Faro Mine Closure Planning Studies Update

Faro Oversight Committee

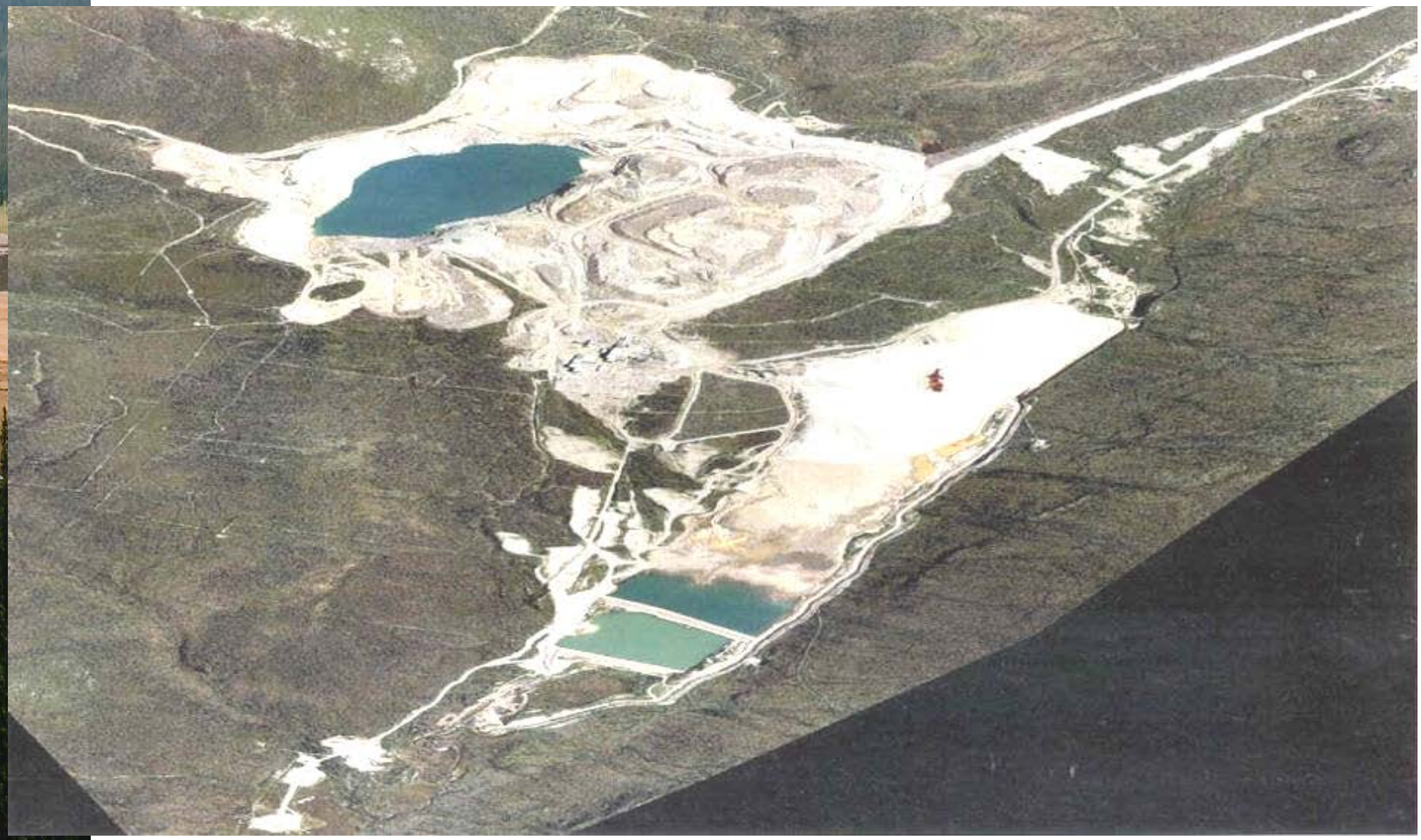
October 20, 2005

Presentation Outline

- Site Overview
- Tailings Studies
- Diversion Studies
- Pit Studies
- Waste Rock Studies
- Site-Wide Studies

Site Overview

Faro Site Overview



Vangorda/Grum Site Overview

Tailings

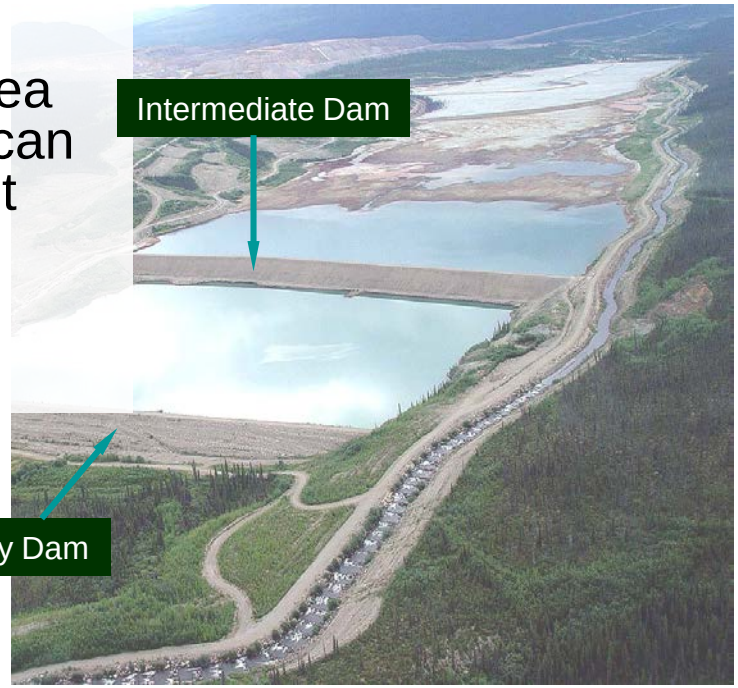
Tailings - Issues

- Approximately 55,000,000 tonnes of acid generating tailings in the Rose Creek Valley.
- Tailings containment involves 4 dams and a 4+ km long diversion: all of these must be able to withstand severe floods and earthquakes.
- Loss of tailings or contaminated water from the tailings impoundment into Rose Creek would cause unacceptable impacts.
- Contaminants are migrating through the tailings into the groundwater beneath the tailings.
- Tailings are likely a significant source of ongoing airborne metal contamination in the area.

Tailings – Previous Studies

Ground Water

- 2004 study by Robertson Geoconsultants developed conceptual flow and contaminant transport model for the Rose Creek Aquifer beneath the tailings.
- Model is intended to allow prediction of future contamination from the tailings area under different closure scenarios. This can be used to predict future water treatment costs.



Tailings – Previous Studies
Ground Water - Results

- A lot of contamination in the Rose Creek Valley seems to come from the old Faro Creek Valley – likely from waste rock and the Emergency Tailings Area.
- There is significant retardation of zinc movement in the aquifer or the tailings – sulphate moves much more quickly. The degree of retardation of zinc is not known.
- There seems to be a significant difference between transport and flow rates between the north and south sides of the valley.

