

DAM 1C

LOCATION:	West side of Pond 2.
FUNCTION:	Minor perimeter closure for water retention: currently retaining no water other than small puddles. Currently functioning only as a road embankment.
LENGTH:	230 +/- m
MAX HEIGHT:	2.0 +/- m above d/s tundra.
AS-BUILT ELEVATION:	485.88 m
CREST WIDTH AND CONDITION:	9 +/- m wide; surfaced with esker material, so that this dam may also function as a roadway, although the downstream toe roadway appears more commonly used. Crest condition is good.
RIPRAP:	Run of Mine rockfill; some minor disturbances noted; overall condition satisfactory.
BACKSLOPE:	Approx. 3H:1V, smooth slope. Some erosional gullies formed. Access road berm appears in good condition.
SEEPAGE:	No seepage observed. No water currently being retained by the structure.
MAINTENANCE RECOMMENDATIONS:	Backfill and grade the minor erosional gullies located on the downstream face.
CONCLUSIONS:	The structure is in good condition; it should be monitored for seepage if Pond 2 rises sufficiently to place a water head against the dam.

DAM 2

LOCATION:	North end of Pond 2.
FUNCTION:	Major perimeter closure for water retention; natural pond downstream of the dam.
LENGTH:	350 +/- m
MAX HEIGHT:	5.5 +/- m above d/s tundra.
AS-BUILT ELEVATION:	486.305 m
CREST WIDTH AND CONDITION:	Approx. 6 m; surfaced with esker material and used as the primary traffic route. Crest condition is good; no cracking is evident.
RIPRAP:	Run of Mine rock forms convex-upward, gently sloped upstream face; erosional scarp formed at higher water level about 2.5 m below the crest; good condition. Minor settlement of rip rap at south abutment was noted.
BACKSLOPE:	Approx. 1.5H:1V with one significant erosion gulley near the north abutment. Minor longitudinal cracking at the toe of the access road berm.
SEEPAGE:	No seepage observed discharging at the toe of the northeast abutment where seepage is typically observed.
INSTRUMENTATION:	<p>Thermistor D2-00-02 is located at the north end of the crest. Active layer depth was greater than 2.2 m in October 2001 and mid-September 2002. Temperatures at depth are subzero. Below 5 m depth (approximate bottom of embankment fill), temperatures are colder than -1.5°C. At depth, foundation zone appears to be cooling over the longer term.</p> <p>Thermistor D2-00-03 is situated near the mid-point of the dam. Active layer depths of greater than was 2 m in October 2001 and 3 m in August 2002. Below the active layer depth, no warm temperatures were recorded since August 2002. Temperatures below 15 m depth are colder than -3.5°C.</p>

DAM 2 CONTINUED

MAINTENANCE

RECOMMENDATIONS:

Backfill erosional scarp on the upstream side rip rap, approximately 2.5 m lower than the crest.

CONCLUSIONS:

The dam is in satisfactory condition. Continue with vigilant monitoring of instrumentation and visual condition assessment.

DAM 3

LOCATION:	East end of now-covered tailings storage area, east of Cells 1 and 2.
FUNCTION:	Minor perimeter closure for tailings retention; Boomerang Lake downstream of the dam. The dam retains tailings covered with an esker material cap, thickened in 1995 by one metre using esker material.
LENGTH:	600 +/- m
MAX HEIGHT:	2.5 +/- m above d/s tundra.
AS-BUILT ELEVATION:	488.4 m
CREST WIDTH AND CONDITION:	Approx. 8 m; surfaced with esker material. Crest condition is good and no cracking is evident. New ditch and discharge swale have been constructed on the east arm. Portions of remnant gullies are located on the east arm of the dam.
RIPRAP:	Inside slope buried with tailings and then covered over.
BACKSLOPE:	Variable in inclination; locally meets the shoreline of Boomerang Lake. Minor toe cracking still occurring along the east and northwest arms.
SEEPAGE:	None observed near the toe of the east arm of the dam.
MAINTENANCE RECOMMENDATIONS:	Flatten the backslope along Boomerang Lake for the northwest part of the dam to prevent cracks from opening any further. Also grade and flatten the toe where cracks are present along the east arm.
CONCLUSIONS:	The dam is in good condition with only minor cracking occurring at the toe.

