Appendix 7.8 Fish Resources

Contents

Appendix 7.8-1 2005 Fisheries Baseline Conditions

PROJECT NO. 1000261

FINAL REPORT TO **Yukon Zinc Foundation**
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FOR **Wolverine Project Environmental Assessment**

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Table of Contents

List of Tables

1.0 REGIONAL SETTING

The Yukon Zinc project site is located within the upper Liard River watershed (Watershed Code 210) in the Yukon Territory. Previous investigations in the Regional Study Area have documented the presence of seven fish species (Table 1). Previous studies confirmed the presence of bull trout rather than Dolly Varden in the study area, based on DNA analyses (Gartner Lee Ltd. 2005). Arctic grayling, bull trout and slimy sculpin have been documented in Go Creek, arctic grayling have been documented in Light Creek, bull trout have been documented in the lower reaches of Bunker Creek and Chip Creek, and slimy sculpin, bull trout, arctic grayling, northern pike and burbot have been documented in Money Creek. As well, lake trout, arctic grayling, burbot and slimy sculpin have been confirmed in Wolverine Lake and lake trout, arctic grayling, and longnose sucker have been confirmed in Little Wolverine Lake. Arctic grayling, lake trout, burbot, longnose sucker, northern pike and slimy sculpin have also been documented in some streams tributary to Wolverine Lake (Westmin Resources Ltd. 1996; White Mountain Environmental Consulting 1997; Gartner Lee Ltd. 2005). Fish absence has also been noted in Hawkowl Creek and Go Creek upstream from the Hawkowl Creek confluence as well as in Pup Creek (Gartner Lee Ltd. 2005).

TABLE 1 Common and Scientific Names of Fish Present in the Yukon Zinc Project Area

Family	Common Name	Scientific Name
Salmonidae	arctic grayling	*Thymallus arcticus*
Salmonidae	bull trout	*Salvelinus confluentus*
Salmonidae	lake trout	*Salvelinus namaycush*
Gadidae	burbot	*Lota lota*
Catostomidae	longnose sucker	*Catostomus catostomus*
Esocidae	northern pike	*Esox lucius*
Cottidae	slimy sculpin	*Cottus cognatus*

Bull trout has been designated as a “sensitive” species in the Yukon by the General Status of Species in Canada (National General Status Working Group 2004). A sensitive designation indicates that a “species is not believed to be at risk of immediate extirpation or extinction but may require special attention or protection to prevent them from becoming at risk”. However, bull trout is not listed as a species at risk under the federal *Species at Risk Act* (Environment Canada 2005).

Selected habitat components (including spawning, rearing, overwintering and migration requirements) of four of the Yukon’s more common fish species in the Liard Watershed (arctic grayling, lake trout, bull trout, and slimy sculpin) are presented in Table 2.

Table 2. Selected Habitat Components for Fish Species Present in the Liard Watershed

Species	Spawning	Rearing	Overwintering	Migration
arctic grayling	Small gravel or rock bottom tributaries and larger streams; side channels. Spawn during ice break-up.	Side channels, backwater areas, riffles, broken flows, substrate of boulders. Runs for juveniles and adults. Pools.	Ice-covered lakes and pools in large rivers.	Poor swimmers – obstacles are common (i.e., chutes and culverts).
lake trout	Shallow inshore areas of large lakes and occasionally rivers with large rubble substrate. Spawn in late summer or fall.	Shallow inshore areas of large lakes, moving to offshore areas as juveniles mature.	Large lakes.	Good swimmers – generally spend their entire lifecycle within lakes.
bull trout	Medium to large gravel substrate in tributaries. Gentle stream slopes. Spawn in fall (Sept. to Nov.).	Tributaries with large substrate runs and riffles. Pools and log/debris jams. Cold water/boulder substrate/moderate gradient or low gradient/undercut banks/debris. Juvenile bull trout are often found at or near the stream bottom.	Migratory bull trout may move into cold lakes, gravelly to muddy rivers.	Good swimmers – need significant obstacle to impede migration.
slimy sculpin	Shallow water with cobble/boulder substrate.	Deep water of lakes and cold streams. Rock/gravel streams.	Deep riffle, glide and pool habitat	Poor swimmers – obstacles are common (i.e., chutes and culverts).

2.0 METHODS

2.1 Physical Habitat Assessment and Fish Sampling

Between August 3 and 7, 2005, fish and fish habitat assessments were conducted at all watercourses potentially affected by the project, including stream crossings along the proposed road access route. A total of 27 potential road crossing and mine drainage-related sites were assessed on the ground for fish and fish habitat. An additional ten sites were assessed for fish habitat by aerial reconnaissance. Inventory methods followed those established by the Resource Inventory Committee (RIC) in the Reconnaissance (1:20 000) Fish and Fish Habitat Inventory: Standards and Procedures v. 2.0 (BC Fisheries Information Services 2001) and associated RIC Site Field Card Guide (BC Fisheries Information Services 1999). Ground assessment sites were photographed upstream and downstream (Appendix 7.8-4).

Fish sampling and fish habitat assessments were conducted at all watercourses (27 sites) with sufficient flow, over a minimum distance of ten times mean channel width (Wb). As habitat features of most watercourses are typically repeated

approximately every six channel widths, this distance ensures that all representative habitat types are sampled. Physical habitat data, fish collection data and individual fish data were recorded on appropriate RIC cards.

Fish migration obstructions, fisheries sensitive zones (tributaries, side-channels, flood channels, swamps/sloughs and beaver ponds), potential fish production limiting factors and any special features were identified and recorded. Significant habitat quality components (rearing, spawning, overwintering and cover) were noted for fish species known or suspected to occur in a particular reach or watershed. Habitat data collected at all stream crossings included the following physical attributes: site length, residual pool depth, bankfull depth, stream stage, percentage cover (woody debris, boulder, cutbank, deep pool, overstream vegetation and instream vegetation), crown closure, bank shape, bank texture, turbidity, dominant and sub-dominant bed materials, D95, D50, channel morphology, disturbance indicators, channel pattern, islands, bars, coupling, confinement and riparian vegetation community.

In addition to the 27 sites assessed on the ground, 10 were assessed by aerial reconnaissance. Ground surveys were not necessary at those locations due to dry channel conditions (trickle flow, no visible channel [NVC], etc.) and negligible fish habitat value.

Fish distribution and species composition sampling was conducted in all watercourses with sufficient flow using a Smith-Root Model 15-C electrofisher and baited (cat food) Gee-type minnow traps set for approximately 24 hours. Electrofishing effort varied with habitat type, but was generally used in shallow pool, glide and riffle habitats. Increased effort was expended in areas that typically provide refuge for fish (i.e., undercut banks, submerged logs, boulder cover, overhanging vegetation).

In addition to electrofishing, spawning, rearing, and overwintering habitat potential were assessed visually. In deep pools with negligible flow and/or where channel morphology or substrate material prevented efficient use of other sampling techniques, baited Gee-type minnow traps (in pairs, overnight where possible) were set to determine fish presence/absence. Minnow traps were also deployed where electrofishing did not produce fish but where fish habitat values appeared to be high. Fish captures were enumerated, identified to species and measured (fork-length in mm) at each productive fish sampling site.

The following list details specific equipment used to complete biophysical data collection:

- Smith-Root Model 15-C back-pack electrofisher;
- Gee minnow traps and bait;
- Dip nets;

- Field Key to the Freshwater Fishes of British Columbia (McPhail and Carveth, 1994);
- Fish Collection/Individual Fish Data Forms;
- Fish measuring board (mm);
- Graduated metre sticks;
- SUUNTO Clinometer;
- Field notebook with waterproof site cards;
- Flagging tape (orange);
- Digital camera;
- Yukon Zinc Corporation Fisheries Field Map;
- Oakton pH (accuracy + 0.2 pH) and conductivity (accuracy + 1%) meters; and
- Handheld VHF radio and satellite telephone.

2.2 Fish Tissue Analysis

Samples of slimy sculpin were collected for subsequent tissue analyses from three sites (W11, W12 and W14) during the August field program and one sample of slimy sculpin was collected during the September field program. Latex gloves were used when handling fish samples and care was taken to prevent the samples from contacting any metal. Slimy sculpin samples were weighed (±0.1g), measured (fork length) and placed in Ziploc bags. Samples were stored frozen until shipped to the lab for analysis. All other fish captured were released, unharmed at point of capture, immediately following meristic data collection.

3.0 RESULTS

3.1 Physical Habitat Assessment and Fish Sampling

Assessment Sites

Given that many watercourses to be crossed by the proposed road are unnamed, streams have been assigned unique identifiers (Figure 7.8-1, EA report, Volume 2). Table 3 provides location and survey details for each of the 27 watercourse crossings assessed on the ground. The ten sites surveyed by aerial reconnaissance are shown in Table 4 and are deemed to provide negligible fish habitat value.

Table 3. Location of Fish and Fish Habitat Assessment Sites (NAD 27), Yukon Zinc August 2005

Site	Zone	Easting	Northing	Date of Survey
Light Ck. 1	9	451616	6820600	6-Aug-05
Light Ck. 2	9	452353	6818299	4-Aug-05
Light Ck. 3	9	452314	6817741	4-Aug-05
Light Ck. 4	9	452383	6817239	7-Aug-05
4	9	451233	6814664	4-Aug-05
Bunker Ck. 1	9	450443	6809915	5-Aug-05
Bunker Ck. 2	9	448436	6811630	5-Aug-05
Bunker Ck. 3	9	447744	6813106	5-Aug-05
Bunker Ck. 4	9	447780	6813394	4-Aug-05
Bunker Ck. 5	9	447682	6814100	4-Aug-05
Bunker Ck. 6	9	447377	6814934	5-Aug-05
5	9	448864	6810851	4-Aug-05
13	9	447266	6806155	4-Aug-05
W14	9	443024	6801893	3-Aug-05
W11	9	443239	6801805	3-Aug-05
W13	9	443209	6801961	3-Aug-05
W12	9	443177	6802001	3-Aug-05
Go Ck. 1	9	443540	6803243	5-Aug-05
Go Ck. 2	9	443464	6804746	5-Aug-05
Go Ck. 3	9	442692	6806148	6-Aug-05
W16	9	442693	6807468	6-Aug-05
W15	9	442710	6807503	6-Aug-05
W22	9	443231	6807633	6-Aug-05
W23	9	443177	6807759	6-Aug-05
W24	9	442133	6808032	6-Aug-05
W9	9	437932	6810924	3-Aug-05
14	9	439474	6810820	7-Aug-05

Table 4. Location of sites surveyed by aerial reconnaissance (NAD 27), Yukon Zinc August 2005

Site	Zone	Easting	Northing	Date of Survey
1	9	451874	6817116	4-Aug-05
2	9	451894	6816512	4-Aug-05
3	9	451537	6815366	4-Aug-05
6	9	448528	6810856	4-Aug-05
7	9	448555	6810409	4-Aug-05
8	9	448555	6810459	4-Aug-05
9	9	447890	6809077	4-Aug-05
10	9	447131	6807506	4-Aug-05
11	9	447116	6807396	4-Aug-05
12	9	447047	6806890	4-Aug-05

In Situ Water Quality

In situ water quality data are presented in Table 5. Water temperature ranged from 3.5°C (Site 14) to 10°C (Money Creek). Conductivity ranged from 20 µS/cm (Site 13) to 270 µS/cm (Light Ck. 4). The pH values were generally neutral, with the exception of Bunker Ck. 4 and W24, which were slightly basic (pH: 8.0). With the exception of Light Ck. 4, all streams were clear at time of sampling.

Table 5. *In Situ* Water Quality Results, August 2005

Site	Water Temperature (°C)	Conductivity (µs/cm)	pH	Turbidity
Light Ck. 1	6.5	240	7.6	C
Light Ck. 2	8	240	7.8	C
Light Ck. 3	4	80	7.7	C
Light Ck. 4	6.5	270	7.3	L
4	5	200	7.6	C
Bunker Ck. 1	7	120	7.8	C
Bunker Ck. 2	7.5	150	7.6	C
Bunker Ck. 3	8	170	7.7	C
Bunker Ck. 4	6.5	120	8	C
Bunker Ck. 5	8	150	7.6	C
Bunker Ck. 6	7.5	150	7.8	C
5	6	80	7.6	C

Site	Water Temperature (°C)	Conductivity (µs/cm)	pH	Turbidity
13	8	20	7.7	C
W14	10	90	ND	C
W11	10	90	ND	C
W13	4.5	80	ND	C
W12	5	110	ND	C
Go Ck. 1	8	120	7.8	C
Go Ck. 2	9	120	7.8	C
Go Ck. 3	6	130	7.5	C
W16	6	100	7.8	C
W15	5	80	7.7	C
W22	4	70	7.8	C
W23	5.5	90	7.7	C
W24	7	110	8	C
W9	3.5	170	ND	C
14	5	170	7.4	C

ND = no data

Physical Habitat Assessment and Fish Sampling

Physical habitat data, including channel, substrate and riparian characteristics, are provided in Tables 6 and 7. Mean channel width at the sampling sites ranges from 0.3 m (W9) to 25.0 m (Bunker Ck. 3). Approximately one half (48%) of the watercourses assessed have channel widths of less than 3 m.

Residual pool depths (maximum pool depth minus riffle depth) range from 0.10 m to 0.85 m and are less than 0.50 m at 72% of the sites. Shallow residual pool depths in most of the watercourses indicate a lack of overwintering habitat, which likely limits fish production. Most pools observed during August 2005 likely freeze solid during winter.

Channel gradients are generally low to moderate and range from 0.5% (Light Ck. 2) to 11% (Site W22). Despite low to moderate gradients, rearing bull trout and/or arctic grayling habitat is extremely limited by swift, unimpeded flows, most often with negligible boulders and functioning large woody debris to create low velocity pools.

Potential fish migration barriers were observed at 16 sites. Some barriers are likely seasonal, and dependent on water levels (i.e., during summer and early fall). Barriers include beaver dams, trickle flows, shallow pools, steep gradients,

subsurface water flow, a perched culvert and a weir. The v-notch weir at Site W9 is reportedly out of use and should be removed.

Bottom substrate is dominated by cobbles (dominant substrate in 44% of sites) and fines (33% of sites). An estimated 15% of sites contain suitable spawning gravel for bull trout and/or arctic grayling.

Total fish cover at the crossing locations range from none to over 20% (Table 7). Overhanging vegetation provides the majority of the cover and is the dominant cover type at 44% of sites sampled. Riparian vegetation consists primarily of the shrubs scrub birch (*Betula glandulosa*) and willow (*Salix sp*.) and grasses. Eight watercourses flow through or are adjacent to a mature coniferous forest.

Habitat requirements (Table 2) of four of the region's more common species, arctic grayling, mountain whitefish, bull trout, and slimy sculpin, were used as a basis for determining habitat quality of each of the watercourses assessed. Overall habitat quality rating is based on the spawning, rearing, migration, and overwintering opportunities provided at each site. Swift flows and extremely limited overwintering pool habitat availability are likely the primary limiting factors to fish productivity in the area. A summary of fish habitat potential for each site is listed below.

Table 6. Physical Habitat Data, Yukon Zinc August 2005

Site	Mean Channel Width (m)	Mean Wetted Width (m)	Mean Residual Pool Depth (m)	Gradient (%)	Dominant Substrate	Sub-dominant Substrate	Additional Comments
Light Ck. 1	2.00	1.97		0.5	Fines	Gravels	Perched culvert (1.7 m) crossing highway does not allow fish access from the Finlayson River
Light Ck. 2	3.13	3.05	0.60	0.5	Fines	N/A	
Light Ck. 3	1.52	1.25	0.23	4	Fines	N/A	
Light Ck. 4	2.43	2.38	0.28	0.5	Gravel	Fines	
4	0.62	0.58	0.10	1.5	Fines	N/A	
Bunker Ck. 1	8.08	7.25	0.62	2	Gravel	Fines	Large beaver dam 200 m upstream from site prevents upstream fish passage
Bunker Ck. 2	3.85	3.73	0.30	2	Cobble	Boulders	
Bunker Ck. 3	25.00	25.00		1	Fines	Cobbles	Beaver pond
Bunker Ck. 4	3.85	3.38	0.30	1.5	Cobble	Gravels	Beaver dams occur d/s from this site
Bunker Ck. 5	2.95	3.00	0.65	1	Fines	Boulders	Site is located u/s from several beaver dams 250-500m apart; fish access from mainstem is doubtful
Bunker Ck. 6	4.80	4.95	0.62	1.5	Fines	Boulders	
5	1.15	1.10	0.20	3	Fines	Gravels	Steep gradient (>25%) d/s from road crossing to mainstem; surface flows likely to freeze during winter
13	2.22	1.88	0.23	5	Cobble	Boulders	
W11	17.17	17.17	0.60	1.5	Cobble	Boulders	
W14	14.00	12.65	0.78	1.5	Cobble	Gravels	
W13	1.84	1.92	0.35	2	Gravel	Cobbles	
W12	4.15	3.95	0.27	3	Cobble	Fines	

Site	Mean Channel Width (m)	Mean Wetted Width (m)	Mean Residual Pool Depth (m)	Gradient (%)	Dominant Substrate	Sub-dominant Substrate	Additional Comments
Go Ck. 1	3.84	3.86	0.85	3	Cobble	Boulders	Partial barrier (0443527E, 6803941N); 1m falls created by lwd. D/s end of site begins at major beaver dam (2m fish barrier)
Go Ck. 2	5.63	5.13	0.20	3	Cobble	Boulders	
Go Ck. 3	4.18	3.60	0.37	2	Cobble	Fines	
W16	3.35	3.08	0.20	3.5	Cobble	Gravels	
W15	2.90	2.90	0.25	5	Boulders	Cobbles	
W22	1.58	1.55	0.23	11	Cobble	Boulders	Channel is forded by a gravel road
W23	2.25	2.22	0.38	8.5	Boulders	Cobbles	Channel is forded by a gravel road
W24	1.40	1.37	0.25	2	Cobble	Gravels	
W9	0.30	0.30	0.16	2	Gravel	Fines	V-notch weir at W9 is an impasse which should be removed
14	0.63	0.70	0.28	3	Fines	Gravels	Channel runs subsurface periodically and has a steep gradient entering the lake

Definitions:
u/s = upstream
d/s = downstream
lwd = large woody debris

Table 7. Selected Bank and Riparian Habitat Attributes, Yukon Zinc August 2005

Site	Crown Closure (%)	Total Cover (%)	Dominant Cover Type	Bank Shape (left, right)	Bank Texture (left, right)	Riparian Vegetation / Stage
Light Ck. 1	1-20	5-20	U	U, V	F, F	G, S / SHR, MF
Light Ck. 2	1-20	5-20	OV	V, U	F, F	G / SHR
Light Ck. 3	1-20	5-20	OV	V, V	F, F	S,C / MF
Light Ck. 4	0	5-20	DP	V, U	F, F	S / SHR
4	1-20	>20	OV	U, V	F, F	S,C / SHR, MF
Bunker Ck. 1	1-20	5-20	LWD	V, S	F, F	S,C / MF
Bunker Ck. 2	1-20	5-20	U	U, V	F, F	S, C / SHR, MF
Bunker Ck. 3	0	0	DP	S, S	F, F	S / SHR
Bunker Ck. 4	1-20	5-20	OV	V, V	F, F	G, S / SHR
Bunker Ck. 5	1-20	5-20	DP	V, V	F, F	S / SHR
Bunker Ck. 6	0	5-20	U	U, V	F, G	G, S / SHR
5	1-20	5-20	OV	U, V	F, F	S / SHR
13	0	5-20	B	V, V	G, G	G, S / SHR
W11	1-20	5-20	B	V, U	F, F	S,C / SHR
W14	1-20	5-20	DP	S, U	G, G	S,C / SHR
W13	1-20	>20	U	U, U	F, G	S,C / SHR, MF
W12	1-20	>20	OV	U, U	F, F	S / SHR
Go Ck. 1	71-90	>20	B	U, V	F, F	S, C / SHR, MF
Go Ck. 2	0	5-20	B	V, V	F, F	S / SHR
Go Ck. 3	0	5-20	OV	V, S	F, F	S / SHR
W16	0	>20	OV	V, V	F, F	S / SHR
W15	0	5-20	OV	V, S	F, G	S / SHR
W22	1-20	>20	OV	U, V	F, F	S,C / MF
W23	1-20	>20	B	V, V	G, F	S, C / SHR

Site	Crown Closure (%)	Total Cover (%)	Dominant Cover Type	Bank Shape (left, right)	Bank Texture (left, right)	Riparian Vegetation / Stage
W24	0	>20	OV	U, V	F, F	S / SHR
W9	1-20	>20	OV	U, U	F, F	S / SHR
14	0	5-20	OV	U, U	F, F	S / SHR

Definitions:

1. Cover Type: SWD = Small Woody Debris; LWD = Large Woody Debris; B = Boulder; U = undercut Banks; DP = Deep Pool; OV = Overhanging Vegetation; IV = Instream Vegetation
2. Bank Shape: U = Undercut, V = Vertical, S = Sloping, O = Overhanging
3. Bank Texture: F = Fines, G = Gravels, C = Cobbles, B = Boulders, R = Rock, A = Anthropogenic
4. Riparian Vegetation: N = none; G = Grass; S = Shrub; C = Coniferous; D = Deciduous; M = Mixed C&D; W = Wetland
5. Riparian Vegetation Stage: INIT = Initial; SHR = Shrub; PS = Pole-Sapling; YF = Young Forest; MF = Mature Forest; NA = Absent (grass or wetland)

Light Creek 1

This reach of Light Creek has a mean channel width of 2.0 m and flows down a gradient of 0.5% (see Photo 4). It is characterized by large channel morphology (LC; no riffle-pool sequence) and provides poor spawning substrates for arctic grayling and bull trout. Rearing and overwintering potential are moderate (see Photos 1 to 3). A perched culvert at the Robert Campbell Highway creates a barrier to fish migration upstream from the Finlayson River.

