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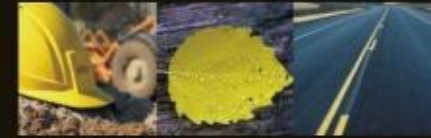


Incorporation of Ecological Risk Assessment into Phase II ESAs for Abandoned Mine Sites in the NWT.

(Davidson, Widemeyer, Zier-Vogel and Dillon)

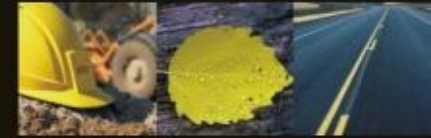
Presented by: Scott Davidson, M.Sc., P.Geo (BC)
EBA Whitehorse

EBA TEAM



- Project Manager – Herb Zier-vogel
- Ecological Risk Assessor – Joline Widmeyer
- Field Crew
 - Kyle Levac/Michel Hiebert – technologists
 - Karla Langlois – biologist
 - Scott Davidson – lead assessor West Bay
 - Sean Dillon – lead assessor Outpost Island

ACKNOWLEDGEMENTS



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 - Ms Jane Amphlett
 - Mr. Regan Fielding
 - Mr. Bill Coedy

PURPOSE



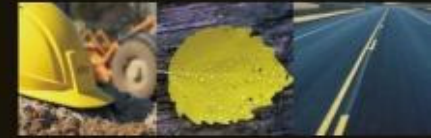
- The purpose of this presentation is to discuss the importance of incorporating ecological risk assessments (ERA's) into Phase II environmental site assessments (ESA's).
 - **FOUR key elements for integration of ERA into Phase II ESAs**
- A similar approach applies to Human Health Risk Assessments (HHRA's) but different standards and thresholds apply.
- The presentation will also briefly describe the results of this approach for 2 abandoned minesites in the Northwest Territory.

WHAT IS ECOLOGICAL RISK ASSESSMENT?

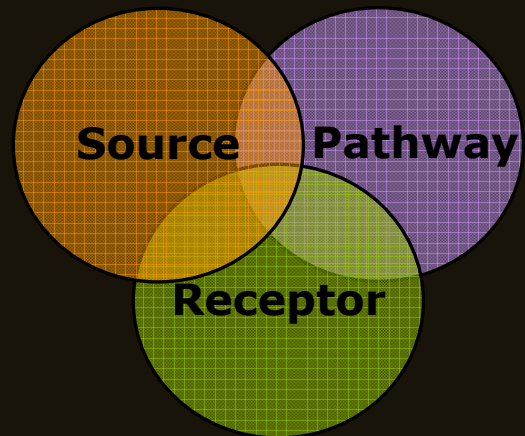


- A tool for deciding how to address contamination to ensure no unacceptable adverse impacts to human health or the environment and that the site use is sustainable for the future
- **Determines relationship between Sources, Pathways, and Receptors and integrates into a risk calculation to determine if risk is acceptable or not**
- Applicability of, and need for, risk assessment are regulatory-driven based on regulations and standards
- Risk assessment is reactive (contaminated site clean-up) but can be proactive (EIA, security reviews, re-development) or retroactive (fish kill).

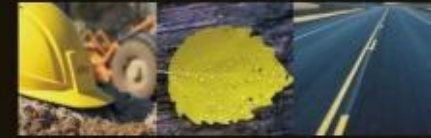
The Basics of Ecological Risk Assessment



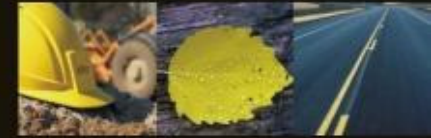
ECOLOGICAL RISK



Ecological Risk Assessment



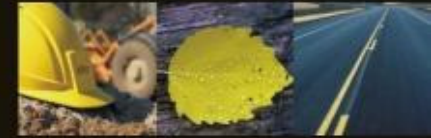
- The purpose of ecological risk assessment is to determine the probability of an adverse effect to an ecological receptor.
- Involves quantification of the hazard resulting from exposure to a stressor within an ecosystem
- Involves identification of most relevant receptor - the specie(s) most sensitive or at risk?
- Process is a non-linear, multi-tiered process encompassing many parallel activities
- Risk assessment is a multi-disciplinary science



Terrestrial and Aquatic

- 1) **Sources**; chemical contaminant, temperature, gas, UV radiation
- 2) **Key Pathways**; soil/sediment, vapors, water (ground/surface), atmosphere, food chain
- 3) **Receptors**; insect, benthic invertebrate, bird, amphibian, mammal, fish, plant

WHY IS THIS IMPORTANT?



