



## DORIS NORTH PROJECT – 2004 AQUATIC STUDIES SUMMARY

Miramar Hope Bay Limited (MHBL) proposes to construct and operate a underground gold mine (“Doris North Project”) in the West Kitikmeot Region of Nunavut. The project is located 685 km northeast of Yellowknife and 160 km southwest of Cambridge Bay. The mine is on Inuit owned land, approximately 5 km south of the Arctic Ocean. The nearest communities are Umingmaktok, located 65 km to the west and Bathurst Inlet located 110 km to the southwest.

The objective of the 2004 fisheries program was to address data gaps from the Environmental Impact Statement (EIS). The issues addressed in the 2004 field program included the use of the Roberts Lake system by Arctic char; fish use of near-shore areas in Tail and Roberts lakes; water quality in selected lakes and streams in the study area; seasonal monitoring of discharge in Doris, Roberts and Little Roberts outflows; and lake level monitoring in Doris, Tail, and Roberts lakes.

### *Hydrology*

Lake water level and stream discharge monitoring in 2004 was mostly due to snowmelt. Doris, Tail and Roberts Lake water surface elevations and Doris, Tail, Roberts and Little Roberts outflow discharges were monitored from May to September. Streams began to flow in the first half of June and peak stream discharges were observed between 28 June and 4 July. No significant secondary peaks caused by summer or autumn rainfall were observed. Measured water yields were approximately 42 mm for the Tail Lake watershed, 62 mm for the Doris and Roberts Lake watersheds, and 64 mm for the Little Roberts Lake watershed. The annual water balance for the Doris and Tail Lake watersheds indicates that 2004 was an extremely dry year. Snow accumulation and rainfall were far below normal, as was water yield.

### *Physical Limnology and Water Quality*

The lakes sampled in 2004 were generally isothermic and uniformly mixed during the open-water season. Roberts Lake was the only lake that exhibited any thermal stratification. In all sampling locations and throughout the open-water season, dissolved oxygen concentrations met the CCME guideline for the protection of aquatic life. However during July, dissolved oxygen concentrations were below the guideline for supporting early life stages of fish at water depths greater than 1.0 to 2.0 m for all waterbodies. Under-ice sampling was conducted in Doris Lake, Tail Lake, and Roberts Lake during June. The profiles in Tail Lake and Doris Lake showed winter stratification patterns and dissolved oxygen concentrations fell below the guidelines for early life stages of fish (at about 4.5 m water depth) and the protection of aquatic life (at about 6.0 m water depth).

At various times during the open-water season, total aluminum concentrations exceeded CCME water quality guidelines in Roberts Lake, Tail Lake, and Little Roberts Lake. Because the dissolved samples were not above guideline, the high total aluminum concentrations were most likely due to the presence of suspended sediment in the sample. In Little Roberts Lake, the total iron concentration was above CCME guideline in August and pH was below CCME guideline in September. The elevated iron result was likely caused by wind-induced increases in suspended sediment in the sample. The cause of the acidic pH result is unknown.

In all of the streams and throughout the sampling season, dissolved oxygen concentrations met the CCME guideline and were therefore suitable for the protection of aquatic life. On occasion, however, the dissolved oxygen guideline for early life stages of fish was not met. Also, at various times during the open-water season, aluminum concentrations exceeded the CCME guideline in Roberts Outflow and Little Roberts Outflow. This was most likely due to the presence of suspended sediment in the samples.

### *Fish Communities*

In total, 570 fish representing 10 species were captured in the Doris North Project area during fisheries surveys conducted in 2004. Fish sampling was conducted in two lakes and 10 streams. The most common fish species captured was Arctic char (47.2%), followed by lake trout (37.5%) and ninespine stickleback (6.8%).

### *Lake Communities*

Small fish sampling was conducted in Roberts and Tail lakes to assess near-shore habitat use. Ninespine stickleback were directly captured in Tail Lake for the first time. In Roberts Lake, least cisco, juvenile arctic char, and juvenile lake trout were captured. Catch-per-unit effort for all of these species was very low, despite using sampling methods that target small fish. A large fish sampling program was conducted in Roberts Lake. Lake trout and lake whitefish dominated the catch. Broad whitefish were also captured.

### *Stream Communities*

Fish sampling was conducted in 10 streams; these included Roberts, Little Roberts, and Pelvic outflows, and inflows to Roberts Lake (n=7). In total, 466 fish representing of five species were captured. Fish were captured in Little Roberts Outflow, Roberts Outflow and two tributaries to Roberts Lake. Arctic char was the dominant species in Roberts Outflow and the tributaries to Roberts Lake. Ninespine stickleback was the dominant fish species captured in Little Roberts Outflow. Other species captured in streams included lake trout and cisco. One Arctic flounder was captured in Little Roberts Outflow near Roberts Bay.