Light Creek 2

This reach of Light Creek is classified as large channel habitat and has a mean channel width of 3.1 m and shallow gradient of 0.5% (see Photos 5 and 6). This reach provides poor grayling and bull trout spawning habitat due to the lack of appropriate substrate; however, it does provide good rearing and overwintering habitat. No fish were captured from this reach.

Light Creek 3

This reach of Light Creek has an average channel width of 1.5 m, flows down a gradient of 4% and has riffle-pool morphology (see Photos 7 and 8). In generally, this reach provides poor fish habitat, based on lack of spawning habitat. Rearing habitat is moderately abundant but overwintering habitat quality and quantity is poor due to infrequent pools that likely freeze solid during winter. No fish were captured from this reach.

Light Creek 4

This reach of Light Creek has a mean channel width of 2.4 m and flows down a gradient of 0.5% (see Photos 9 and 10). Light Creek 4 has excellent spawning substrates for arctic grayling and bull trout, as well as deep water available for rearing and potential overwintering. Productivity is limited by cover (provided by undercut banks). The main creek flows into a wetland. Arctic graying were captured in this reach.

Site 4 (Unnamed tributary of Light Creek)

Habitat at this site is characterized by a small meandering channel (mean channel width 0.6 m) that flows subsurface and drains a wetland further upstream (see Photos 11 and 12). It has no fish value at this site or upstream towards the proposed road crossing. No fish were observed in this reach.

Bunker Creek 1

This reach of Bunker Creek has a mean channel width of 8.1 m and flows down a gradient of 2%. It provides excellent habitat for all life stages of arctic grayling and bull trout. It is limited only by fast flows throughout most of reach (see Photos 13 to

16). A large, active beaver dam (estimated height: 3 m) located immediately upstream (200 m) from Bunker Creek 1 extends from valley wall to valley wall and likely prevents upstream fish passage to upper watershed reaches at least on a seasonal basis. Cascade-pool (boulder) channel morphology and high velocity water flows occur between Bunker Creek site 1 and site 2 and may also limit fish migration up into the upper watershed.

Bunker Creek 2

This reach of Bunker Creek has a mean channel width of 3.8 m and flows down a gradient of 2% (see Photos 17 and 18). It provides moderate habitat for arctic grayling and bull trout at all life stages but is limited by swift flows throughout most of the reach.

Bunker Creek 3

This reach of Bunker Creek flows through a beaver pond, and has a mean channel width of 25.0 m and a gradient of 1% (see Photos 19 to 21). There is no spawning substrate at this site; however, the pond provides excellent rearing for grayling and bull trout. It is too shallow for overwintering. No fish were captured in this reach.

Bunker Creek 4

This reach of Bunker Creek has a mean channel width of 3.8 m and flows down a gradient of 1.5% (see Photos 22 to 24). An abundance of gravel substrate provides excellent spawning habitat for grayling and bull trout and there are pools for overwintering and excellent cover for rearing. No fish were observed in this reach.

Bunker Creek 5

This reach of Bunker Creek comprises large channel morphology (mean channel width 3.0 m) and low gradient (1%) (see Photos 25 to 27). An absence of gravels limits spawning potential; however, this channel has excellent rearing and overwintering habitat. No fish were observed in this reach.

Bunker Creek 6

This reach of Bunker Creek has a mean channel width of 4.8 m and flows down a gradient of 1.5% (see Photos 28 and 29). It provides limited spawning substrates but excellent rearing habitat for grayling and bull trout. Limited deep pools restrict overwintering capabilities. No fish were observed in this reach.

Site 5 (Unnamed tributary of Bunker Creek)

This reach has a mean channel width of 1.2 m and flows down a gradient of 3%. Downstream of this site, this channel has a very steep gradient of >20% (see Photos 30 and 31). This reach has low habitat quality. It is characterized by swift

flows and negligible rearing and spawning habitat for bull trout and arctic grayling. No fish were captured in this creek.

Site 13 (Chip Creek)

This reach is at the top of its watershed in the alpine zone (see Photos 32 and 33). It has cascade-pool morphology, with a gradient of 5% and mean channel width of 2.2 m. Downstream from this site the channel follows through a very steep gradient (>25%). The stream at this site has no fish value.

W14 (Money Creek downstream from Go Creek)

Money Creek downstream from Go Creek has large riffle-pool morphology, with a mean channel width of 14.0 m (see Photos 34 and 35 for aerial views of Money Creek and Photos 36 and 37 for site pictures). Although habitat fish productivity is likely constrained by limited amounts of spawning habitat and swift flows, several deep pools and boulder substrates provide low velocity areas suitable for rearing and overwintering. Arctic grayling and slimy sculpins were captured in this reach.

W11 (Money Creek upstream from Go Creek)

Money Creek immediately upstream from the Go Creek confluence has large riffle-pool morphology (small river; mean channel width: 17.2 m) (see Photos 38 and 39). The reach provides excellent bull trout and grayling habitat for all life stages, limited only by a moderate abundance of spawning gravels. Arctic grayling and slimy sculpins were captured from this reach.

W13 (Pup Creek near Go Creek confluence)

This reach of Pup Creek has a mean channel width of 1.8 m and moderate gradient of 2% (see Photos 40 and 41). It provides limited quantities of adult bull trout and grayling spawning gravels. Although undercut banks provide some good rearing and overwintering opportunities, generally swift flows and lack of habitat complexity (i.e. LWD) preclude even moderate fish production capability. No fish were observed in or captured from this reach.

W12 (Go Creek upstream from Pup Creek)

This reach of Go Creek has a moderate channel gradient (3%) and mean channel width of 4.2 m. (See Photos 42 and 43 for site photographs and Photos 44 and 45 for aerial views of lower Go Creek. Photo 46 displays a beaver dam in the lower reaches of Go Creek. This dam is not a barrier to fish migration). Similar to W13 in Pup Creek, W12 provides potentially useable rearing and spawning habitat for grayling and bull trout; however, fish production capability is constrained by swift flows and low habitat diversity. Slimy sculpin were captured from this reach. Several juvenile arctic grayling escaped electrofishing effort but were positively identified.

Go Creek 1

This reach of Go Creek has a mean channel width of 3.8 m and flows down a gradient of 3% (see Photos 47 and 48). The very swift current limits spawning, rearing and overwintering. The channel also has limited spawning substrates; all rearing habitat occurs in eddies behind boulders and large woody debris. Arctic grayling and bull trout were captured in this reach.

Go Creek 2

This reach of Go Creek has a mean channel width of 5.6 m and flows down a gradient of 3% (see Photo 49). Inadequate gravels limit spawning capability, while swift flows limit both spawning and rearing potential. The low frequency of deep pools limits overwintering capability. No fish were captured in this reach.

Go Creek 3

This reach of Go Creek has a mean channel width of 4.2 m and flows down a 2% gradient (see Photos 50 to 52). Excellent spawning gravels are present, however, swift flow limits bull trout and grayling production at all life stages. Marginal overwintering habitat exists due to a lack of deep pools. No fish were captured in this reach.

W16 (Go Creek upstream from Hawkowl Creek)

Go Creek at this reach has a mean channel width of 3.4 m and follows a gradient of 3.5% (see Photo 53 and 54). There is poor spawning habitat due to limited spawning substrates and poor overwintering habitat due to infrequent deep pools. Swift flows limit habitat capabilities for fish at all life stages.

W15 (Lower Hawkowl Creek)

Lower Hawkowl Creek at this location has a mean channel width of 2.9 m and follows a gradient of 5% (see Photos 55 and 56). This reach is characterized by cascade-pool morphology and provides negligible amounts of spawning substrate. Swift flows limit char and grayling habitat in all life stages.

W22 (Upper Hawkowl Creek)

Upper Hawkowl Creek at this reach has a mean channel width of 1.6 m and flows down a gradient of 11% (see Photos 57 and 58). It is characterized by cascade-pool morphology and provides negligible amounts of spawning substrate. Poor overwintering habitat exists due to few infrequent deep pools. Swift flows limit bull trout and grayling habitat in all life stages.

W23 (Upper Hawkowl Creek)

Upper Hawkowl Creek at this reach has a mean channel width of 2.2 m and flows down a gradient of 8.5% (see Photos 59 and 60). Swift flows limit bull trout and grayling habitat in all life stages; however, large pools are available for overwintering habitat.

W24 (Go Creek)

Reach W24 has a mean channel width of 1.4 m and flows down a gradient of 2% (see Photos 61 and 62). This reach provides poor spawning substrates for arctic grayling and bull trout. Generally, swift flows limit production potential.

W9 (Lower Wolverine Creek)

Wolverine Creek, near its confluence with Little Wolverine Lake, has a moderate slope (2% gradient) and small riffle-pool type channel with a mean channel width 0.3 m (see Photos 63 and 64). This reach has excellent gravels for arctic grayling and bull trout spawning and abundant cover providing for rearing potential but poor overwintering capability due to a lack of deep pools. A v-notch, flow monitoring weir located approximately 40 m upstream from the lake outlet is impassable to fish and should be decommissioned if no longer in use. Adfluvial juvenile lake trout were captured from the lower portion of this creek, below the v-notch weir.

14 (Upper Wolverine Creek)

Upper Wolverine Creek in this reach is a small channel (mean width of 0.6 m) which frequently runs subsurface (see Photos 65 to 67). At this site, the gradient is 3%. Downstream, toward Little Wolverine Lake, gradient increases and becomes steep and impassable to fish. The channel bed contains poor spawning substrates for arctic grayling and char and there are limited pools to provide rearing and overwintering habitat. The channel probably freezes over winter. No fish were captured in this reach.

3.2 Fish Tissue Analysis

Results of the slimy sculpin tissue analyses are provided in Appendix 7.8-3. Some inconsistencies have been noted for data collected in 1996 and 2005, suggesting that further analyses will be useful in establishing baseline conditions. Monitoring of selenium levels in slimy sculpin (whole fish) is currently recommended for assessment of mining effects, given that evidence of bioaccumulation has been noted in North America (Chapman, 2004). Results for bull trout and arctic grayling are also presented in Appendix 7.8-3.

For 2005, levels of some metals appear to vary according to size of fish rather than location, given that the sample from Go Creek consisted of one 5 g fish and

samples from Money Creek upstream and downstream of the Go confluence consisted of composites of three smaller fish, totaling 5 g per sample. The following results are based on the limited sampling conducted in 2005:

- copper levels are higher in the one sample from Go Creek (2.8 mg/kg dry weight) than the two from Money Creek (1.0 to 1.7 mg/kg);
- arsenic levels are higher in the Go Creek (2.2 mg/kg) than the Money Creek samples (<0.2 mg/kg);
- nickel levels are higher in the Go Creek (84.7 mg/kg) than the Money Creek samples (1.5 mg/kg); and
- levels of several metals are similar in fish from all three sites: cadmium (0.07 to 0.12 mg/kg), lead (<0.1 to 0.3 mg/kg), selenium (1.3 to 2.0 mg/kg) and zinc (46.3 to 54.1 mg/kg).

The value of 84.7 mg/kg nickel for Go Creek appears to be an anomaly (perhaps indicative of contamination or analytical problems), given that levels in fish from Money Creek, as well as from 1996, are considerably lower.

Tissue samples collected in 1996 (Westmin, 1996) indicated no substantial differences in metals levels in slimy sculpin from Money and Go Creeks, based on four and one sample, respectively (Appendix 7.8-3). Results for arsenic, copper, lead and selenium are similar in 1996 and 2005, but the following metals differed from those of 2005:

- cadmium levels range from 0.19 to 0.42 mg/kg (higher than in 2005);
- nickel levels range from <0.2 to 0.6 mg/kg; and
- zinc levels range from 102 to 141 mg/kg dry weight (higher than in 2005).

4.0 SUMMARY

Potential of the 27 watercourses in the vicinity of the proposed road or mine site to provide potential fish presence ranges from excellent to negligible (Table 8), as follows:

- excellent potential for 5 stream crossings: W11, W14, Bunker Ck. 1, Bunker Ck. 4 and Light Ck. 4 (fish were captured in all of these except Bunker Creek 1 and 4);
- moderate potential for 9 stream crossings (Sites W9, W12, W13, Light Ck. 2, Bunker Ck. 2, Bunker Ck. 3, Bunker Ck. 5, Bunker Ck. 6 and Go Ck. 1); fish were captured in W9, W12, Light Ck. 2, and Go Ck. 1;
- low potential in 13 stream crossings, likely non fish-bearing (Sites 4, 5, 13, 14, Go Ck. 2, Go Ck. 3, W16, W15, W22, W23, W24, Light Ck. 1 and Light Ck. 3); no fish captured at these sites; and

- negligible potential at an additional ten sites that were assessed visually with aerial reconnaissance.

Table 8. Fish and Fish Habitat Sampling Summary, Yukon Zinc August 2005

Site	Sampling Method	Fish Captured / Known Presence	Habitat Quality
Light Ck. 1	EF, MT	NFC	Poor
Light Ck. 2	EF, MT	NFC	Moderate
Light Ck. 3	EF	NFC	Poor
Light Ck. 4	EF	GR	Excellent
1	AR	NA	Poor
2	AR	NA	Poor
3	AR	NA	Poor
4	EF	NFC	Poor
Bunker Ck. 1	EF	NFC	Excellent
Bunker Ck. 2	EF	NFC	Moderate
Bunker Ck. 3	MT	NFC	Moderate
Bunker Ck. 4	EF	NFC	Excellent
Bunker Ck. 5	EF, MT	NFC	Moderate
Bunker Ck. 6	EF	NFC	Moderate
5	EF	NFC	Poor
6	AR	NA	Poor
7	AR	NA	Poor
8	AR	NA	Poor
9	AR	NA	Poor
10	AR	NA	Poor
11	AR	NA	Poor
12	AR	NA	Poor
13	EF	NFC	Poor
W14	EF	GR, CCG	Excellent
W11	EF	GR, CCG	Excellent
W13	EF	NFC	Moderate
W12	EF	GR, CCG	Moderate
Go Ck. 1	EF	GR, BT	Moderate
Go Ck. 2	EF	NFC	Poor
Go Ck. 3	EF, MT	NFC	Poor
W16	EF	NFC	Poor
W15	EF	NFC	Poor
W22	EF	NFC	Poor
W23	EF	NFC	Poor
W24	EF, MT	NFC	Poor

Site	Sampling Method	Fish Captured / Known Presence	Habitat Quality
W9	EF	LT	Moderate
14	EF	NFC	Poor
Definitions:	1. Sampling Methods: EF = Electrofishing; MT = Minnow Trap; AR = Aerial reconnaissance 2. Fish Captured: BT = bull trout; CCG = slimy sculpin; GR = arctic grayling; LT = lake trout; NFC = no fish captured; NA = not applicable (aerial survey)		

5.0 REFERENCES

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Appendix 7.8-2 Wolverine Area Historic Fisheries Investigations

Fisheries Resource Investigations

Wolverine Lake Property

Westmin Resources Limited

(Spring, Summer and Fall Surveys)

December, 1996

List of Tables and Figures

Note: A summary of the results from these investigations is contained within the Baseline Biophysical Surveys Report produced by Westmin Resources.

ADDENDUM #1

Preliminary Fish Habitat and Utilization Assessments
Wolverine Lake Area
Spring, 1996

White Mountain Environmental Consulting (WMEC) conducted preliminary fisheries investigations in the Wolverine lake area between June 11 and June 16, 1996. During the course of these investigations WMEC undertook the following:

- Conducted small mesh (non-destructive) gillnet surveys on Wolverine Lake, Little Wolverine Lake and Little Jimmy Lake.
- Investigated the inlet and outlet of Wolverine Lake for spawning activity.
- Investigated the lower reaches of Money and Nouga (Wolverine) creeks for spawning activity and conducted general habitat evaluations.
- Initiated a creel census program at the exploration camp on Wolverine lake.
- Collected fish flesh samples for heavy metal analysis.

METHODS

Gillnetting on Wolverine, Little Wolverine and Little Jimmy Lakes was conducted between June 12 and 15, 1996. A total of 35, 1 hour sets using a net gang consisting of 3, 25 meter panels (3.8mm, 6.4mm and 8.9 mm stretch measure) were completed. Surface water temperature, maximum depth of set and catch by mesh size and species was recorded for each net set (refer to Figure 1 for the locations of gillnet sets)

All fish captured were live sampled for fork length, round weight and any external observations were recorded before the fish were released, unharmed back to the waters of origin.

Incidental mortalities that occurred during gillnetting were sampled for round weight, fork length, stomach contents, sex and maturity, and an otilith was taken and stored for age analysis (aging was not completed as a part of this study, although the otoliths have been appropriately stored and age analysis can be conducted as necessary). Six of the lake trout mortalities were also used to provide fish for metal sample analysis. Flesh of these fish suitable for human consumption was given to local residents working at the exploration camp. Refer to Tables 1 to 6 for data on the fish collected or observed during the study.

RESULTS

Gillnetting survey:

Three species of fish were encountered during the index gillnetting, these were; lake trout(*Salvelinus namaycush*, Walbaum*)*, Arctic grayling (*Thymallus arcticus)*, and longnose sucker*(Catostomus catostomus).* A total of 85 lake trout, 199 Arctic grayling and 5 longnose sucker were captured (refer to Tables A to C).

The capture of grayling releasing eggs implies that at least one area of Wolverine Lake shore is used by spawning grayling (on the mainland directly north-east of the island).

Long nose sucker exuding eggs were captured near the outlet of Little Jimmy Lake indicating that the site may be a spawning area for suckers.

Inlet and Outlet of Wolverine Lake:

Based on the ground and aerial surveys conducted on June 11, 13 and 15 the inlet and outlet of Wolverine Lake is a popular spawning area for Arctic grayling. Large numbers of grayling were observed congregating in the inlet and outlet areas. Subsequent capture of fish in these vicinities showed them to be in spawning condition with some females exuding eggs and some males exuding milt. Grayling eggs were found during seining of the inlet to Wolverine lake as were lake trout fry (refer to Figure 2 for the locations of Lake Tributaries and Lake sample sites).

Lower reaches of Money and Wolverine Creeks:

Cursory assessments were conducted at the mouth of Money creek, where it empties into Francis Lake, on June 11 and 16. Seine netting, electrofishing and angling caught only a small number of slimy sculpin (*Cottus cognatus*). No Arctic grayling were caught or observed at this site during these investigations, although suitable habitat was prevalent.

