Giant Mine Remediation Project
Risk Management

National Executive Symposium
May 30, 2013
Presentation Outline

- Site History
- Site Overview
- Project Objectives
- Remediation Approach
- Project Timelines
- Project Risks
- Risk Management
- Next Steps
Site History

• Operated from 1948 through 2004
• In 1999 Royal Oak was assigned into Receivership
• Royal Oak Lease area is now under the care of Aboriginal Affairs and Northern Development Canada

• Site Characteristics:
  ▪ Covers approximately 850 hectares;
  ▪ Mining extracted over 7.6 million ounces of gold; and
  ▪ Processing of gold ore by roasting resulted in the production of arsenic trioxide dust:
    ▪ 237,000 tonnes stored underground; and
    ▪ Various building and surface areas around the property are also contaminated with arsenic and asbestos.
- NWT Commissioner's Land
- Within Yellowknife City Limits
- Includes Town Site
- Traditional Akaitcho lands
- TliCho Monfwii economic measures
Giant Mine – Site Overview

- Jojo Lake
- B1 Pit
- C Shaft
- Highway 4
- Baker Creek
- C1 Pit
- Roaster Complex
- Mill Conveyor
- Underground Arsenic Chambers
Remediation Project Objectives

• Minimize public and worker health and safety risks
• Implement an approach that is cost effective and robust over the long-term
• Minimize the release of contaminants from the site to the surrounding environment
• Remediate the site in a manner that instills public confidence
## Overview of Remediation Approach

<table>
<thead>
<tr>
<th>Focus Area</th>
<th>Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Arsenic Trioxide Dust</strong></td>
<td>Freeze the arsenic and the rock around each of the 15 underground chambers</td>
</tr>
<tr>
<td><strong>Underground Stability</strong></td>
<td>Support and stabilize the bulkheads, concrete plugs and other areas of the mine</td>
</tr>
<tr>
<td><strong>Baker Creek</strong></td>
<td>Reduce the risk of the mine flooding – diversion or control mechanisms (i.e., dam, channels)</td>
</tr>
<tr>
<td><strong>Open Pits &amp; Waste Rock</strong></td>
<td>Backfill or surround pits by berms or fences to prevent access</td>
</tr>
<tr>
<td><strong>Contaminated Soils</strong></td>
<td>Soils and mine rock will be excavated and disposed or moved to tailings or sludge impoundments</td>
</tr>
<tr>
<td><strong>Tailings and Sludge</strong></td>
<td>Areas to be covered with two layers, graded with ditches and spillways – allowing for re-vegetation</td>
</tr>
<tr>
<td><strong>Buildings and Waste Disposal</strong></td>
<td>Over 100 buildings will be removed – arsenic and asbestos contaminated materials will be placed underground</td>
</tr>
<tr>
<td><strong>Water Management</strong></td>
<td>A new water treatment plant will be constructed to collect and treat contaminated surface and mine water</td>
</tr>
</tbody>
</table>
Project Timeline

Phase 1 – Project Assessment (1999 – 2006)
• Site Assessment, Care and Maintenance

Phase 2 – Project Definition (2006 – 2017)
• Environmental Assessment – Remediation Plan Finalization
• Site Stabilization Plan - Advanced Remediation of High Risks
• Engineering Designs, Water Licence

Phase 3 – Project Implementation (2017 - 2025)
• Full Site Remediation
• Close-Out

Phase 4 – Monitoring and Maintenance (2025 onward)
• Post Remediation Adaptation
Managing Risk

Objectives:

- To provide:
  - A consistent methodology for developing an inventory and evaluating the many different types of risk at contaminated sites;
  - A process to ensure that no high risk items “fall through the cracks”; and
  - A basis for prioritizing risk mitigation or control activities.
Giant Mine Remediation Project Risk Framework

1. **Project Risks** – Project management risks, planning and implementation risks, and financial, human resources, and stakeholder engagement risks. This includes near term and long term strategic risks.

2. **Technical Risks** – Risks associated with care and maintenance activities, legacy infrastructure, new infrastructure, and operations.
GMRP Risk Framework

Project timeline

Present                   Construction Phase          Completion

1. Project Risk Register

2. Technical Risk Register

Update and report quarterly

Rolling wave model

detailed                        high-level
Project Risks

• **Procurement** – appropriate processes and strategies to deliver the project and socio economic benefits

• **Human Resources** – acquiring and maintaining the necessary skills, experience and expertise

• **Governance** – complexity of operating within federal bureaucracy, developing appropriate decision making structure for complex / mega project

• **Planning and Controls** – ensuring processes in place to manage effectively scope, schedule and budget
Project Risks

• **Community Engagement** – obtaining community trust and support

• **Duty to Consult** – fulfilling legal obligations under Section 35 of the constitution

• **Regulatory** – managing timelines and the complexity associated with delivering the project while obtaining approvals (including completing the environmental assessment)

• **Funding** – securing short, medium and long-term funding required to manage the project
Technical Risks

• This will evolve into risks related to remediation activities and associated remediation infrastructure
• Currently technical risks are focused on Care and Maintenance activities

A. Dams
B. Diversions
C. Tailings and sediments
D. Open Pits
E. Underground
F. Waste Rock Dumps
G. Water treatment
H. Infrastructure
I. Buildings, tanks, structures