DAM 4

LOCATION:	South end of Cell 4 for K Dam sub-pond.
FUNCTION:	Perimeter closure for water retention at present; natural pond downstream of the dam at its west end.
LENGTH:	900 +/- m
MAX HEIGHT:	6 +/- m above u/s native ground elevation.
AS-BUILT ELEVATION:	489.586 m
CREST WIDTH AND CONDITION:	Approximately 12 m wide crest width in good condition, no cracks found.
RIPRAP:	Run of Mine rockfill in generally good condition on upstream slope. Some construction machinery/dozer activity on the upstream side has disturbed the overall slope of the riprap.
BACKSLOPE:	Esker sand; slope steeper in upper portion and flattens in the lower portion, approximately 2H:1V. Several erosional gullies noted. Geogrid exposed in places. Some minor cracks parallel the contours in the lower portion of the slope (seen previously and not of concern), adjacent to the steep toe.
SEEPAGE:	No apparent seepage but the head of water across the dam is relatively low. Temporary cofferdams, which were on the downstream side of dam, have been graded along the toe; the west end cofferdam remains. After pumping of the toe berm pond was undertaken, seepage into pond was coming from downstream lake side, not from the upstream side of the dam. This case has been previously observed.
INSTRUMENTATION:	<p>Four thermistors are currently monitored in Dam 4. From east to west across the crest, the four cables are numbered TD4-1 to -4.</p> <p>Thermistor TD4-1 displayed just over 2 m of active layer thaw in October 2001 and about the same thaw depth in mid-September 2002. Below a depth of 6 m (approximately embankment fill thickness), the subsurface temperatures have all been colder than -2.5°C with no signs of significant warming.</p>

DAM 4 CONTINUED

INSTRUMENTATION:

Thermistor TD4-2 displayed just over 3 m of active layer thaw in October 2001 and just less than 3 m in mid-September 2002. Below a depth of 8 m, the subsurface temperatures have all been colder than -2.3°C and the subsurface points appear to be cooling over the longer term.

Thermistor TD4-3 displayed over 2 m of active layer thaw in October 2001 and slight more thaw depth in mid-September 2002. Below a depth of 6 m (approximately embankment fill thickness), the subsurface temperatures have all been colder than -2.0°C with no signs of significant warming.

Thermistor TD4-4 displayed just over 2 m of active layer thaw in October 2001 and slightly more thaw depth in mid-September 2002. Below a depth of 6 m (approximately embankment fill thickness), the subsurface temperatures have all been colder than -2.7°C with no signs of significant warming.

MAINTENANCE

RECOMMENDATIONS:

Repair disturbed rip rap on the upstream side. Backfill erosional gullies at the east end of the dam backslope.

CONCLUSIONS:

The dam is in good condition and is functioning without apparent seepage. Any plan for significantly increasing the pond water level should include considerations for beach placement in view of its contribution to potential seepage mitigation.

DAM 5

LOCATION:	Southeast corner of Cell 3, just northwest of Dam 4.
FUNCTION:	Minor perimeter closure intended for future tails and water retention; currently functioning as a road embankment.
LENGTH:	250 +/- m
MAX HEIGHT:	1.5 +/- m above d/s tundra.
AS-BUILT ELEVATION:	491.537 m
CREST WIDTH AND CONDITION:	Approximately 8 m wide and esker surfaced so that the dam may also function as roadway. Crest is in good condition with no evidence of cracking.
RIPRAP:	Angular rockfill, maximum particle size from 20 to 30 cm, has been placed on the upstream face. Approximate slope of 3H:1V and in good condition.
BACKSLOPE:	About 1.5 to 2H:1V with till and esker sand. Numerous erosional gullies have formed.
SEEPAGE:	No seepage observed. No water head being retained by the structure.
MAINTENANCE RECOMMENDATIONS:	Backfill numerous gullies on the backslope.
CONCLUSIONS:	The dam is in good condition and should be inspected for seepage when pond levels place a water head against it.

