Current Liability Estimate

Liability: $997 million
Potential liability: $622 million
Speech from the Throne in Fall 2002 announced the intention to accelerate the clean up of federal contaminated sites. Budget in February 2003 announced $175 million over two years.

A new investment of $3.5 billion towards the clean up of federal contaminated sites was announced in the 2004 Speech from the Throne and reaffirmed in the 2004 Budget.
Remediation Timeframe

- Large-size sites (Faro & Giant)
- S&M-size sites
- DEW-line sites

2006 - 2021 - Future Decades
Unique Challenges in the North

- Remote sites
  - Mobilization challenges
  - Winter road and air access
- Short field season
- Permafrost
  - Use in construction
  - Climate change implications
- Wildlife
  - Sensitive areas
  - Traditional land use
  - Health & safety (bear attacks)
- Labour & Construction Costs
  - Competing for resources
  - Winter roads
Faro Mine Complex: **General Location**

**Faro Mine** – operational from 1969 to 1998; located in the traditional territory of the Ross River Dena Council, and upstream of the community of Pelly Crossing.

**Pelly Crossing**
home to the Selkirk First Nation (SFN) and directly downstream of the mine site.

**Town of Faro**
established to service the Faro Mine in 1969, now home to 400 people.

**Ross River**
home to the Ross River Dena Council (RRDC), part of the Kaska Nation.
Faro Mine Complex: Site Overview

1969  Faro Mine opens & Town of Faro established

1970s  Largest lead/zinc mine in Canada • 15% of world’s Pb/Zn output • population of Faro reaches 2000 by early 1980’s.

1982  First of numerous shutdowns • population of Faro drops to 97 by mid-1980’s.

1998  Reclamation bond in place approx. $14 million • after 29 years of intermittent operations, last owner placed into receivership • care and maintenance carried out by receiver
Faro Mine Complex: Site Components

Faro Mine Area

- 70 million MT tailings
- 4 dams
- 1 open pit – Faro Pit
- 2 stream diversions
- 250 million MT waste rock

Vangorda Plateau

- No tailings
- 2 open pits: Vangorda & Grum
- 1 stream diversion
- 70 million MT waste rock

13km Haul Road
Faro Mine Complex: Faro Pit Components

- Faro Pit
- Faro Creek Diversion
- Waste Rock Dumps
- North Fork
- Rose Creek
- Low Grade Ore & Oxide Fines
Faro Mine Complex: Tailings Components
Faro Mine Complex: Tailings Groundwater
There are 5 objectives associated with a final closure and remediation plan:

1. Protect human health & safety
2. Protect, and to the extent practicable, restore the environment including land, air, water, fish and wildlife
3. Return the mine site to an acceptable state of use that reflects pre-mining land use where practicable
4. Maximize local and Yukon socio-economic benefits
5. Manage long-term site risk in a cost effective manner
Faro Mine Complex: Present Day

Estimated liability: $400-800 million

Faro Mine Site currently under the Care and Maintenance mode, implemented by Deloitte and Touche, the court appointed Interim Receiver (IR)

Closure plan development by 2009, submitted for initial federal approval, and Yukon regulatory review

Implementation start approx 2012 ● implementation period 10-40 years, followed by 500+ years of water treatment and other care and maintenance activities

_No walk away solution_ – collection and treatment of contaminated water will be needed for several hundred years
Faro Mine Complex: Technical Studies 2003-06

Basic Technical Studies
- Terrestrial Risk Data
- Site Specific CCME-based Water Quality Objectives
- Borrow Source Studies
- Water Treatment Cost Assumptions
- Earthquake Hazard Studies
- Faro/Vangorda Creek Hydrology
- Human Health & Risk Assessment