Tailings – Previous Studies

Ground Water - Results

Option	Peak Year	Peak Conc. (mg/l in Rose Cr.)
No Remediation	2174	15.2
Collect and Treat	2174	3.0
Collect, Pump and Treat	2174	1.1
Full Relocation	2047	3.3
Partial Relocation and Dry Cover	2047	3.4
Partial Relocation and Water Cover	2047	5.0
Full Water Cover	2052	159
Dry Cover	2047	3.4
Full Relocation and Collect, Pump, Treat	2047	0.33
Partial Relocation w/ Dry Cover and Collect, Pump and Treat	2047	0.34
Dry Cover and Collect, Pump and Treat	2047	0.36

Notes: 1. These are preliminary numbers which are only being used to guide subsequent studies.
2. Durations of high concentrations are substantially different for different options.

Tailings – Previous Studies
Ground Water - Conclusions

- All remediation options will likely require some collection and treatment from groundwater in the Rose Creek Aquifer.

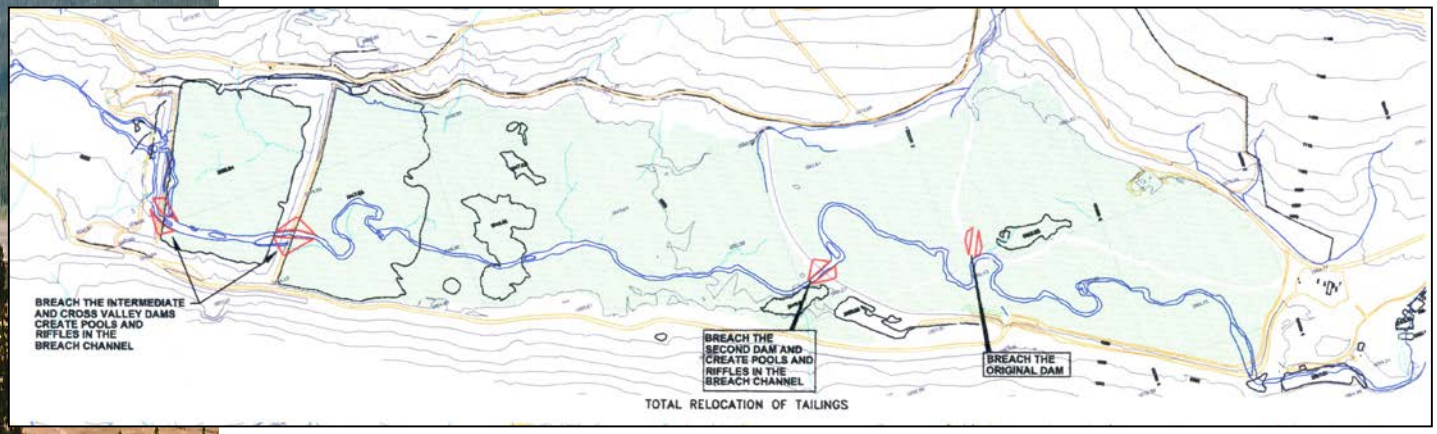
- Primary difference between covering and relocation options is the time period over which groundwater collection would be required – 40-60 years for relocation options vs. 100s of years for in-situ options.

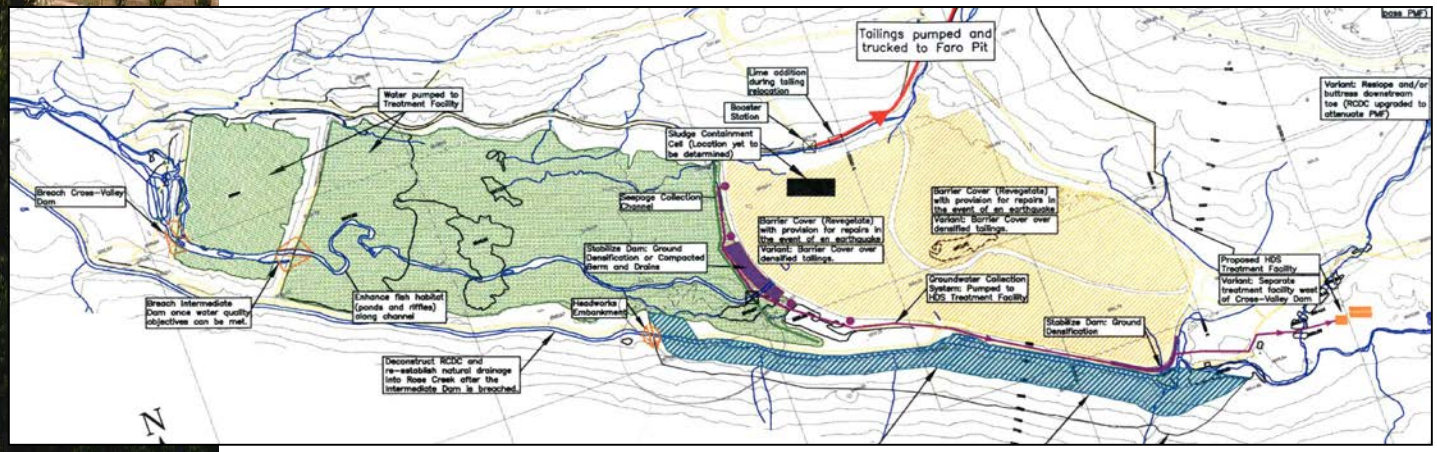
Tailings – Previous Studies
Covers

- Previous studies have confirmed that covers would be difficult to build on the Faro tailings and they would be subject to failure under earthquake conditions.
  - We do not know the extent of failure that could be expected.
  - Low infiltration covers would be most susceptible to construction problems and earthquake related failures.
- Covers are probably needed even if they don't limit infiltration – in order to control dust release.
- Cover test pads were constructed in 2004 to evaluate constructibility, differential settlement and contaminant transport through covers.

Tailings – Previous Studies

Tailings Relocation





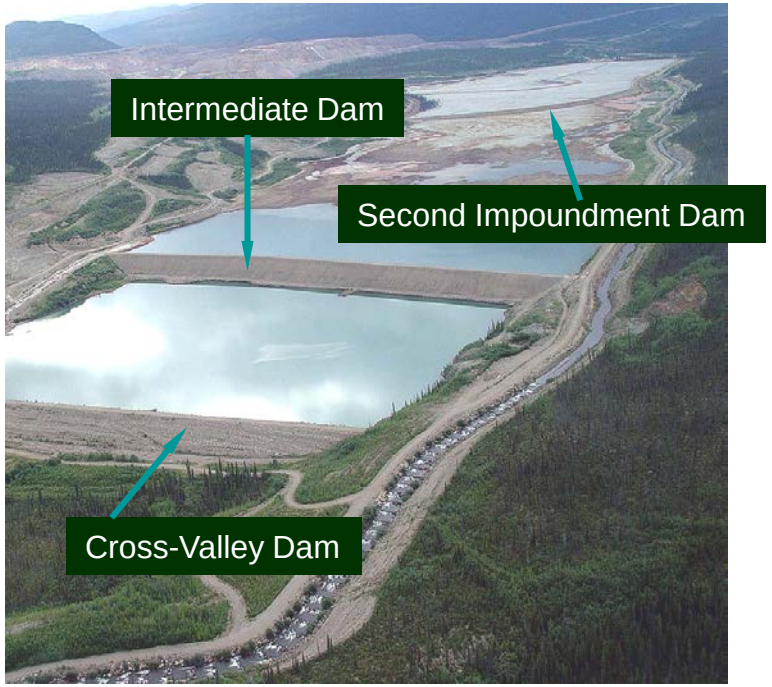
- Two options are under consideration for Tailings Relocation:
  - Moving all of the tailings to the Faro Pit.
  - Moving the tailings from the Intermediate Impoundment to the Faro Pit.