Cursory assessments of the lower reaches of Nougha creek were undertaken on June 16. Angling, electro-fishing and visual surveys indicated Arctic grayling congregating in the mouth area . Longnose sucker fry and slimy sculpin were also captured in very small numbers at the creek mouth (refer to Figure 3 for the locations of Creek sample sites).

Creel Census

A voluntary creel census was initiated for anglers at the Wolverine lake exploration camp on June 15. An environmental person stationed at the camp will oversee the implementation of this census. A catch and release policy is in effect for personnel associated with the exploration camp.

Metal samples

A total of 6 lake trout were taken for heavy metal contaminant analysis, these fish were incidental mortalities from the index gillnetting. A set of three samples from each fish was obtained, a back flesh sample, a stomach flesh sample, and the liver. The metal samples will be sent to Quanta trace laboratories for analysis at the completion of the field studies program.

ADDENDUM #2

Preliminary Fish Habitat and Utilization Assessments
Wolverine Lake Area
Summer 1996

White Mountain Environmental Consulting (WMEC) conducted preliminary summer fisheries investigations in the Wolverine lake area between July 12 and 17, 1996. These summer investigations consisted of the following:

- preliminary fish habitat and utilization assessments of both Money and Nougha creeks.
- habitat assessments and cursory fish utilization assessments of 36 creek sites within the study area.
- investigating the extent of Dolly Varden trout utilization of Money and Nougha creeks.
- monitoring the creel census program in place at Wolverine lake exploration camp.
- collection of fish flesh samples for heavy metal analysis.

METHODS

Habitat and Fish Utilization Assessments.

A total of 36 creek sites were investigated during the summer assessment. The inlet and outlet of Wolverine Lake were sampled as were any tributaries flowing into the lake. All tributaries flowing into Little Wolverine and Little Jimmy lakes were also sampled.

Aerial surveys of Nougha, Money and Go Creeks were conducted by helicopter to map fish habitats and to note any barriers to fish passage.

Sites where a possible access road may cross small tributary creeks were sampled for fish utilization.

RESULTS

Lake Inlet Creeks

Slimy sculpin were found in most watercourses sampled. Burbot, lake trout fry, Arctic grayling, longnose sucker and/or slimy sculpin were found to utilize the mouths of some tributaries flowing into Wolverine and Little Wolverine Lakes. Lake trout fry and Arctic grayling were found to utilize the inlet and outlet areas of Wolverine Lake (refer to Table 4).

Nougha Creek

An aerial survey of Nougha creek was conducted from its mouth at the Finlayson River to Wolverine lake. At this time, fish habitat was mapped and any barriers to fish passage were noted. Nougha creek was sampled at 4 locations to determine fish utilization.

Arctic grayling was the most abundant species found, followed by slimy sculpin, northern pike and burbot. No Dolly varden were found in Nougha Creek.

Money Creek

An aerial survey of Money Creek was conducted from its mouth at Frances Lake to a point several kilometers above its junction with Go Creek. Fish habitat was mapped and any barriers to fish passage noted. It was also sampled at 7 sites during to determine fish utilization as were 2 tributaries to Money Creek.

Dolly varden trout were present in the upper reaches of Money Creek both above and below its junction with Go Creek. Suitable spawning habitat was observed at various locations throughout Money creek, including above the junction of Money and Go Creeks. Arctic grayling, slimy sculpin and northern pike were the only other species encountered in Money Creek.

Go Creek

An aerial survey of Go Creek was conducted from its mouth at Money creek to just above the site of the airstrip. Fish habitat was mapped and four sites were sampled for fish utilization.

Dolly varden were found in the lower reaches of this creek along with slimy sculpin and adult and sub adult Arctic grayling.

Access Road Creeks

Three creeks that drain into Wind Lake and two creeks draining into Nougha Creek were found to be very poor fish habitat and no fish were found in any of these creeks.

Creel Census

The catch and release policy in place at the exploration camp was generally adhered to. The extent of compliance to the creel census was difficult to assess. It appears that angling pressure from personnel at the exploration camp has been minimal at this time. Angling pressure consisted mostly of angling from shore at camp by camp personnel. An average of 40 minutes angling time per day was observed.

Metal samples

A total of 10 slimy sculpin samples (consisting of 3 to 7 individual fish each)and 4 Arctic grayling samples were taken for heavy metal analysis. The slimy sculpin samples were taken from two tributaries to Little Wolverine Lake, three tributaries to Wolverine Lake, the outlet of Wolverine Lake, and three sites on Money Creek. The Arctic grayling samples were taken from the inlet and outlet of Wolverine Lake (two fish from each site). Arctic grayling samples consisted of both flesh and liver samples.

ADDENDUM #3

Preliminary Fish Habitat and Utilization Assessments
Wolverine Lake Area
FALL 1996

White Mountain Environmental Consulting (WMEC) conducted fall fisheries investigations in the Wolverine lake area between September 22 and 25, 1996. These investigations constituted the third and final field investigation of the 1996 season. The investigations consisted of the following:

- An Aerial survey of Money Creek to detect any congregations of spawning dolly varden or any signs of dolly spawning such as redds. Ground surveys were conducted at the outlet of Go Creek.
- Investigating the lake trout spawning locations on Wolverine, Little Wolverine, Little Jimmy and Francis lakes.
- Monitoring the creel census program in place at Wolverine Lake exploration camp.
- Conducting preliminary fisheries investigations of Wind Lake including using non-destructive small mesh gillnetting.
- Conducting ground investigations of Nougha Creek at the confluence with the Finlayson River, including angling in the Finlayson River downstream of Nougha Creek to detect presence or absence of dolly varden.
- Investigations into fish utilization of Francis Lake near the outlet of Money Creek, including determination of key fish habitats such as lake trout spawning.
- Obtaining fish samples from Wolverine Lake to determine sexual maturity and timing of spawn and for stomach analysis.
- Obtaining fish samples for heavy metal analysis from Little Jimmy Lake.

Refer to Figures 1, 2 and 3 for the locations of sample sites in the study area. Refer to Tables 1 to 6 for information on the fish captured during the study.

RESULTS

Money creek

The aerial survey of Money Creek found no evidence of dolly varden spawning. No aggregations of fish were detected and no obvious signs of redd building were observed.

Ground surveys near the outlet of Go Creek into Money Creek found only slimy sculpin

Dolly varden spawning strategies vary throughout the species range. Little information on spawning strategies for this type (small river) of population in the Liard River drainage has been compiled. It was suspected that that dolly varden spawning occurred prior to our investigation. Thus. the investigations do not provide sufficient information on dolly varden spawning strategies in Money Creek.

Lake Trout Spawning Surveys

The locations of lake trout and Arctic grayling spawning sites is shown on Figure 4. Note: The spawning sites locations are confidential and should not become published information.

Surveys for lake trout spawning areas were conducted in two stages. The first stage was aerial surveys of the lakes, with flights conducted during the evening and early morning. Fish observations were plotted on topographic maps. The second stage of the survey was conducted by boat using sonar and angling to locate and capture fish.

During the aerial survey, fish were observed in the outlet areas of Little Jimmy, Wolverine and Little Wolverine lakes. Fish were also detected at four other locations on Wolverine Lake.

Boat /sonar surveys showed fish were not widely dispersed in the lakes with most of the fish located occurring in a few large aggregations. Angling was used to determine species and spawning condition.

Little Jimmy Lake

Examination of lake trout captured in Little Jimmy Lake showed these fish had spawned several days prior to September 24. Stomach analysis revealed that the trout in this area were cannibalizing there own eggs and indicated that the outlet area is likely a spawning location for lake trout on this lake.

Little Wolverine Lake

Few fish were observed in Little Wolverine Lake. Arctic grayling were observed in the channel between Little Wolverine and Wolverine lakes and the occasional lake trout was observed near the outlet of Little Wolverine Lake. Two lake trout were captured from this area and sacrificed for metals analysis. Both of these trout were resting fish, one a male and the other a female. This survey indicates that Little Wolverine Lake is not likely a spawning location for lake trout, and trout utilizing this lake are of the same population as those in Wolverine Lake.

Wolverine Lake

Ground surveys in Wolverine Lake indicated that most of the Arctic grayling had moved into shallow areas near creeks, particularly in the outlet area at Nougha Creek. Large numbers of "stacked" lake trout were encountered at two locations in the south east end of the lake, both adjacent to shore in areas with steep drop-offs and water depths in excess off 40 meters within 30 meters of shore. The first of these locations is approximately 1 km north of the exploration camp on the northwest shore. The second location is directly across the lake on the southeast shore. The site on the southeast shore was considerably larger than the site on the northwest shore and fish were stacked in an area approximately 300m long (following the shoreline) and extending 30 meters from shore. Trout were in water depths of 3 to 35 meters.

Trout were easily angled at the site on the southeast shore and several fish were taken for dead samples. Sampling revealed that the fish were close to spawning, skeins in the females had burst, but the eggs had not become loose in the body cavity, indicating that spawning would likely occur during the first few days of October.

Francis Lake

Boat sonar surveys in Francis Lake found significant numbers of fish near the mouth of Money Creek. Based on the number of fish observed, this area appears to be important fish habitat. No fish were captured in the area and the species composition of fish utilizing this area is unknown. Some stacking of fish was found in an area approximately two kilometers north of the mouth of Money Creek. Angling at this site proved unsuccessful and the fish species could not be positively determined, sonar readings did resemble those found at the spawning sites on Wolverine Lake. Because of Francis Lakes lower elevation in comparison to Wolverine Lake it is expected that lake trout spawning would occur at a later date than on Wolverine Lake.

Wind lake

Wind Lake was surveyed on September 23, 1996. A gang of small mesh gillnets consisting of 20 m x 1", 20m x 2" and 25 m x 2.5" was set for 1 hour periods at three different locations on the lake. One large lake trout (5.5kg) was the only trout captured, arctic grayling were numerous as were long nose sucker. The lake has an even bottom with steep drop offs from shore. The maximum depth found was 10 meters (32').

Creel Census

The catch and release policy previously in place at the exploration camp is no longer adhered to, although the high quality waters limit of 1 fish per day has been maintained . The informal creel census was not a camp priority and results were therefore not complete. It appears that angling pressure from personnel at the exploration camp has been minimal and has consisted mostly of angling from shore at the camp.

Metal samples

Samples collected from Muskrat House Lake were used to complete the collection of fish for heavy metal analysis. A composite of livers from 6 trout was taken as was a single flesh sample from one of the trout. Flesh not required for metal analysis was given to local residents working at the exploration camp.

WHITE MOUNTAIN ENVIRONMENTAL CONSULTING

Proposed Access Road Creek Crossings

Fish Habitat Evaluation and Utilization Assessment, 1997

INTRODUCTION

At present two possible access roads to the Wolverine Lake property are being considered to access the property for future development. All creeks crossed by the two proposed routes were investigated by White Mountain Environmental Consulting (WMEC) during the 1997 open water season. Creeks were evaluated at the proposed crossing locations and at their outlets for the presence of both fish and fish habitat. Site investigations were conducted during June, July and September in order to provide an evaluation of spring, summer and fall utilization and account for seasonal movements of fish. The following report documents habitat availability and utilization during all seasons of investigation.

METHODS

A total of fifteen creeks were studied during the proposed access road crossing investigation. The creeks investigated consisted of the following:

- A tributary to East Lake;
- Two tributaries to Wind Lake;
- Seven tributaries of Nougha Creek;
- Nougha Creek;
- Three tributaries to Wolverine Lake, and
- A small headwater feeder creek of Van Bibber Creek.

The titles and descriptions of each of the 1996 and 1997 sample sites are provided on Table 1.

Table 1 Sample Sites

Site	Description
TE	Tributary to East Lake
TW-1	Access Road Crossing Site, a Tributary that Drains into Wind Lake
TW-2	Access Road Crossing Site, a Tributary that Drains into Wind Lake
WO	Outlet of Wolverine Lake
TN-1	Access Road Crossing Site, a Tributary that Drains into Nougha Creek 300 m Downstream of Wolverine Lake Outlet
TN-2	Access Road Crossing Site, a Tributary that Drains into Nougha Creek 350 m Downstream of Wolverine Lake Outlet
TN-3	Tributary of Nougha Creek, 800 m Downstream of Wolverine Lake Outlet
TN3F	Feeder Tributary to TN3
NTN3	Nougha at Mouth of TN3
TN-7	Tributary to Nougha Creek Approximately 8.9 km Downstream of Wolverine Lake
TN-8	Tributary to Nougha Creek Approximately 8.6 km Downstream of Wolverine Lake
TN-9	Tributary to Nougha Creek Approximately 7.6 km Downstream of Wolverine Lake
TN-10	Tributary to Nougha Creek Approximately 6.9 km Downstream of Wolverine Lake
TWV-1	Tributary to Wolverine Lake
TWV-2	Tributary to Wolverine Lake
TWV-3	Tributary to Wolverine Lake
TVB	Tributary to Van Bibber Creek
TVB-1	Tributary to TVB

The location of each of sample sites are presented in Figure 1. Figure 2 shows the two potential access routes to the Wolverine Lake property. A general description of the physical fish habitat for each site investigated is provided in Appendix 1. Results from all fish utilization assessments, including catch and sample records are contained in Appendix 2, Tables 1 to 3. Photos were also taken at each site and are provided in Appendix 3.

Habitat characteristics evaluated at each site included; creek depths and widths, water velocities, pool to riffle ratios, substrates, overhanging and adjacent vegetation and potential fish cover. Methods used to determine fish presence were electro-fishing, seining (where possible), angling and visual observations. Polarized glasses were used at all times to enhance visibility.

Insert Figure 1

Insert Figure 2

With the exception of Nougha Creek, all crossing sites occur in areas where the creek flows in a small draw with dense willow cover over and adjacent to the creeks. These creeks flow through dense tangles of willow in incised channels which are typically deeper than they are wide. These creeks rarely exceed a width of greater than 0.3 m, and have velocities averaging >1 m/sec. This type of creek, generally, does not provide good fish habitat. Aufies noted during spring investigations implies the creeks bottom freeze, a factor that severely limits ability to support over-wintering by fish. Rare and occasional ground water feeds may provide habitats suitable for slimy sculpin over wintering, and Arctic grayling may move into the creeks during summer months. During our investigations no fish were found in any of the creeks above the point where streamflow flowed through dense willows.

TE: The tributary to East Lake, as marked on the map sheet, does not at this time represent an above ground flow. This creek has been denoted as non-fish bearing and as such requires no further fisheries investigations.

TW-1: Tributary to Wind Lake #1 has two distinct reaches, the first being from the outlet to Wind Lake upstream for 400 m through a large wetland area, the second reach is above the first and extends up its valley, as a willow tangled draw, to the headwater area. The lower reach provides critical spawning, rearing and feeding habitat for Arctic grayling, particularly where it is closer to the lake. Long nose sucker and slimy sculpin also utilize this reach. Arctic grayling fry were the only species utilizing this reach during fall investigations. The upper reach is of little value as fish habitat; the proposed access road crosses the upper reach near the headwater area in an area not considered as fish habitat.

TW-2: Tributary to Wind Lake #2 consists of a small creek flowing through a willow draw. This creek does not provide fish habitat in its upper reaches. The only reach of this creek to provide fish habitat is the lowest 35 m, which forms a small bay of the lake. This area has significant influence from the lakes warmer water. The location of the proposed crossing site is approximately 2 km upstream of the lake in non-fish habitats.

WO and N: Nougha Creek near the outlet from Wolverine Lake represents important fish habitat. Utilization of the reach adjacent to the lake was documented as supporting Arctic grayling spawning and rearing, lake trout rearing and adult feeding and long nose sucker, slimy

sculpin, and burbot were also present. Large numbers of adult Arctic grayling observed during fall surveys may indicate this is an over-wintering site for grayling. Fish habitats vary seasonally with water levels and velocities.

TN-1: Tributary to Nougha Creek #1 is a small creek (0.35 m wide x 0.05 m depth). The lowest 10 m of the creek consists of a gravel boulder bottomed riffle with velocities >1m/sec. Above this reach, the creek flows through tangled willows alternating between being a narrow incised channel with velocities >1m/sec to areas with little or no defined channel with flows flooding out through the adjacent willows and sedges. Limited fish habitats exist in the creek in the form of eddies and pools below boulders. Two trails cross this creek 35 and 50 m upstream of Nougha Creek. Small pools with gravel substrates have been created by the trails crossing the creek. No fish were found in this creek.

TN-2: Tributary to Nougha Creek #2 does not have a defined channel outlet into Nougha Creek, rather it spills over the bank along a 10 m reach. Above this the creek flows through a tangle of willow and the channel is not well defined in most places. The most defined channel area occurs where the creek has been crossed by two winter trails, 30 and 40 m upstream of Nougha Creek. This creek does not represent fish habitat.

TN-3: Tributary to Nougha Creek #3 has flow and size sufficient to support fish. The outlet into Nougha Creek creates two important eddy pools in Nougha, one upstream and one downstream of the outlet. The first 10 m of the creek upstream of Nougha consist of a shallow glide at the mouth then a fast riffle before narrowing and entering into heavy willow tangles. Substrates in the creek are consistently heavily silted with clay and sand in the lower reach, gravel and cobbles occur occasionally at distances greater than 20 m upstream of Nougha Creek.

This creek is crossed by two winter trails 40 and 50 m upstream of Nougha Creek. Significant ice buildups were observed at the crossing sites during our spring investigations. The creek flows in a gully at the site of crossing with banks rising as much as 2.5 m above the actual flow. Arctic grayling juveniles were recorded in the first 20 m of the creek upstream of Nougha Creek during fall investigations and in the zone of influence during both summer and fall investigations.

TN-7: Tributary to Nougha Creek #7 does not have a discernible flow above ground at the outlet to Nougha Creek. The creek does have a large ponded area adjacent to Nougha Creek but flows from the creek enter this pond as seepage from the surrounding area. The distinct above ground channel that flows into a small alluvial area 50 m up from Nougha quickly dissipates into the wetland area leaving no above ground flow. Flows within the ponded area occur as seepage. The creek proper drains a willow tangled and spruce filled draw. Vegetation adjacent to the channel is alpine shrub.

The creek does not provide fish habitat, nor access to Nougha Creek, however the outlet bay formed by the creeks historic flows does offer a zero velocity area adjacent to Nougha Creek and as such provides some fish habitat.

TN-8: Tributary to Nougha Creek #8 is a small creek (depth was 0.2 m and width was 0.8 m), narrowing to < 0.25 m) which flows as stepped 0.3 m waterfalls interspersed by riffle/rapids (velocity > 2 m/sec) through a dense tangle of willow. The tributary flows directly into Nougha Creek in a narrow, confined and incised channel. There is very little in terms of a zone of influence where the tributary enters Nougha Creek, since it enters on a deep side into velocities >2m/sec. The tributary provides very limited fish habitat, primarily due to steep gradient and high velocities. This creek does not merit further fisheries investigations.

TN-9: Tributary to Nougha Creek #9 enters Nougha Creek as a waterfall approximately 3 m high. A second waterfall occurs within 20 m. The waterfalls cascade over bedrock with boulders. Above the waterfall area the creek channel is narrow and confined with velocities >2 m/sec over predominantly boulder/cobble substrates. The creek is heavily covered with willow and spruce.

The potential for fish utilization of this tributary is extremely limited due to high water velocities. The first 20 m of the creek forms a permanent barrier to fish passage. The creek enters Nougha directly with very little zone of influence. Nougha Creeks flows are fast (>2 m/sec) in this reach with a narrow and confined channel that provides very little low velocity habitats. This tributary creek does not provide fish habitat.

TN-10: Tributary to Nougha Creek #10. The upper reach starts 15 m u/s of Nougha Creek and is narrow and confined in an incised channel. The upper reach is 0.3 m wide and 0.5 m deep, on average, with surface velocities >1 m/sec.

The lower 15 m reach consists of mostly boulder substrates with a wetted width of 2 m, or greater. The lower reach of the creek has potential to support fish. The boulder substrates are clear of any silts or fines, a situation that may indicate ground welling.

