sites.
Chemistry data are evaluated by “exposure unit” or “pathway”
## RR Support Tool

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>INPUTS</th>
<th>SCREENING VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GENERAL INFORMATION</strong></td>
<td></td>
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<tr>
<td>Site Name</td>
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<tr>
<td>High Risk of Major Event (e.g., geotechnical collapse, flooding etc.) that would cause significant impact to receptor</td>
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</tr>
<tr>
<td>Maximum Thickness of GPR in the area</td>
<td>Value</td>
<td>Screening Value</td>
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<tr>
<td>Maximum Concentration of any metal at a depth</td>
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<tr>
<td>Maximum Concentration of PCBs in soil</td>
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<tr>
<td><strong>HUMAN HEALTH TERRESTRIAL RISK RANKING</strong></td>
<td></td>
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<tr>
<td>Human Health Exposure Unit Name/Description</td>
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<tr>
<td>Exposure Unit (ex)</td>
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<tr>
<td>Measure of Exposure</td>
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<tr>
<td>Number of Analyzed Soil Samples for Exposure Unit</td>
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<tr>
<td>Human Health Exposure Unit Average Surface Soil Concentrations (mg/kg)</td>
<td>Average</td>
<td>Maximum</td>
</tr>
<tr>
<td>Arsenic</td>
<td>%</td>
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<tr>
<td>Cadmium</td>
<td>%</td>
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<tr>
<td>Chromium</td>
<td>%</td>
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<tr>
<td>Copper</td>
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<tr>
<td>Lead</td>
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<td>Nickel</td>
<td>%</td>
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<tr>
<td>Zinc</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Average Arsenic Bioaccessibility (default 29%)</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Average Lead Bioaccessibility (default 19%)</td>
<td>%</td>
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<tr>
<td>Human Health Exposure Unit Background Soil Concentrations</td>
<td>30th Percentile</td>
<td></td>
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<tr>
<td>Arsenic</td>
<td>%</td>
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<td>Cadmium</td>
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<td>Zinc</td>
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<tr>
<td>Measures of Pathways and Receptors</td>
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<td>Human Usage Frequency</td>
<td>Constrained Use</td>
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<tr>
<td>Human Use</td>
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<tr>
<td>Place from on Site Contaminated by Human</td>
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<tr>
<td>Volatile Hydrocarbons (C9+ saturated) vapor within 30m of Buildings</td>
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**HUMAN HEALTH AQUATIC RISK RANKING**
Workshop

- Output of ‘Tool’: multiple lines of evidence for each site
- Expert-based but remains technical (no subjectivity)
- Trade-off preferences are recorded
- Triage: Results in ranked management actions for all sites under consideration
- Can be maintained year-to-year and new site compared with old inventories
Re-evaluate risk

High priority site?

Identification of remediation options for site cleanup with a range of preliminary cost estimates

Additional investigation required?

Complete site remediation (risk management strategy or numeric standards)

Monitor site as necessary

Establish long-term monitoring plan, if applicable
Risk Ranking Methodology

• Developed RRM in 2006-7 and then trialed it, making small tweaks; in annual use since then
• RRM is dovetailed with program delivery, providing standardized approach over time
• Challenges: customized, data-intense, needs up-front investment
• Benefits: defensible, risk-based, systematic
• Provides rational for the expenditure of public funds
A Risk-Ranking Methodology for Prioritizing Historic, Potentially Contaminated Mine Sites in British Columbia

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(Submitted 5 February 2009; Returned for Revision 26 March 2009; Accepted 24 June 2009)

ABSTRACT
The Crown Land Restoration Branch (CLRB) of the British Columbia Ministry of Agriculture and Lands is responsible for managing thousands of historic and abandoned mine sites on provincial lands (referred to as Crown Contaminated Sites). For most of these sites, there is limited information available regarding the extent of potential contamination or potential human health and ecological risks. Given the large number of sites, the CLRB sought a system for prioritizing investigation and management efforts among them. We developed a Risk-Ranking Methodology (RRM) to meet this objective, which was implemented in 2007/2008 with an emphasis on historic mine sites because of the significant number of sites and related potential risk. The RRM uses a risk-based Preliminary Site Investigation to gather key information about the sites. The information for each site is analyzed and summarized according to several attributes aimed at characterizing potential health and ecological risks. The summary information includes, but is not limited to, generic comparisons of exposure with effects levels (screening quotients) for human and ecological exposure pathways. The summary information (more than 25 attributes) is then used in a workshop setting to evaluate relative rankings among sites, and also to identify subsequent management actions for each site. Application of the RRM in 2007/2008 was considered successful, because there was confidence in the process, the content and the outputs. A key challenge was keeping the number of attributes to a manageable level. Ranking was based on discussion and consensus, which was a feasible approach given the relatively small number of sites that need to be ranked each year, and facilitated transparency in the ranking process. We do not rule out the future possibility of developing a quantitative function to capture trade-offs among attributes.

Keywords: Risk ranking Historic mine site Decision analysis Contaminated site