Tailings – Previous Studies
Tailings Relocation

- Hydraulic Monitoring appears to be the best relocation method.
  - This will require valley cleanup using mechanical means – assumption is that this will be ½ to 1 m thickness over the entire valley.
- Lime will have to be added to the tailings during relocation.
- Rehabilitation of the valley after relocation will take a long time.

Tailings – Previous Studies
Tailings Dams

- If tailings remain in the Rose Creek Valley, dams will have to be retained for the long-term.
- Dams will need to withstand the Maximum Credible Earthquake:
  - 2004 studies found that the foundation of the Second Impoundment Dam requires upgrading in two areas where the soil under the dam is too loose – only if part of the tailings are moved.
  - 2004 studies were inconclusive about the Intermediate and Cross-Valley Dams.



Tailings Studies
Ground Water – 2005 Programs

- Testing of zinc attenuation in aquifer soils
  - Degree of attenuation
  - Types of attenuation
  - Permanence of attenuation mechanisms
  - No results yet available
- Emergency Tailings Area
  - Amount of loading entering aquifer
  - No results yet available
  - Data for seepage collection system design
- Leaking Wells - remediation

Tailings Studies
Covers – 2005 Programs

- Additional monitoring of tailings cover test pads.
- Further consideration of expected damage to covers under earthquake conditions.
- Evaluation of potential increased infiltration into tailings if a waste rock cover is applied.
- No results yet available.

Tailings Studies
Tailings Relocation – 2005 Programs

- Updated Tailings Relocation Plan to be developed.
  - Additional evaluation to address uncertainty about methodology and sequence:
    - More information about relocation at other locations
    - Further evaluation of tailings transport between hydraulic monitoring points and sumps.
    - Development of an adaptive management approach that considers outstanding uncertainties about methodology and sequence.
  - Further evaluation of lime addition and power costs.
  - Further consideration of pumping and transport components of the project.
  - Evaluation of valley clean-up requirements – how much tailings can be left in valley?

Tailings Studies
Tailings Dams – 2005 Program

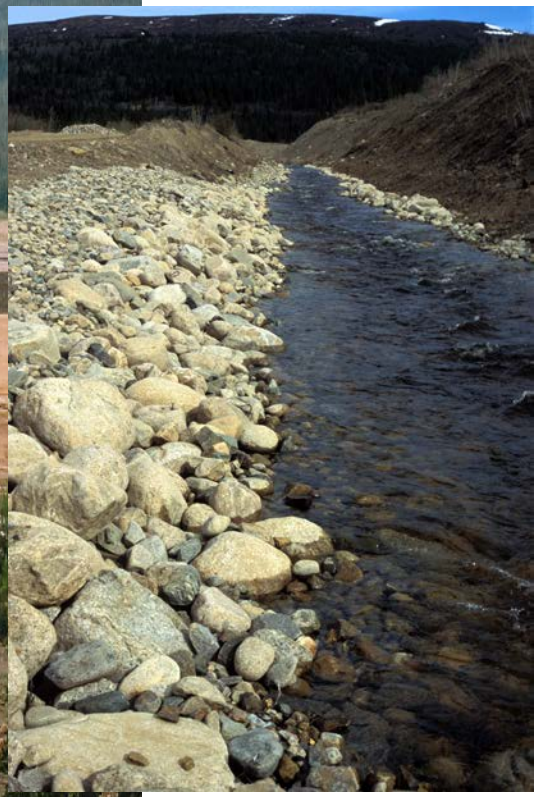
- Additional drilling was completed on the Cross-Valley, Intermediate and Second Dams in 2005 to confirm adequacy of foundation conditions.

- Early results suggest that:
  - Foundation conditions under the Intermediate Dam is sufficient for the structure to withstand the MCE without additional foundation remediation work.
  - Seismic upgrading of the Cross-Valley Dam will likely be required if the dam is to be retained in the long-term.

Stream Diversions

- There are three main stream diversions on the site:
  - Faro Creek around the Faro Pit.
  - Rose Creek around the Down Valley Tailings.
  - Vangorda Creek around the Vangorda Pit.

Stream Diversions - Issues



- Rose Creek, Vangorda Creek and Faro Creek have all been diverted from their original channels and will all have to be routed through constructed channels for closure.
- The sizing of the channels depends on the severity of consequences associated with their failure.
- The Rose Creek Diversion Canal plays a critical role in keeping the tailings in the tailings impoundment. Consistent with Canadian Dam Association, Dam Safety Guidelines, it must be designed to withstand severe flood and earthquake events in order to minimize the potential for failure of tailings dams.
- Leakage of clean water from any of the diversions will lead to increased requirements for water treatment.

Stream Diversions – Previous Studies
Rose Creek Diversion

- If the tailings remain in the valley, the Rose Creek Diversion will have to be upgraded so that it can withstand the Probable Maximum Flood:
  - PMF estimates have ranged from approximately 700 to 1400 m^3/s
- The existing diversion is about 12 metres wide and a 2003 analysis indicated it could probably handle about 80 m^3/s.
- In 2004, some maintenance work was completed and the channel is now considered capable of handling approximately 135 m^3/s

Stream Diversions – Previous Studies
Rose Creek Diversion

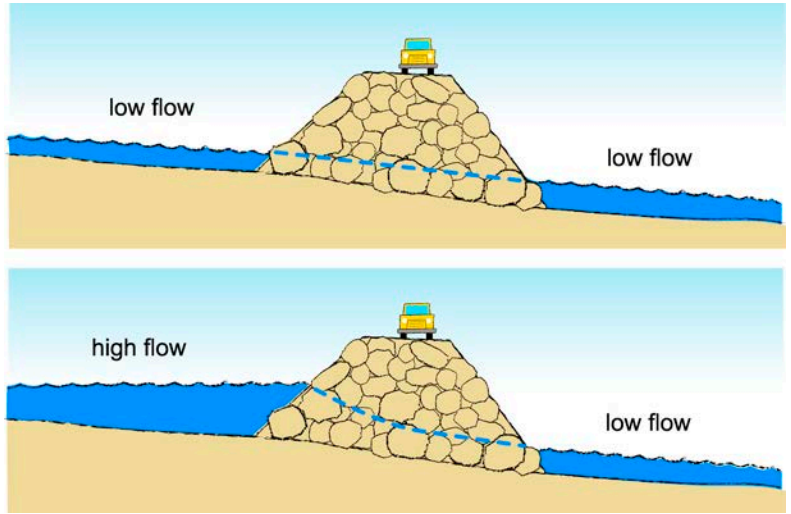
- Several options have been proposed for upgrading of the Rose Creek Diversion Canal to handle the PMF flow, but the current option under consideration is to widen the channel (up to 50+ metres) into the hillside.
- No robust long-term spillway options have been identified yet.
- Cost is still uncertain.