Tailings Area Studies
- Tailings Groundwater Studies
  - Water Balance
  - Tailings Source Terms
  - Rose Creek Valley Load Balance
  - Attenuation Testing
- Tailings Relocation
  - Requirements for Groundwater Collection
  - Tailings Relocation Methods
  - Tailings Reprocessing
- Tailings Cover
  - Tailings Cover Trials
  - Seismic Stability Assessment
  - Foundations Liquefaction Study
  - Rose Creek Dam Upgrades
  - North Fork Rock Drain
  - Rose Creek Diversion Sizing & Design
- Seepage
  - Seepage Investigation and Design
- Rose Creek Diversion Options

Mine Area Studies
- ARD Monitoring & Lab Studies
- Dump Water Quality Predictions
- Waste Rock Cover Methods
- Plug Dam Investigation and Design
- Pit Lake Water Treatment Methods
- Vangorda Seepage Requirements
- Grum Seepage Requirements
- Waste Dump Water Balance
- Waste Rock Cover Tests
- Plug Dam
- Pit Lakes Treatment
- Vangorda Pit Backfill
- Seepage Investigation and Design

Methods
- Waste Rock Cover Methods
- Plug Dam
- Pit Lakes Treatment
- Vangorda Pit Backfill
- Seepage Investigation and Design
Environmental Issues: 
Tailings

Acid generation & release of metals
(continue to increase 400-600 yrs)

→ Ground & Surface Water Contamination
(Groundwater “breakthrough” expected in 10-20 years)

Stability of dams/diversion
(Probable Maximum Flood & Maximum Credible Earthquake)

→ Mass tailings release to aquatic environment after extreme event
(Rose Creek, Anvil Creek, Pelly River)

Dust transport
(from tailings and mill area)

→ Contamination of terrestrial environment
(ongoing – currently no risk to human and ecological health)
Environmental Issues: Waste Rock

Acid generation & release of metals → Ground & Surface Water Contamination
(continue to increase 400-600 yrs)

Exposed Waste Rock Piles → Direct contact by human/animals & future land use and aesthetics
(320 million MT in total across whole site)

(waste rock varies in composition & potential to release metals)

(mine complex in traditional territory of Ross River Dena)
Environmental Issues: Water Diversions

Three main stream diversions convey water around open pits and the Rose Creek Tailings impoundment.

Stream diversions were designed for short-term life spans to support active mining operations.

Any diversion relied upon for a final remediation plan must be upgraded to acceptable design standards; Probable Maximum Flood and Maximum Credible Earthquake.
Faro Mine Complex: Independent Peer Review Panel

Independent panel of 9 experts in aspects of Mine Remediation:

Tony Hodge      Ken Raven      Randy Knapp
Laurie Chan     Bill Price     Leslie Smith
Terry Mudder    Ken Froese    Andy Robertson

IPRP Mandate

1. Has the full range of viable closure alternatives been considered?

2. Have the technical studies characterized the alternatives in sufficient detail to allow selection of a preferred alternative?

3. Are there any concerns or deficiencies in the technical studies, such that the alternatives may be clarified or modified, as necessary.
Based upon Peer Review recommendations and outputs of community consultation, closure alternatives were refined into 6 closure options.
Two areas

A. Faro Mine Area
   (this combines the Faro Pit and Waste Rock with the Tailings Area)

B. Vangorda/Grum Area

3 options for the Faro Mine Area

2 options for the Vangorda/Grum Area

5 total
Faro Mine Complex: Short-listed Closure Options

<table>
<thead>
<tr>
<th>Combined Faro Mine Area</th>
<th>Vangorda/Grum Mine Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move All Tailings</td>
<td>Move Vangorda Waste Rock into Vangorda Pit</td>
</tr>
<tr>
<td>or</td>
<td>or</td>
</tr>
<tr>
<td>Cover Tailings with Soil + Upgrade Faro Creek Diversion and Cover/Revegetate Faro Waste Rock</td>
<td>Cover Vangorda Waste Rock in Place</td>
</tr>
<tr>
<td>or</td>
<td>or</td>
</tr>
<tr>
<td>Move Some Tailings and Cover Some Tailings with Soil + Upgrade Faro Creek Diversion and Cover/Revegetate Faro Waste Rock</td>
<td>= 2 Options</td>
</tr>
</tbody>
</table>