DAM 6

LOCATION:	West side of Cell 3 retaining tailings placed behind K-dam.
FUNCTION:	Minor perimeter closure. Retaining some tailings beach and ponded water on the northern portion of the dam.
LENGTH:	300 +/- m
MAX HEIGHT:	2.5 +/- m above d/s tundra.
AS-BUILT ELEVATION:	490.246 m
CREST WIDTH AND CONDITION:	Approximately 10 m wide and esker surfaced so that dam may also function as a roadway. Crest in good condition, no cracking evident. Settlement of the crest near the north abutment amounts to approximately 0.5 m.
RIPRAP:	Run of mine rockfill in good condition on upstream slope; slightly steeper in southern portion.
BACKSLOPE:	About 2H:1V with till and esker sand; minor cracking observed. Numerous erosional gullies observed.
SEEPAGE:	No seepage observed.
INSTRUMENTATION:	<p>Three thermistors were installed in Dam 6 in May 2003 as part of the site investigation program. From north to south along the dam, the three cables are numbered BGC03-01, -02 and 03. The first two thermistors on crest were destroyed in June 2003.</p> <p>Thermistor BGC03-01 is located on the crest, approximately 50 m south of the north abutment. This location is proximal to a small pond located on the upstream side within the settled portion of the crest. The trumpet curve shows frozen conditions through the depth measured to approximately -4°C at 20 m depth.</p> <p>Thermistor BGC03-02 is located on the crest, approximately 150 m south of the north abutment. The trumpet curve shows frozen conditions through the depth measured to -4.5° to -4.8°C at 18 to 22 m depth.</p>

DAM 6 CONTINUED

INSTRUMENTATION:	Thermistor BGC03-03 is located on the upstream side of the dam, within the tailings, approximately 225 m south of the north abutment. The trumpet curve shows frozen conditions through the depth measured.
MAINTENANCE RECOMMENDATIONS:	Backfill and grade gullies at the toes. Monitor crest at north end for additional settlement.
CONCLUSIONS:	The dam is in good condition. Monitor for seepage if retained pond level continues to rise.

TAILINGS DUMP POND #1 DIKE

LOCATION:	Along access road to sewage containment area, approximately 0.8 km from Lupin Mine complex. The dump pond is located directly downstream of the Upper Sewage Containment Dike.
FUNCTION:	Two-sided dike for retention of tailings solids and water from tailings pipeline should it be necessary to drain the line. Surface water runoff into the southwest side of the pond is prevented by a small surface water deflection berm. This berm is approximately 0.75 to 1.25 m high above adjacent grade.
LENGTH:	200 +/- m.
MAX HEIGHT:	4 +/- m above downstream toe.
AS-BUILT ELEVATION:	Unknown; survey required to confirm elevation.
CREST WIDTH AND CONDITION:	Approximately 6 m wide and surfaced with -20 mm crushed rockfill so that crest may function as a roadway. The crest is in good condition with no cracking or settlement evident.
UPSTREAM SLOPE AND RIPRAP:	The upstream slope is sitting at approximately 2.5H:1V. No rip rap placed; occasional cobbles on the slope due to sorting. Numerous longitudinal tension cracks and associated settlement troughs observed. Numerous small scarps notched by higher water levels. Highest watermark observed was approximately 0.75 m below the crest.
BACKSLOPE:	About 2H:1V flattening to approximately 3H:1V on the southern arm.
WATER CONVEYANCE:	Very small pond located on the inside face. Floating barge and pump shack on crest likely used for conveyance of water out of the pond.
SEEPAGE:	No seepage observed, but only a very small pond currently retained.

TAILINGS DUMP POND #1 DIKE CONTINUED

MAINTENANCE

RECOMMENDATIONS:

No design or as-built information is currently available for the dike. It appears to be constructed from esker sand and gravel directly placed on native material. Need to investigate dike design and whether embankment section includes a geosynthetic liner. Stability of the upstream face may be marginal, given the numerous cracks observed. An assessment of the face stability and cracks should be undertaken and the upstream face should be rehabilitated should it be necessary to use the pond.

CONCLUSIONS:

The dike appears in satisfactory condition but an assessment of the upstream slope needs to be undertaken.

