Appendix V5-6Q

Proposed Access Road Fisheries Assessments, Doris North Project 2015

Memorandum

Refer to File: C.1 - 0298923-0038 (Proposed Access Road Fisheries Assessment Memo 2015).docx

Date: November 24, 2015

To: John Roberts, VP Environmental Affairs
Katsky Venter, Environmental Advisor
Sharleen Hamm, Project Manager

From: Fraser Ross (B.Sc., R.P.Bio.)

Cc: April Hayward (Ph.D.), Project Manager
Marc Wen (M.Sc., R.P.Bio.), Partner in Charge

Subject: **Proposed Access Road Fisheries Assessments, Doris North Project, 2015**

GLOSSARY AND ABBREVIATIONS

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

CPUE	Catch-per-unit-effort
DELTs	Deformities, Erosion, Lesions, or Tumors
ERM	ERM Consultants Canada Ltd.
FHAP	Fish Habitat Assessment Procedures
FL	Fork Length
SHIM	Sensitive Habitat Inventory Mapping
TMAC	TMAC Resources Inc.

1. INTRODUCTION

ERM Consultants Canada Ltd. (ERM) conducted fisheries assessments along proposed access roads at the request of TMAC Resources Inc. (TMAC) during the open-water season of 2015. The three proposed road routes are:

- Doris Connector Vent Raise Access Road;
- Doris Central Vent Raise Access Road; and
- Roberts Bay Discharge Access Road (Figure 1-1).

The objectives of the 2015 Proposed Access Road Fisheries Assessments were as follows:

- to determine the locations of waterbodies along each of three proposed road routes;
- to sample the fish communities in all waterbodies along each road route;
- to assess the habitat value of each waterbody; and
- to assess the surface connectivity of these waterbodies to other fish-bearing waterbodies.

This memorandum presents the results of these assessments.

A rainfall event in the latter half of July 2015 caused unseasonably high flow conditions in streams around the Doris North Project (the Project) area. At the Doris Creek hydrology station, located downstream of Doris Lake, discharge was greater at that time than during spring freshet (3.24 m^3/s on July 29th whereas the freshet peak on June 15 was 2.92 m^3/s; ERM 2015 in progress). In 2015, the average discharge in Doris Creek between July 15 and September 15 was 1.54 m^3/s, whereas during the same period in previous years (2009 to 2014) discharge was 0.60 m^3/s. Although none of the sample sites reported herein are located on Doris Creek downstream of the lake, the hydrograph data substantiates field observations that discharge levels at the sample sites and in the general Project area were more typical of peak freshet conditions than what would be expected in mid-August.

2. METHODOLOGY

2.1 Desktop Assessment

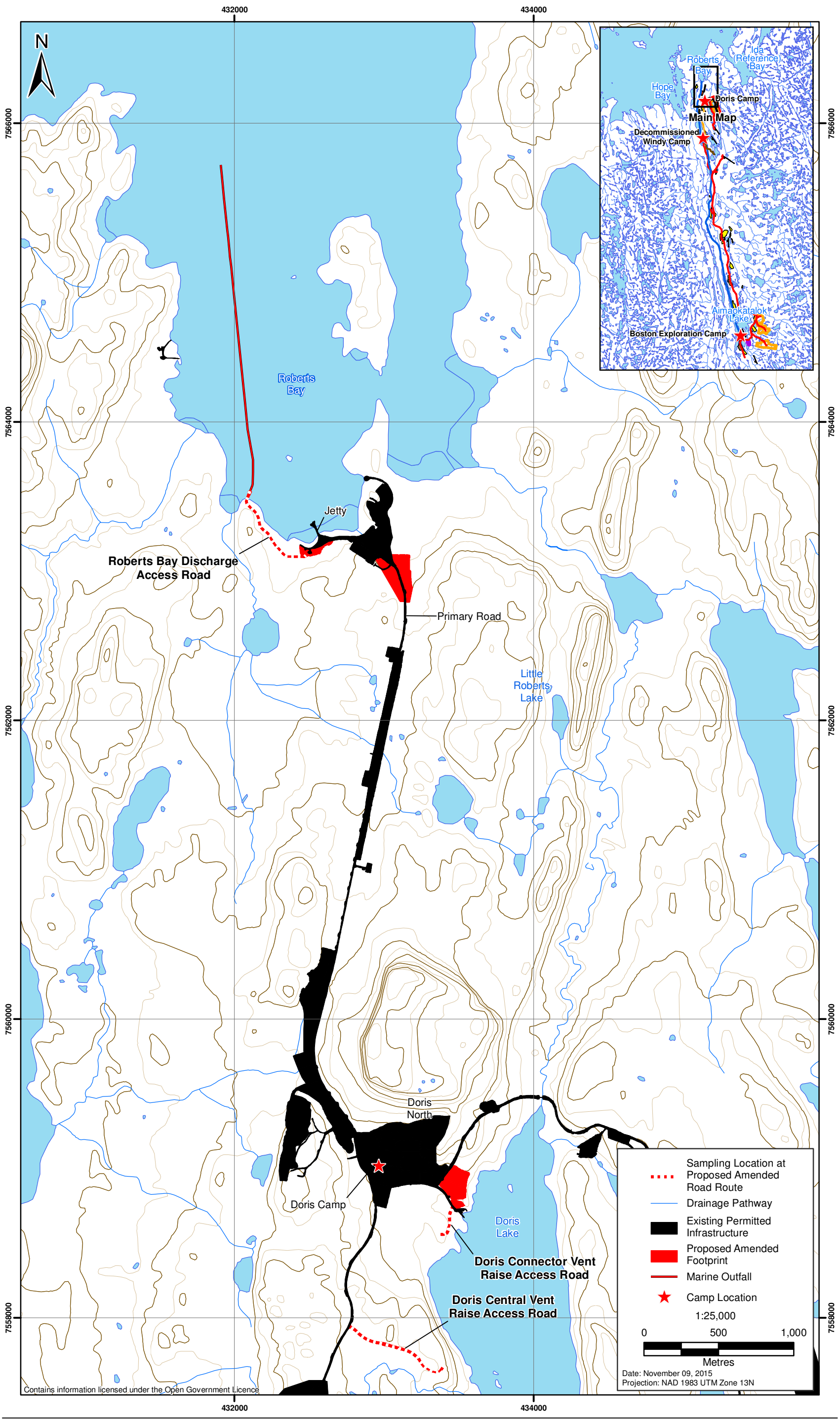
Prior to fieldwork, the proposed roads were plotted on topographic maps to identify locations where the routes bisect waterbodies. The fisheries values of these locations would later be assessed in the field.