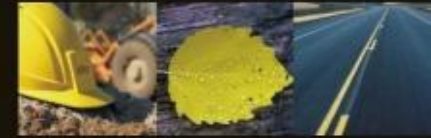
- The Phase II ESA stage is intended to confirm areas of contamination at a site that are present through field sampling and to start the development of **appropriate** remedial measures that may be implemented during the final stages of remediation.
- Quantification of the potential for ecological impacts at the Phase II ESA stage allows for the various pathways to be considered, based on the relevant standards and regulations, and for appropriate Phase III workplans to be developed.
- Knowing this sooner rather than later allows for the Phase III ESA to target most relevant issues identified in the Phase II investigation – potentially economizing sampling efforts and delineation in the Phase III investigation.
- The goal is to have all the required data in place at the end of the Phase III ESA to allow for development of the final Remedial Action Plans for the site.

HOW CAN RISK ASSESSMENT HELP ESA SITE ASSESSMENTS?



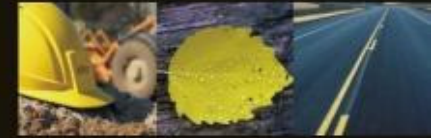
- Achieve regulatory closure on sites where a standard approach is not possible or very expensive
- Demonstrates that human health and the environment are being protected (due diligence)
- Can reduce or focus remediation and monitoring costs
- May save time to achieve regulatory closure when compared to costs of complete remediation
- If done properly - promotes communication amongst all parties involved allowing for a transparent end product

FIRST TWO KEY ELEMENTS TO SUCCESSFUL INTEGRATION OF ERA INTO PHASE II ESA



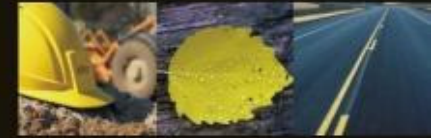
1. Proper Team composition – biologist, risk assessor, contaminated sites specialist, mining effects (ARD/ML) specialist.
2. Enough time and budget allocated for the team to review data and identify all relevant pathways to develop Phase II sampling plan. Including:
 - Bathymetric maps for relevant watercourses
 - Topographic maps for groundwater flow direction
 - Good site plans

SECOND TWO KEY ELEMENTS TO SUCCESSFUL INTEGRATION OF ERA INTO PHASE II ESA



3. Have a biologist on PII site visit to conduct an onsite **bioinventory** (and help with sample collection) with a focus in:
 - Riparian habitat
 - All watercourses
 - Sensitive habitat in surrounding area
4. Allow **sufficient onsite time** to collect enough data at locations with Potential Contaminants of Concern for all pathways.

A Word of Caution to ESA Folk

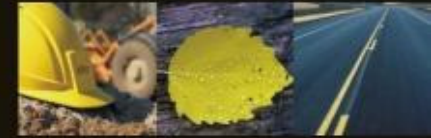


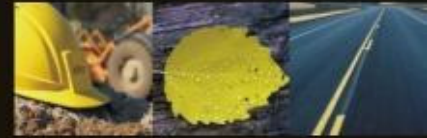
- Data used as input to the ERA must reflect the existing site conditions and should also capture potential changes to those conditions. This additional testing may be part of the Phase III ESA workplan resulting from the Phase II ESA.
- The ERA results may support the use of kinetic testing in order to further characterize materials at a site. The ERA results may indicate the need for flooded column tests to quantify potential loadings from submerged tailings – this goes beyond standard humidity cell testing.
- Where submergence of oxidized materials is being considered it is important to ensure that ESA testing assesses potential loadings resulting from changes in oxygenated to anoxic conditions (due to a change in the solubility). This is the same for consideration of artificial wetlands but then the consideration of increased vegetative uptake and vegetation management must also be included.