= 3 Combined Options

info@faromine.ca | www.faromine.ca

Pelly Crossing: 867.537.3144 | Ross River: 867.969.2103 | Town of Faro: 867.994.2728

Yukon Government | Canada
Faro Mine Complex: Common Elements of Options

Any overall closure plan for the Faro Mine Complex will include some common elements:

• Resloping and covering waste rock
• Revegetation of soil covers and other areas
• Diversion of clean water around the site
• Long-term collection and treatment of contaminated water
• Long-term management of water treatment sludge
• Long-term storage of water in pits
• Long-term maintenance of remaining site facilities (diversions, covers, water collection systems, water treatment systems, dams, etc.)
• Long-term monitoring of environmental conditions (water, animals, plants, climate, etc.)
Combined Faro Mine Area
Option 1

Upgrade Faro Creek diversion
Reslope, cover and revegetate Faro waste rock
Move all tailings

Estimated Jobs: 975 person years
Estimated Cost: $590 M
Combined Faro Mine Area Option 1:
Upgrade Faro Creek Diversion / Cover Faro Waste Rock

**Closure Approach**

**What is involved?**

- Build new diversion channel for Faro Creek
- Remove North Fork Rock Drain
- Build lined channel for North Fork Rose Creek
- Waste Rock
  - Reslope and cover with soil
  - Possibly move some waste rock to Faro Pit
- Revegetate covered waste rock

- Move tailings from Emergency Tailings Area to Faro Pit or Tailings Area.
- Collect and treat contaminated water from below waste rock, Zone 2 Pit and in Faro Pit (100s of years)
- Maintain covers and channels (100s of years)
- Monitor environmental conditions and adapt to changes

**Estimated cost to build and maintain:** $150M

**Estimated employment:** 230 person years

Each option is designed to meet technical and environmental standards.

An overall closure plan will be created by choosing one option for the Faro Mine Area and one for the Vangorda/Grum Area.
Combined Faro Mine Area Option 1:
Move all tailings

Move All Tailings to Faro Pit

What is involved?

- Mix tailings with lime and water
- Pump tailings to Faro Pit
- Clean up remaining tailings with trucks and loaders
- Collect and treat contaminated water from under tailings (20 years?)
- Cut through dams and revegetate valley
- Construct channel for Rose Creek and put Rose Creek back in the valley when soil and water are clean
- May have to collect and treat contaminated water from mine area in Rose Creek Valley (100s of years)
- Monitor environmental conditions and adapt to changes

Estimated cost to build and maintain: $440M
Estimated employment: 745 person years

Each option is designed to meet technical and environmental standards.

An overall closure plan will be created by choosing one option for the Faro Mine Area and one for the Vangorda/Grum Area.

Before remediation (Now)

After remediation (approximately 40 years time)
Combined Faro Mine Area Option 1: Moving Tailings

Tailings slurry pumped to Faro Pit with lime

Hydraulic monitoring
1. Use trucks and excavators to clean up contaminated material left behind

2. Collect and treat water until valley is clean (10 to 20 years)

3. Cut through dams and the diversion and return Rose Creek to the valley
Combined Faro Mine Area
Option 2

Upgrade Faro Creek diversion
Reslope, cover and revegetate Faro waste rock

Cover tailings with soil

Estimated Jobs: 566 person years
Estimated Cost: $410 M
Combined Faro Mine Area Option 2: 
Cover tailings with soil

**Cover Tailings with Soil**

**What is involved?**

- Remove Cross-Valley Dam or change/upgrade it for emergency water storage
- Stabilize Second Dam
- Regrade tailings and cover with waste rock and soil
- Revegetate covered tailings and other areas
- Build/upgrade diversions, channels and spillways to deal with floods

- Collect and treat contaminated water from valley (100s of years)
- Maintain covers, channels and dams (100s of years)
- Monitor environmental conditions and adapt to changes

*Estimated cost to build and maintain: $260M
Estimated employment: 336 person years

Each option is designed to meet technical and environmental standards.