Historical fish community and habitat data were reviewed for waterbodies along and surrounding each road route to determine the proximity of known fish-bearing waterbodies to potential crossing sites.

2.2 Fish Habitat Assessment

Fish habitat was assessed along each road route on August 13 and 14, 2015. A preliminary assessment was completed to determine whether locations identified during the desktop mapping exercise contained habitats that could support fish (e.g., defined stream channels, ponds). Locations were categorized as "potential fish habitat" or as "not fish habitat" (e.g., subsurface flow, surface water with no defined channel). Sites that did not contain fish habitat were not considered further in the assessment.

Figure 1-1
Proposed Access Road Sampling Locations, Doris North Project, 2015



For sites categorized as potential fish habitat, additional habitat data were collected to determine its value. Habitats were surveyed using methods based on the Fish Habitat Assessment Procedures (FHAP; Johnston and Slaney 1996). Representative sections of each reach were chosen for assessment and individual habitat units were measured with respect to length, bankfull and wetted width, depth, substrate composition, residual pool depth, bank stability, bank height, and instream cover. Stream attributes were marked using a handheld GPS unit and representative photographs were taken. Barriers or seasonal restrictions to fish migration were also noted and measured, where appropriate. Habitat suitability for spawning, rearing, and overwintering was described and an overall habitat quality ranking was applied (Table 2-1).

Table 2-1. Overall Habitat Quality Rankings and Criteria

	Habitat Quality Ranking		
	High	**Medium**	**Low**
Definition	Habitat that is necessary to sustain an Aboriginal, commercial, or recreational fishery, any species at risk*, or because of the habitat's relative rareness, productivity, and/or sensitivity.	Habitat that is used by fish for feeding, growth, and migration but is not deemed to be essential. This category of habitat usually contains a large amount of similar habitat that is readily available to the fishery.	Habitat that has low productive capacity and contributes marginally to fish production.
Indicators	The presence of high-value spawning or rearing habitat (e.g., locations with an abundance of suitably sized spawning gravels, deep pools, undercut banks, or stable debris, which are necessary to the population), or the presence of any species at risk*, its residence, or its critical habitat.	Migration corridors, the presence of suitable spawning habitat, habitat with moderate rearing potential for the fish species present.	The absence of suitable spawning habitat, and habitat with low rearing potential (e.g., locations with a distinct absence of deep pools, undercut banks, or stable debris, and with little or no suitably sized spawning gravels for the fish species present).

*Notes: * those designated by the Committee on the Status of Endangered Wildlife in Canada, or species listed on Schedule 1 of the Species At Risk Act (2002).*

The connectivity of each stream to other fish-bearing waterbodies was assessed to help determine whether the stream might provide seasonal habitat to fish. Small Arctic streams flow seasonally; some flow only during freshet then become dry later in the summer, while others flow throughout the ice-free period but freeze to the substrate in winter. These seasonal streams are only of value to fish if they are connected to other habitat types where fish can overwinter, such as lakes or deep ponds.

2.3 Fish Community Assessment

Backpack electrofishing was the primary method used to sample stream fish communities on August 13 and 14, 2015. Figures 2.3-1 and 2.3-2 show the stream sections sampled by electrofishing in an unnamed tributary to Doris Lake and an unnamed tributary to Roberts Bay respectively. A crew leader operated a Smith-Root LR-24 and was accompanied by one dip netter. Anode ring diameter was 28 cm and dip net diameter was 21 cm with 3.2 mm mesh.