- The North Fork Rock Drain may help to reduce peak flows in the Rose Creek Diversion Canal.

Stream Diversion – Previous Studies
Rose Creek - North Fork Rock Drain

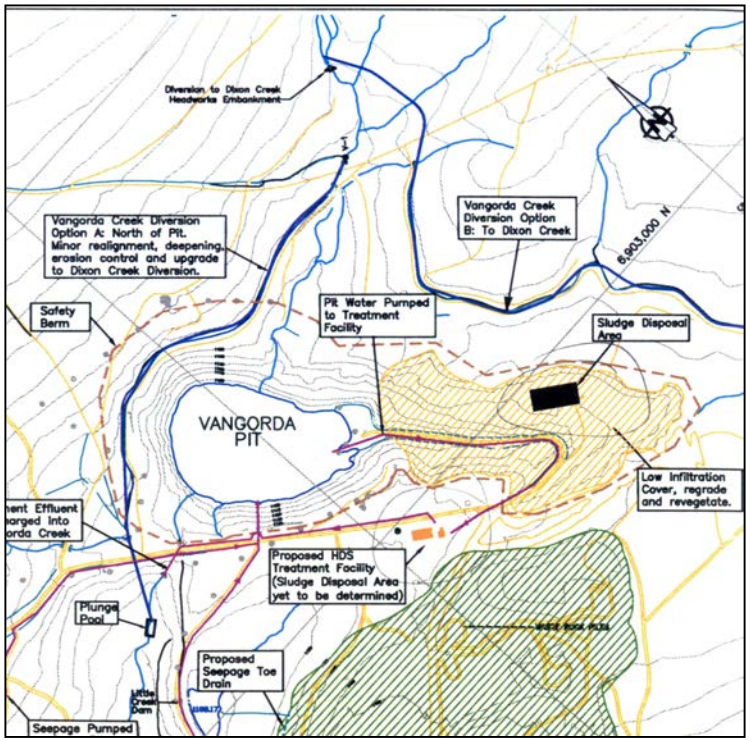
- The North Fork Rock Drain is large rock in the haul road that allows water from the North Fork of Rose Creek to pass through.

- In big floods, the Rock Drain slows some of the water down which means that the flows are lower in the Rose Creek Diversion. The Rock Drain wasn't built for this purpose and we still need to understand how well it will work in the long-term and how much it will reduce the flood flows.



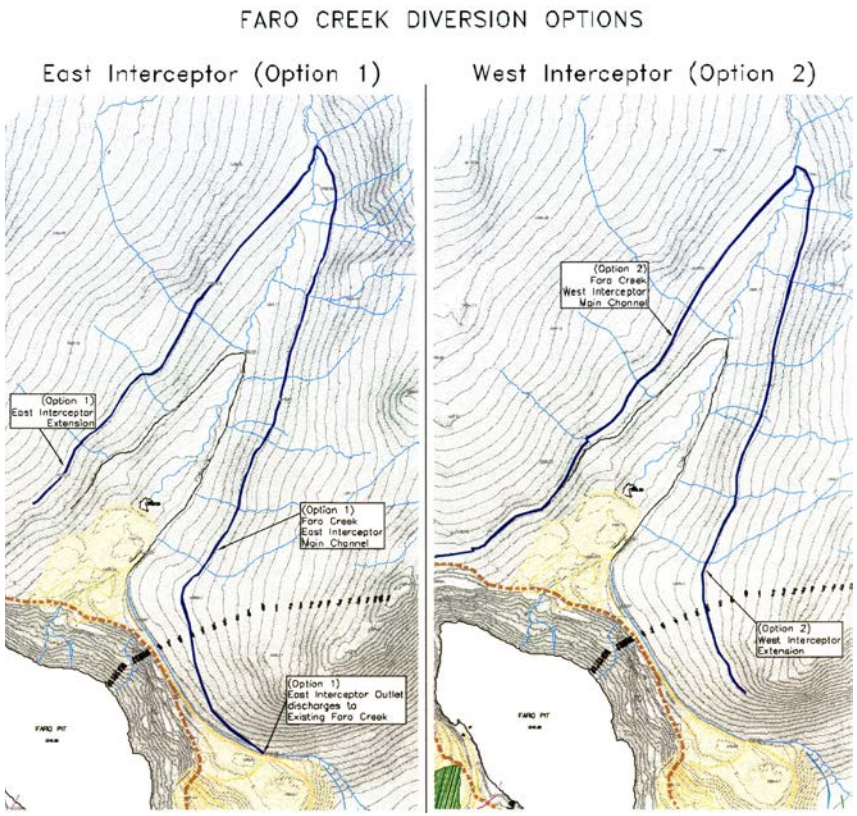
Stream Diversions – Previous Studies
Vangorda Creek Diversion

- If the Vangorda Pit is filled with waste rock, Vangorda Creek can flow over the top of the pit near its original location.
- If the Vangorda Pit is not filled with waste rock, the Vangorda Creek Diversion will have to be moved and upgraded. Two options have been considered for an upgraded Vangorda Creek Diversion:
  - A diversion along the same side of the pit as the existing diversion, flowing into Vangorda Creek.
  - A diversion along the east side of the pit, flowing into Dixon Creek.
- Information considered adequate for decision making about alternatives – but some minor 2005 investigation of practicality of Dixon Creek option.



Stream Diversions – Previous Studies
Faro Creek Diversion

- If pit water quality is acceptable Faro Creek Diversion may not be necessary because Faro Creek can flow into the pit. This would require construction of new channels for water to flow into and out of the pit.
- If Faro Creek water has to be kept out of Faro Pit for closure, the diversion will have to be moved. Two options have been considered for an upgraded Faro Creek Diversion:
  - The East Ditch option would flow east, into the North Fork of Rose Creek, at the same location as the existing Faro Creek Diversion.
  - The West Ditch option would flow west, eventually to Rose Creek downstream of the tailings.



Stream Diversions
Rose Creek Diversion - 2005 Programs

- More comprehensive evaluation of probably maximum flood size.
- Investigation of fish habitat and fish usage of Rose Creek above the Rock Drain.
- Investigation of geotechnical conditions along alignment of proposed expansion for Rose Creek Diversion.
- Additional hydraulic design work to identify acceptable channel and spillway options.

High water discharge at X_14 May

X_13 discharge measurements

Stream Diversions

Rose Creek Diversion, North Fork Rock Drain - 2005 Programs

- 2005 studies are underway to evaluate upgrades and long-term maintenance requirements that would be required for the Rock Drain if it is to be retained. If the rock drain is retained there will be a residual risk that will have to be managed.

- Consideration of a rock drain for flow attenuation is atypical for closure planning.

Stream Diversions
Faro Creek Diversion – 2005 Programs

- Evaluation of options for construction of a Faro Pit outflow channel – this channel would be used in the case of a flow-through Faro Pit:
  - Primary options include:
    - routing to Rose Creek downstream of the tailings via the north wall interceptor ditch or
    - Routing to the North Fork or Rose Creek upstream of the Rock Drain
  - Drilling program completed in 2005 along the alignment to the North Wall Interceptor to get a better understanding of construction conditions and costs.