This creek enters Nougha Creek were the flows are mostly <1 m/sec and some channel braiding occurs. The zone of influence to Nougha consists of an upstream pool of 2 m by 3 m and a downstream mix trail of approximately 2 m by 8 m, both of these areas have depths >0.5 m. Fish were captured in Nougha Creek adjacent to the tributary, however no fish were captured in the tributary itself. Sculpins and Arctic grayling juveniles were recorded in the zone of influence during summer and fall investigations.

TWV-1 Tributary to Wolverine Lake #1, also known as Jasper Creek, provides very little fish habitat and shows very low utilization. The creek is small with a depth of 0.3 m and a width of 0.6 m and has a high flow (<2 m/sec) through a heavy tangle of willow. The creek does provide an important mix zone as it enters Wolverine Lake. Several slimy sculpin and a single Arctic grayling juvenile were recorded in the creek. Large numbers of lake trout fry and grayling fry were recorded in the mix area of Wolverine Lake. Seines pulled in adjacent areas of Wolverine Lake had very low catches relative to those pulled in area influenced by TWV-1.

TWV-2 Tributary to Wolverine Lake #2 is a very small creek with depths of <0.01 m and width that does not exceed 0.3 m. The Creek does not provide any fish habitat.

TWV-3 Tributary to Wolverine Lake #3 drains a wetland area adjacent to Wolverine Lake. The creek is has a low gradient in its lower reaches and in several locations throughout its length. Numerous species of fish, in limited numbers, were recorded in the creek near the outlet during all seasonal investigations. Available fish habitat occurs predominantly within 150 m of the lake, however small pockets of good habitat occur 500 m upstream of the lake near the confluence of two feeder creeks.

TVB & TVB-1 Tributary to van Bibber Creek, and tributary to this tributary. The site of investigation consisted of the headwater reaches at the confluence of two feeder creeks. The northern most of the feeder creek intersects the proposed access route just upstream of its confluence with the second feeder creek. The creeks both consist of wide, flat, stepped riffles with available structural habitats with very low conductivity (i.e. very pure water) and cold water temperatures. The reaches investigated are above a long reach consisting of high velocity water and a narrow channel with limited fish migration potential. Fish were not recorded in any of the channels of this creek.

Investigations into the outlet areas of these creeks revealed several to have significant fish values. The tributary to Wind Lake, TW-1, has an extended outlet area flowing through small bluffs of willow mixed with dwarf birch. The area is extensively worked by beavers and extends over 300 m from the lake. This area provides spawning and rearing habitat for Arctic grayling. Juvenile long nose sucker and juvenile Arctic grayling utilize the ponds associated with the creek near the lakeshore.

Tributary TWV3, at its outlet to Wolverine Lake, provides rearing habitats for juvenile Arctic grayling, juvenile lake trout, juvenile long nose sucker and juvenile burbot, resident slimy sculpin also utilize this creek. Suitable habitats are located upstream of the lake for a distance of 150 m, aerial assessments showed potential for fish habitat in scattered pockets up to the point of the confluence of two feeder creeks 500 m from the lake.

Most of the tributaries entering Nougha Creek are colder than Nougha throughout the year. Tributaries TN1 and TN3 provide limited fish habitats near the outlets, however utilization was restricted to within 20 m of Nougha Creek. Several of the tributaries create eddying in Nougha Creek at their point of entry creating important habitats in an otherwise fast flowing Nougha Creek.

Although most of the creeks investigated did not provide fish habitat, the outlet areas often enhanced fish habitats by introducing oxygen and nutrient rich waters to the lake and receiver creek. This was especially evident in the lakes where utilization of the waters at the creek outlet was significantly higher than in similar adjacent areas.

WHITE MOUNTAIN ENVIRONMENTAL CONSULTING

Habitat Evaluation of Money Creek

Summary

Aerial assessments of Money Creek were conducted on July 14,1997 in order to provide an evaluation of the creek and it's potential to support fish. The July survey was a continuation of the 1996 investigation which focussed on species utilization along specific sections of Money Creek.

Money Creek flows as a high velocity creek with predominantly cobble substrates interspersed with boulders and sorted gravel. Fish habitats are limited and typically small. Concentrated pockets of key habitats exist along the creek, the most notable being the potential over wintering sites near Reach #7. The creek flows clear and shallow with high velocities that provide poor cover and few resting areas for fish.

The descriptions start at the creeks outlet at Francis Lake and continue upstream in ascending order to a point above Go Creek in the alpine headwaters of Money Creek. Money and Go Creek are shown on Figure 1 of the "Proposed Access Road Creek Crossings – Habitat Evaluation and Utilization Assessment, 1997" report.

Reach #1

Outlet area to Frances Lake 61°24.80 N/ 129°38.30 W.
Some silting of gravel and sand substrates, open area with many exposed gravel bars. Mostly shallow flat glide. Reach extends 150 m from Francis Lake.

Reach #2

Starts 150 m from lake, extends 350 m upstream of the Robert Campbell Highway bridge. Gravel/cobble substrate with some braiding the creek is primarily riffle runs and glides with few pools. This reach is 1.4 km long.

Reach #3

Increasing boulders and riffles begin above the Robert Campbell highway. Rapids begin at the point where the creek becomes confined by a canyon. Rapids interspersed by occasional pools and gravel bars. This reach is 3 km long.

Reach #4

Start at 61°24.00 N/ 129°40.75 W.

Canyon becomes deeper and more abrupt, many cliff areas, rapids at bends of the creek, typically against cliffs. Mostly high velocity riffles over boulder cobble substrates. This reach includes sample site M3. This reach is 1 km long.

Reach #5

Starts at 61°23.85 N/ 129°41.00 W.

Longer glides with fewer pools and riffles, cobble/boulder substrates with very few side pools. The creek velocity has slowed with rare rapid “shoots” occurring in confined areas. Reach is 4 km long.

Reach #6

Starts at 61°23.85 N/ 129°44.00 W.

The creek develops more rapids and deep pools with large boulders becoming more common in boulder cobble substrates. Creek remains confined by canyon Riffle / pool sequences common. The reach is 2.3 km long and flows out across the edge of the Pelly Mountains.

Reach #7

Starts at 61°24.20 N/ 129°46.20 W.

A short reach that consists of a series of deep pools below stepped rapid / small pool sequences. This reach represents the most likely over wintering habitats (deepest and most frequent pools) observed on Money Creek. Reach is 0.8 km long.

Reach #8

Approximately three foot high falls at 61°24.17 N/ 129°46.45 W.

May be an impediment to fish passage at certain flows (high or low). Does not likely form a constant barrier to fish passage but is the most restrictive area in terms of fish passage on Money Creek. Substrates are predominantly bedrock with boulders and areas of sorted gravels. This reach is approximately 150 m long.

Reach #9

Starts at waterfall in Reach #8.

Long flat glide/riffle with high velocities, substrates predominantly boulder with some cobble/ gravel areas. This reach is 2.5 km long.

Reach #10

Starts at 61°24.33 N/ 129°48.50 W.

Large boulders occur commonly in fast flowing riffles, with some corner pools and glide areas. Substrates consist of an even mix of boulder, cobble, gravel substrate. A narrow flood plain exists within the continuing steep sided canyon. Occasional islands occur in braided areas were substrates are composed mainly of gravel and cobble mix (this includes site 10a). This reach is 3.5 km long.

Reach 10a

At 61°24.20 N/ 129°50.00 W.

Island with shallow, low volume channel on north side.

Reach #11

Starts at 61°24.33 N/ 129°52.00 W.

Wide shallow glides, creek channel up to 20 m wide, confined by steep sided valley. Gravel / cobble substrate.

Reach #11a

At 61°24.10 N/ 129°53.20 W.

Boulder strewn riffle area of higher velocity at tight meander scroll, steep sided cliff on north bank.

Reach #12

Starts at Outlet of tributary creek TM4 at sample site M4, located at 61°23.85 N/ 129°53.60 W

Wide flat glides with few smaller boulders dispersed throughout. Several gravel point bars and side channels, occasional small cliff banks with small pools associated at outside corners. Valley broadens to 800m wide flood plain, creek channel confined by banks averaging 2 m in

height above water line. Creek becomes more meandering with abandoned channels visible. This reach is 4 km long.

Reach #12a

Large point bar with sorted gravels. Two old channels apparent on downstream side.

Reach #12b

At 61°24.33 N/ 129°48.50 W

Marks the downstream edge of recent burn. This burn extends up the Money Creek valley into the headwater area. Channel is braided in the wide flood plain, with substrates predominantly gravel. Large island (5m x 200m) formed by braided channel, excellent combination of habitat with pools and back eddies.

Reach #13

Starts at 61°22.10 N/ 129°53.70 W.

Finer gravel substrates with few boulders. Mainly glides with few riffles. Moderate velocities. Reach is 1.5 km long.

Reach #14

Starts at 61°21.50 N/ 129°53.90 W.

Creek increases in velocity and becomes more sinuous with increasing numbers of boulders. Few log sweepers with stick and log jams along corner banks, several boulder riffle runs interspersed by gravel bottom glides. The reach is 5.8 km long.

Reach #14a

At 61°21.00 N/ 129°54.80 W.

A potential obstruction created by a log jam backs water levels up to between 0.75 and 1.2 m high along the log jam area. Beaver activity has added to the obstruction. The channel has split as a result of the log jam. The original channel no longer flows through and exists as a pond, the new channel, also obstructed has backed up water so that the creek flows through adjacent vegetated areas to pass the obstruction.

Reach #15

Starts at 61°19.25 N/ 129°57.00 W.

Channel is wide and flat (up to 20 m wide) and boulder filled. Wide flood plain ends and vegetation becomes more dispersed typical of higher altitudes. Creek has predominantly cobble substrates with boulders consistently dispersed throughout; glide areas are short and rare. The reach is 3 km long.

Reach #15a

Ends at 61°18.65 N/ 129°59.00 W.

Large braided channel has shifted main flow into what map shows as side channel, which now has main flow. Old channel has maintained some flow now has limited flow linked by gentle shallow riffles. New channel is 650 m long. The downstream end (junction) of both channels is sample site M5.

Reach #16

Starts at 61°18.45 N/ 129°59.50 W.

Creek becomes noticeably smaller, substrates are boulder strewn cobbles and gravel, with occasional patches (up to 200 m in length) of sorted fine gravel. Creek consists mostly of long riffle areas, few glides or pools, open flood plain, glides with point bars, occasional strip of fine gravel (up to 200 m in length). This reach is 9.4 km long.

Reach #17

Starts at 61°24.33 N/ 129°48.50 W.

Channel narrows with the average width in this reach is 7 m and is as narrow as 3 m. Creek consists of mainly boulder riffles interspersed with gravel bottom glides with some wetland areas nearby. Wide flood plain with willow vegetation (no spruce near channel). Evidence of channel shifting throughout the reach with many abandoned channels visible. This reach includes sample sites M6 and M7 (outlet of Go Creek area) and is approximately 9 km long.

Reach #18

Starts at 61°21.15 N/ 130°04.50 W.

Area above Go Creek confluence. Flood plain narrows, adjacent vegetation remains similar with little streamside vegetation as elevation increases and vegetation becomes alpine with few

shrubs and no trees. Approximately 10 km up this reach the creek flows shallow and braided over a glacial feature with angular and fractured cobbles for almost 1 km. This same type of creek structure occurs in several other areas further up the creek. The braided area 10 km up this reach marks the furthest point studied during our investigation.

WHITE MOUNTAIN ENVIRONMENTAL CONSULTING

Habitat Evaluation of Nougha Creek

Summary

The lower reaches may provide habitats for bull trout, although none were recorded during 1996 or 1997 surveys. Nougha Creek provides many good fish habitat areas but fish passage is blocked to upstream movements by waterfalls in Reach # 4. The creek provides many habitats for Arctic grayling.

Aerial assessments of Nougha Creek were conducted on July 16,1997 in order to provide general comments about the creek and it's potential to support fish.

The reaches of Nougha Creek are described below in ascending order, starting at the outlet to Finlayson River and moving upstream to the mouth of the creek at Wolverine Lake. Nougha Creek is shown on Figure 1 of the "Proposed Access Road Creek Crossings – Habitat Evaluation and Utilization Assessment, 1997" report.

Reach #1

Outlet to Finlayson River at 61°36.05 N/ 130°08.04W.

Flat slow glides with deep silts near the outlet and fine gravels becoming more prevalent nearer the Robert Campbell highway. This reach is 1.2 km long.

Reach #2

Starts at bridged crossing of the Robert Campbell highway at 61°35.65 N/ 130°08.04W.

Above the Robert Campbell highway cobble/gravel bottom glides with occasional boulders and deep pools occurring near undercut banks at creek bends. This reach is 2.8 km long.

Reach #2a

At 61°35.10 N/ 130°11.80 W.

A new channel has been cut due to beaver activity, beavers continue to dam in this location on the new channel. This beaver dam (>1 meter height) represents a partial obstruction to fish passage.

Reach #3

This reach starts at 61°35.30 N/ 130°10.75 W.

Boulders become more common, velocity increases causing more riffles with fewer pools, creek flows through a steep sided valley with the channel constricted by bedrock rock in places. This reach is 2.5 km long.

Reach #3a

At 61°35.10 N/ 130°11.80 W.

A small waterfall followed by 100 meter section of deep rapids with pools and many boulders. May limit fish passage during high or low flow periods.

Reach #4

Starts at 61°34.80 N/ 130°11.75 W.

Valley constricts, channel narrows and water velocity increases. Many large boulders with intermittent deep pools. First downstream rapid may present a barrier to fish during low water periods. This reach is 1 km long.

Reach #4a

At 61°34.50 N/ 130°12.85 W.

Area marked “rapids” on 1:50,000 topographic maps. Channel confined by a narrow gorge, mainly boulder rapids interspersed with deep pools. These rapids likely present a barrier to fish passage.

Reach #5

Starts at 61°33.44 N/ 130°13.75 W.

Valley broadens and channel flattens with gravel/cobble/boulder substrates. Long riffles/runs with some pools at stream bends. Riffles have high velocities. Good fish habitats are dispersed throughout the reach. This reach includes the outlets of tributaries TN7 and TN8. This reach is 2 km long.

Reach #6

Starts at 61°33.40 N/ 130°13.75 W.

Stepped rapids 100 meters in length likely present a barrier to fish passage. This reach flows at the point were Nougha Creek exits the Campbell Range of the Pelly Mountains. This reach is 0.8 km long.

Reach #7

Starts at 61°33.20 N/ 130°14.45 W.

Gradient decreases and stepped rapids become more dispersed with good pools between, several long glides exist and side channels are common, large pools have formed at creek bends. Substrates mostly cobble, some gravel patches and a few areas of fine gravel. This reach includes the outlets of tributary creeks TN9 and TN10 and is 2.3 km long.

Reach #8

Starts at 61°32.35 N/ 130°14.45 W.

Channel widens and velocity is significantly reduced. Gentle riffles followed by slow pools. Glide pools and back eddies are common. Aquatic vegetation and siltation occurs in mid channel areas. Above #8A substrates are composed of fine gravels in an area with sharp meander curves and varying velocities, flows still occur as glides with the occasional short riffle. Heavy willow vegetation encloses the creek and several ponds associated with the creek occur near the top of this reach. This reach is 3 km long.

Reach #8a

At 61°31.75'N/ 130°16.15W.

Wide meanders with sluggish flow and silted bottom. Old ox bow lakes connected and likely recharged during high water events. An extensive patch of fine well sorted pea gravels occurs at this site just above the ox bow lakes. Recent beaver activity is in evidence.

Reach #9

Starts at 61°31.08 N/ 130°17.25 W.

Extensive beaver dam area, a series of beaver dams creates wetland over 100 meters wide and presents an obstruction to fish passage. A wide willow flood plain occurs in this area and shows signs of recent and old beaver activities. Substrates are cobble and gravel in flow areas,

silt in areas behind beaver dams and other low flow areas. This reach is 1 km long and includes the outlet area of a significant tributary from the South and South East (this tributary was not part of WMEC's investigation).

Reach #10

Starts at 61°30.80 N/ 130°17.90 W.

The creek channel is flat with a mix of substrates, gravel/cobble/boulder riffles occur with few pools interspersed. Good shoreline habitats in the form of side pools and cut banks exist. This reach extends to the mouth of Nougha Creek at the outlet of Wolverine Lake and is 1.6 km long.

WHITE MOUNTAIN ENVIRONMENTAL CONSULTING

Money Creek – Bull Trout Utilization Assessment, 1997

Assessments of Money Creek and two of its tributaries, Go Creek and an unnamed tributary that enters Money Creek from the north approximately 19 km upstream of Francis Lake, were investigated to determine potential spawning and over-wintering areas for bull trout. The assessments were conducted between September 15 and 18, 1997 and consisted of:

- aerial assessments conducted by helicopter to observe any aggregations of fish and map deep pools suitable for over-wintering;
- ground surveys using minnow traps, electro-fisher, seine net, angling and visual observations; and
- Float surveys conducted with dry suits, mask and snorkel to investigate micro-habitats and determine presence of adult fish.

Table 1 provides a description of the sample sites on Money and Go Creek, including tributaries to Go Creek, during 1996 and 1997 investigations.

Table 1 Station Descriptions and Locations

Site	Description
M1	Mouth of Money Creek at Francis Lake
M2	Money Creek - Mouth at Robert Campbell Highway
M3	Money Creek Approximately 3.5 km Upstream of the Outlet to Francis Lake
M4	Money Creek - Mouth Area of Major Tributary to Money Creek Approximately 18 km upstream of the Outlet to Francis Lake
M5	Money Creek Approximately 36 km Upstream of the Outlet to Francis Lake
M6	Money Creek 1 km Downstream of its Junction with Go Creek
M7G	Money Creek at its Junction with Go Creek
M8	Money Creek Downstream of Little Jimmy Valley Tributary
M9	Money Creek at Downstream End of Wide Gravel Area
G1	Go Creek at Junction Area with Money Creek
G2	Go Creek Approximately 2.5 km Upstream of the Mouth of Go Creek
G3	Go Creek Approximately 5.6 km Upstream of the Mouth of Go Creek
G4	Go Creek Approximately 5.9 km Upstream of the Mouth of Go Creek
G5	Go Creek Approximately 7.5 km Upstream of the Mouth of Go Creek
P1	Pup Creek, a Tributary of Go Creek
HO	Hawk Owl Creek, a Tributary of Go Creek

The species of fish in the study belongs to the dolly varden/ bull trout (*Salvelinus malma-confluentus*) complex. To determine the exact species involved, specific genetic tests were undertaken. Three specimens were taken during the field assessment, frozen and later delivered to Yukon Territorial Government Fisheries Department representatives. Genetic testing was done at the University of British Columbia by Eric Taylor, Assistant Professor, Department of Zoology. Growth hormone diagnostic testing was conducted and resulted in a positive identification of the specimens as bull trout *Salvelinus confluentus.* Further testing confirmed the initial result.

Bull trout are a sub-species of the genus *Salvelinus*, which includes Arctic char, lake trout and dolly varden. The species is wide spread throughout western North America and eastern Asia. Within the dolly varden / bull trout complex numerous forms exist, including northern and southern, anadromous and non-anadromous, stream resident and lake resident populations (Armstrong and Morrow, 1980). The different forms have developed varying life history strategies that make it difficult to confidently describe the Money Creek population based on existing models from other areas.

Although a great deal of information has been compiled on the species understanding, references in this specific type of habitat are limited. The similarities between land locked and anadromous individuals are subtle but distinct enough that the species complex has often been subjected to sub-species classifications, (e.g. bull trout/ dolly varden). The life history and habits of the various forms varies greatly depend on the surrounding environment. The fish in Money Creek correspond most closely with the stream resident form of dolly varden/ bulltrout, typically confined to clear water tributaries of major rivers. However, there are similarities with a form described as a stream-lake resident (Morrow and Armstrong, 1980). Genetic analysis, conducted by the Yukon Territorial Government Fisheries Department, in conjunction with the University of British Columbia, on specimens taken from the Liard River drainage in the Yukon has shown all specimens analyzed to be bull trout.