A systematic sweep sampling approach was conducted moving in an upstream direction that covered the entire wetted width of the stream, including all channels where flow was braided. Electrofishing effort was not pre-determined because the primary objective was to determine whether fish were present in the stream and, if so, determine fish community composition. Electrofisher voltage (V), duty cycle (%) and frequency (Hz) settings were adapted at each site to maximize catch efficacy.

All captured fish were identified to species and given a unique sample number. Fork Length (FL) was measured to the nearest 1 mm with a measuring board and wet weight was measured to the nearest 0.1 g using an electronic scale for each fish. Where parasites or deformities, erosions, lesions, or tumors (DELTs) were observed, this information was recorded for each fish. In addition, all observations of fish that were seen but not captured were noted.

All captured fish were placed immediately in a holding tank for species identification, enumeration, and biological processing and then released back into the site once collection was complete. Electrofishing effort was standardised as Catch Per Unit Effort (CPUE), which was calculated as the number of fish captured per 100 s.

*CPUE = number of fish caught * [100/(electrofishing effort in seconds)]*

Field crews intended to set minnow traps as a second method of sampling fish communities; however, insufficient water depths prevented their use.

3. RESULTS AND DISCUSSION

3.1 Desktop Assessment

The review of topographic maps identified locations where both the proposed Doris Connector Vent Raise Access Road and the Roberts Bay Discharge Access Road bisect drainages. Conflicting data exists for a third drainage under the proposed Doris Central Vent Raise Access Road; 1:50,000 map data indicates that the drainage turns south and away from the road route before they cross (e.g. Figure 1-1), whereas more recent, site plan map data indicates that this road would cross a drainage (e.g. Figure 2.3-1). Given this uncertainty, the drainage routes would later be assessed in the field.

3.2 Historical Fisheries Data Review

Historical fisheries data are summarized below for waterbodies along and surrounding each road route.

3.2.1 Doris Connector Vent Raise Access Road

Topographic mapping indicates that the Doris Connector Vent Raise Access Road bisects one small unnamed surface drainage that discharges directly into Doris Lake. No historical fisheries data exists for this waterbody. Doris Lake has been extensively sampled; the fish community consists of Lake Trout (*Salvelinus namaycush*), Lake Whitefish (*Coregonus clupeiformis*), Cisco (*Coregonus artedii*), and Ninespine Stickleback (*Pungitius pungitius*; Rescan 2010).

Figure 2.3-1

Electrofishing Sample Route along Unnamed Tributary to Doris Lake, Doris North Project, 2015