Pits

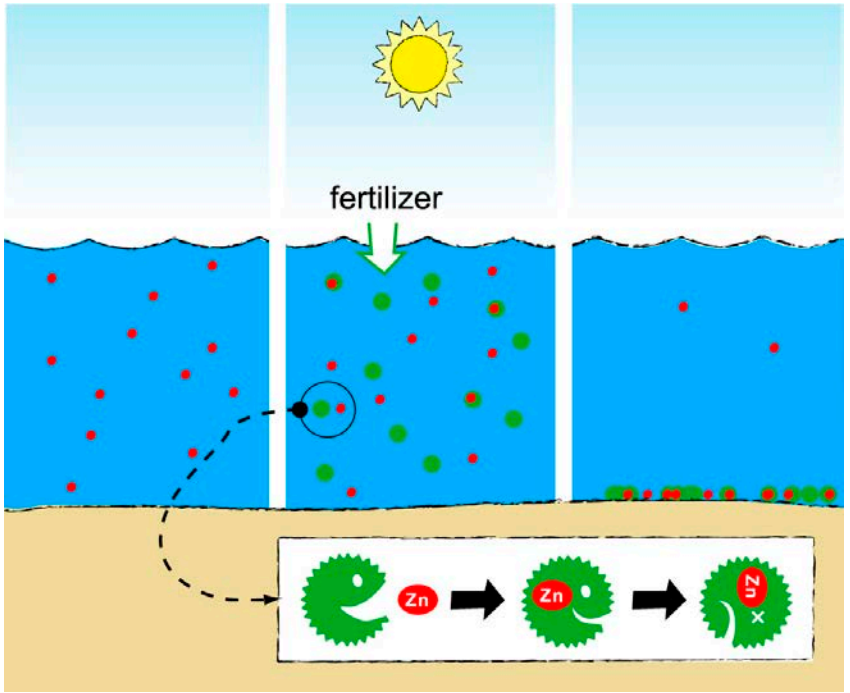
- There are three pits remaining at the site: the Faro, Grum and Vangorda Pits.
- There is one pit at the Faro site that is filled with waste rock; the Zone 2 Pit.

Pits - Issues

- All four pits at the Anvil Range site contain contaminated water.
- Water accumulates in the pits from precipitation and ground water inflows. All pits would eventually fill with water.
- Contaminants are released to the pits by oxidation of pit wall materials and from leaching of waste rock within the pit catchments.
- Some type of water treatment will be required before water can be released from any of the pits.

Pits - Previous Studies
In-Pit Biological Treatment

- 2004 programs confirmed that algae in pits can help to remove metals from water: they absorb the metals and when they die, they settle to the bottom with the metals.
- Fertilizer has to be added to the pits to feed the algae.
- Overall biological removal has to exceed the overall loading coming in to the pits.



Pits – Previous Studies
Grum Pit

- 2004 program confirmed that biological treatment in the Grum Pit will likely be able to remove metals that continue to enter the pit water.

Pits - Previous Studies
Faro Pit – Biological Treatment

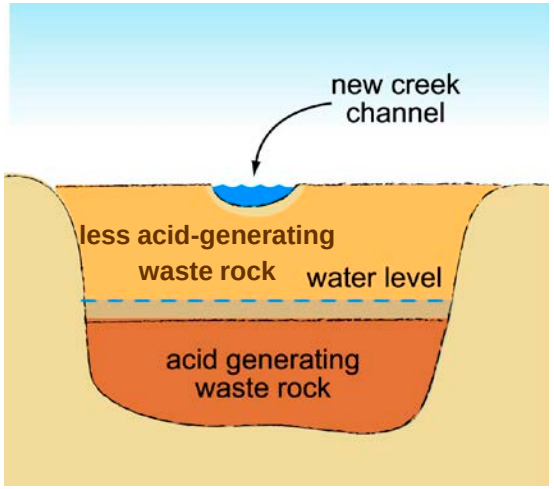
- 2004 studies were inconclusive about biological treatment in the Faro Pit.
  - Biological treament might be able to remove most of the existing contamination, but it would take a long time. Even after this, biological treatment would definitely have to continue so that metals do not accumulate.
  - Right now, we pump water from the Zone 2 pit into the Faro pit. There are a lot of metals in this water. We don't know if biological treatment can address this load.
  - There are some seasonal issues related to performance of biological treatment in the Faro pit.

Pits - Previous Studies
Vangorda Pit – Biological Treatment

- In the Vangorda Pit, biological treatment will not be able to treat metals that will continue to enter the pit water. Metals come into the pit too quickly.

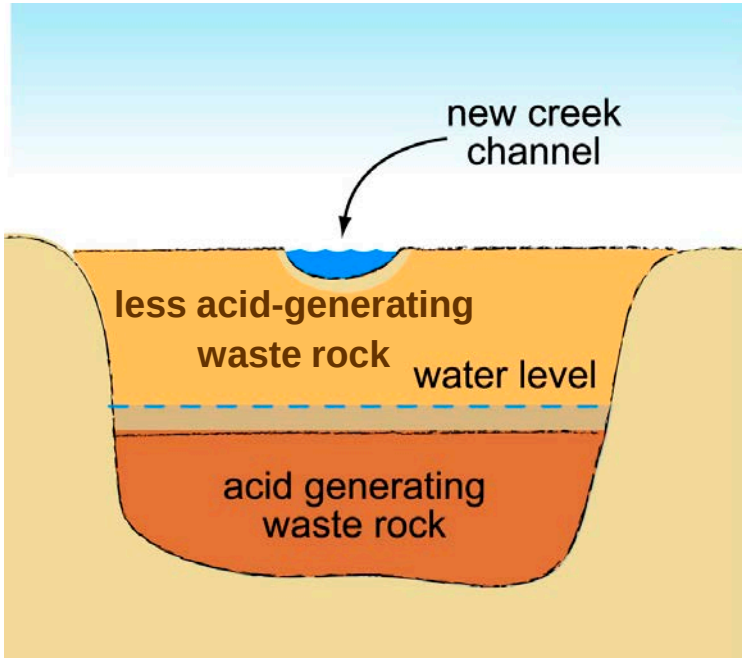
Pits - Previous Studies
Vangorda Pit

- Two options are being considered for the Vangorda Pit:
  1. Backfilling the pit with waste rock.
  2. Leaving the pit as a contaminated water reservoir.
- Adequate information is available for decision making about closure options for the Vangorda Pit.



Pits - Previous Studies
Vangorda Pit

- Vangorda waste rock, which is mostly acid generating, could be put back in the pit.
- Strongly acid generating rock would mostly be below the water level, which is the best location to lower metal release.
- Lime would likely be added to the acid generating rock.
- Once the pit is full of rock, then Vangorda Creek could be rebuilt near its original location. It would flow across the waste rock in a new channel.
- Water treatment might be needed for ground water passing through the filled pit.



Pits - Previous Studies
Faro Pit – Plug Dam

- Many remediation options are likely to include construction of a Faro Pit Plug Dam between the main Faro Pit and the Zone 2 Pit.
- 2004 studies related to dam construction conditions were inconclusive.