An overall closure plan will be created by choosing one option for the Faro Mine Area and one for the Vanfjord/Grum Area.
Combined Faro Mine Area Option 2:
Cover tailings with soil

- Remove Cross Valley Dam
- Strengthen Other Dams
- Widen and straighten Rose Creek Diversion
Combined Faro Mine Area Option 2: Cover tailings with soil

Install groundwater collection system

Treat water for several hundred years
Combined Faro Mine Area Option 2: Cover tailings with soil
Combined Faro Mine Area
Option 3

Upgrade Faro Creek diversion
Reslope, cover and revegetate Faro waste rock
Move some tailings and cover some tailings with soil

Estimated Jobs: 782 person years
Estimated Cost: $490 M
Combined Faro Mine Area Option 3: Move some tailings and cover some tailings with soil

**Move Some Tailings and Cover Some Tailings**

**What is involved?**
- Remove Cross-Valley Dam or change/upgrade it for emergency water storage
- Stabilize Second Dam
- Mix Intermediate Tailings with lime/water and pump to Faro Pit
- Clean up remaining Intermediate Tailings with trucks and loaders
- Regrade Original and Second Tailings and cover with waste rock and soil
- Revegetate covered tailings and valley area
- Upgrade diversion channel for upper part of Rose Creek
- Construct channel for lower part of Rose Creek and return the creek to the valley when soil and water are clean
- Collect and treat contaminated water (100s of years)
- Maintain covers, channels and dams (100s of years)
- Monitor environmental conditions and adapt to changes

**Estimated cost to build and maintain:** $340M
**Estimated employment:** 552 person years

*Image for illustration purposes only.*

Each option is designed to meet technical and environmental standards.

An overall closure plan will be created by choosing one option for the Faro Mine Area and one for the Vangorda/Grum Area.

*Before remediation (Now)*

*After remediation (approximately 40 years time)*
Combined Faro Mine Area Option 3:
Move some tailings & cover some tailings with soil

Hydraulically mine and relocate Intermediate Pond tailings to Faro Pit
Combined Faro Mine Area Option 3:
Move some tailings & cover some tailings with soil

- Drain pond and remove sludge
- Breach Intermediate Dam
- Breach Cross Valley Dam
- Buttress or densify foundation of Secondary Dam
Combined Faro Mine Area Option 3:
Move some tailings & cover some tailings with soil
Combined Faro Mine Area Option 3:
Move some tailings & cover some tailings with soil

Install wells where needed below relocated tailings, and below second dam

Pump water to treatment plant
Combined Faro Mine Area Option 3:
Move some tailings & cover some tailings with soil

- Widen and straighten upper portion to route PMF around remaining tailings
- Lower portion – allow Rose Creek to return to its original channel
- Construct spillway
- Widen and straighten upper portion to route PMF around remaining tailings
Selection of Preferred Option

Multi-variable Assessment

• Structured method to compare remediation options to project objectives

• Proven method used for complex decision making applications:
  • Nuclear Waste Management long-term disposal assessment
  • Other mine closure projects; ex. Ekati Mine, Red Dog

• Useful for multi-stakeholder assessments where consensus is desired
Selection of Preferred Option
Multi-variable Analysis

• Established Assessment Team with representation by 2FN and advisors, technical advisor, IPRP, YG and INAC
• Hired MVA/decision analysis experts used in NWMO disposal options analysis
• Significant reports going into process:
  • Draft alternatives report
  • IPRP report and comments by expert departments
  • Implementation approach
  • Risk assessment of options
Selection of Preferred Option

How did we go about it?