Timing of field investigations was coordinated after assessing several reference sources. The closest (proximity) bull trout population to have existing information is at Shiltsky Lake, Yukon, where spawning occurred between September 16 and 21, consistently over a five year period. Water temperatures at spawning vary with the reference; the 1995 spawn at Shiltsky Lake was

recorded at 12°C, in contradiction to other recorded references which suggests spawning occurs between 5 and 7°C (Blackett, 1968) or near 8°C (Scott and Crossman, 1974).

Water temperatures in Money Creek were monitored with a data logger located 500 m downstream of the outlet of Go Creek (site W-14). Temperature data was recorded 20 times per day from August 20 to September 12. During this time period daily temperatures rose to highs of between 9 and 12°C, while night time lows fell as low as 5.7°C. Daily temperatures typically fluctuated between 3 to 5°C.

Thermographic records taken at site W-14 on Money Creek indicate that temperatures were approaching a high of 5 to 7°C on September 12 when the recorder was removed. Temperatures remained at that level until our investigations were conducted. Blackett (1960) reported that anadromous dolly varden in Alaska spawned at temperatures between 5 and 6°C but spawning ceased abruptly after a further 2°C drop in temperature. Temperatures at the time of our field investigations were near 6°C. In light of this, the lack of spawning individuals observed during the surveys may indicate that spawning occurred prior to the investigations.

Spawning did not appear to occur in large aggregations, as few suitable locations were recorded and those investigated showed no signs of a recent spawn. One potential area that large numbers may have spawned in is the gravel shoals located immediately upstream of the outlet of Money Creek to Francis Lake. Alternatively, small pockets of sorted, clean washed gravels were observed under undercut banks during the float surveys. These potential micro-spawning sites were small, usually oblong in shape and less than 0.5 x 0.3 m. Fish of this species complex have been recorded utilizing similar habitats (Armstrong and Morrow,1980, and Blackett 1968).

Money Creek may be used as a spawning and rearing creek for bull trout, with adults utilizing Francis Lake and only entering the creek for spawning. Unpublished data from YTG (Thompson Per. Com, 1997) shows that eleven adult dolly varden / bull trout were captured during index gillnetting surveys of Francis Lake conducted in 1990. Of the eleven fish captured, one was taken in the East arm, one was taken in the small lake at the north end of the West arm, and nine were captured just to the south of the Money Creek outlet. This data suggested that the creek is used for spawning and rearing while the lake is used by adults. This model

would explain why extensive effort to capture bull trout produced only randomly scattered immature specimens. Considering this model it seems likely that the spawning locations would be located in the lower reaches of the creek. The steep canyon areas and rapids would present a barrier to adult fish migration during spawning in September when water levels are low. These same rapids become more passable to the fry during high water in the spring, allowing the upstream movement of fry that would rear in the creek for as much as several years, or until they reach sexual maturity.

Given the extended effort into locating bull trout in Money Creek and the low numbers of fish captured or observed, it seems likely that the population density and extent of utilization is quite low. Results of fish sampling from this investigation are provided in Appendix 2 of the Proposed Access Road Creek Crossings – Fish Habitat Evaluation and Utilization Assessment, 1997 report. The locations of the sample sites are shown on Figure 1 within the above noted report.

Potential over wintering sites exist in an area only accessible by helicopter. A very tight canyon starting approximately 8 km upstream of Francis Lake extends for a distance of approximately 2.5 km. The canyon has abrupt valley walls, is 100% confined and flows in a narrow channel interspersed with deep pools below abrupt rapids and steep riffles. This canyon area represents a unique habitat on Money Creek. Pools of the same depth occur rarely elsewhere on the creek and definitely do not occur in such a concentrated cluster. The series of pools starts at a small waterfall at coordinates 61°09’17”N / 129°46’45”W. Float surveys were conducted in the uppermost pool of the reach and Arctic grayling, in an aggregation of 24 adults and sub adults, were observed. One juvenile bull trout was observed below the pool.

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Table 1 Index Gillnetting Survey, Catch Record, Wolverine Lake area - 1996

							CATCH			
Set #	Date (M/D/YR)	Time set	Time lifted	H2O Temp.(C)	Mesh size (cm)	Max. Depth (ft)	LT	AG	LNS	Comments
WLV1	12/06/96	8:05	9:05	4.5	3.8	74	0	0	0	
					6.4		1	0	0	
					8.9		1	0	0	
WLV2	12/06/96	8:45	9:45	4.4	3.8	96	0	0	0	
					6.4		0	0	0	
					8.9		0	0	0	
WLV3	12/06/96	9:30	10:30	4.5	3.8	101	0	0	0	
					6.4		1	2	0	
					8.9		1	0	0	
WLV4	12/06/96	10:05	11:15	4.4	3.8	130	2	0	0	
					6,4		0	0	0	
					8.9		0	0	0	
WLV5	12/06/96	11:00	12:00	4.8	3.8	75	0	0	0	
					6.4		0	0	0	
					8.9		1	1	0	
WLV7	12/06/96	12:50	13:50	4.3	3.8	34	1	0	0	
					6.4		4	0	0	
					8.9		0	0	0	
WLV8	12/06/96	14:25	15:30	5.1	3.8	34	0	0	0	
					6.4		2	4	0	spawning area ?
					8.9		0	0	0	
WLV9	12/06/96	14:50	15:59	5.1	3.8	40	0	0	0	
					6.4		2	0	0	
					8.9		1	2	0	
WLV10	12/06/96	15:55	16:55	5.3	3.8	30	0	2	0	
					6.4		2	9	0	
					8.9		3	0	0	
WLV11	12/06/96	16:25	17:25	6.8	3,8	7	0	0	0	
					6.4		2	0	0	
					8.9		3	2	0	
WLV12	13/06/96	8:55	9:55	6.8	3.8	6	0	0	0	
					6.4		0	5	0	
					8.9		1	2	0	
WLV13	13/06/96	9:35	10:35	6.4	3.8	6	0	0	0	
					6.4		3	2	0	
					8.9		3	6	0	
WLV14	13/06/96	10:15	11:15	5.8	3.8	8	0	1	0	
					6.4		2	2	0	
					8.9		3	12	0	

Set #	Date (M/D/YR)	Time set	Time lifted	H2O Temp.(C)	Mesh size (cm)	Max. Depth (ft)	LT	AG	LNS	Comments
WLV15	13/06/96	12:00	13:00	5.1	3,8	76	0	0	0	
					6,4		0	0	0	
					8.9		1	0	0	
WLV16	13/06/96	12:45	13:45	4.9	3.8	38	0	0	0	
					6,4		0	0	0	
					8.9		0	7	0	
WLV17	13/06/96	13:35	14:35	4.5	3.8	43	0	0	0	
					6.4		0	2	0	
					8.9		0	0	0	
WLV18	13/06/96	14:15	14:50	4.1	3.8	36	0	0	0	
					6.4		0	0	0	
					8.9		1	1	0	net pulled early - zodiac problems
WLV19	13/06/96	16:27	17:27	4.5	3.8	29	0	0	0	
					6.4		0	1	0	
					8.9		0	0	0	
WLV20	13/06/96	17:00	18:00	4.2	3.8	48	0	0	0	
					6.4		0	0	0	
					8.9		2	1	0	
WLV21	13/06/96	17:43	18:43	3.6	3.8	57	0	0	0	
					6.4		1	0	0	
					8.9		0	0	0	
WLV22	13/06/96	7:20	8:20	3.1	3.8	51	0	0	0	
					6.4		1	0	0	
					8.9		0	0	0	
WLV23	23/09/96	14:10	15:10	4.8	3.8	96	1	0	0	
					6.4		2	0	0	
					8.9		0	0	0	
WLV24	15/06/96	14:40	15:45	4.4	3.8	125	1	0	0	
					6.4		0	0	0	
					8.9		0	0	0	
WLV25	15/06/96	15:27	16:27	4.8	8.9	26	3	0	0	
					3.8		1	0	0	
					6.4		2	1	0	
LWV 1	15/06/96	8:00	9:00	8.9	3.8	4	5	4	0	
					6.4		2	6	0	
					8.9		6	8	4	
LWV 2	15/06/96	8:35	9:50	7.5	3.8	36	0	0	0	
					6.4		5	5	0	
					8.9		0	0	0	
LWV 3	15/06/96	9:46	10:46	7.5	3.8	22	0	1	0	
					6.4		3	9	0	
					8.9		2	12	0	

Set #	Date (M/D/YR)	Time set	Time lifted	H2O Temp.(C)	Mesh size (cm)	Max. Depth (ft)	LT	AG	LNS	Comments
LWV 4	15/06/96	10:28	11:28	7.8	3.8	39	0	0	0	
					6.4		2	12	0	
					8.9		0	0	0	
LJ1	14/06/96	10:05	11:05	5.9	3.8	21	0	1	0	
					6.4		0	12	1	
					8.9		0	0	0	
LJ2	14/06/96	10:38	11:45	5.4	3.8	32	0	1	0	
					6.4		0	7	0	
					8.9		0	4	0	
LJ3	14/06/96	11:40	12:40	5.6	3.8	21	0	0	0	
					6.4		0	5	0	
					8.9		0	0	0	
LJ4	14/06/96	12:15	13:16	6	3.8	26	0	0	0	
					6.4		0	0	0	
					8.9		1	9	0	
LJ5	14/06/96	13:04	14:05	6.2	3.8	31	0	4	0	
					6.4		1	20	0	
					8.9		0	0	0	
LF6	14/06/96	13:35	14:35	5.9	3.8	103	0	1	0	
					6.4		0	1	0	
					8.9		1	15	0	
WND1	23/09/96	12:45	13:45		6.4	24	1	4	3	
					5.1		0	9	0	
					2.5		1	1	0	
WND2	23/09/96	14:15	15:15		6.4	17	0	4	3	
					5.1		0	2	0	
					2.5		0	2	0	
WND3	23/09/96	15:30	16:40		6.4	28	0	0	1	
					5.1		0	4	0	
					2.5		0	0	0	

Table 2. Electro-fishing Results, Wolverine Lake area - 1996

DATE	SITE	EFFORT (sec)	TEMP (c)	CATCH						comments
				AG	LT	SS	BB	LNS	DV	
11/06/96	M1	156		0	0	0	0	0	0	
11/06/96	M1	460		0	0	9	0	0	0	
14/06/96	WC	184	6.9	0	0	2	0	0	0	
14/06/96	WC	57	6.9	1	0	0	0	0	0	
14/06/96	WT1	64		0	0	0	0	0	0	
16/06/96	N1	258	7.7	1	0	12	0	16	0	
12/07/96	TLW1	445	0.9	0	0	13	1	0	0	5 ss taken for metal samples
12/07/96	TLW2	101	4.6	0	0	5	0	0	0	
12/07/96	TLW2	81	4.6	0	0	0	0	0	0	
12/07/96	TLW3	177	1.9	0	0	0	0	0	0	
12/07/96	TLW4	197	2.4	40	1	11	1	0	0	
12/07/96	TLW4	205	2.4	30	5	21	0	0	0	
12/07/96	TLW4	205	2.4	50	0	5	0	0	0	
13/07/96	TWV3	335	2.1	1	0	5	4	0	0	2 ss taken for metal samples
13/07/96	TWV3	279	2.1	0	0	3	0	0	0	3 ss taken for metal samples
13/07/96	TWV4	160	11.8	31	0	0	0	85	0	20 u.i. fry (LNS?)
13/07/96	TWV5	173	10.7	0	8	0	2	0	0	
13/07/96	TWV5	356	10.7	0	1	6	1	0	0	3 ss taken for metal samples
13/07/96	TWV5	340	10.7	0	1	16	0	0	0	5 ss taken for metal samples
13/07/96	TWV6	179	9.2	0	2	33	4	0	0	
13/07/96	TWV6	109	9.2	0	4	21	2	0	0	3 ss taken for metal samples
13/07/96	TWV6	181	5	0	8	10	0	0	0	2 ss taken for metal samples
13/07/96	TWV6	136	4.7	0	0	5	0	0	0	2 ss taken for metal samples
13/07/96	TWV6	46	4.7	0	0	0	0	0	0	
13/07/96	WO	338	12.5	2	19	32	3	0	0	7 ss taken for metal samples
13/07/96	WO	89	12.5	0	2	2	1	0	0	
13/07/96	WO	148	12.5	12	11	25	0	0	0	
13/07/96	WO	158	12.5	30	3	6	1	0	0	
14/07/96	M3	964	7.8	40	0	17	1	0	0	3 ss taken for metal samples
14/07/96	M4	249	7.6	0	0	9	0	0	5	
14/07/96	M4	195	7.6	1	0	20	0	0	5	
14/07/96	M4 (trib)	129	4.6	0	0	7	0	0	0	upper fork

Table 2. Electro-fishing Results, Wolverine Lake area - 1996

DATE	SITE	EFFORT (sec)	TEMP (c)	CATCH						comments
				AG	LT	SS	BB	LNS	DV	
14/07/96	M4 (trib)	122		0	0	0	0	0	2	
14/07/96	M4 (trib)	128	7.6	0	0	0	0	0	1	lower fork
14/07/96	M5	632		4	0	135	0	0	2	4 ss taken for metal samples
14/07/96	M5	117		143	0	26	0	0	0	
14/07/96	TLJ1	102	2.6	0	0	3	1	0	0	
14/07/96	TLJ1	177	2.6	0	1	3	0	0	0	
15/07/96	AR1	147	2.2	0	0	0	0	0	0	
15/07/96	AR1	80	2.2	0	0	0	0	0	0	
15/07/96	G1	80	4.9	0	0	1	0	0	1	
15/07/96	G1	152	4.9	0	0	4	0	0	1	1 ss taken for metal samples
15/07/96	G1	512	4.9	1	0	6	0	0	2	1 ss taken for metal samples
15/07/96	G1	175	4.9	0	0	10	0	0	1	1 ss taken for metal samples
15/07/96	M6	573	6.5	11	0	118	0	0	5	
15/07/96	M6	120	6.5	0	0	18	0	0	1	
15/07/96	M6	149	6.5	0	0	12	0	0	0	
15/07/96	M6	55	6.5	0	0	5	0	0	0	
15/07/96	M6	74	6.5	0	0	3	0	0	0	
15/07/96	M7G	88	5.1	0	0	4	0	0	0	
15/07/96	M7G	154	5.1	0	0	14	0	0	1	
15/07/96	M7G	443	7.2	6	0	59	0	0	2	4 ss taken for metal samples
15/07/96	M8	148		1	0	12	0	0	0	
15/07/96	M8	139		0	0	18	0	0	0	
15/07/96	M9	302	9.3	19	0	21	0	0	0	
15/07/96	M9	164	9.3	0	0	8	0	0	0	
15/07/96	P1	175	2.8	0	0	6	0	0	0	
16/07/96	AR3	83	3.3	0	0	0	0	0	0	
16/07/96	N4	159	8.5	0	0	11	0	0	0	1 u.i. salmonid
16/07/96	N4	214	8.5	10	0	6	0	0	0	
16/07/96	N4	432	8.5	75	0	32	0	0	0	
16/07/96	N5	52	11.9	100	0	0	1	0	0	
16/07/96	N5	213	11.9	88	0	0	1	0	0	
16/07/96	N5	122	11.9	225	0	0	1	0	0	

Table 2. Electro-fishing Results, Wolverine Lake area - 1996

DATE	SITE	EFFORT (sec)	TEMP (c)	CATCH						comments
				AG	LT	SS	BB	LNS	DV	
16/07/96	N5	196	11.9	150	0	0	1	0	0	
16/07/96	N5	297	11.9	83	0	0	2	0	0	
16/07/96	N5	120	11.9	0	0	7	1	0	0	
16/07/96	N5	20	11.9	60	0	0	0	0	0	
16/07/96	N5	112	11.9	6	0	14	3	0	0	
16/07/96	TN1	148	2	0	0	0	0	0	0	
16/07/96	TWV	109	3.4	0	0	0	0	0	0	
16/07/96	WND	163	16.1	91	0	19	0	0	0	
16/07/96	WND	75	16.1	2000	0	0	0	0	0	
17/07/96	G2	447	5.3	3	0	0	0	0	0	
17/07/96	G3	232	4.1	0	0	0	0	0	0	
17/07/96	G4	90	4.7	0	0	0	0	0	0	
17/07/96	G5	209	2.7	0	0	0	0	0	0	
17/07/96	HO1	244	3.6	0	0	0	0	0	0	
25/09/96	G1	89	1.2	0	0	0	0	0	0	
25/09/96	M7G	159	1.1	0	0	25	0	0	0	
25/09/96	M7G	183	1.1	0	0	5	0	0	1	
25/09/96	N2	165	2.5	15	0	0	0	0	0	
25/09/96	N2	371	2.5	19	0	17	0	0	0	
25/09/96	N2	154	2.5	4	0	2	0	0	0	

Table 3. Angling Results, Wolverine Lake area, 1996.

Date (d/m/yr)	Site	Temp (C)	Effort (min)	Catch		Comments
				Arctic grayliing	Lake trout	
13/07/96	WO	12.5	7	2	2	grayling in riffles, trout above riffles
13/07/96	TWV5	10.7	15	4	0	
13/07/96	TWV6	9.2	40	2	4	
13/07/96	TWV3		15	0	3	lake at outlet area
14/07/96	M3	7.8	20	3	0	
14/07/96	LJ		15	1	1	
16/07/96	N4	8.5	15	7	0	
16/07/96	WO		22	3		taken for metal samples
16/07/96	WND	16.1	5	0	0	
16/07/96	WI		60	3	8	2 grayling taken for metal samples
17/07/96	M6		25	4	0	
23/09/96	WO	5	7	2	2	
24/09/96	WO	5	15	10	0	
24/09/96	WI		20	0	0	
24/09/96	LJ	6.4	40	0	16	
24/09/96	LWV		25	0	2	
14/06/96	WC	8.9	52	0	10	
16/06/96	M1	14	50	0	0	
14/06/96	LJ	5.9	3	0	1	
14/06/96	LJ	5.9	1	0	1	
16/06/96	N1	7.7	2	5	0	
23/09/96	WLV		20	0	0	near island
24/09/96	WLV		20	0	0	near island
24/09/96	WLV		20	0	0	spawning site east
24/09/96	WLV		40	0	7	spawning site west
25/09/96	N2		5	2	0	below culverts
25/09/96	Frances Lake		70	0	0	

Table 4. SEINE NETTING RESULTS, WOLVERINE LAKE AREA, 1996.

DATE	SITE	TEMP (c)	EFFORT (m2)	DEPTH (avg.)	CATCH				
(d/m/yr)					AG	LT	SS	BB	DV
11/06/96	M1	6.6	25		0	0	1	0	0
11/06/96	M1	6.4	40		0	0	1	0	0
11/06/96	M1		35		0	0	1	0	0
11/06/96	M1		35		0	0	0	0	0
11/06/96	M1		25		0	0	0	0	0
15/06/96	WO	10.2	20		0	1	1	0	0
15/06/96	WO	10.2	25		0	4	2	0	0
15/06/96	WO	10.2	12		2	0	2	0	0
12/07/96	WI	13.6	50	0.4	114	3	4	0	0
12/07/96	TLW1	3.7	25	0.1	0	0	0	0	0
13/07/96	TWV6	5	42	0.4	0	0	0	0	0
13/07/96	TWV6	5	27	0.4	0	2	1	0	0
13/07/96	TWV6	9.2	84	0.7	4	1	3	0	0
14/07/96	M4 (trib)	7.6	15	0.35	0	0	0	0	0
14/07/96	M4	7.6	30	0.2	0	0	0	0	0
14/07/96	M5		36	0.9	2	0	1	0	0
15/07/96	WI	10.2	20		0	1	0	0	0
15/07/96	WI	10.2	25		0	4	0	0	0
15/07/96	WI	10.2	10		2	0	2	0	0

DATE	SITE	TEMP (c)	EFFORT (m2)	DEPTH (avg.)	CATCH				
(d/m/yr)					AG	LT	SS	BB	DV
16/06/96	N1	8.9	20		0	0	2	0	0
16/06/96	N1	8.9	15		0	0	11	0	0
16/06/96	N2	9.8	32		0	0	0	0	0
16/06/96	N2	9.8	18		0	0	0	0	0
16/06/96	N2	9.8	40		0	0	6	0	0

Table 5. Master Sample Records, Wolverine Lake Area, 1996.