Pit Studies

Biological Treatment – 2005 Programs

- Biological treatment was continued at Grum Pit, with ongoing monitoring to confirm whether this treatment method can achieve the low metal concentrations that will be necessary for discharge.
- A biological treatment program was initiated in the Faro Pit in 2005 to confirm performance in this pit:
  - The program was discontinued very quickly because algae growth rates were quite high and began to interfere with operation of the lime treatment system in the Faro Mill.
  - Data were collected throughout the summer to evaluate the performance of the short biological treatment test.
- Additional work may have to be done in 2006 to consider whether biological treatment and conventional treatment can operate simultaneously, and to identify options for addressing seasonal issues.

Faro Pit June 8

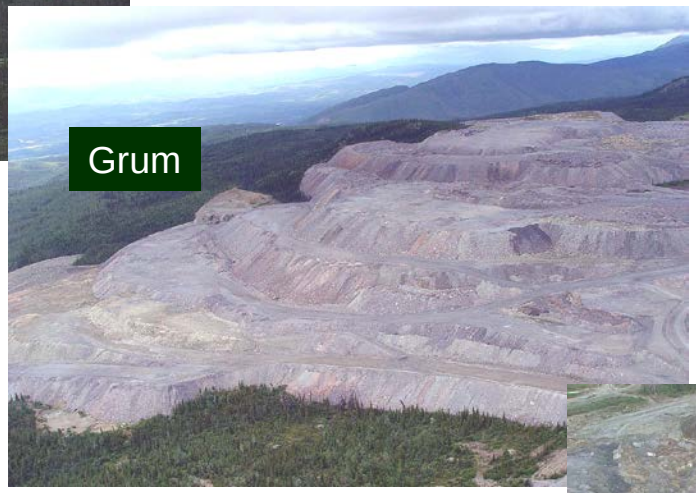
Faro Pit June 8

Pit Studies

Plug Dam – 2005 Programs

- Drilling was completed at the proposed plug dam location in 2005 to confirm foundation conditions and grouting requirements.

Waste Rock

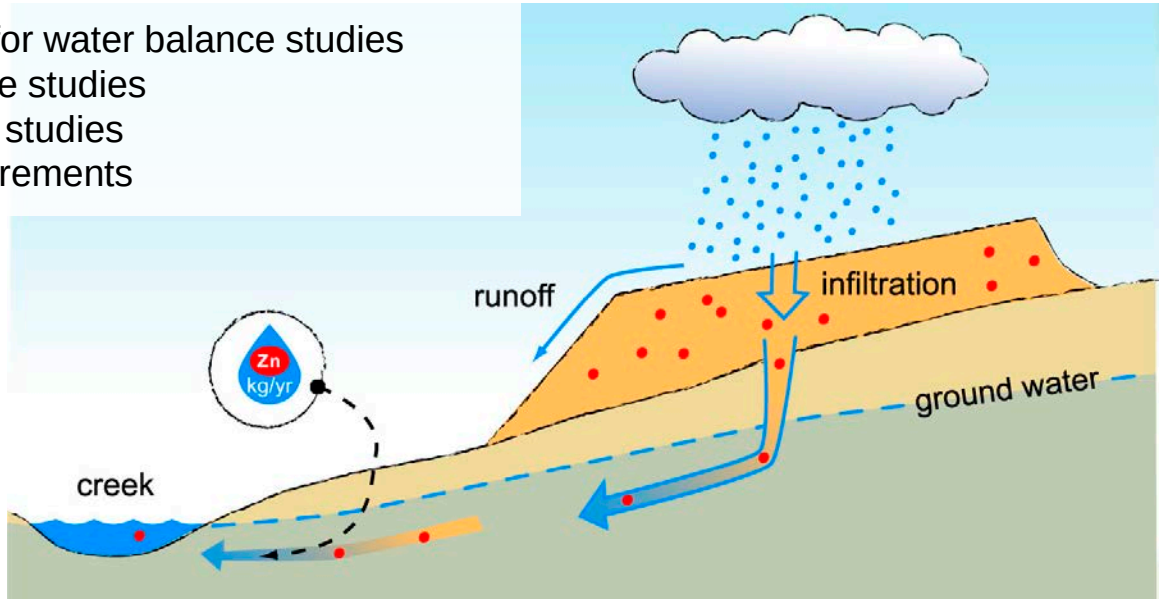


Waste Rock - Issues

- There are approximately 250,000,000 tonnes of waste rock at the Faro Mine and 70,000,000 tonnes at the Vangorda/Grum Mines.
- Much of the waste rock is acid generating to varying degrees. Oxidation of the acid generating rock has been ongoing for many years in some cases.
- Highly contaminated seepage is evident from some waste rock areas.
- Increases in contaminant levels in other areas have been identified.
- Acid generation and metal leaching are expected to continue for the long-term.
- Some waste rock piles are mixed waste rock. Others have segregated sulphide areas.
- Infiltration conditions into the rock piles (both current and future) are not well understood.
- Groundwater conditions beneath the waste rock are not well understood.

Waste Rock – Previous Studies
Water Quality

- There are approximately 320,000,000 tonnes of waste rock on the site. Various types of rock produces different levels of contamination. Several studies have been completed to gain an understanding of water quality emanating from various waste rock:
  - Ongoing acid rock drainage monitoring
  - Ongoing temperature and oxygen monitoring within waste rock dumps
  - Ongoing data collection for water balance studies
  - Waste rock water balance studies
  - Waste rock water quality studies
  - Seepage collection requirements



Waste Rock – Previous Studies
Water Quality Results - Faro

- Estimated current loading from Faro Waste Rock:
  - Sulphate: 1,200 tonnes per year
  - Zinc: 150 tonnes per year
- Estimated worst case future loading from Faro Waste Rock
  - Sulphate: 12,000 tonnes per year
  - Zinc: 2,000 tonnes per year

Waste Rock – Previous Studies
Water Quality Results - Grum

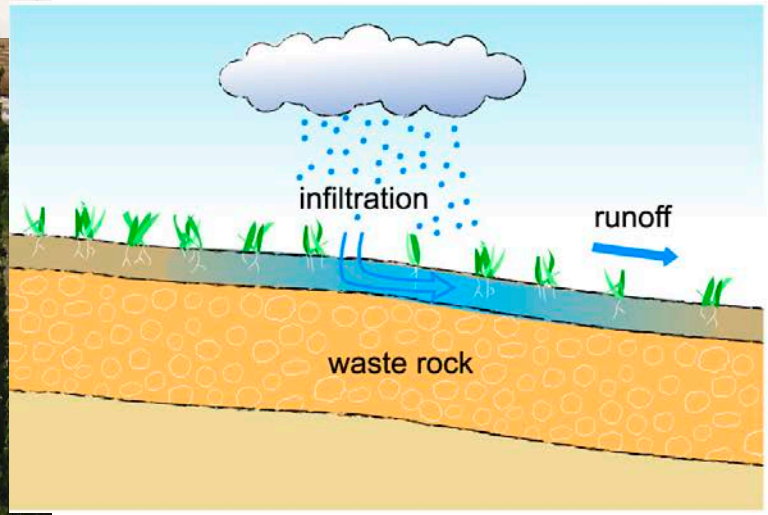
- Estimated current loading from Grum Waste Rock:
  - Sulphate: 200 tonnes per year
  - Zinc: 0.4 tonnes per year
- Estimated worst case future loading from Grum Waste Rock
  - Sulphate: 1,600 tonnes per year
  - Zinc: 250 tonnes per year

