

A Practitioners Perspective on the Challenges in the Application of Risk Assessment to Management Decisions

Presented By:

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Risk Assessment (1)

- ❑ **Integral component of Federal Contaminated Sites Action Program**
- ❑ **There are a variety of RA applications on large undertakings such as FCSAP**
- ❑ **Focus of this paper is on identification of some of the challenges faced in incorporating Ecological Risk Assessment (ERA) results into the development of Remedial Action Plans**

Risk Assessment (2)

- ❑ **The answers are not always clear!**
- ❑ **For example,**
 - ❖ **Are actions warranted if contaminant concentrations in sediments > guidelines?**
 - ❖ **How are exposures to tailings and waste rock dealt with in an ERA?**
 - ❖ **How are tailings ponds considered within ERAs and Remedial Action Plans?**
- ❑ **These questions are examined below through Case Study examples**

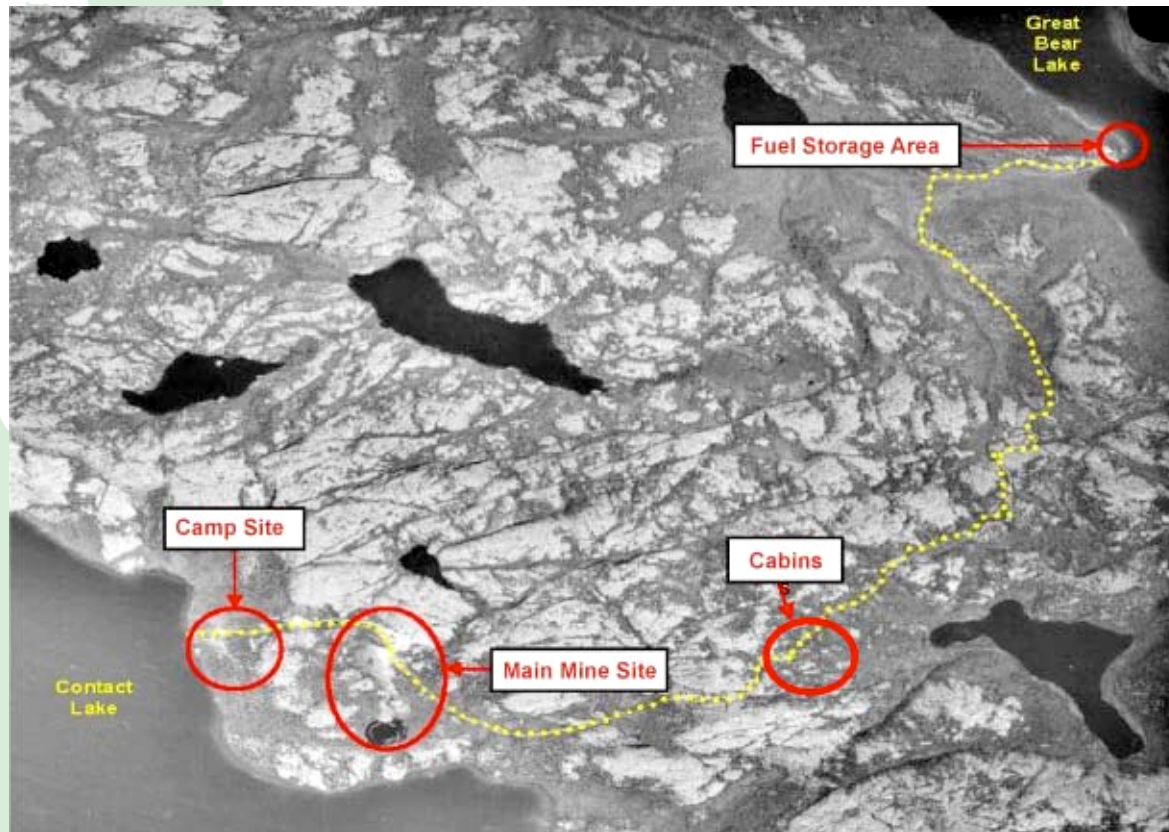
Case Study #1

Contaminated Sediments Contact Lake Mine

Contact Lake Location Map



Contact Lake Mine Site



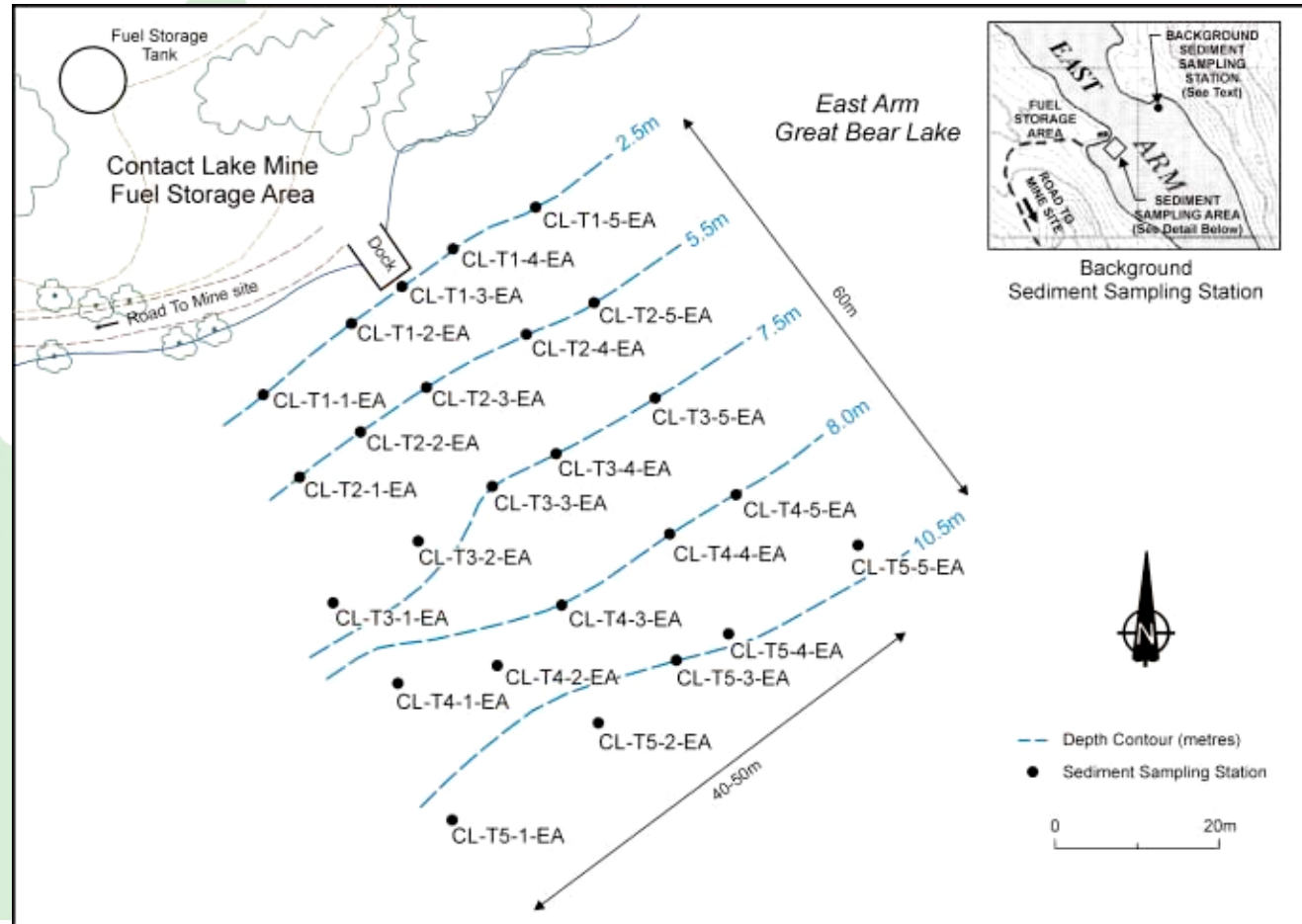
Former Contact Lake Mine Dock and Fuel Tank, East Arm of Great Bear Lake