Location	Species	Species code	Date (m/d/yr)	Method	Site	Fork Length (mm)	Round Weight (g)	Comments	sex/mat	stomach
WOLVERINE LAKE	**Arctic grayling**	AG	16/07/96	ANG	WI	344	300		mature male	
(includes inlet and outlet)		AG	16/07/96	ANG	WI	321	250		mature male	ants=6
		AG	13/06/96	ANG	WO	394	650			
		AG	13/06/96	ANG	WO	417	800			
		AG	13/06/96	ANG	WO	408	750			
		AG	16/07/96	ANG	WO	384	500		mature male	
		AG	16/07/96	ANG	WO	388	525		mature male	
		AG	16/07/96	ANG	WO	470				
		AG	23/09/96	ANG	WO	350				
		AG	23/09/96	ANG	WO	395				
		AG	14/06/96	ELS	WC	82				
		AG	13/07/96	ELS	WO	23				
		AG	13/07/96	ELS	WO	41				
		AG	13/07/96	ELS	WO	35				
		AG	13/07/96	ELS	WO	34				
		AG	13/07/96	ELS	WO	31				
		AG	13/07/96	ELS	WO	30				
		AG	13/07/96	ELS	WO	125				
		AG	13/07/96	ELS	WO	280				
		AG	12/06/96	GL	WLV10	296	300			
		AG	12/06/96	GL	WLV10	360	650			
		AG	12/06/96	GL	WLV10	399	750			
		AG	12/06/96	GL	WLV10	357	475			
		AG	12/06/96	GL	WLV10	317	325			
		AG	12/06/96	GL	WLV10	272	200			
		AG	12/06/96	GL	WLV10	387	675			
		AG	12/06/96	GL	WLV10	279	275			
		AG	12/06/96	GL	WLV10	342	500			
		AG	12/06/96	GL	WLV10	263	275			
		AG	12/06/96	GL	WLV10	479	650			
		AG	12/06/96	GL	WLV11	378	600			
		AG	12/06/96	GL	WLV11	386	675			
		AG	13/06/96	GL	WLV12	380	675			
		AG	13/06/96	GL	WLV12	405	700			
		AG	13/06/96	GL	WLV12	317	350			
		AG	13/06/96	GL	WLV12	300	250			
		AG	13/06/96	GL	WLV12	290	300			
		AG	13/06/96	GL	WLV12	309	375			
		AG	13/06/96	GL	WLV12	271	200			
		AG	13/06/96	GL	WLV13	366	575			
		AG	13/06/96	GL	WLV13	292	250			
		AG	13/06/96	GL	WLV13	389	650			
		AG	13/06/96	GL	WLV13	334	500			
		AG	13/06/96	GL	WLV13	416	800			
		AG	13/06/96	GL	WLV13	380	600			
		AG	13/06/96	GL	WLV13	382	625			
		AG	13/06/96	GL	WLV13	370	600			
		AG	13/06/96	GL	WLV14	410	700			
		AG	13/06/96	GL	WLV14	410	775			
		AG	13/06/96	GL	WLV14	410	775			
		AG	13/06/96	GL	WLV14	380	700			
		AG	13/06/96	GL	WLV14	389	650			
		AG	13/06/96	GL	WLV14	422	850	growth on side of body taken as sample		
		AG	13/06/96	GL	WLV14	423	800			
		AG	13/06/96	GL	WLV14	391	675	voluntering milt	male	
		AG	13/06/96	GL	WLV14	400	750			
		AG	13/06/96	GL	WLV14	387	700			
		AG	13/06/96	GL	WLV14	401	725			
		AG	13/06/96	GL	WLV14	407	700			

Location	Species	Species code	Date (m/d/yr)	Method	Site	Fork Length (mm)	Round Weight (g)	Comments	sex/mat	stomach
		AG	13/06/96	GL	WLV14	398	750			
		AG	13/06/96	GL	WLV14	402	750			
		AG	13/06/96	GL	WLV14	372	600			
		AG	13/06/96	GL	WLV16	394	700			
		AG	13/06/96	GL	WLV16	415	850			
		AG	13/06/96	GL	WLV16	355	600			
		AG	13/06/96	GL	WLV16	412	800			
		AG	13/06/96	GL	WLV16	384	700			
		AG	13/06/96	GL	WLV16	368	575			
		AG	13/06/96	GL	WLV16	399	565			
		AG	13/06/96	GL	WLV17	387	750			
		AG	13/06/96	GL	WLV17	366	600			
		AG	13/06/96	GL	WLV18	392	700			
		AG	13/06/96	GL	WLV19	403	825			
		AG	13/06/96	GL	WLV20	380	600			
		AG	15/06/96	GL	WLV25	360	525			
		AG	12/06/96	GL	WLV3	404	700			
		AG	12/06/96	GL	WLV3	389	675			
		AG	12/06/96	GL	WLV5	375	600			
		AG	12/06/96	GL	WLV8	348	575			
		AG	12/06/96	GL	WLV8	368	525	voluntering eggs	female	
		AG	12/06/96	GL	WLV8	367	675			
		AG	12/06/96	GL	WLV8	380	650			
		AG	12/06/96	GL	WLV9	412	825			
		AG	12/06/96	GL	WLV9	351	575	voluntering eggs	female	
		AG	15/06/96	SN	WI	407	700			
		AG	12/07/96	SN	WI	148				
		AG	12/07/96	SN	WI	114				
		AG	12/07/96	SN	WI	93				
		AG	12/07/96	SN	WI	131				
		AG	12/07/96	SN	WI	142				
		AG	12/07/96	SN	WI	114				
		AG	12/07/96	SN	WI	118				
		AG	12/07/96	SN	WI	109				
		AG	12/07/96	SN	WI	141				
		AG	12/07/96	SN	WI	135				
		AG	12/07/96	SN	WI	98				
		AG	12/07/96	SN	WI	138				
		AG	12/07/96	SN	WI	124				
		AG	12/07/96	SN	WI	111				
		AG	12/07/96	SN	WI	118				
		AG	12/07/96	SN	WI	108				
		AG	12/07/96	SN	WI	115				
		AG	12/07/96	SN	WI	125				
		AG	12/07/96	SN	WI	140				
		AG	12/07/96	SN	WI	118				
		AG	12/07/96	SN	WI	121				
		AG	12/07/96	SN	WI	116				
		AG	12/07/96	SN	WI	109				
		AG	12/07/96	SN	WI	94				
		AG	12/07/96	SN	WI	78				
		AG	12/07/96	SN	WI	107				
		AG	12/07/96	SN	WI	118				
		AG	12/07/96	SN	WI	127				
		AG	12/07/96	SN	WI	124				
		AG	12/07/96	SN	WI	114				
		AG	12/07/96	SN	WI	114				
		AG	12/07/96	SN	WI	111				
		AG	12/07/96	SN	WI	109				
		AG	12/07/96	SN	WI	114				
		AG	12/07/96	SN	WI	97				

Location	Species	Species code	Date (m/d/yr)	Method	Site	Fork Length (mm)	Round Weight (g)	Comments	sex/mat	stomach
		AG	12/07/96	SN	WI	107				
		AG	12/07/96	SN	WI	38				
		AG	12/07/96	SN	WI	132				
		AG	12/07/96	SN	WI	29				
		AG	12/07/96	SN	WI	41				
		AG	12/07/96	SN	WI	26				
		AG	12/07/96	SN	WI	22				
		AG	12/07/96	SN	WI	27				
		AG	12/07/96	SN	WI	23				
		AG	12/07/96	SN	WI	24				
		AG	12/07/96	SN	WI	41				
		AG	12/07/96	SN	WI	23				
		AG	12/07/96	SN	WI	24				
		AG	12/07/96	SN	WI	41				
		AG	12/07/96	SN	WI	23				
		AG	12/07/96	SN	WI	25				
		AG	12/07/96	SN	WI	24				
		AG	12/07/96	SN	WI	22				
		AG	12/07/96	SN	WI	27				
		AG	12/07/96	SN	WI	26				
		AG	12/07/96	SN	WI	26				
		AG	12/07/96	SN	WI	29				
		AG	12/07/96	SN	WI	30				
		AG	12/07/96	SN	WI	31				
		AG	12/07/96	SN	WI	18				
		AG	12/07/96	SN	WI	29				
		AG	12/07/96	SN	WI	39				
WOLVERINE LAKE	**Burbot**	BB	13/07/96	ANG	WO	138				
		BB	13/07/96	ANG	WO	142				
		BB	13/07/96	ELS	WO	245				
		BB	13/07/96	ELS	WO	93				
WOLVERINE LAKE	**Lake trout**	LT	14/06/96	ANG	WC	374	700			
		LT	14/06/96	ANG	WC	405	1000			
		LT	14/06/96	ANG	WC	387	650			
		LT	14/06/96	ANG	WC	400	725			
		LT	23/09/96	ANG	WO	400				
		LT	24/09/96	ANG	WO	428	625	on spawning site	F2	
		LT	24/09/96	ANG	WLV	400	750	on spawning site	M10	shrimp=5
		LT	24/09/96	ANG	WLV	410	925	on spawning site	M9	empty
		LT	24/09/96	ANG	WLV	415	925	on spawning site	F4	shrimp=8,snails=2
		LT	13/07/96	ELS	WO	27				
		LT	13/07/96	ELS	WO	32				
		LT	13/07/96	ELS	WO	34				
		LT	13/07/96	ELS	WO	32				
		LT	13/07/96	ELS	WO	36				
		LT	13/07/96	ELS	WO	39				
		LT	13/07/96	ELS	WO	42				
		LT	13/07/96	ELS	WO	34				
		LT	12/06/96	GL	WLV1	760	5500			
		LT	12/06/96	GL	WLV1	364	675			
		LT	12/06/96	GL	WLV10	770	6450			
		LT	12/06/96	GL	WLV10	846	7500			
		LT	12/06/96	GL	WLV10	802	6400			
		LT	12/06/96	GL	WLV10	424	900			
		LT	12/06/96	GL	WLV10	391	675			
		LT	12/06/96	GL	WLV11	423	800	metal sample #3		
		LT	12/06/96	GL	WLV11	406	825			
		LT	12/06/96	GL	WLV11	407	990			
		LT	12/06/96	GL	WLV11	382	625	metal sample #4		
		LT	12/06/96	GL	WLV11	450	950	metal sample #5		
		LT	13/06/96	GL	WLV12	471	1200			

Location	Species	Species code	Date (m/d/yr)	Method	Site	Fork Length (mm)	Round Weight (g)	Comments	sex/mat	stomach
		LT	13/06/96	GL	WLV13	405	775			
		LT	13/06/96	GL	WLV13	445	975			
		LT	13/06/96	GL	WLV13	405	800			
		LT	13/06/96	GL	WLV13	440	800			
		LT	13/06/96	GL	WLV13	420	975			
		LT	13/06/96	GL	WLV13	415	800			
		LT	13/06/96	GL	WLV14	389	700			
		LT	13/06/96	GL	WLV14	404	800			
		LT	13/06/96	GL	WLV14	394	800			
		LT	13/06/96	GL	WLV14	436	980			
		LT	13/06/96	GL	WLV14	394	750			
		LT	13/06/96	GL	WLV15	680	4200			
		LT	13/06/96	GL	WLV18	425	950			
		LT	13/06/96	GL	WLV20	388	700			
		LT	13/06/96	GL	WLV20	439	875	Sample #6		
		LT	13/06/96	GL	WLV21	414	775	Sample #7		
		LT	14/06/96	GL	WLV22	424	900			
		LT	15/06/96	GL	WLV23	87				
		LT	15/06/96	GL	WLV23	409	650			
		LT	15/06/96	GL	WLV23	431	1000			
		LT	15/06/96	GL	WLV24	437	750			
		LT	15/06/96	GL	WLV25	421	820			
		LT	15/06/96	GL	WLV25	440	1100			
		LT	15/06/96	GL	WLV25	403	750			
		LT	15/06/96	GL	WLV25	406	750			
		LT	15/06/96	GL	WLV25	417	950			
		LT	15/06/96	GL	WLV25	422	925			
		LT	12/06/96	GL	WLV3	578	2600			
		LT	12/06/96	GL	WLV3	393	800			
		LT	12/06/96	GL	WLV4	273	225	Leeches on tail		
		LT	12/06/96	GL	WLV4	172	50			
		LT	12/06/96	GL	WLV5	396	850			
		LT	12/06/96	GL	WLV7	293	250			
		LT	12/06/96	GL	WLV7	444	1050			
		LT	12/06/96	GL	WLV7	404	800			
		LT	12/06/96	GL	WLV7	411	750			
		LT	12/06/96	GL	WLV7	378	675			
		LT	12/06/96	GL	WLV8	395	675	metal sample #1		
		LT	12/06/96	GL	WLV8	458	1100			
		LT	12/06/96	GL	WLV9	345	480	metal sample #2		
		LT	12/06/96	GL	WLV9	401	725			
		LT	12/06/96	GL	WLV9	408	900			
		LT	15/06/96	SN	WI	30				
		LT	15/06/96	SN	WI	30				
		LT	15/06/96	SN	WI	30				
		LT	15/06/96	SN	WI	30				
		LT	15/06/96	SN	WI	30				
		LT	12/07/96	SN	WI	132				
		LT	12/07/96	SN	WI	41				
		LT	12/07/96	SN	WI	41				
WOLVERINE LAKE	**Slimy sculpin**	SS	13/07/96	ELS	WO	71				
		SS	13/07/96	ELS	WO	68				
		SS	13/07/96	ELS	WO	59				
		SS	13/07/96	ELS	WO	89				
		SS	13/07/96	ELS	WO	55				
		SS	13/07/96	ELS	WO	78				
		SS	13/07/96	ELS	WO	99				
		SS	15/06/96	SN	WI	31				
		SS	12/07/96	SN	WI	32				
		SS	12/07/96	SN	WI	37				
		SS	12/07/96	SN	WI	36				

Location	Species	Species code	Date (m/d/yr)	Method	Site	Fork Length (mm)	Round Weight (g)	Comments	sex/mat	stomach
LITTLE WOLVERINE LAKE	Arctic grayling	AG	15/06/96	GL	LWV 1	372	500			
		AG	15/06/96	GL	LWV 1	313	350			
		AG	15/06/96	GL	LWV 1	368	475			
		AG	15/06/96	GL	LWV 1	271	175			
		AG	15/06/96	GL	LWV 1	318	350			
		AG	15/06/96	GL	LWV 1	290	200			
		AG	15/06/96	GL	LWV 1	265	190			
		AG	15/06/96	GL	LWV 1	354	500			
		AG	15/06/96	GL	LWV 1	380	550			
		AG	15/06/96	GL	LWV 1	294	300			
		AG	15/06/96	GL	LWV 1	351	500			
		AG	15/06/96	GL	LWV 1	305	350			
		AG	15/06/96	GL	LWV 1	398	675			
		AG	15/06/96	GL	LWV 1	360	500			
		AG	15/06/96	GL	LWV 1	380	600			
		AG	15/06/96	GL	LWV 1	348	500			
		AG	15/06/96	GL	LWV 1	310	300			
		AG	15/06/96	GL	LWV 1	300	275			
		AG	15/06/96	GL	LWV 2	344	525			
		AG	15/06/96	GL	LWV 2	352	450			
		AG	15/06/96	GL	LWV 2	300	250			
		AG	15/06/96	GL	LWV 2	372	550			
		AG	15/06/96	GL	LWV 2	370	550			
		AG	15/06/96	GL	LWV 3	336	400	voluntering milt	male	
		AG	15/06/96	GL	LWV 3	368	500			
		AG	15/06/96	GL	LWV 3	308	300			
		AG	15/06/96	GL	LWV 3	318	325			
		AG	15/06/96	GL	LWV 3	354	400			
		AG	15/06/96	GL	LWV 3	262	200			
		AG	15/06/96	GL	LWV 3	340	400			
		AG	15/06/96	GL	LWV 3	322	300			
		AG	15/06/96	GL	LWV 3	314	300			
		AG	15/06/96	GL	LWV 3	335	375			
		AG	15/06/96	GL	LWV 3	348	400			
		AG	15/06/96	GL	LWV 3	372	650			
		AG	15/06/96	GL	LWV 3	308	350			
		AG	15/06/96	GL	LWV 3	310	300			
		AG	15/06/96	GL	LWV 3	322	325			
		AG	15/06/96	GL	LWV 3	344	400			
		AG	15/06/96	GL	LWV 3	350	450			
		AG	15/06/96	GL	LWV 3	324	325			
		AG	15/06/96	GL	LWV 3	342	375			
		AG	15/06/96	GL	LWV 3	358	450			
		AG	15/06/96	GL	LWV 3	342	425			
		AG	15/06/96	GL	LWV 3	330	400			
		AG	15/06/96	GL	LWV 4	364	450			
		AG	15/06/96	GL	LWV 4	333	400			
		AG	15/06/96	GL	LWV 4	343	475			
		AG	15/06/96	GL	LWV 4	297	300			
		AG	15/06/96	GL	LWV 4	337	400			
		AG	15/06/96	GL	LWV 4	343	400			
		AG	15/06/96	GL	LWV 4	357	475			
		AG	15/06/96	GL	LWV 4	322	350			
		AG	15/06/96	GL	LWV 4	314	300			
		AG	15/06/96	GL	LWV 4	339	375	voluntering eggs	female	
		AG	15/06/96	GL	LWV 4	326	425			
		AG	15/06/96	GL	LWV 4	295	250			
LITTLE WOLVERINE LAKE	Longnose sucker	LNS	15/06/96	GL	LWV 1	430	1000			
		LNS	15/06/96	GL	LWV 1	460	1350			

Location	Species	Species code	Date (m/d/yr)	Method	Site	Fork Length (mm)	Round Weight (g)	Comments	sex/mat	stomach
		LNS	15/06/96	GL	LWV 1	480	1400			
		LNS	15/06/96	GL	LWV 1	400	875	voluntering eggs	female	
LITTLE WOLVERINE LAKE	Lake trout	LT	24/09/96	ANG	LWV	650				
		LT	24/09/96	ANG	LWV	623	2650	on spawning site	M7	hairbal?=5
		LT	24/09/96	ANG	LWV	418	750	on spawning site	F2	shrimp=10,clams=0
		LT	24/09/96	ANG	LWV	2700				
		LT	15/06/96	GL	LWV 1	437	975			
		LT	15/06/96	GL	LWV 1	395	750			
		LT	15/06/96	GL	LWV 1	428	1000			
		LT	15/06/96	GL	LWV 1	400	925			
		LT	15/06/96	GL	LWV 1	410	900			
		LT	15/06/96	GL	LWV 1	476	1250			
		LT	15/06/96	GL	LWV 1	468	1200			
		LT	15/06/96	GL	LWV 1	429	1100			
		LT	15/06/96	GL	LWV 1	368	550			
		LT	15/06/96	GL	LWV 1	425	900			
		LT	15/06/96	GL	LWV 1	402	750	Sample # 9		
		LT	15/06/96	GL	LWV 1	462	1300			
		LT	15/06/96	GL	LWV 1	444	1100			
		LT	15/06/96	GL	LWV 2	440	800			
		LT	15/06/96	GL	LWV 2	786	6050	Sample # 8		
		LT	15/06/96	GL	LWV 2	392	775			
		LT	15/06/96	GL	LWV 2	338	425	Sample # 10		
		LT	15/06/96	GL	LWV 2	364	500			
		LT	15/06/96	GL	LWV 3	770	6500			
		LT	15/06/96	GL	LWV 3	466	900			
		LT	15/06/96	GL	LWV 3	500	1400			
		LT	15/06/96	GL	LWV 3	382	650	Sample #11		
		LT	15/06/96	GL	LWV 3	415	650			
		LT	15/06/96	GL	LWV 4	528	1450			
		LT	15/06/96	GL	LWV 4	400	800			
LITTLE JIMMY LAKE	Arctic grayling	AG	14/06/96	GL	MHL 1	249	175			
		AG	14/06/96	GL	MHL 1	334	400			
		AG	14/06/96	GL	MHL 1	322	425			
		AG	14/06/96	GL	MHL 1	299	300			
		AG	14/06/96	GL	MHL 1	285	275			
		AG	14/06/96	GL	MHL 1	274	200			
		AG	14/06/96	GL	MHL 1	262	200			
		AG	14/06/96	GL	MHL 1	289	300			
		AG	14/06/96	GL	MHL 1	341	500			
		AG	14/06/96	GL	MHL 1	306	375			
		AG	14/06/96	GL	MHL 1	362	525			
		AG	14/06/96	GL	MHL 1	272	200			
		AG	14/06/96	GL	MHL 2	330	375			
		AG	14/06/96	GL	MHL 2	n/a	350			
		AG	14/06/96	GL	MHL 2	274	200			
		AG	14/06/96	GL	MHL 2	305	450			
		AG	14/06/96	GL	MHL 2	318	450			
		AG	14/06/96	GL	MHL 2	342	450			
		AG	14/06/96	GL	MHL 2	327	400			
		AG	14/06/96	GL	MHL 2	348	525			
		AG	14/06/96	GL	MHL 2	285	300			
		AG	14/06/96	GL	MHL 2	318	350			
		AG	14/06/96	GL	MHL 2	358	450			
		AG	14/06/96	GL	MHL 2	343	450			
		AG	14/06/96	GL	MHL 3	330	500			
		AG	14/06/96	GL	MHL 3	318	450			
		AG	14/06/96	GL	MHL 3	342	525			
		AG	14/06/96	GL	MHL 3	289	250			