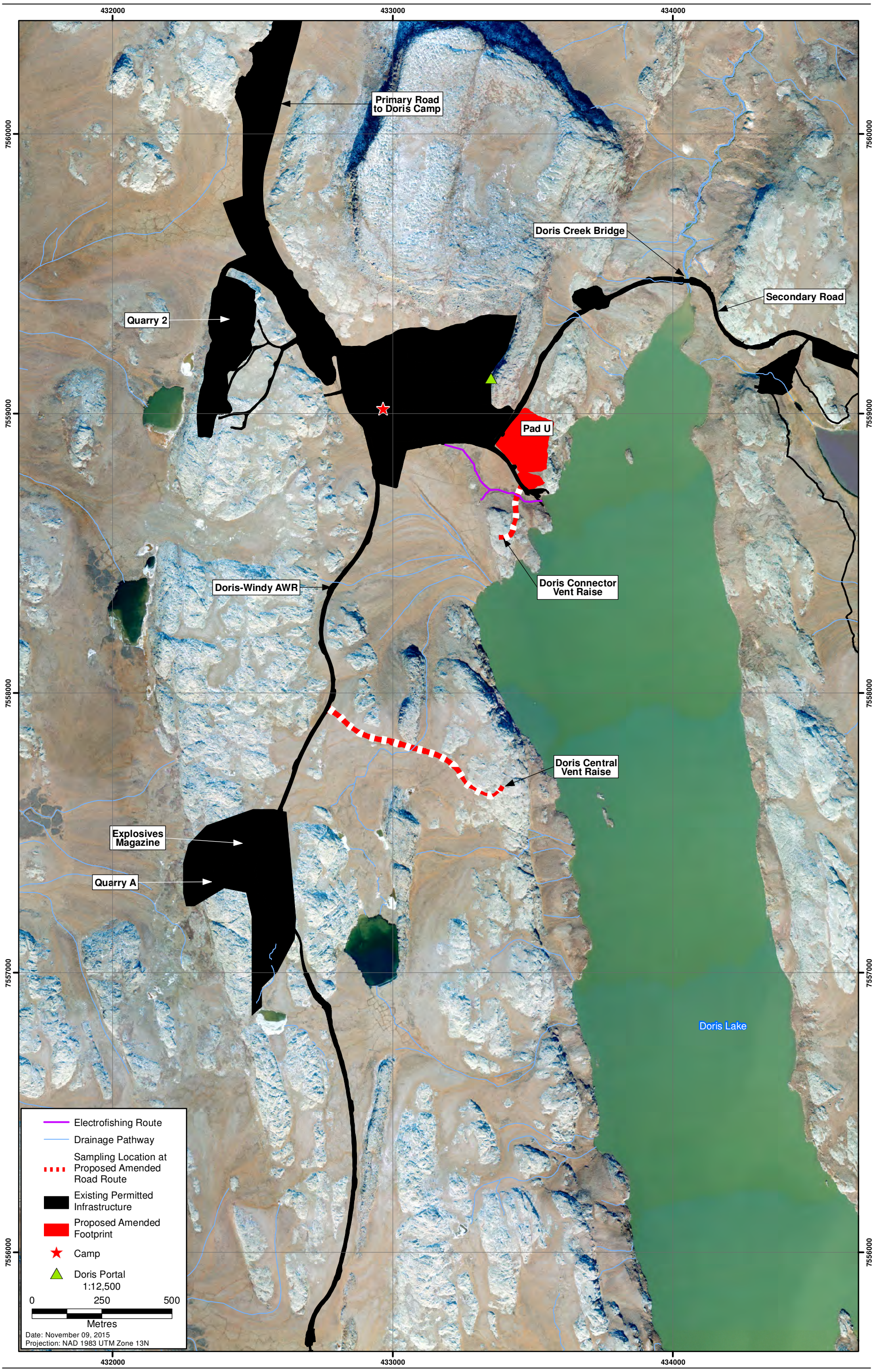
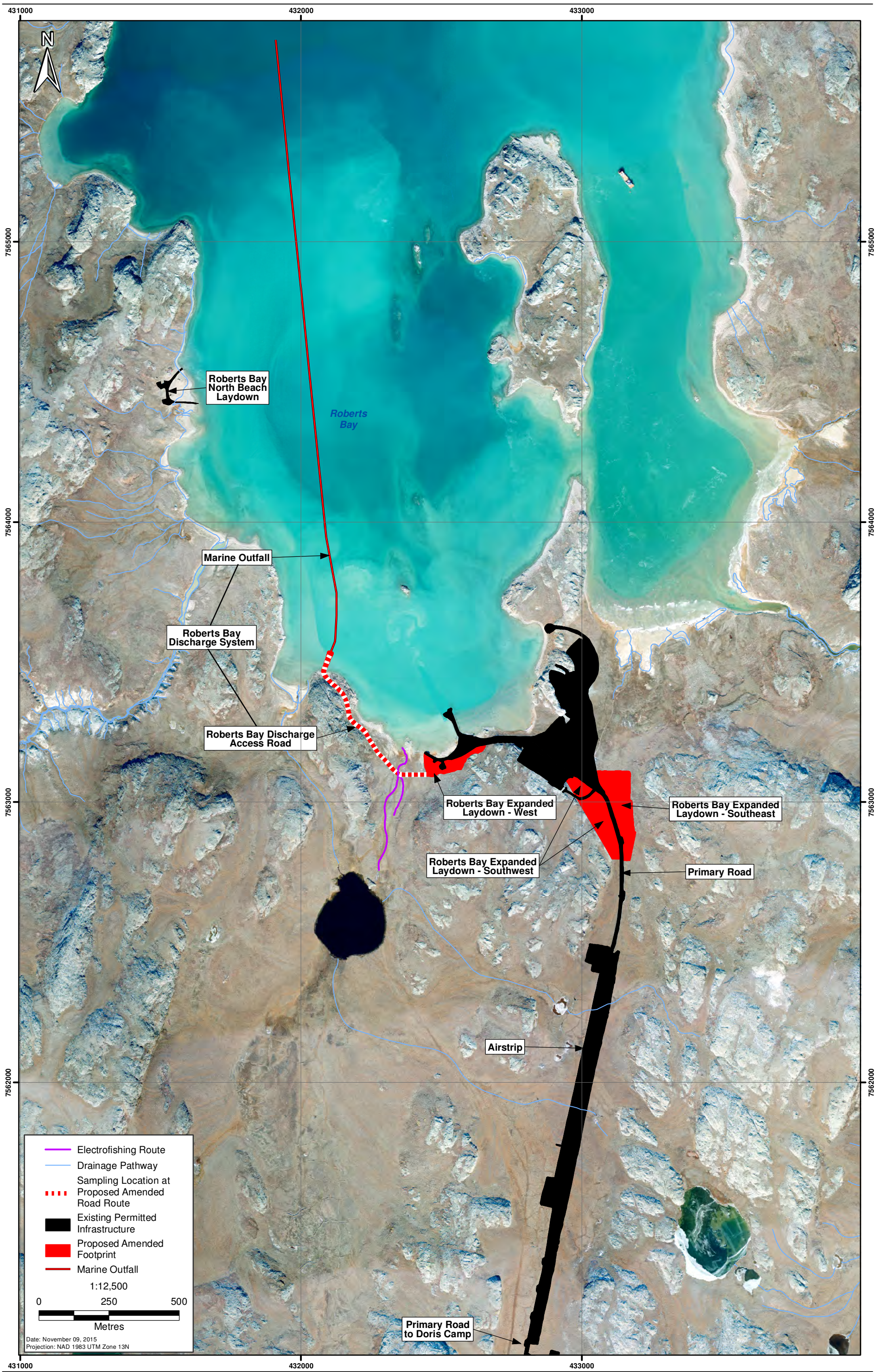