A. Baker Creek
B. Tailings and sediments
C. Open Pits
D. Underground
E. Water treatment Plant
F. Freeze Plant
G. Chambers
H. …
# Technical Risks

<table>
<thead>
<tr>
<th>ELEMENT</th>
<th>SUB ELEMENTS</th>
<th>TYPES OF RISK EVENTS</th>
</tr>
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<tr>
<td>1. Dams</td>
<td>multiple dams</td>
<td>breach, seepage, releases</td>
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<tr>
<td>2. Diversions</td>
<td>creek diversions, rock cuts</td>
<td>runoff, freezing</td>
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<tr>
<td>3. Tailings and sediments</td>
<td>ponds, piles, beaches</td>
<td>public access and safety, dusting</td>
</tr>
<tr>
<td>4. Open pits</td>
<td>multiple pits</td>
<td>public /worker access and safety</td>
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<tr>
<td>5. Underground</td>
<td>bulkheads, pillars, shafts</td>
<td>bulkhead failure, arsenic release</td>
</tr>
<tr>
<td>6. Waste rock</td>
<td>rock piles, debris</td>
<td>public access and safety</td>
</tr>
<tr>
<td>7. Water treatment</td>
<td>Treatment plants, feed lines</td>
<td>operational / mechanical failure</td>
</tr>
<tr>
<td>8. Infrastructure (roads, landfills)</td>
<td>Culverts, boneyards, power systems, dumps, etc.</td>
<td>public access, vandalism, safety</td>
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<tr>
<td>9. Buildings, tanks and structures</td>
<td>Boiler and roaster complexes, tanks, mills, etc.</td>
<td>fire, spills, public access, asbestos</td>
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Managing Risk - Project-Level Risk

Risk Matrix:
- Consider an Event
  - Example: public access to open pits leads to a fatality
- Risk = consequence severity times likelihood

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<tr>
<th>Likelihood</th>
<th>Consequence Severity</th>
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<tr>
<td></td>
<td>Low</td>
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<td>Almost Certain</td>
<td>Moderate</td>
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## Managing Risk - Project-Level Risk

### Tolerance:

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**ALARP Region**

**Intolerable Region**

**Broadly Acceptable Region**
Managing Risk - Project-Level Risk

Action Limits:

• Intolerable Region
  • Very High - priority to mitigate immediately
  • High - priority to mitigate within 2 years
• ALARP (As Low As Reasonably Practicable) Region
  • Moderately High Risk - mitigate within 2 years subject to priority
  • Moderate Risk - mitigate within 5 years subject to priority
• Broadly Acceptable Region
  • Low Risk - Monitor over 10 years
Managing On-Site Risks

• Every year the Giant Mine Remediation Project Team reviews the risk register to review the status of risks and the mitigation measures completed over the year. These meetings are attended by:
  • Program staff responsible for the day to day management of the Giant Mine Site remediation project;
  • Government experts on contaminated sites remediation;
  • Expert advisors contracted to provide ongoing advice to the Remediation Team and address specific risks at the Giant Mine site (eg. Design Team, Technical Advisors).
Updating the Risk Registry

• Annual risk registry update meetings follow a standardized format

1. How has it changed?
2. Are existing mitigation measures adequate?
3. Are there implications to schedule?
4. Are there implications to budget?

Discuss Risk Element

Discuss Risk Events

Modify risk ratings and mitigation

Identify follow up and Action Plan
Example: Dams

DAMS 3C & 3D

1.3.1 Seepage from sump contained by Dam 3C leads to release of contaminated water to environment

<table>
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<th>Consequence</th>
<th>Severity</th>
<th>Likelihood</th>
<th>Risk</th>
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<td>Consequence costs</td>
<td>Low</td>
<td>Likely</td>
<td>Moderate</td>
</tr>
<tr>
<td>Environmental impact</td>
<td>Major</td>
<td>Likely</td>
<td>High</td>
</tr>
<tr>
<td>Human health &amp; safety</td>
<td>Low</td>
<td>Likely</td>
<td>Moderate</td>
</tr>
<tr>
<td>Legal obligation</td>
<td>Moderate</td>
<td>Likely</td>
<td>Moderately High</td>
</tr>
<tr>
<td>Special consideration</td>
<td>Moderate</td>
<td>Likely</td>
<td>Moderately High</td>
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2002

Mitigation:

- Since 2002 - maintained low water levels in sump
- May 2007 - Implementation of OMS manual
- Dec 2010 – Increased surface water management reporting requirements
Comparison of the Dam Element Between 2002 and 2011

- The number of events and related consequences has increased over time.
- Regular updates of the risk register have allowed AANDC to systematically monitor the status of risks and the effectiveness of mitigation measures.
Comparing the Overall Level of Risk Between 2002 and 2011

2002

- High: 12%
- Moderately High: 19%
- Moderate: 35%
- Low: 34%

Events = 91
Consequences = 319

2011

- High: 7%
- Moderately High: 15%
- Moderate: 35%
- Low: 43%

Events = 134
Consequences = 415

- Despite an increase in the number of events and consequences at the Giant Mine Site, AANDC has been able to effectively reduce or minimize the level of risk at the site.
Current Project Status

AANDC is committed to risk management of the site and continual improvement of our risk management practices

Currently in process of addressing urgent on-site risks in order to protect human health and safety as well as the environment

Advanced Remediation of High Risks (2012 to 2016)

- Roaster Complex Deconstruction,
  Underground Stabilization