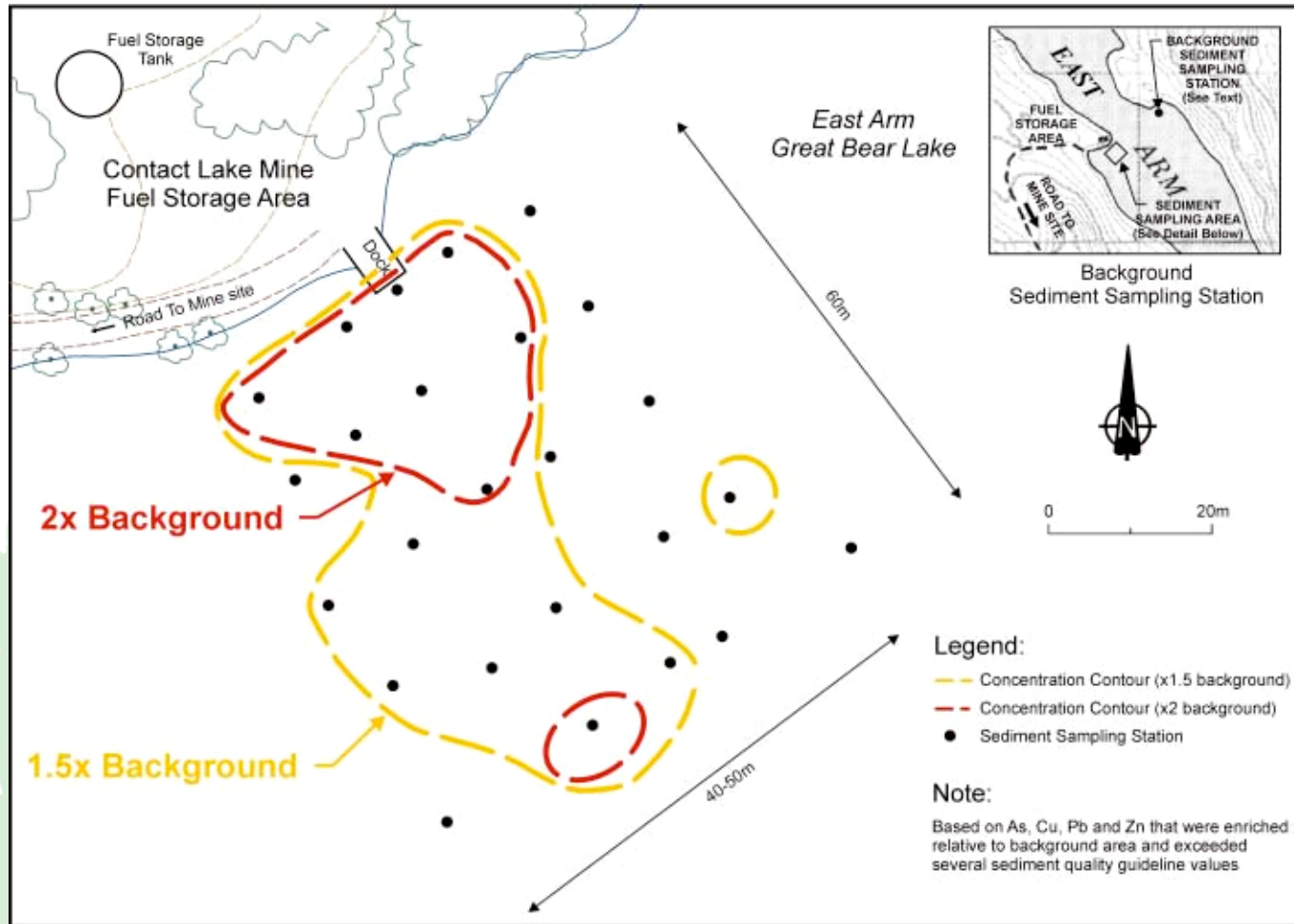
Contact Lake Sediment – Chemical Testing Programs

- ❑ Initial sediment sample collection near dock indicated elevated levels of several metals (Ag, As, Cu, Pb and Zn) and PHC
- ❑ Results triggered a more comprehensive sediment monitoring program including:
 - ❖ Collection of surface sediment samples from 25 locations opposite the dock for metals and PHC analyses
 - ❖ Collection of surface sediment samples from 5 locations at a background reference area