Figure 2.3-2

Electrofishing Sample Route along Unnamed Tributary to Roberts Bay, Doris North Project, 2015



3.2.2 Doris Central Vent Raise Access Road

A review of historical fisheries data found that Sensitive Habitat Inventory Mapping (SHIM) was completed on a drainage that crosses the proposed Doris Central Vent Raise Access Road in 2010 (Rescan 2011). SHIM is a field-based method used to collect reliable, high quality, current and spatially accurate information about freshwater habitats and watercourses (Mason and Knight 2001). SHIM found that the general direction of drainage does cross the proposed access road (despite what 1:50,000 topographic mapping suggested), but there is no defined stream channel in the area; instead the area is covered with terrestrial vegetation that seeps towards Doris Lake through poorly defined pathways. When the SHIM sampling was completed, no fish community sampling could be completed as there was not a defined waterbody to sample.

3.2.3 Roberts Bay Discharge Access Road

The proposed Roberts Bay Discharge Access Road crosses one small, unnamed stream that drains into the southern end of Roberts Bay. This stream was sampled on one previous occasion; in August 2009 fish community and fish habitat were sampled (Rescan 2010). In 4,455 seconds of electrofishing effort, 12 Ninespine Sticklebacks were captured (CPUE = 0.27). On August 1, 2009 the lowest 100 m of the stream was flowing; above this section were isolated pockets of water and seepage through terrestrial vegetation. In the flowing section of the creek, the mean wetted depth was 0.2 m and wetted width was 0.3 m. Spawning habitat was rated as fair due to the presence of riffles with gravel substrate that could be used by spawning salmonids and wetted vegetation that could be used by spawning coarse fish species. Overall, fine sediment was the dominant substrate type (90%) and gravels comprised the remainder. Rearing, adult feeding, and migration quality were all rated as poor, and no overwintering habitat was observed.

A small, unnamed pond located in the headwaters of the stream's watershed had not been sampled previously.

3.3 Fish Habitat Assessment

3.3.1 Doris Connector Vent Raise Access Road

The desktop assessment identified one location where the Doris Connector Vent Raise Access Road intersects a waterbody; the proposed route crosses a small, unnamed tributary to Doris Lake. The field assessment of the road route completed on August 13, 2015 confirmed that this was the only location where the road bisects a drainage.

The stream is approximately 500 m in length, draining land to the south and east of the existing Float Plane Dock Access Road. Its headwaters consist of a series of discontinuous channel braids, which converge into a poorly connected channel in the vicinity of the proposed stream crossing. From there, the stream flows intermittently in a channel to a culvert under the Float Plane Dock Access Road and into Doris Lake.

The upper section of the watershed provides poor quality fish habitat. The braided channels are poorly defined, narrow (mean width 0.28 m), shallow (mean depth 0.11 m), and have poor connectivity with each other and with the lower section of the creek (Plate 3.2-1). Dense in-channel terrestrial vegetation and low discharge even during peak periods limit fish

movement and the habitat value in this section. Where the proposed road route crosses the stream, the stream channel is poorly defined and is dominated by terrestrial vegetation, suggesting that it contains flow for a short period during most years (Plate 3.2-2). This area did contain a small amount of flow during August 2015 due to anomalous weather conditions; however, it is expected that this area would cease flowing soon after freshet in most years. Habitat throughout this section is of poor quality.

Plate 3.2-1. The upper stream section consists of small, braided channels with poor connectivity to the lower section of the stream, August 13, 2015.

Just upstream of Doris Lake the stream flows through a single 6″ diameter culvert under the Doris Lake boat launch ramp. Just upstream of the culvert there is a 3 m section of creek that has a defined channel that could provide some rearing habitat to coarse fish. During the site visit, the channel downstream of the culvert was poorly defined and contained little flow; the majority of water discharging from the culvert percolated subsurface through loose gravels before entering Doris Lake (Plate 3.2-3).

Access to the entire stream for fish in Doris Lake is limited; subsurface flow downstream of the culvert and heavy instream vegetation will restrict fish movement during most flow conditions.

Plate 3.2-2. The stream section upstream of the culvert is poorly defined due to heavy in-channel vegetation, August 13, 2015.

Plate 3.2-3. Discharge from the Doris Lake boat launch culvert percolates into loose gravels, August 13, 2015.

3.3.2 Doris Central Vent Raise Access Road

A field crew walked the full length of the proposed Doris Central Vent Raise Access Road but no waterbodies were identified. Similar to results from historical SHIM mapping, the field assessment found that the proposed road route does cross the drainage pathway, but there is no defined stream channel. Instead, the area is covered with terrestrial vegetation and the land drains towards Doris Lake through poorly defined pathways. As no fish habitat exists along this route, no additional habitat data were collected.

3.3.3 Roberts Bay Discharge Access Road

The desktop assessment identified one location where the Roberts Bay Discharge Access Road intersects a waterbody; the proposed route crosses a small, unnamed tributary to Roberts Bay. The field assessment of the road route completed on August 13, 2015 confirmed that this was the only location where the road bisects a drainage.