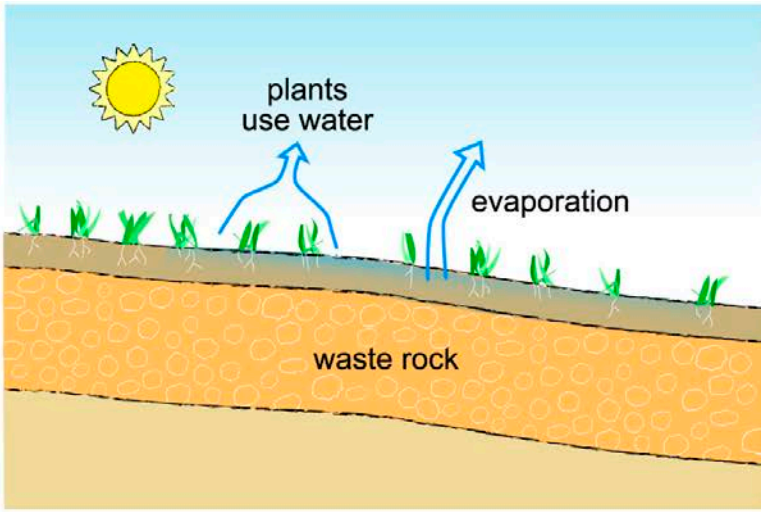
Waste Rock – Previous Studies
Water Quality Results - Vangorda

- Estimated current loading from Vangorda Waste Rock:
  - Sulphate: 600 tonnes per year
  - Zinc: 100 tonnes per year
- Estimated worst case future loading from Vangorda Waste Rock
  - Sulphate: 1300 tonnes per year
  - Zinc: 250 tonnes per year

Waste Rock – Previous Studies
Covers

- Previous work included modeling of cover performance and effectiveness in limiting infiltration of water into waste rock materials. Modelling results were not reliable because of inadequate site-specific data.
- Store and release covers have been identified as the most practical and feasible cover option for the Faro Mine site:
  - Can be constructed with materials present on site
  - Performance of these covers is less susceptible than other types of covers to frost action
  - Covers will serve as reclamation covers too.
  - Adeqaute material is present for construction of these types of covers.
- Covering waste rock will require a lot of regrading of slopes





Waste Rock – Previous Studies
Oxide Fines and Low-Grade Ore

- Oxide fines and low-grade ore are waste rock that have very high levels of soluble contaminants and are likely contributing a large portion of contamination emanating from some areas of the waste rock.
- Previous studies have investigated specific remediation options for these discrete waste rock contamination sources.

Waste Rock Studies
Seepage Collection – 2005 Programs

- 2005 studies of waste rock seepage collection have focused on three areas:
  - Emergency Tailings Area.
  - “S Wells” area adjacent to North Fork of Rose Creek downstream of the North Fork Rock Drain.
  - Grum waste rock dump.
- Studies are intended to evaluate seepage collection concepts for areas with most immediate seepage quality concerns.

Waste Rock Studies
Covers – 2005 Program

- Waste rock cover test pads were constructed at the Vangorda waste rock dump in 2004/05 with extensive instrumentation to provide input data for future modelling of cover performance.

- Monitoring is ongoing.

Waste Rock Studies

Oxide Fines and Low-Grade Ore – 2005 Program

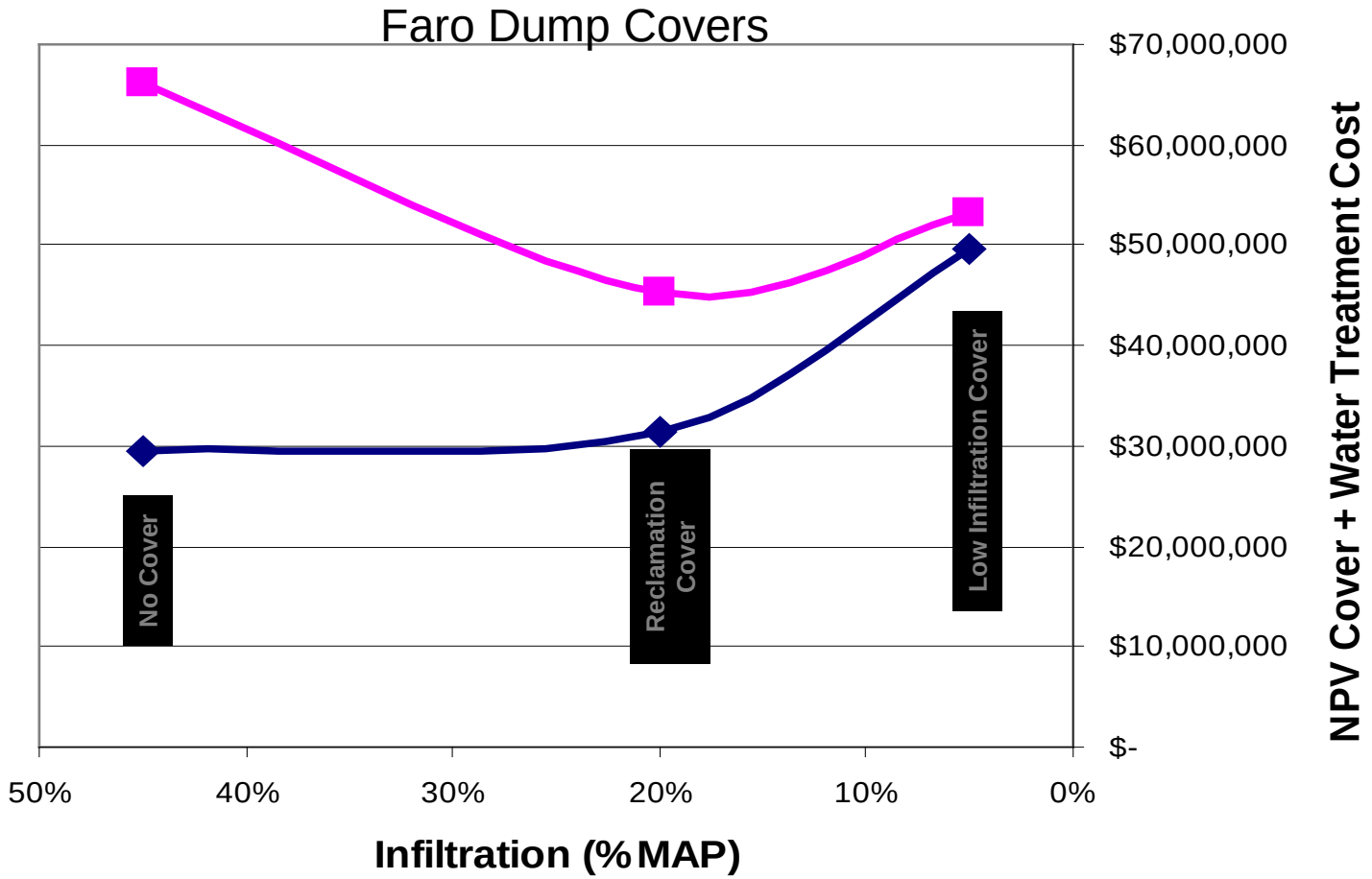
- 2005 program of drilling in Oxide Fines and Low-Grade Ore was intended to better delineate the amount of material present so that better cost estimates can be developed for some remediation options.