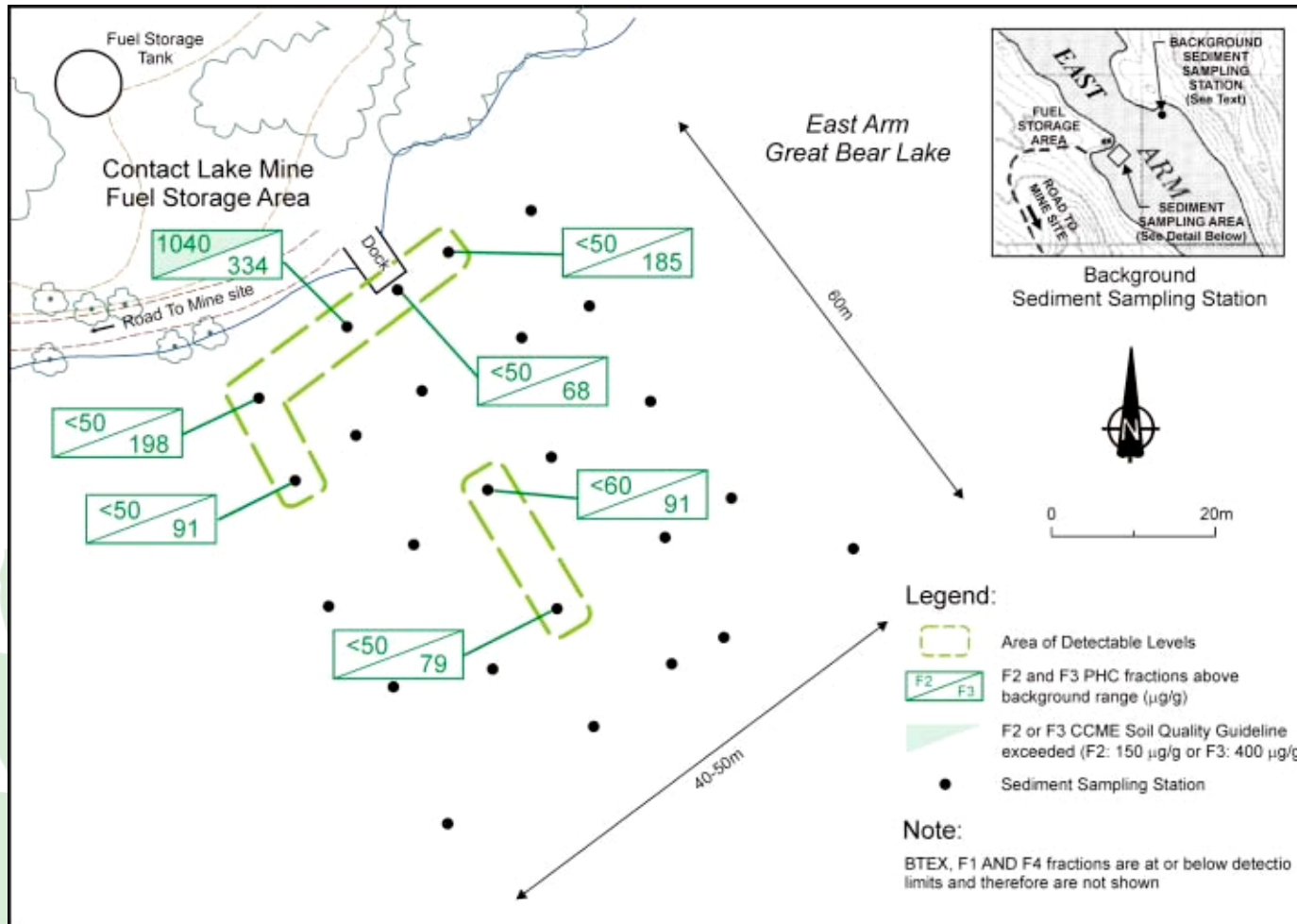
Sediment Sampling Stations Opposite Contact Lake Dock, August 2007



Metal Impacted Areas



PHC Impacted Areas



Contact Lake Sediment – Benthic Community Surveys

□ Included:

- ❖ Collection of benthic invertebrate samples from 5 near shore stations adjacent to the dock and at a reference location
- ❖ Collection of sediment samples for toxicity testing at two stations with highest contaminant concentrations in the exposure area

Contact Lake Sediment – Grain Size Analysis Results

	Reference Area	Exposure Area
Gravel	< 1%	<3 %
Sand	13.7 %	21.7 %
Silt	54.7 %	43.0 %
Clay	31.5 %	33.8 %
TOC	17.1 mg/g	21.0 mg/g

Contact Lake Sediment – Benthic Survey Results

	Reference Area	Exposure Area
Benthic Endpoints		
Taxon Richness	16	15
Total Density (#/m²)	12,542	15,236
EPT	0.67	1.07

Conclusion: benthic endpoints were similar between areas

Contact Lake Sediment – Toxicity Testing Program

- ❑ Toxicity tests were conducted on two sediment samples and a control sample using two invertebrate species, the midge *Chironomus tetans* and the amphipod *Hyalella azteca*
- ❑ The first sediment sample was collected ~10m offshore from the dock and the second sample was collected ~30m from the dock

Contact Lake Sediment - Toxicity Test Results

□ Test results showed:

- ❖ No adverse effects on growth or survival of either test species on the offshore sediment sample and the control sample
- ❖ Severe effects on growth and survival of both test species on the near shore sediment sample

Summary

- ❑ The “Decision-Making Framework for Contaminated Sites in the Great Lakes Area” developed by Peter Chapman was used in the sediment assessment
- ❑ Sediment chemistry and toxicity test results suggest that a portion of the sediments may be toxic to benthic invertebrates
- ❑ Benthic community survey results; however, did not show evidence of adverse effects