The stream is approximately 500 m in length, draining land at the southern end of Roberts Bay. The stream can be divided into two sections; the upper section has a poorly defined channel and is dominated by terrestrial vegetation, and the lower section contains a well-defined channel that discharges into Roberts Bay.

Marginal fish habitat exists in the upstream section of the stream. No salmonid spawning, rearing, migration, or overwintering habitat exists, but it may provide limited rearing habitat to coarse fish. This section is approximately 400 m in length and has a poorly defined channel where water seeps downslope primarily through dense terrestrial vegetation. Some surface water was flowing through grasses in this section of the stream during the August 2015 fieldwork, but this is likely atypical for this time of year based on the aforementioned high flows observed locally in 2015. Dense terrestrial vegetation indicates that this area typically flows for only a brief period during spring snow melt.

There was poor, but existing, connectivity between the upper reaches of the stream and an unnamed pond during the site visit on August 13, 2015. The dominant outflow of this pond flows to the northwest, but some water does seep through a heavily vegetated area and into the creek when water levels are high. This connection is weak, but small bodied fish may occasionally pass through this avenue.

The downstream section of the stream is approximately 100 m in length, containing multiple braided, well defined channels that gradually merge and provide good connectivity between the creek and Roberts Bay. The proposed road route intersects with the upstream portion of this section of the creek. Similar to the habitat assessment completed in 2009, fine sediments dominated the streambed substrate with lesser amounts of gravel also. The overall value of the creek was rated as poor as the stream has low quality rearing, adult feeding, and migration habitat and has no overwintering habitat; however, the downstream section may provide fair spawning and juvenile rearing habitat.

3.4 Fish Community Assessment

3.4.1 Doris Connector Vent Raise Access Road

Fish do inhabit the stream that intersects with the Doris Connector Vent Raise Access Road, but fish density and diversity are both low. In 1962 seconds of electrofishing, four Ninespine Sticklebacks were captured (CPUE = 0.20) and two additional fish were observed but not captured. All of these fish were caught or observed in a 3 m section of stream just upstream of the existing culvert, confirming that fish are able to pass from the lake upstream through the culvert during freshet (Figure 3.4-1). Fish use appears to be restricted to this small section of the stream; no fish were captured or observed in the remainder of the stream, including where the stream and the road intersect, despite a high level of effort. Upstream of this small fish-bearing section of the creek, the channel is poorly defined and is dominated by dense terrestrial vegetation that limits fish passage. The fish-bearing section of stream is approximately 50 m downstream of the intersection of the stream and the proposed road route.

In 2015, stream flow conditions were unusual due to a large rainfall event in July. Channel morphology and an abundance of terrestrial vegetation suggest that this stream typically flows for a far shorter period than was observed in 2015. This stream provides a small amount of poor quality rearing habitat for a short duration to coarse fish in Doris Lake.

3.4.2 Doris Central Vent Raise Access Road

No waterbodies exist along the route of the proposed Doris Central Vent Raise Access Road, so no community sampling was completed in this area. Terrestrial drainage passes under the proposed access road, but there is no defined stream channel; instead the area is covered with terrestrial vegetation that seeps towards Doris Lake through poorly defined pathways.

3.4.3 Roberts Bay Discharge Access Road

A total of four Ninespine Sticklebacks were captured in the stream that flows under the proposed Roberts Bay Discharge Access Road in 4,284 seconds of electrofishing (CPUE = 0.01). This finding is similar to 2009, where only Ninespine Sticklebacks were captured. All fish were captured in the lower section of the stream downstream of the location where the proposed road intersects (Figure 3.4-2). This indicates that poor habitat conditions and dense vegetation prelimit upstream movement of fish from Roberts Bay beyond the lower 100 m section of the stream.

Figure 3.4-1

Fish-bearing Reach of an Unnamed Stream that Intersects the Doris Connector Vent Raise Access Road on August 13 2015, Doris North Project