Waste Rock Studies
Trade-off Studies – 2005 Program

- Remediation activities for waste rock can reduce future water treatment costs.
- Trade-off studies will compare the cost of waste rock remediation options against the cost of future water treatment, to evaluate cost-effectiveness for specific remediation methods
  - No covers
  - Simple covers
  - Robust covers
  - Relocation

Waste Rock Studies

Trade-off Studies – 2005 Program



Note: These are incomplete results presented for illustrative purposes only – work is still in progress.

Site-Wide Studies - 2005

- Water Treatment Costs
- Sludge Handling
- Water Quality Modelling
- Pelly River Aquatic Effects Study
- Site-Specific Water Quality Objectives
- Terrestrial Effects
- Human Health and Ecological Risk Assessment

Site-Wide Studies - 2005
Water Treatment Costs

- 2005 program included completion of a model for evaluating lime demand, sludge production and treatment costs for water treatment at the Faro site.
- High density sludge treatment has been identified as the most cost-effective water treatment technology for the site.
- Model can be used to predict water treatment costs associated with various remediation options.

Site-Wide Studies - 2005

Long-term Sludge Handling

- Sludge handling can be an important component for long-term closure planning. Ongoing water treatment will continue to produce sludge which will have to be stored appropriately. Current sludge handling practices will not suffice for the long-term.
- 2005 program evaluated the amount of sludge that could be produced and various sludge storage/handling options:
  - Thickening
  - Filtration
  - Freezing
  - Evaporation/Drying
  - Gravity Consolidation
- Disposal options most likely to receive further consideration were identified:
  - Rose Creek Tailings Impoundment
  - Waste rock dumps
- Further details are required to confirm specific disposal locations and methods. Adequate information is now available for closure planning purposes.

Site-Wide Studies - 2005
Water Quality Modelling

- The results of many studies have been combined to explain how water and contaminants move on the site, and how they enter receiving waters.
- This helps to understand when and where the water will enter the streams (Rose Creek or Vangorda Creek) and what level of contamination may occur.
- The model can be used to predict performance of various remediation options.

Site-Wide Studies - 2005
Pelly River Aquatic Effects Study

- Selkirk First Nation began an aquatic effects study in 2001 to assess whether the Faro Mine is causing any downstream effects on the aquatic environment. The program was continued through 2004, and monitoring has now been completed for the 2005 program.

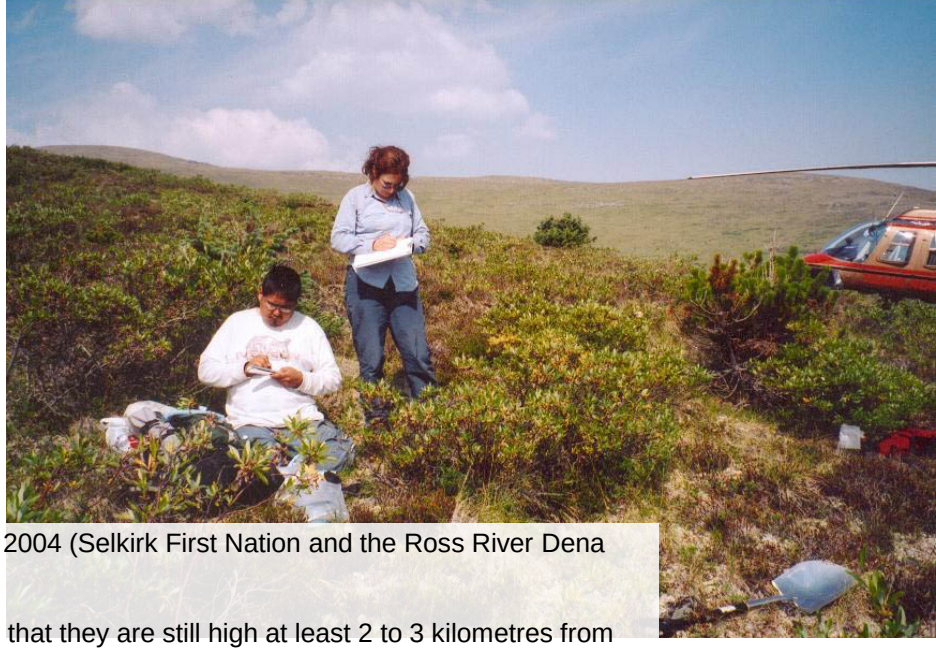
- Sampling includes:
  - Water
  - Sediment
  - Benthic Invertebrates
  - Fish and fish habitat

- The 2004 and 2005 studies also included assessment of the 1975 tailings spill.

Site-Wide Studies - 2005
Site Specific Water Quality Objectives

- 2004 and 2005 studies are under way to identify appropriate site-specific water quality objectives for aquatic ecosystems in Rose Creek.
  - Focussing on zinc.
  - Following CCME methodology for developing site-specific objectives
  - Considering application of BC approach where zinc objectives vary depending on water hardness.

Site-Wide Studies - 2005
Terrestrial Effects



- Levels of metals in plants, soil and animals were studied in 2003 and 2004 (Selkirk First Nation and the Ross River Dena Council helped to identify appropriate plants and animals).
- 2003 test work concluded that metals likely come from mine dust and that they are still high at least 2 to 3 kilometres from the mine site.
- 2004 studies, using moss bags, found that metals are still moving from the mine site.
- Lichen and plants eaten by animals and humans have been evaluated in the studies.
  - Berries included kinnikinnick, low bush cranberry, red bearberry, crowberry, soopalallie, blueberry and cloudberry.
- Animals in three categories were studied:
  - Small mammals like voles and shrews.
  - Furbearers including snow shoe hare and marten.
  - Hunted animals including moose and grouse.
- The Conservation Officer Service in Faro and Ross River assisted in collecting furbearer carcasses and animal organs from trappers and hunters.
- Additional studies is being carried out in 2005 to help determine what environmental effects are occurring from the mine.
  - Finalize information from moss bags
  - Complete air sampling to determine extent of ongoing contamination
  - Evaluate sources (using lead isotopes) of ongoing contamination – i.e. tailings vs. waste rock.

Site-Wide Studies - 2005

Human Health and Ecological Risk Assessment

- A 2005 study is underway to better understand how the closed mine might affect the environment and people.
- This study uses the results of the terrestrial effects study, other monitoring programs and the overall site water balance.
- With these results, we hope to be able to predict how various alternatives might affect plants, animals and humans in the long-term.

Faro Mine Closure Planning Studies Update

Faro Oversight Committee Meeting

October 2005