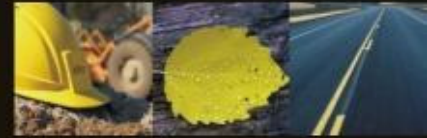
Former Westbay and Outpost Mines Results From the 2008 SLRA and PQRA

LOCATIONS

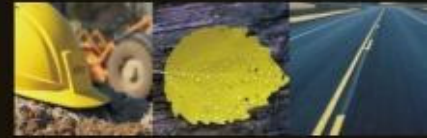




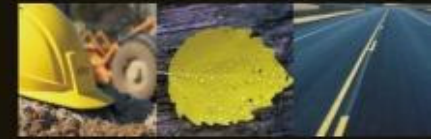
WEST BAY



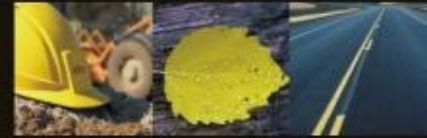
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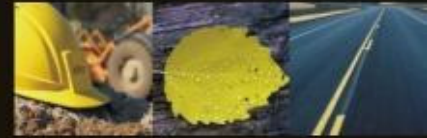
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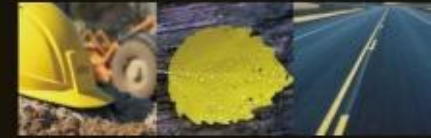
Outpost Island



Outpost Island



ONSITE INVESTIGATION



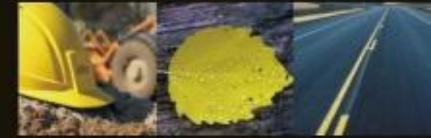
- Included Proper Team Composition
- Included adequate workplan development by all team members
 - Identifying sediment, surface water, soil and mine tailings as potential sources of contamination
- Included onsite bioinventory by a qualified biologist
- Included sample collection of sediments, groundwater, surface water (standing and lake), soil, tissues (plant & fish), and mine tailings

DATA ANALYSIS – CCME benchmarks



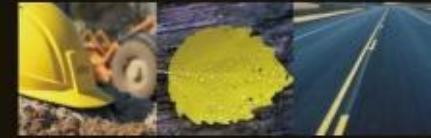
- Confirmed soil exceedances - not significant as exceedances were not within the vicinity of “quality” terrestrial or aquatic habitat
- Confirmed surface water exceedances – yet minimal when fish tissue levels were examined and compared to prior regional studies
- Confirmed sediment exceedances – more testing needed in locations with highest metal exceedances
- Triad approach for sediment toxicity (the beginnings of, not complete...)
 - Benthic invertebrate identification
 - Laboratory sediment toxicity testing
 - Analytical benchmark exceedances

RESULTS AND SAVINGS DUE TO ERA INTEGRATION INTO PHASE II ESA



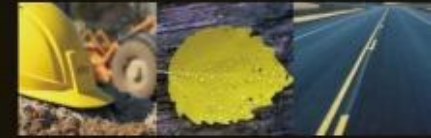
- Contamination was identified and either
 - a) Eliminated based upon location and proximity to receptors (incomplete pathway)
 - b) Put forth for further delineation and investigation for Phase III ESA
- Five quality ecological habitats were identified onsite
 - Overall low diversity for aquatic environment based upon benthic ID and fish trapping data
 - High potential terrestrial habitat due to young stage of community ecological succession (due to recent fire in area)
 - Habitat quality good to high for moose, barren-ground caribou, loons, martens, muskrat, black bears

OVERALL BENEFIT



- Have a solid set of data to build upon to complete further PQERA in Phase III ESA
 - Analytical data
 - Benthic ID (not a complete analytical set)
 - Sediment toxicity testing
 - Plant and fish tissue contaminant levels
- Further information required to complete a dietary uptake model for confirmed onsite aquatic and terrestrial receptors
 - More benthic ID at contaminated locations
 - Further delineation of PCOCs
- With additional PIII information a PQERA can be completed and site specific risk based standards generated for the sites along with a modified remedial action plan (if necessary)

CAUTIONS



- If prior sampling information is not available samples for ERA may be collected during the Phase II that may not contain contamination
- If site specific information (sediment, soil, groundwater exceedances) is not available to develop Phase II workplan, more samples than necessary can be collected and held – processing for ERA testing (benthic ID, toxicity testing) can be completed once analytical results are available
 - Not always possible with time sensitive analytical parameters (PHCs, vapours, speciation)



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