

Options for Closure of the Faro Mine Complex

Prepared for

Indian and Northern Affairs Canada (INAC)

and

**Yukon Government, Assessment
and Abandoned Mines**

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Executive Summary

This document discusses options for the closure of the Faro Mine Complex. It is intended to support further evaluation of closure options by communities and governments, and selection of a preferred set of closure options by the Federal, Territorial and First Nation governments.

Background

The Faro Mine Complex consists of three main areas: the Faro Mine area, the Tailings area, and the Vangorda/Grum area. The Faro Mine area, located approximately 15 km north of the Town of Faro, includes the Faro Pit, waste rock dumps and the former ore processing facilities. The adjacent Tailings area includes a series of dams and impoundments located below the mine in the Rose Creek valley. The Vangorda/Grum area, located approximately 9 km northeast of the Town of Faro, includes the Vangorda and Grum Pits and waste rock dumps, as well as water treatment facilities.

The site includes over 300,000,000 tonnes of waste rock, which is rock that was mined to expose the ore, and over 50,000,000 tonnes of tailings, which are the finely ground rock residue from processing of the ore. (That's enough waste material to completely fill BC Place Stadium more than seventy times!). The waste rock and tailings are acid generating, meaning that they release contaminants at accelerating rates the longer they remain exposed. Other concerns that need to be addressed in a closure plan include public and worker safety, contamination of water, risks from severe events (i.e. floods and earthquakes), contamination of air and land by dust, and possible direct contact of humans and animals with the metal-rich waste materials. All of the closure options discussed in this report are designed to address those issues.

Project Framework

In 2003, the Federal and Yukon Governments accepted responsibility for remediation of the Faro Mine Complex. In early 2004 Canada, Yukon, Selkirk First Nation and the Ross River Dena Council (on behalf of the Kaska Nation) endorsed a partnership agreement in which they committed to work cooperatively to develop a closure plan for the Faro Mine Complex. This role has been exercised through the creation of the project Oversight Committee, comprised of senior representatives from these four parties.

After an extensive program of public and stakeholder consultation, the Oversight Committee formulated five overarching objectives for the closure of the Faro Mine Complex:

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

Canada and Yukon have dedicated internal resources to the development of a closure plan, creating the Faro Project Management Team. They have also provided resources to both First Nations to establish community offices for the closure planning project, including full-time coordinators in each First Nation community. A coordinated Technical Advisor team provides technical advice to the Faro Project Management Team. An Independent Peer Review Panel, comprised of nine international experts in fields relevant to the closure and remediation of the Faro Mine Complex, reviews major technical reports and supporting studies.

Development of Closure Options

Options for closure and remediation of the Faro Mine Complex have been under consideration for over 25 years. Several closure plans for the site or portions of it were developed during operations. The current closure planning process began in April 2002 with a series of technical workshops that included identification and screening of closure options.

Following the final closure planning workshop in January 2005, SRK Consulting Inc. was asked to lead the development of “example alternatives” to represent the range of options that the prior work had shown to be technically reasonable. Work on the example alternatives continued through mid-2006. Between September 2006 and March 2007, the Independent Peer Review Panel reviewed the example alternatives and the supporting technical documentation. This report incorporates recommendations arising from the 2006-2007 IPRP review as well as their subsequent review of a draft “options report.”

Closure Options Recommended for Further Consideration

Common Elements

The options that are recommended for further consideration have many common elements:

- Covering of Waste Materials. Any remaining exposed waste rock or tailings will be covered with soil.
- Upgrade of Dams and Diversions. Remaining dams and diversions will be upgraded to meet conservative design criteria.
- Long-term Groundwater Collection. Contaminated water arising from contact with waste materials will be captured for treatment. It is expected that in all cases water treatment will be required for hundreds of years.
- Long-term Water Treatment. Contaminated water will be stored in the pits and then treated in a new water treatment plant.
- Risks to Water Quality in Creeks. There will always be a risk that contaminant concentrations in uncaptured seepage will increase to a level that will impact local creeks.

- Long-term Site Presence. Given the above requirements and risks, the site will require long-term (hundreds of years) supervision, including security, inspections, maintenance, and environmental monitoring.
- Adaptive Management. An “adaptive management plan” that describes uncertainties and the future changes that might be needed to address them, will be required in all cases.

Faro/Rose Creek Options

For the Faro Mine area, a single option is recommended for further consideration. For the Rose Creek tailings area, three options remain, Stabilize in Place, Complete Relocation and Partial Relocation. The Faro mine area and Rose Creek tailings options are combined into three “Faro/Rose Creek” options to simplify further assessments.

In the Faro Mine area, all of the waste rock would be regraded, covered with soil, and revegetated. The covers would be designed to reduce the amount of water that reaches the underlying waste. Water that becomes contaminated by seeping through waste materials will be collected and stored in Faro pit prior to treatment. The Faro Creek diversion would be upgraded in a stable location to continue routing clean water around the site in the long term.

The dry cover option for the Tailings area would leave all of the tailings in their current location, and cap them with a soil cover. The dams containing the tailings would be upgraded to withstand the maximum credible earthquake. The Rose Creek Diversion Channel, which carries Rose Creek around the tailings, would be upgraded to pass a 500-year flood. The channel would be configured so that any larger floods would pass over the covered tailings to a widened spillway on the north side of the valley. That arrangement would allow even the probable maximum flood to pass through the area without allowing any release of tailings.