Major Steps in assessment were:

1. Converted each project objective into measurable sub-objectives. They are:
   1. environment
   2. public health and safety
   3. worker health and safety
   4. traditional land use
   5. local land-use
   6. local socio-economic
   7. Yukon socio-economic
   8. cost

2. Worked through factors that influence the sub-objectives

3. For each sub-objective short term (40 years) and long-term (500-1000 years) were considered

4. Developed technical notes describing the performance of each alternative for each sub-objective for both short and long-terms scenarios
Major Steps in assessment were (Cont’d):

5. Conducted assessment by individually assigning scores from 0-10 for the expected performance of each option to meet sub-objectives

6. Assigned individual weightings for each sub-objective (relative importance of each objective)

7. Produced bar charts of results

8. Conducted sensitivity analysis to determine the influence of weightings on the results
These are the improvements in long term environmental risk. Note that the differences are not that great, there are risks in all cases. Also note that Complete Relocation option, which has the lowest long term risk, actually scores poorest in the short term.
For traditional land use, the relocation options clearly offer lower long-term risks. But, again, all options have significant risks. Also, again, Complete Relocation option scores poorest in the short term.

### Faro Mine & Tailings

#### Traditional Land Use Scores

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Ideal performance. No adverse impact to traditional land use. Site fully restored to natural state.</td>
</tr>
<tr>
<td>9</td>
<td>Very good performance. Some remaining aesthetic affects, but only insignificant and impacts on traditional land use. Necessary aquatic resources fully restored. Site allows hunting, trapping, trails, trap lines essentially as existed prior to mine. Unimpeded access available at traditional trails.</td>
</tr>
<tr>
<td>8</td>
<td>Good performance. Some minor, localized impacts to traditional land use. People are affected and for only a limited amount of time. Necessary aquatic resources fully restored. Site allows hunting, trapping, trails, trap lines essentially as existed prior to mine. Unimpeded access available at traditional trails.</td>
</tr>
<tr>
<td>7</td>
<td>Fair performance. Some moderate, highly localized, short-term limitations to traditional land use. Affects utilization of some, but not all traditional resources.</td>
</tr>
<tr>
<td>6</td>
<td>Mediocre performance. Some significant limitations over a small area on traditional land use remain. Between 5 and 7.</td>
</tr>
<tr>
<td>5</td>
<td>Poor performance. Significant problems (e.g., reduction in habitat productivity) but do not eliminate uses essential for survival. The impact is over a moderately sized area. Between scores of 4 and 6.</td>
</tr>
<tr>
<td>4</td>
<td>Very poor performance. Serious problems result in significant and permanent limitations on traditional land use over a relatively large area. Affects usage of many important traditional resources. Severely adversely affects traditions for some communities.</td>
</tr>
<tr>
<td>2</td>
<td>Very bad performance. Major problems. Key traditional resources lost. Permanent and major limitations on traditional land use over a very large area. Affects usage of nearly all important traditional resources for many people. Traditions lost for many peoples.</td>
</tr>
<tr>
<td>0</td>
<td>Abominable performance. A disaster for traditional land use. Permanent loss of traditional land use opportunities over an extensive area and for nearly all people resulting in irreparable harm to traditions.</td>
</tr>
</tbody>
</table>

#### NPV Total Cost

<table>
<thead>
<tr>
<th>Option</th>
<th>NPV Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do Noting</td>
<td>$0</td>
</tr>
<tr>
<td>Complete Relocation</td>
<td>$100,000,000</td>
</tr>
<tr>
<td>Partial Relocation</td>
<td>$200,000,000</td>
</tr>
<tr>
<td>Dry Cover</td>
<td>$300,000,000</td>
</tr>
<tr>
<td>Partial Relocation</td>
<td>$400,000,000</td>
</tr>
<tr>
<td>Complete Relocation</td>
<td>$500,000,000</td>
</tr>
<tr>
<td>Partial Relocation</td>
<td>$600,000,000</td>
</tr>
<tr>
<td>Complete Relocation</td>
<td>$700,000,000</td>
</tr>
</tbody>
</table>

For traditional land use, the relocation options clearly offer lower long-term risks. But, again, all options have significant risks. Also, again, Complete Relocation option scores poorest in the short term.
Next Steps: Roadmap to Remediation

- The communities and governments are now conducting their own assessment processes.

- Information from these processes will be used by the project Oversight Committee to arrive at a final closure and remediation plan to recommend to the federal government for initial funding approval.
Questions?