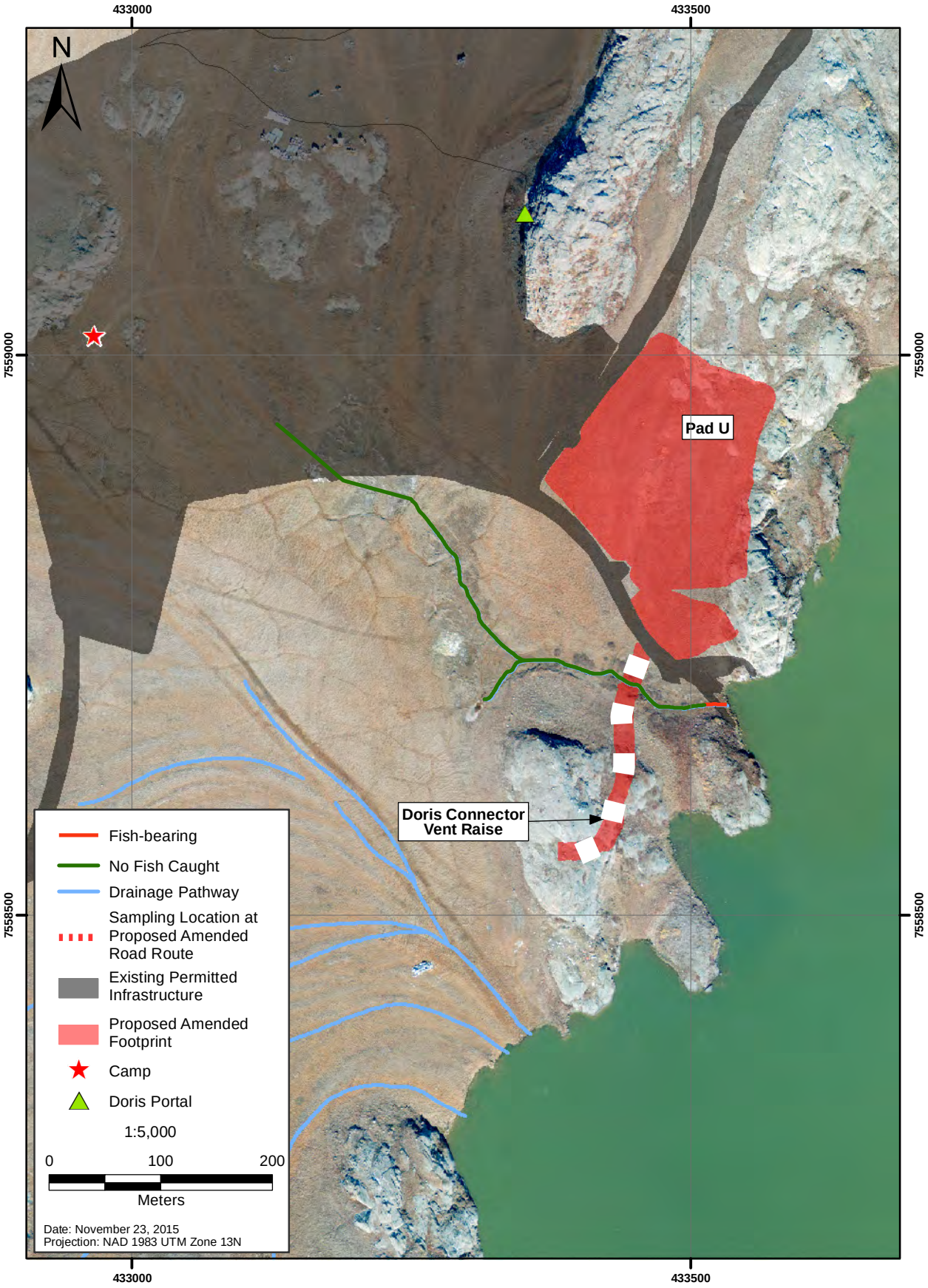
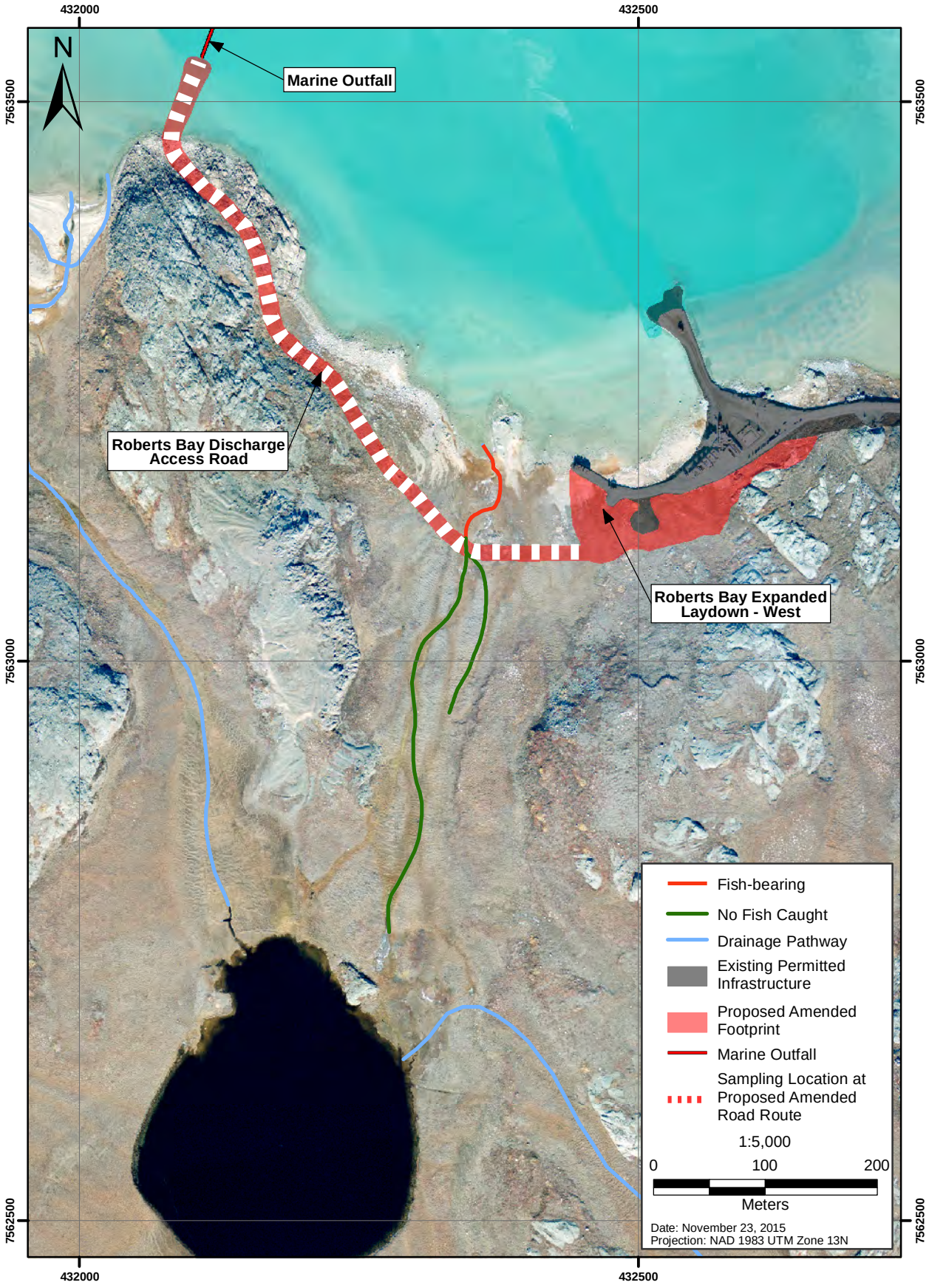