The complete relocation option for the Tailings area would move all of the tailings into the Faro pit. The tailings relocation would require about fifteen years of seasonal work using hydraulic mining of the tailings and pumping of the resulting slurry up to the pit. Lime would need to be added to counteract the existing acidity in the tailings. The tailings relocation would be followed by excavation of contaminated footprint soils and many years of collecting and treating any impacted groundwater. Rose Creek would be restored to its original location only after completing the groundwater cleanup, estimated to be 10-20 years after the tailings relocation is finished.

The partial relocation option would move only the downstream half of the tailings to the pit. The methods used would be the same as those for the complete relocation option. The first half of the Rose Creek Diversion Channel, which wraps around the remaining tailings, would be upgraded to pass the probable maximum flood. The lower half would ultimately be redirected into the valley floor following soil and groundwater cleanup.

Vangorda/Grum Options

For the Vangorda/Grum area, two options are recommended for further consideration, the Stabilize in Place option and the Backfill Vangorda Pit option. For both options, the activities on the Grum side of the area are the same. The Grum waste rock pile would be regraded, covered with soil and revegetated. Contaminated water from the waste rock pile would be collected. The Grum Pit would serve as a storage reservoir for contaminated water prior to treatment.

The significant differences between the two options are on the Vangorda side. In the Stabilize in Place option, the Vangorda waste rock pile would be regraded and capped with a soil cover. In the Backfill Pit option, the Vangorda waste rock would be moved into the Vangorda pit where it would be covered. In the former option, Vangorda Creek would be moved to a new, more stable diversion somewhere uphill of its current alignment. In the latter option, Vangorda Creek would be routed over the backfilled pit in a constructed channel that approximates the creek's original alignment.

Initial Evaluation

A multi-attribute analysis method was developed and applied to examine the similarities and differences among the options. The analysis considered the performance of each option against eight objectives in both the short and long term, and under both expected and risk conditions. The eight objectives were re-statements of the five overarching objectives specified by the Oversight Committee:

- Maximize public health and safety;
- Maximize worker health and safety;
- Maximize restoration, protection and enhancement of the environment;
- Minimize restriction on traditional land use;
- Minimize restrictions on local land use;
- Maximize local socio-economic benefits;
- Maximize Yukon socio-economic benefits; and
- Minimize cost.

The analysis of the Faro Mine/Tailings options showed no significant difference in worker health and safety or Yukon socio-economic benefits. There were differences in the following categories:

- Public health and safety. The tailings relocation options scored slightly lower in the short-term, largely as a result of the increased highway truck traffic that would be required to bring lime to the site.
- Environmental restoration and protection. In general all options scored similarly under expected conditions. The dry cover option scored slightly higher in the short term, because it would allow final reclamation to be achieved many years sooner than the other options. The

complete relocation option was scored as having slightly less risk in the long term. The reason is that, although both the dry cover and partial relocation options can be designed to meet the highest level of stability criteria, there was concern that a loss of funding over the long term would lead to decreased maintenance and non-negligible risks of tailings releases.

- Local socio-economic benefits. The tailings relocation options scored slightly higher, largely because of the higher expenditures involved. However, detailed analysis showed that the bulk of the expenditures go to material purchases, so the differences in local socio-economic opportunities are much less than the differences in total expenditures.
- Traditional land use and Local land use. In both of these categories, the tailings relocation options scored slightly lower in the short term, due to the prolonged time before complete reclamation of the valley is achieved. The dry cover option was judged to have slightly higher risk in the long term.
- Cost. There are significant differences in cost. Implementation of the dry cover option is estimated to cost about 340 million dollars, the partial relocation option about 436 million dollars, and complete relocation about 560 million dollars. Long-term costs are estimated at 3.5 million per year for the dry cover option, 2.8 million per year for partial relocation, and 1.4 million per year for complete relocation. Taking uncertainties into account and expressing the total costs as net present values (calculated at a discount rate of 3%), the ranges are:
 - Dry Cover \$380M – \$500M
 - Partial Relocation \$450M – \$620M
 - Complete Relocation \$530M – \$770M

The analysis of the Vangorda/Grum options showed no significant differences in terms of worker health and safety, local socio-economic benefits or Yukon socio-economic benefits. There were differences in the following categories:

- Public health and safety. The backfill pit option scored slightly lower in the short term, largely as a result of the increased highway truck traffic associated with bringing lime to the site.
- Environmental restoration and protection. Both options are expected to perform well in the short and long term, but both have a risk that a loss of funding could lead to releases of contaminated water. The backfill pit option has a slightly wider range of expected performance. In the best case it could lead to complete restoration of the Vangorda side of the property, but in the worst case it could lead to greater problems if Vangorda Creek were to fail during the backfilling operation.
- Traditional Land use and Local land use. The backfill pit option scored slightly higher in both of these categories, because the entire Vangorda side of the property would eventually be reclaimed and available for traditional or local uses.
- Cost. There are significant differences in cost. Implementation of the Stabilize in Place option is estimated to cost about 57 million dollars, and the backfill pit option about 95 million dollars. Long-term costs are estimated at 0.9 million per year for the Stabilize in Place option, and

0.8 million per year for the backfill put option. In terms of total NPV costs, calculated at a discount rate of 3% and including uncertainties, the ranges are:

- Stabilize in Place \$ 70M – \$ 90M
- Backfill Pit \$100M – \$130M

Conclusion

The Technical Advisor Team, the Independent Peer Review Panel and the Faro Project Management Team all agree that the short-listed options represent the range of reasonable options for closure of the Faro Mine Complex, and that sufficient technical information is available to support the selection of a preferred option.

The differences among the options' performance with respect to the project objectives have been examined and documented. Further discussion of the options can now focus on the importance of those differences to each of the affected communities and stakeholders.