Location	Species	Species code	Date (m/d/yr)	Method	Site	Fork Length (mm)	Round Weight (g)	Comments	sex/mat	stomach
		AG	14/06/96	GL	MHL 3	346	500			
		AG	14/06/96	GL	MHL 4	322	325			
		AG	14/06/96	GL	MHL 4	342	400			
		AG	14/06/96	GL	MHL 4	348	375			
		AG	14/06/96	GL	MHL 4	322	350			
		AG	14/06/96	GL	MHL 4	350	400			
		AG	14/06/96	GL	MHL 4	350	450			
		AG	14/06/96	GL	MHL 4	327	475			
		AG	14/06/96	GL	MHL 4	322	450			
		AG	14/06/96	GL	MHL 4	360	450			
		AG	14/06/96	GL	MHL 5	324	350			
		AG	14/06/96	GL	MHL 5	332	425			
		AG	14/06/96	GL	MHL 5	223	100			
		AG	14/06/96	GL	MHL 5	274	200			
		AG	14/06/96	GL	MHL 5	320	300			
		AG	14/06/96	GL	MHL 5	288	200			
		AG	14/06/96	GL	MHL 5	324	400			
		AG	14/06/96	GL	MHL 5	320	325			
		AG	14/06/96	GL	MHL 5	337	375			
		AG	14/06/96	GL	MHL 5	344	375			
		AG	14/06/96	GL	MHL 5	323	325			
		AG	14/06/96	GL	MHL 5	358	450			
		AG	14/06/96	GL	MHL 5	319	325			
		AG	14/06/96	GL	MHL 5	277	250			
		AG	14/06/96	GL	MHL 5	362	450			
		AG	14/06/96	GL	MHL 5	342	450			
		AG	14/06/96	GL	MHL 5	321	350			
		AG	14/06/96	GL	MHL 5	334	320			
		AG	14/06/96	GL	MHL 5	355	550			
		AG	14/06/96	GL	MHL 5	350	400			
		AG	14/06/96	GL	MHL 5	339	400			
		AG	14/06/96	GL	MHL 5	335	350			
		AG	14/06/96	GL	MHL 5	362	450			
		AG	14/06/96	GL	MHL 5	347	450			
		AG	14/06/96	GL	MHL 6	317	300			
		AG	14/06/96	GL	MHL 6	312	300			
		AG	14/06/96	GL	MHL 6	351	450			
		AG	14/06/96	GL	MHL 6	350	400			
		AG	14/06/96	GL	MHL 6	345	500			
		AG	14/06/96	GL	MHL 6	329	450			
		AG	14/06/96	GL	MHL 6	368	500			
		AG	14/06/96	GL	MHL 6	340	425			
		AG	14/06/96	GL	MHL 6	320	325			
		AG	14/06/96	GL	MHL 6	352	400			
		AG	14/06/96	GL	MHL 6	320	400			
		AG	14/06/96	GL	MHL 6	340	420			
		AG	14/06/96	GL	MHL 6	339	400			
		AG	14/06/96	GL	MHL 6	340	425			
		AG	14/06/96	GL	MHL 6	338	475			
		AG	14/06/96	GL	MHL 6	355	450			
		AG	14/06/96	GL	MHL 6	344	400			
LITTLE JIMMY LAKE	**Lake trout**	LT	24/09/96	ANG	LJ	418	850	on spawning site	M10	empty
		LT	24/09/96	ANG	LJ	395	650	on spawning site	F5	clam=0,eggs=0,sculpin=15
		LT	24/09/96	ANG	LJ	395	700	on spawning site	F5	bettle=0,eggs=5,shrimp=15
		LT	24/09/96	ANG	LJ	400	750	on spawning site	M10	eggs=0,rocks=0
		LT	24/09/96	ANG	LJ	385	600	on spawning site	M10	eggs=5
		LT	24/09/96	ANG	LJ	410	700	on spawning site	F2	eggs=4,rocks=1
		LT	24/09/96	ANG	LJ	435	900	on spawning site	F5	plecoptra=2,rocks=4,eggs=4,snail=0
		LT	14/06/96	GL	LJ 4	472	650			
		LT	14/06/96	GL	LJ 5	652	3550			
		LT	14/06/96	GL	LJ 6	705	4800			

Location	Species	Species code	Date (m/d/yr)	Method	Site	Fork Length (mm)	Round Weight (g)	Comments	sex/mat	stomach
MONEY CREEK	Arctic grayling	AG	14/07/96	ANG	M3	365				
		AG	14/07/96	ANG	M3	240				
		AG	14/07/96	ANG	M3	290				
		AG	17/07/96	ANG	M6	430				
		AG	17/07/96	ANG	M6	405				
		AG	17/07/96	ANG	M6	370				
		AG	17/07/96	ANG	M6	365				
		AG	14/07/96	ELS	M3	26				
		AG	14/07/96	ELS	M3	26				
		AG	14/07/96	ELS	M3	24				
		AG	14/07/96	ELS	M3	18				
		AG	14/07/96	ELS	M3	27				
		AG	14/07/96	ELS	M3	26				
		AG	14/07/96	ELS	M3	30				
		AG	14/07/96	ELS	M4	98				
		AG	14/07/96	ELS	M5	23				
		AG	14/07/96	ELS	M5	19				
		AG	14/07/96	ELS	M5	18				
		AG	14/07/96	ELS	M5	19				
		AG	14/07/96	ELS	M5	22				
		AG	14/07/96	ELS	M5	21				
		AG	14/07/96	ELS	M5	24				
		AG	14/07/96	ELS	M5	24				
		AG	15/07/96	ELS	M6	18				
		AG	15/07/96	ELS	M6	102				
		AG	15/07/96	ELS	M7G	102				
		AG	15/07/96	ELS	M7G	84				
		AG	15/07/96	ELS	M7G	21				
		AG	15/07/96	ELS	M8	80				
		AG	15/07/96	ELS	M9	18				
		AG	14/07/96	SN	M5	19				
		AG	14/07/96	SN	M5	21				
		AG	14/07/96	SN	M5	22				
MONEY CREEK	Dolly varden	DV	14/07/96	ELS	M4	84				
		DV	14/07/96	ELS	M4	75				
		DV	14/07/96	ELS	M4	102				
		DV	14/07/96	ELS	M4	36				
		DV	14/07/96	ELS	M4	38				
		DV	14/07/96	ELS	M4	34				
		DV	14/07/96	ELS	M4	95				
		DV	14/07/96	ELS	M4	39				
		DV	14/07/96	ELS	M4	142				
		DV	14/07/96	ELS	M5	216				
		DV	15/07/96	ELS	M6	135				
		DV	15/07/96	ELS	M6	90				
		DV	15/07/96	ELS	M6	78				
		DV	15/07/96	ELS	M7G	75				
		DV	15/07/96	ELS	M7G	84				
		DV	15/07/96	ELS	M7G	90				
		DV	24/09/96	ELS	M7G	90				
MONEY CREEK	Slimy sculpin	SS	14/07/96	ELS	M4	20				
		SS	14/07/96	ELS	M4	20				
		SS	14/07/96	ELS	M4	20				
		SS	14/07/96	ELS	M4	20				
		SS	14/07/96	ELS	M4	40				
		SS	14/07/96	ELS	M4	80				
		SS	14/07/96	ELS	M4	80				
		SS	15/07/96	ELS	M7G	88				
		SS	15/07/96	ELS	M7G	76				

Location	Species	Species code	Date (m/d/yr)	Method	Site	Fork Length (mm)	Round Weight (g)	Comments	sex/mat	stomach
		SS	15/07/96	ELS	M7G	91				
		SS	15/07/96	ELS	M7G	71				
		SS	11/06/96	SN	M1	45				
		SS	11/06/96	SN	M1	55				
		SS	11/06/96	SN	M1	45				
		SS	11/06/96	SN	M1	47				
		SS	14/07/96	SN	M5	59				
		SS	14/07/96	SN	M5	101				
		SS	14/07/96	SN	M5	62				
		SS	14/07/96	SN	M5	80				
		SS	14/07/96	SN	M5	89				
GO CREEK	**Dolly varden**	DV	15/07/96	ELS	G1	64				
		DV	15/07/96	ELS	G1	168				
GO CREEK	**Slimy sculpin**	SS	15/07/96	ELS	G1	76				
		SS	15/07/96	ELS	G1	78				
NOUGHA CREEK	**Arctic grayling**	AG	16/07/96	ANG	N4	280				
		AG	16/07/96	ANG	N4	290				
		AG	16/07/96	ANG	N4	170				
		AG	16/07/96	ANG	N4	200				
		AG	16/07/96	ANG	N4	380				
		AG	16/07/96	ANG	N4	260				
		AG	16/07/96	ANG	N4	270				
		AG	25/09/96	ELS	N2	64				
		AG	25/09/96	ELS	N2	60				
		AG	25/09/96	ELS	N2	66				
		AG	25/09/96	ELS	N2	66				
		AG	25/09/96	ELS	N2	70				
		AG	25/09/96	ELS	N2	70				
		AG	25/09/96	ELS	N2	80				
		AG	25/09/96	ELS	N2	58				
		AG	25/09/96	ELS	N2	56				
		AG	25/09/96	ELS	N2	54				
		AG	25/09/96	ELS	N2	59				
		AG	25/09/96	ELS	N2	64				
		AG	25/09/96	ELS	N2	68				
		AG	25/09/96	ELS	N2	69				
		AG	25/09/96	ELS	N2	66				
		AG	25/09/96	ELS	N2	62				
		AG	25/09/96	ELS	N2	66				
		AG	25/09/96	ELS	N2	70				
		AG	25/09/96	ELS	N2	70				
		AG	16/07/96	ELS	N4	34				
		AG	16/07/96	ELS	N4	29				
		AG	16/07/96	ELS	N4	27				
		AG	16/07/96	ELS	N4	36				
		AG	16/07/96	ELS	N4	28				
		AG	16/07/96	ELS	N4	29				
		AG	16/07/96	ELS	N4	31				
		AG	16/07/96	ELS	N5	18				
		AG	16/07/96	ELS	N5	22				
		AG	16/07/96	ELS	N5	30				
		AG	16/07/96	ELS	N5	33				
		AG	16/07/96	ELS	N5	21				
		AG	16/07/96	ELS	N5	20				
		AG	16/07/96	ELS	N5	41				
		AG	16/07/96	ELS	N5	42				
		AG	16/07/96	ELS	N5	45				

Location	Species	Species code	Date (m/d/yr)	Method	Site	Fork Length (mm)	Round Weight (g)	Comments	sex/mat	stomach
		AG	16/07/96	ELS	N5	41				
		AG	16/07/96	ELS	N5	38				
		AG	16/07/96	ELS	N5	43				
		AG	16/07/96	ELS	N5	44				
		AG	16/07/96	ELS	N5	21				
		AG	16/07/96	ELS	N5	27				
		AG	16/07/96	ELS	N5	18				
		AG	16/07/96	ELS	N5	47				
		AG	16/07/96	ELS	N5	48				
		AG	16/07/96	ELS	N5	49				
		AG	16/07/96	ELS	N5	49				
		AG	16/07/96	ELS	N5	44				
		AG	16/07/96	ELS	N5	41				
		AG	16/07/96	ELS	N5	42				
		AG	16/07/96	ELS	N5	45				
		AG	16/07/96	ELS	N5	47				
		AG	16/07/96	ELS	N5	38				
		AG	16/07/96	ELS	N5	43				
		AG	16/07/96	ELS	N5	49				
		AG	16/07/96	ELS	N5	39				
		AG	16/07/96	ELS	N5	25				
		AG	16/07/96	ELS	N5	32				
		AG	16/07/96	ELS	N5	26				
		AG	16/07/96	ELS	N5	38				
		AG	16/07/96	ELS	N5	108				
		AG	16/07/96	ELS	N5	132				
		AG	25/09/96	VIS	N2	120				
		AG	25/09/96	VIS	N2	190				
NOUGHA CREEK	**Burbot**	BB	16/07/96	ELS	N5	115				
		BB	16/07/96	ELS	N5	132				
		BB	16/07/96	ELS	N5	108				
NOUGHA CREEK	**Longnose sucker**	LNS	16/06/96	ELS	N1	35				
NOUGHA CREEK	**Slimy sculpin**	SS	16/06/96	SN	N1	43				
		SS	16/06/96	SN	N1	22				
		SS	16/06/96	SN	N1	26				
		SS	16/06/96	SN	N1	25				
		SS	16/06/96	SN	N1	28				
		SS	16/06/96	SN	N1	23				
		SS	16/06/96	SN	N1	25				
		SS	16/06/96	SN	N1	25				
		SS	16/06/96	SN	N1	25				
		SS	16/06/96	SN	N1	22				
		SS	16/06/96	SN	N1	26				
		SS	16/06/96	SN	N1	21				
		SS	16/06/96	SN	N1	26				
		SS	16/06/96	SN	N2	50				
		SS	16/06/96	SN	N2	43				
		SS	16/06/96	SN	N2	24				
		SS	16/06/96	SN	N2	26				
		SS	16/06/96	SN	N2	26				
		SS	16/06/96	SN	N2	22				
WIND CREEK	**Arctic grayling**	AG	16/07/96	ELS	WND	121				
		AG	16/07/96	ELS	WND	26				
		AG	16/07/96	ELS	WND	28				
		AG	16/07/96	ELS	WND	32				
		AG	16/07/96	ELS	WND	32				
		AG	16/07/96	ELS	WND	43				
		AG	16/07/96	ELS	WND	45				

Location	Species	Species code	Date (m/d/yr)	Method	Site	Fork Length (mm)	Round Weight (g)	Comments	sex/mat	stomach
WIND LAKE	**Arctic grayling**	AG	23/09/96	GL	WNDL1	300				
		AG	23/09/96	GL	WNDL1	310				
		AG	23/09/96	GL	WNDL1	290				
		AG	23/09/96	GL	WNDL1	305				
		AG	23/09/96	GL	WNDL2	260				
		AG	23/09/96	GL	WNDL2	265				
		AG	23/09/96	GL	WNDL2	275				
		AG	23/09/96	GL	WNDL2	240				
		AG	23/09/96	GL	WNDL2	300				
		AG	23/09/96	GL	WNDL2	300				
		AG	23/09/96	GL	WNDL2	345				
		AG	23/09/96	GL	WNDL3	250				
		AG	23/09/96	GL	WNDL3	210				
		AG	23/09/96	GL	WNDL3	290				
		AG	23/09/96	GL	WNDL3	210				
WIND LAKE	**Longnose sucker**	LNS	23/09/96	GL	WNDL1	310	400			
		LNS	23/09/96	GL	WNDL2	380	600			
		LNS	23/09/96	GL	WNDL3	320				
WIND LAKE	**Lake trout**	LT	23/09/96	GL	WNDL1	700	5600			
TRIBUTARIES TO WOLVERINE LAKE	**Arctic grayling**	AG	13/07/96	ANG	TWV6	410				
		AG	13/07/96	ANG	TWV6	432				
		AG	13/07/96	ELS	TWV3	85				
		AG	13/07/96	ELS	TWV4	32				
		AG	13/07/96	ELS	TWV5	408				
		AG	13/07/96	ELS	TWV5	385				
		AG	13/07/96	ELS	TWV5	398				
		AG	13/07/96	ELS	TWV5	425				
		AG	13/07/96	SN	TWV6	25				
		AG	13/07/96	SN	TWV6	27				
		AG	13/07/96	SN	TWV6	29				
		AG	13/07/96	SN	TWV6	28				
TRIBUTARIES TO WOLVERINE LAKE	**Burbot**	BB	13/07/96	ELS	TWV3	92				
		BB	13/07/96	ELS	TWV3	108				
		BB	13/07/96	ELS	TWV3	86				
		BB	13/07/96	ELS	TWV5	106				
		BB	13/07/96	ELS	TWV5	86				
		BB	13/07/96	ELS	TWV5	92				
		BB	13/07/96	ELS	TWV6	96				
		BB	13/07/96	ELS	TWV6	115				
		BB	13/07/96	ELS	TWV6	88				
		BB	13/07/96	ELS	TWV6	84				
		BB	13/07/96	ELS	TWV6	87				
TRIBUTARIES TO WOLVERINE LAKE	**Longnose sucker**	LNS	13/07/96	ELS	TWV4	73				
		LNS	13/07/96	ELS	TWV4	83				
		LNS	13/07/96	ELS	TWV4	68				
		LNS	13/07/96	ELS	TWV4	71				
		LNS	13/07/96	ELS	TWV4	65				
		LNS	13/07/96	ELS	TWV4	72				
		LNS	13/07/96	ELS	TWV4	74				
		LNS	13/07/96	ELS	TWV4	79				
		LNS	13/07/96	ELS	TWV4	81				
		LNS	13/07/96	ELS	TWV4	75				
TRIBUTARIES TO WOLVERINE LAKE	**Lake trout**	LT	13/07/96	ANG	TWV6	400				
		LT	13/07/96	ANG	TWV6	440				
		LT	13/07/96	ANG	TWV6	515				
		LT	13/07/96	ANG	TWV6	410				
		LT	13/07/96	ELS	TWV5	42				
		LT	13/07/96	ELS	TWV5	41				

Location	Species	Species code	Date (m/d/yr)	Method	Site	Fork Length (mm)	Round Weight (g)	Comments	sex/mat	stomach
		LT	13/07/96	ELS	TWV5	41				
		LT	13/07/96	ELS	TWV5	42				
		LT	13/07/96	ELS	TWV5	45				
		LT	13/07/96	ELS	TWV6	39				
		LT	13/07/96	ELS	TWV6	36				
		LT	13/07/96	ELS	TWV6	34				
		LT	13/07/96	ELS	TWV6	33				
		LT	13/07/96	ELS	TWV6	64				
		LT	13/07/96	ELS	TWV6	40				
		LT	13/07/96	ELS	TWV6	37				
		LT	13/07/96	ELS	TWV6	35				
		LT	13/07/96	SN	TWV6	32				
		LT	13/07/96	SN	TWV6	34				
		LT	13/07/96	SN	TWV6	41				
TRIBUTARIES TO WOLVERINE LAKE	**Slimy sculpin**	SS	13/07/96	ELS	TWV3	51				
		SS	13/07/96	ELS	TWV3	60				
		SS	13/07/96	ELS	TWV3	83				
		SS	13/07/96	ELS	TWV3	62				
		SS	13/07/96	ELS	TWV5	66				
		SS	13/07/96	ELS	TWV5	64				
		SS	13/07/96	ELS	TWV5	56				
		SS	13/07/96	ELS	TWV5	71				
		SS	13/07/96	ELS	TWV5	63				
		SS	13/07/96	ELS	TWV5	71				
		SS	13/07/96	ELS	TWV5	61				
		SS	13/07/96	ELS	TWV5	68				
		SS	13/07/96	ELS	TWV6	51				
		SS	13/07/96	ELS	TWV6	58				
		SS	13/07/96	ELS	TWV6	60				
		SS	13/07/96	ELS	TWV6	58				
		SS	13/07/96	ELS	TWV6	75				
		SS	13/07/96	ELS	TWV6	63				
		SS	13/07/96	ELS	TWV6	68				
		SS	13/07/96	ELS	TWV6	61				
		SS	13/07/96	ELS	TWV6	61				
		SS	13/07/96	SN	TWV6	57				
		SS	13/07/96	SN	TWV6	37				
		SS	13/07/96	SN	TWV6	41				
		SS	13/07/96	SN	TWV6	42				
TRIBUTARIES TO LITTLE WOLVERINE LAKE	**Burbot**	BB	12/07/96	ELS	TLW1	105				
		BB	12/07/96	ELS	TLW4	88				
	Lake trout	LT	12/07/96	ELS	TLW4	42				
		LT	12/07/96	ELS	TLW4	36				
TRIBUTARIES TO LITTLE WOLVERINE LAKE	**Slimy sculpin**	SS	12/07/96	ELS	TLW1	80				
		SS	12/07/96	ELS	TLW1	84				
		SS	12/07/96	ELS	TLW1	91				
		SS	12/07/96	ELS	TLW1	63				
		SS	12/07/96	ELS	TLW1	56				
		SS	12/07/96	ELS	TLW2	73				
		SS	12/07/96	ELS	TLW2	81				
		SS	12/07/96	ELS	TLW2	75				
TRIBUTARIES TO LITTLE JIMMY LAKE	**Burbot**	BB	14/07/96	ELS	TLJ1	82				
	Lake trout	LT	14/07/96	ELS	TLJ1	91				

Table 6 . Number of Visual Observations of Fish in the Wolverine Lake Area, 1996.