Conclusion

- ❑ **Taking into consideration:**
 - ❖ **The small size of the contaminated area**
 - ❖ **The stable conditions of the sediments after 25 years of inactivity**
 - ❖ **The results of the benthic community survey which showed no evidence of adverse effects**
- ❑ **It was concluded that remediation of the sediments was not warranted**

Case Study #2

Tailings Management Port Radium Mine Site

Port Radium Site Tailings



Ecological Risk Assessment Receptors and Locations



McDonough Tailings Basin

- ❑ Located inland with no connection to any other waterbody
- ❑ Water and sediment solids quality were found to exceed environmental quality guidelines for one or more constituents (notably As, Cu, Pb, U and Zn)
- ❑ Biological surveys confirmed that there are no fish present in the McDonough Basin
- ❑ Hence, risks to aquatic species were judged to be low

McDonough Tailings Basin Ecological Risk Assessment Results Waterfowl

Analyte	Screening Index Value		
	Mallard	Merganser	Scaup
Arsenic	0.52	0.42	0.88
Uranium	0.34	0.10	0.52
Zinc	1.63	0.06	2.66

Note: Screening Index values based on ratio of estimated exposures to LOAEL benchmarks. SI values above 1 imply potential for an effect.

Results of ERA for Waterfowl

- ❑ ERA results suggested that individual waterfowl that consume primarily aquatic plants and benthic invertebrates (e.g. mallard and scaup) may be at risk from exposure to zinc and possibly arsenic
- ❑ The primary exposure pathway was related to consumption of benthic invertebrates
- ❑ Considering that metal levels in benthic invertebrate were estimated using very conservative transfer factors as site-specific data could not be measured due to low invertebrate densities, it was concluded that the risks may be substantially over-stated
- ❑ Taking into consideration the conservative nature of the assessment, it was concluded that remediation of McDonough Tailings Basin was not warranted

Port Radium Surface Tailings – Ecological Risk Assessment Results

Analyte	Screening Index Value			
	Hare		Grouse	
	Cobalt Channel Area Tailings	Murphy Bay Area Tailings	Cobalt Channel Area Tailings	Murphy Bay Area Tailings
Arsenic	14.4	12.2	0.5	0.4
Uranium	10.3	2.1	3.1	1.7
Zinc	0.2	0.1	0.5	0.6

Note: Screening Index values based on ratio of estimated exposures to LOAEL benchmarks. SI values above 1 imply potential for an effect.

Results of ERA for Hare and Grouse

- ❑ High SI values for hare in particular suggested that small individual terrestrial animals may be at risk in the area of the Cobalt and Murphy tailings spills
- ❑ Soil/tailings ingestion was assessed to be the primary exposure pathway to hare
- ❑ Observation in the field of a large healthy looking hare near the Cobalt tailings spill area suggested that the predicted risk may be over-stated
- ❑ Nonetheless, it was concluded that remediation of the areas affected by spilled tailings was warranted and the remediation plan for the site took this recommendation into account

Site-Wide Exposure Ecological Risk Assessment Results Large Game

Analyte	Screening Index Value			
	Caribou	Bear	Moose	Fox
Arsenic	0.1	0.4	0.7	1.6
Uranium	0.05	0.05	0.06	0.3
Zinc	<0.01	0.01	0.03	0.02

Note: Screening Index values based on ratio of estimated exposures to LOAEL benchmarks. SI values above 1 imply potential for an effect.

Results of ERA for Large Game

- ❑ Contaminant levels at the Port Radium site pose no risk to large game such as caribou that would spend only a small fraction of the year on-site
- ❑ Risks to animals such as the fox that could spend a large portion of the year on-site was assessed to be higher and primarily related to the elevated contaminant levels in the area of the Cobalt and Murphy tailings spills
- ❑ Remediation of these areas as previously discussed was recommended to reduce the risk to fox to an acceptable level (i.e. $SI < 1$)

Summary

- ❑ **Case studies presented in our paper demonstrate some of the typical dilemmas faced in applying the results of ecological risk assessments to the development of remedial action plans at remote sites**
- ❑ **Ecological risk is generally the driver at remote sites where human activity is quite limited**
- ❑ **Environmental quality guidelines are not always applicable in these situations**
- ❑ **Follow-up monitoring is recommended when ERA results suggest the potential for adverse effects (e.g. benthic community surveys)**
- ❑ **Important to understand the underlying assumptions used in a risk assessment when developing remedial action plans as RA findings are often not definitive**

Thank You!