### *Arctic Char in Roberts Lake System*

Two fish fences were installed above and below the boulder garden located in Roberts Outflow between 8 August and 8 September. These fish fences were installed to determine the number of Arctic char migrating from the ocean to Roberts Lake. Fish were also captured using backpack electrofishing and beach seining. In total, 403 fish representing four species were caught in Roberts Outflow. Arctic char was the predominant species in the overall catch (59%), followed by lake trout (37%).

The open-water period during 2004 was a low flow year, which made migration through the boulder garden difficult for large fish. Approximately 78% of the Arctic char population and 48% of the lake trout population were stranded within the boulder garden section below Roberts Lake, and most likely perished. This represents a considerable loss of fish numbers, biomass, and future reproductive potential of fish from the Roberts Lake system.

## DORIS NORTH UYAGAKHIURVIKHAK – 2004 IMARMIUTANIK QAUYIHAINIIT

Miramar Hope Bay Limited-kut (MHL) nappaqtiriniarhimayut uyagakhiurviqarlutik guulhiurivngmik Ualiniani Kitikmeot Nunavunmi. 685 kilometres-nguyuuq Yallunaimit 160 kilometres-nguluni Ikaluktuttiamit. Uyagakhiurvikhak Inuit nanminiq nunaqutainniittuq, 5 kilometres-nuaq taryumit. Qanitqiat nunaliik Umingmaktuq, 65 kilometres ualiniani Kingauktauq 110 kilometres-nguyuuq hivugaani.

2004-mi ikaluktigut qauyihaiyut kiutyutauniaqtunik ilitturiyaunngitunik Avatimut Aktumayuliriyunit. Kiutyutauyuuq 2004-mi nunami qauyihaiyut tapkuninga Roberts Lake tahirmit kuungnit atuqtauvaktut ikalukpinit; ikaluit atuqpagait hinaaniit Tail Lake Roberts Lake-milu; imarikiillu tattit kuungniillu qauyihagtauyumi; ukiumilu qanngagugaikpat munarlugit kuvipkaktauniit imakkut Doris Lake-mit, Roberts-mit Little Roberts-millu; tattillu imaqquqtuniinik Doris-mi, Tail-mi Roberts-milu.

### *Imartigut*

Tattit imaqquqtuniit kuungniillu munaqtauyuuq 2004-mi aputainnaq mahaktirniat. Doris, Tail Roberts-lu tattit imaqquqtuniit Doris, tail, Roberts Little Roberts-lu tattit kuungniit munaqtauvaktut May-mit Saptampamut. Kuungniit kurluaqpalirhutik June atukhaavyaliqtilugu imaqquqtuhimplutik June 28-mit July 4-mut. Imaqquqtuhiutiunik takunnangittuq auyami ukiakhamilu. Uktuqtaptingnit imakyminiinnik 42 mm Tail lake-mi, 62 mm Doris-mi Roberts –milu 64 mm Little Roberts-mittauq. Ukiumi imaqquqtunia Doris tattip Tail –milu naunairutuuq 2004 ukiuuq paniupavallaaq. Apinnia nipalungnialu katakpiarhutik itquhianit imarlu. Tattip Hikuqannginirmi Itquhia Imariknialu

### *Tattit Hikuqannginirmi itquhiit Imarikniillu*

Tattit ukturviuyut 2004-mi unaarniit atjigiginnaqtut atjigiiktumiglu avurhimapluni hikuilgumi auyami. Roberts lake talvatuq tahiik ilitturiyaayuuq allatqiinik imarmi nilaumaniaqtuq. Tamainni uktuqtauvingni hikuilgumi auyami, avurhimayut anirnikhaqarniit naliutimayut CCME-kut maligainnut hapuminirmut imarmiuttanik. Kihimi Julaimi, avurhimayut anirnikhat hakugikniit ataaniitut ikalungulihhat inuuyagini imarmi itiniqaqtuni 1.0-mit 2.0-mut tamainni imaqarni. Hikup ataani uktuqpaktut Doris-mi, Tail-milu Roberts-milu Junemi. Piksait Tail-mi Doris-milu naunaittut ukiumi qaliriikniit avurhimayullu anirnikhat hakugikniit akatakaktut ataanut maligat ikalungulihhaqtunut (4.5 metres-mi itiniqaqtumi) hapuminirmullu imarmiuttanik (6.0 metres-mi imaq itiniiani).