Figure 3.4-2

Fish-bearing Reach of an Unnamed Stream that intersects the Roberts Bay Discharge Access Road on August 13 2015, Doris North Project



4. SUMMARY

4.1.1 Doris Connector Vent Raise Access Road

One short stream that contains poor quality fish habitat intersects the proposed Doris Connector Vent Raise Access Road. The stream channel throughout is poorly defined and fish movement within the stream is limited by a culvert, dense vegetation growth, and shallow water depths.

Ninespine Sticklebacks inhabit the stream in low densities. Their distribution appears to be restricted to the lowest few metres of the creek just upstream of Doris Lake and approximately 50 m downstream of the proposed road crossing. It appears that fish from Doris Lake can access this section of the creek during peak discharge events, but movement beyond this section is limited as the stream channel is poorly defined and it is dominated by dense terrestrial vegetation.

4.1.2 Doris Central Vent Raise Access Road

No fish habitat exists along the proposed route for the Doris Central Vent Raise Access Road. Terrestrial drainage passes under the proposed access road, but there is no defined stream channel; instead the area is covered with terrestrial vegetation that seeps towards Doris Lake through poorly defined pathways.

4.1.3 Roberts Bay Discharge Access Road

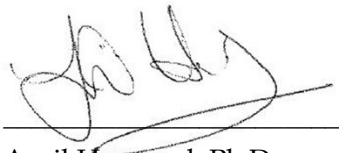
A single stream intersects the proposed route of the Roberts Bay Discharge Access Road. Upstream of the crossing the stream channel is poorly defined, where dense terrestrial vegetation and shallow water depths limit fish passage and use even during peak flow periods. No fish were captured in this section of the creek during the current sampling program or during the one previous sampling event.

The stream does provide some fish habitat adjacent to and downstream of the location where it intersects with the proposed road route. This section of creek (approximately 100 m in length) has a clearly defined channel and provides some rearing habitat for coarse fish that can access the creek from Roberts Bay. In two years of sampling, Ninespine Stickleback is the only species that has been captured in this stream.

Prepared by:

Fraser Ross, B.Sc., R.P.Bio.
Consultant, Fisheries, ERM

Reviewed by:



April Hayward, Ph.D.
Project Manager, ERM

REFERENCES

2002. *Species at Risk Act*, S.C. 2002, C. 29.

ERM. In progress. *Doris North Project: 2015 Hydrology Compliance Monitoring Program Memorandum*. Prepared for TMAC Resources Inc. by ERM Rescan: Yellowknife, Northwest Territories.

Johnston, N. T., and P. A. Slaney. 1996. *Fish habitat assessment procedures*. Watershed Restoration Technical Circular No. 8. Vancouver, BC: British Columbia Ministry of Environment, Lands and Parks.

Mason, B., and R. Knight. 2001. *Sensitive Habitat Inventory and Mapping*. Community Mapping Network, Vancouver, British Columbia. 315pp + viii. M. Johannes, Editor.

Rescan. 2010. *2009 Freshwater fish and fish habitat baseline report, Hope Bay Belt Project*. Prepared for Newmont Mining Corporation by Rescan Environmental Services Ltd.: Vancouver, BC.

Rescan. 2011. *2010 Freshwater fish and fish habitat baseline report, Hope Bay Belt Project*. Prepared for Newmont Mining Corporation by Rescan Environmental Services Ltd.: Vancouver, BC.