TAILINGS DUMP POND #2 DIKE

LOCATION:	Along access road to TCA, approximately 2 km from Lupin Mine complex. The dump pond is located directly downstream of the access road and approximately 300 m from Punkin Lake.
FUNCTION:	Two-sided dike for retention of tailings solids and water from tailings pipeline should it be necessary to drain the line. Surface water runoff into the west side of the pond is prevented by a small surface water deflection berm. This berm is approximately 0.75 to 1 m high above adjacent grade.
LENGTH:	300 +/- m.
MAX HEIGHT:	2.2 +/- m above downstream toe.
AS-BUILT ELEVATION:	492.19 m provided on area site plan. Survey required to confirm low point elevation.
CREST WIDTH AND CONDITION:	Approximately 4 m wide on east arm widening to 8 m on south arm. The crest generally consists of esker sand and gravel. Some -20 mm crushed rockfill has been placed on the crest of the southern arm. The crest is in good condition with no cracking or settlement evident.
UPSTREAM SLOPE AND RIPRAP:	The upstream slope is sitting at approximately 2.5H:1V to 3H:1V. No rip rap placed. One longitudinal tension crack observed. Numerous small scarps notched by higher water levels.
BACKSLOPE:	About 2H:1V steepening to approximately 1.5H:1V on the southern arm.
WATER CONVEYANCE:	No pond located on the inside face. Pump shack on crest likely used for conveyance of water out of the pond.
SEEPAGE:	No seepage observed, but no pond is currently retained.

TAILINGS DUMP POND #2 DIKE CONTINUED

MAINTENANCE

RECOMMENDATIONS:

No design or as-built information is currently available for the dike. It appears to be constructed from esker sand and gravel directly placed on native material. Need to investigate dike design and whether embankment section includes a geosynthetic liner. Stability of the upstream face may be marginal, given the crack observed. An assessment of the face stability should be undertaken and the upstream face should be rehabilitated should it be necessary to use the pond.

CONCLUSIONS:

The dike appears in satisfactory condition but an assessment of the upstream slope needs to be undertaken.

UPPER SEWAGE CONTAINMENT POND DIKE

LOCATION:	Along access road to sewage containment area, approximately 0.8 km from Lupin Mine complex. The Upper Sewage Containment Dike is located directly upstream of Tailings Dump Pond #1. Pond elevation provide as 478 m on area site plan.
FUNCTION:	Provides initial retention of sewage discharged from the plant site. Effluent from the Upper Sewage Lake then flows into Lower Sewage Lake for additional holding before discharge to the environment. Also acts as roadway embankment for access and supports the tailings pipeline.
LENGTH:	150 +/- m
MAX HEIGHT:	3.5 +/- m above d/s toe.
AS-BUILT ELEVATION:	480.14 m provided as one elevation point on the area site plan. Survey required to confirm low point elevation of the crest.
CREST WIDTH AND CONDITION:	Approximately 7 m wide and surfaced with -20 mm crushed rockfill since dike also functions as roadway access. Crest in good condition with several longitudinal cracks noted along the upstream edge. Under the crushed rockfill, the embankment appears to be constructed of esker sand and gravel.
UPSTREAM SLOPE AND RIPRAP:	Bilinear nature of the upstream slope is obvious; top 1 m is oversteepened to between 50° and 60° and lower part of slope flattens to 4H:1V. Numerous small scarps noted on slope from higher water levels and/or ice effects. Not sure if explicit rip rap layer has been placed or if angular fragments on the upstream side result from sorting of eroded material. Water level located approximately 2.5 m below the physical crest.
BACKSLOPE:	About 1.5H:1V to 2H:1V in esker sand and gravel. Minor slough and settlement noted in the toe fill. One longitudinal crack and settlement trough noted directly proximal to tailings pipeline.

UPPER SEWAGE CONTAINMENT POND DIKE CONTINUED

WATER CONVEYANCE:	Two CMP culverts pass through the dike; both are 0.6 m in diameter. Small amount of clear water flowing through one of the culverts. These two culverts do not appear to daylight on the upstream slope. Two 0.2 m diameter siphon pipes cross just under the crest of the dike.
SEEPAGE:	No seepage observed.
MAINTENANCE RECOMMENDATIONS:	No design or as-built information is currently available for the dike. Need to investigate dike design and whether embankment section includes a geosynthetic liner and role of culverts in conveying water across the dike. The upstream face needs to be re-established with appropriate rip rap at the appropriate slope angle. If original design information cannot be located, rip rap with a nominal size of 30 to 40 cm should be placed at a slope of less than 2.5H:1V. Toe also needs to be flattened in the area proximal to crack found adjacent to the tailings pipeline.
CONCLUSIONS:	The dike is in satisfactory condition, but upstream side must be rehabilitated for future use.