Ukiumi kaffiikturhugu hikuilgumi auyami, atauttimut aluminum hakugikniit avatqutpagait CCME-kut imariknikkut maligat Roberts-mi, Tail-mi Little Roberts-milu. Avurhimayut uktuqtauyut avatqumanginmagu maliganiittut, kulvahiktuq aluminum hakugiknia taimaittunarhiuq puqtalaaqtunit hiugavalunit. Little Roberts lake-mi, atauttimut haviyagait hakugikniat avatqumayuuq CCME-kut maligaannut Aagasimi pH-tauq ataaniittuni CCME-kut maligaannut Saptampami. Havaigayariknia taimailiungnarhiuq anurimit puqtalaaqihimayunit. Huuq pH taimailivagiakhaa ilihimayaunngittuq.

Tamainni kuungnini uktuqattarnirmilu, avurhimayut anirnikhat hakugikniit naliutimayut CCME-kut maligainnut talvanga nammakhutik hapumminianut imarmiuttat. Ilani, kihimi, avurhimayut anirnikhat

maligaat ikalunngulihaktunut naliutiuyuittuq. Uvvalu, ilani hikuilgumi auyami, aluminum hakugikniit avatqutpaktut CCME-kut maligainniittunik Roberts Litle Roberts-lu kuungniinni. Imaipuuq puptalaaqtunit hiugavalungnit imarmi.

### *Ikaluqarniit*

Atauttimut, 570 ikaluit saivanit allatqiinit ikaluktauyut Doris havarvikhami ikalungnik qauyihairnirmi 2004-mi. Ikalungnik qauyihaivaktut malruungni tattini kulinilu kuungnini. Amigaitqiyauvaktut ikalukpilluanik (47.2%), ihuuttauq (37.5%) kakkillaarnalgitauq (6.8%).

### **Tattit**

Mikiyunik ikalungnik uktuqpaktut Roberts tahiani Tail-milu qauyiharhugu hinaata ikaluqarniit. Kakkillait ikaluktauvaktut Tail tahiani hivullirmik. Roberts tahiani, kapihilgit, ikalukpiit mikiyut mikiyullu ihuut ikaluktauyut. Ikaliquyuitut ukuninga ikaluilliuqtut, allatqinik uktugaluarhutik mikiunik ikaluktagahuarhutik. Angiyunik ikalungnik uktuqpaktut Roberts tahiani. Ahuunik kapihilingniglu ikalungnatqiyauyuq. Aanaakhikpakhutiglu.

### **Kuungniit**

Ikalungnik uktuqtut kulinit kuungninit; hapkunanga Roberts, Little Roberts, Pelvic-millu kuungninit, uvvalu Roberts-mut kuuktunit (n=7). Atauttimut, 466-nik ikalungnik talimanit allatqiinit ikaluktut. Ikalukpaktut Little Roberts-mit kuuktunit, Roberts-milu malruungnilu kuuktunit Roberts tahianut. Ikalukpinik ikalutqiyauyut Roberts kuungnianiit kuuktunillu Roberts-mut. Kakkilaaqtat ikalutqiyauyut Little Roberts kuungnianiit. Allat ikaluktauyut kuungnini ihuut kapihilgillu. Atauhirmik nataarnaqtut Little Roberts-mit kuungnianiit Roberts Kangiqhuup haniani.

### *Ikalukpiit Roberts Tahirmi*

Malruungnik ikalungnut avalulivaktut kulaani atpanilu uyagakyuaqarniup Roberts kuungniani Aagasi 8-mit Saptampa 8-mut. Hapkuat avaluliuqtauhimayut naunaigahuarhugit kaffiuniit ikalukpiit mayuaqpaktut taryumit Roberts tahianut. Ikalukpaktullu nangmakattarqarhutik quaqhalautitigut kuvyaniglu kalittutik hinaagut. Atauttimut, 403-nik ikaluktut hitamanit allatqiinit ikalungnit ikaluktauyunit Roberts kuungnianiit. Ikalukpinik ikalutqiyauyut (59%), ihuuniglu (37%).

Hikuilguq auyami 2004-mi imaqqukittuq ukiuq, mayuaqtunut uyagakyuaqarnikkut ayurhautaupluni angiyunut ikalungnut. 78%-nguyungnarhiut ikalukpiit 48%-lu ihuut mayunngittut uyagakyuaqarnirmit mayunngittut Roberts tahirmut, tuquyarunarhiut. Hamna ikaluuyautauyuq, umayuniglu allanik, hivunirmilu ikalukhanik Roberts tattip imaqarnianiit.

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[illegible][illegible] $\Delta L \propto \sigma^{5/6}$ [illegible]

ፕላንና ስራ ለማስፈጸም ለሚያስፈልጉት ሰው ምን ዓይነት ስራ ማድረግ እንደሚችል ማረጋገጥ

[illegible][illegible]