Date	Site	Species				
(d/m/yr)		lake trout	Arctic grayling	longnose sucker	dolly varden	Unidentified
13/06/96	WC		20			
13/06/96	WO	1	37			
14/06/96	WC					100
15/06/96	WI		200+			
13/07/96	TWV4		30	95		
13/07/96	TWV5		5			
16/07/96	WND		2000+	2000		
17/07/96	M6				1	
24/09/96	WI		1			
25/09/96	N2		2			

Table A Sampling period,number of gillnet sets,and surface water temperatures at sampling locations during gillnetting surveys wolverine lake,1996.

Lake	Sampling Period	Number of net sets	Surface Temperature © at Sample Locations		
			Average	Maximum	Minimum
Wolverine	June 12 - 15, 1996	24.5	4.8	6.8	3.1
Little Wolverine	15-Jun-96	4	7.9	8.9	7.5
Little Jimmy	14-Jun-96	6	5.8	6.2	5.4

Table B Mean fork lengths and weights of lake trout and Arctic grayling captured during index gillnetting, spring 1996.

Lake	Sample size		Mean Fork Length (mm)		Mean Weight (gm)	
	Lake Trout	Arctic Grayling	Lake Trout	Arctic Grayling	Lake Trout	Arctic Grayling
Wolverine	57	63	431.6	370.8	1263.1	603.4
Little Wolverine	25	57	453	333.2	1344	395.9
Little Jimmy	3	79	609.7	325.4	3000	381.2

Table C Catch/Effort statistics (CPUE) generated from index gillnetting results , spring 1996.

Lake	Number captured per Gillnet Hour		Kilograms Captured per Gillnet Hour	
	Lake Trout	Arctic Grayling	Lake Trout	Arctic Grayling
Wolverine	2.3	2.57	2.94	1.55
Little Wolverine	6.25	14.25	8.4	5.6
Little Jimmy	0.5	13.2	1.5	5

APPENDIX 1

Complete General Descriptions of Creeks Crossed by the Two Possible Access Roads to the Wolverine Property

(Based on data collected on June 23- 26, July 29-31, and September 14-17,1997)

Site:	**TeastL (TE)**
Location:	S.E. end East Lake
Aspect:	South
Date Sampled:	25/06/97
Cover:	100% Willow filled draw
Photos:	Plate 1
Comments:	Creek has no apparent above ground flow. Possible ground flow enters TWND1 before entering the wetland area associated with East Lake.
Fish:	Zero fish habitat.

Site:	**TW1**
Lat/Long:	61°30.52 N / 130°25.48 W
Location:	outlet of Creek to Wind Lake
Aspect:	South East
Date Sampled:	23/06/97
Average Depth:	0.5 m
Average Width	3 m
Average Velocity:	>0 m/s
Temperature:	10.2 °C
Substrate:	sand and sorted gravels in main flow, silt in adjacent slow water
Banks:	abrupt up to 3 m high, mud banks
Cover:	60% willow
Vegetation:	Willow, Dwarf birch and sedges
Channel:	glides with slow pools
Photos:	Plates 2, 3, 4, 5
Comments:	Outlet has several ponds associated along the lake shore. beaver present
Fish:	Numerous adult Arctic grayling in creek and occasional slimy sculpin and long nose sucker.

Site:	**TW1**
Location:	30m u/s of Wind Lake to 300 m u/s of Wind Lake
Date Sampled:	30/07/97
Average Depth:	0.4 m
Average Width:	1.2 m
Average Velocity:	>0.25 m/s
Temperature:	7.9 °C
Substrate:	mostly silt, some gravel
Channel:	even, slow glide
Comments:	three old beaver dams have created a series of ponds, sporadic patches of pea gravel may provide spawning sites for grayling
Fish:	many (65+) grayling juvenile/ sub adults and fry.

Site:	**TW1**
Location:	30m u/s of Wind Lake to 300 m u/s of Wind Lake.
Date:	14/09/97
Substrates:	a new layer of organic silts covers all substrates, including in flow areas.
Fish:	abundant Arctic grayling fry

Site:	**TW2**
Lat/Long:	61°30.51 N / 130°24.06 W
Location:	Outlet to Wind Lake
Aspect:	South
Date:	25/06/97
Average Depth:	0.5 m
Average Width:	0.3 m
Average Velocity:	< 0.3 m/s
Temperature:	0.8°C
Substrate:	silted sand and gravel
Banks:	incised silt and sand 0.2 m high
Cover:	100% willow choked within 30 m of Wind Lake
Channel:	above 35 m from lake narrow and incised, below 1-3 m wide flooded pools
Photos:	Plates 6, 7, 8, 9
Comments:	Zero fish habitat above 30 m from lake
Fish:	Sub adult Arctic grayling adjacent to lake

Site:	**TW2**
Location:	outlet area at Wind Lake
Date:	30/07/97
Average Depth:	0.4 m
Average Width:	0.75 m
Average Velocity:	>0 m/s
Temperature:	1.2°C
Vegetation:	willow/sedge
Cover:	15% willow/sedge to 100% willow by 35 m u/s
Channel:	first 35 m is glide in lake influence area, then to riffle in narrow confined channel (velocity is >1 m/sec above 35 m)
Comments:	creek narrows 35 m from lake to 0.3 m wide into sedge / willow draw
Fish:	very limited fish habitat u/s of 35 m

Site:	**WO**
Location:	Mouth of Nougha Creek at Wolverine Lake
Date:	25/06/97
Average Depth:	0.5 m
Average Width:	12 m
Average Velocity:	> 1 m/s

Temperature:	11.2°C
Substrate:	cobble / gravel with occasional boulders
Banks:	abrupt rising 0.6 m above water level
Cover:	15% willow alder along shorelines only
Channel:	Mostly Glide / reach ends with first riffles
Comments:	see previous surveys
Fish:	numerous grayling adult/ sub-adult, lake trout fry and juvenile., slimy sculpin, burbot

Site:	**WO**
Date:	29/07/97
Fish:	Arctic grayling adults, juvenile and post fry, lake trout adults, juveniles and fry, longnose sucker juveniles, slimy sculpin.

Site:	**WO**
Date:	17/09/97
Fish:	Arctic grayling adults (numerous), juvenile and fry, lake trout adults, burbot juveniles, long nose sucker juveniles and slimy sculpin

Site:	**TN1**
Lat/Long:	61°30.11 N / 130°19.01 W
Location:	Outlet to Nougha Creek
Aspect:	South East
Date:	25/06/97
Average Depth:	0.15 m
Average Width:	0.5 m
Average Velocity:	1 m/s
Temperature:	5.6 °C
Substrate:	90 % gravel / 10 % boulders
Banks:	tight and confined in places, undefined in others with flow through grass and trees
Cover:	willow
Channel:	mostly fast riffles with the occasional boulder pool
Photos:	Plates 10, 11
Comments:	2 trails cross the creek 30 and 40 m from Nougha Creek, some gravel has become exposed on the trails and has developed into shallow riffles.
Fish:	Zero observed / poor and limited fish habitats

Site:	**TN1-1**
Location:	outlet at Nougha Creek u/s for 20 m
Date:	29/07/97
Average Depth:	0.05 m
Average Width:	0.35 m
Average velocity:	>1 m/s

Temperature:	4.5 °C
Substrate:	gravel/boulder, occasional cobble
Fish:	none captured or observed

Site:	**TN1-2**
Location:	trail crossing 30to 40 meters u/s from Nougha
Date:	29/07/97
Average Depth:	0.05 m
Average Width:	0.35 m
Average Velocity	>1 m/s
Temperature:	4.5 °C
Substrate:	40 % cobble/ 60% gravel
Banks:	open roadway with shallow sandy edges
Vegetation:	sedge, with willows adjacent to roadway
Fish:	none captured or observed

Site:	**TN1**
Location:	outlet to Nougha Creek u/s for 20 m
Date:	17/09/97
Temperature:	0.9°C
Fish:	none recorded

Site:	**TN2**
Location:	Outlet to Nougha Creek
Aspect:	South
Date:	25/06/97
Substrate:	organics
Banks:	undefined
Cover:	100%willow/alder
Channel:	overland seepage
Photos:	Plates 12, 13, 14, 15
Comments:	Channel not defined, flow apparent only were it parallels Nougha Creek for 20 m, spills over banks over 5 m reach with no distinct outlet.
Fish:	Zero fish habitat

Site:	**TN2**
Location:	uppermost winter road crossing
Date:	17/09/97
Comments:	Creek channel crossing roadway is fed by ground welling approximately 1 m upstream of the roadway.

Site:	**TN3**
Lat/Long:	61°30.42 N / 13°18.78 W
Location:	Outlet to Nougha Creek
Aspect:	East
Date:	25/06/97
Average Depth:	0.3 m
Average Width:	0.75 m
Average Velocity	1 m/s
Temperature:	3.0 °C
Substrate:	heavily silted with clayey sands
Banks:	mossy 0.5 m high, well defined
Cover:	100% willow above 10 m outlet are
Channel:	outlet is smooth glide/ above creek flows as fast riffle
Photos:	Plates 16, 17
Comments:	crossed by 2 roadways40m from Nougha, large ice builds at upper roadway, entry to Nougha creates good eddy pools up and d/s of outlet
Fish:	None observed, has potential especially near outlet

Site:	**TN3**
Location:	outlet area at Nougha Creek
Date:	29/07/97
Average Depth:	0.35 m
Average Width:	0.8 m
Average Velocity:	<1 m/s
Temperature:	3.8 °C
Fish:	2 Arctic grayling post fry in d/s influence area

Site:	**TN3**
Date:	17/09/97
Temperature:	1.1 °C
Fish:	Arctic grayling juveniles/ post fry within 20 m of Nougha Creek

Site:	**TN7**
Lat/Long:	61°33.55 N / 130°14.15 W
Location:	Outlet to Nougha Creek
Aspect:	North
Date:	24/06/97
Average Depth:	0.35 m
Average Width:	4 m
Average Velocity:	0 m/s
Temperature:	12.7 °C
Substrate:	Silt, organic debris and occasional boulder
Banks:	flooded
Cover:	30% willow

Channel:	Back filled with water from Nougha Creek., small discernible above ground flow
Photos:	Plates 18, 19, 20
Comments:	Above ground flow appears as seepage from adjacent areas
Fish:	Does not provide fish habitat other than flood bay adjacent to Nougha Creek, 1 grayling juvenile.

Site:	**TN8**
Lat/Long:	61°33.44 N / 130°14.24 W
Location:	Outlet to Nougha Creek
Aspect:	North
Date:	24/06/97
Average Depth:	0.2 m
Average Width:	0.8 m
Average Velocity:	> 2 m/s
Temperature:	2.2 °C
Substrate:	cobble boulder with occasional log
Banks:	pinched and confined, incised
Cover:	100% willow
Channel:	Riffle/rapid
Photos:	Plates 21, 22, 23
Comments:	Channel remains narrow until entering Nougha Creek, Zone of influence greatly reduced by swift current in Nougha Creek.
Fish:	Zero fish observed, very limited habitat, limited access due to velocities

Site:	**TN9-1**
Lat/Long:	61°32.57 N / 130°14.96 W
Location:	Outlet to Nougha Creek
Aspect:	North
Date:	24/06/97
Average Depth:	0.4 m
Average Width:	1 m
Average Velocity:	0.1 m/s
Temperature:	3.2 °C
Substrate:	bedrock and boulders
Banks:	moss covered
Cover:	20% willow
Channel:	Waterfall within 1 m of Nougha, slope greater than 30 % for 20 m
Photos:	Plates 24, 25, 26, 27
Comments:	Waterfall poses major and permanent barrier to fish passage, no outlet area habitat
Fish:	None observed, extremely limited habitat

Site:	**TN9-2**
Location:	80m u/s of outlet to Nougha Creek
Aspect:	north
Date:	30/07/97
Average Depth:	0.1 m
Average Width:	0.5 m
Average Velocity:	>2 m/s
Temperature:	4.1 °C
Substrate:	95% cobble/ 5% boulder
Banks:	steep, mossy, incised banks
Vegetation:	willow/moss
Cover:	100% willow
Channel:	high velocity riffle
Comments:	minimal fish habitat
Fish:	no fish captured or observed

Site:	**TN10-1**
Lat/Long:	61°32.56 N / 130°15.15 W
Location:	Outlet to Nougha Creek u/s for 15m
Aspect:	North
Date:	24/06/97
Average Depth:	0.5 m
Average Width:	0.5 m
Average Velocity:	1 m/s
Temperature:	2.0 °C
Substrate:	Boulders
Banks:	constricting and confining above 15 m from Nougha
Cover:	100% willow above 15 m from Nougha
Channel:	Fast flowing riffle
Photos:	Plate 28
Comments:	potential fish habitat in first 15 m from Nougha. Very limited above constriction.
Fish:	Zero observed

Site:	**TN10-2**
Lat/Long:	61°32.54 N / 130°15.03 W
Location:	15 to 40 m u/s of Nougha
Aspect:	north
Date:	30/07/97
Average Depth:	0.5 m
Average Width:	0.3 m
Average Velocity:	>1 m/s
Temperature:	2.4 °C
Substrate:	silt with occasional boulders

Banks:	incised
Vegetation:	willow
Cover:	100% willow
Channel:	fast, narrow and deep, some undercut banks, riffle : rapid ratio = 10:1
Photos:	Plate 29
Fish:	Zero observed

Site:	**TN10**
Location:	Nougha Creek at outlet of TN10
Aspect:	north
Date:	30/07/97
Average Depth:	0.35 m
Average Width:	14 m
Average Velocity:	1 m/s
Temperature:	14.1 °C
Substrate:	40% cobble/ 40% boulder/ 20% gravel
Banks:	stable, 50% slope with rise of 0.5m
Vegetation:	sedge/willow
Cover:	5% willow
Channel:	mainly riffle, two islands present
Fish:	juvenile grayling

Site:	**TN10-1**
Date:	14/09/97
Temperature:	3.0 °C
Fish:	Arctic grayling juveniles in TN10 zone of influence of Nougha Creek.

Site:	**VB1**
Lat/Long:	61°30.31 N / 130°09.80 W
Location:	500 m reach below 2 headwater tributaries that form Van Bibber Creek
Aspect:	East
Date:	25/06/97
Average Depth:	0.2 m
Average Width:	5 m
Average Velocity:	0.75 m/s
Temperature:	2.7 °C
Substrate:	80 % boulder / 20 % cobble / trace gravel
Banks:	shallow but well defined, moss covered
Cover:	None
Channel:	riffle with occasional pool forming behind boulders
Photos:	Plates 30, 31, 32, 33
Comments:	Very low conductivity ELS at 600 v, large aufies build up at confluence area
Fish:	None observed

Site:	**TVB1**
Lat/Long:	61°30.28 N / 130°09.85 W
Location:	immediately above confluence with other feeder to Van Bibber Creek
Aspect:	North East
Date:	25/06/97
Average Depth:	0.3 m
Average Width:	0.8 m
Average Velocity:	> 1 m/s
Temperature:	2.4 °C
Substrate:	60 % boulder/ 35 % cobble / 5 % gravel
Banks:	incised well defined
Cover:	100% willow
Channel:	mostly stepped riffles
Fish:	No fish observed

Site:	**TVB1**
Location:	500 m reach below confluence
Date:	31/07/97
Average Depth:	0.15 m
Average Velocity:	1 m/s
Temperature:	4.4 °C
Substrate:	cobble/boulder
Vegetation:	willow/moss
Channel:	stepped riffle
Fish:	none observed or captured

Sites:	**VB, TVB1,and TVB2**
Date:	14/09/97
Temperature:	2.2 °C
Fish:	None recorded

Site:	**TWV1**
Lat/Long:	61°26.69 N / 130°10.88 W
Location:	Outlet to Wolverine Lake
Aspect:	South West
Date:	26/06/97
Average Depth:	0.2 m
Average Width:	1.2 m
Average Velocity:	< 1 m/s
Temperature:	3.1 °C
Substrate:	80 % gravel / 10 % cobble / 10 % sand
Banks:	well defined
Cover:	70- 100 % willow
Channel:	90 % riffle 10% pooling

Photos:	Plates 34, 35
Comments:	10 m from lake channel narrows to 0.5 m width
Fish:	Slimy sculpin near outlet

Site:	**TWV1**
Location:	outlet to Wolverine Lake u/s for 30 m
Date:	30/07/97
Average Depth:	0.15 m
Average Width:	0.6 m
Average Velocity:	<2 m/s
Temperature:	4.7 °C
Substrate:	40% cobble / 50% gravel / 10% boulder
Vegetation:	willow/moss
Cover:	50% willow for first 10 m then to 100% willow
Fish:	Many grayling and lake trout fry in zone of influence of lake

Site:	**TWV1**
Location:	outlet to Wolverine Lake u/s for 30 m
Date:	16/09/97
Temperature:	1.2 °C
Fish:	Slimy sculpin and one post fry Arctic grayling in creek, numerous Arctic grayling and occasional lake trout fry in creek influence zone of lake.

Site:	**TWV2**
Lat/Long:	61°27.54 N / 130° 13.90 W
Location:	Outlet to Wolverine Lake
Aspect:	South West
Date:	26/06/97
Average Depth:	0.2 m
Average Width:	0.4 m
Average Velocity:	1 m/s
Temperature:	1.0 °C
Substrate:	50 % sand / 50 % gravel
Banks:	mossy 50% slope rise 1 m
Cover:	100 % willow
Channel:	incised and very small
Photos:	Plate 36
Comments:	Limited habitat with poor cover
Fish:	None observed

Site:	**TWV3**
Lat/Long:	61° 28.34 N / 130° 16.70 W
Location:	Outlet into Wolverine Lake
Aspect:	South West

Date:	26/06/97
Average Depth:	0.35 m
Average Width:	1 m
Average Velocity:	< 0.5 m/s
Temperature:	1.1 °C
Substrate:	silted sand/ gravel with much submerged willow
Banks:	abrupt and defined rise 0.5 to 1 m
Cover:	0 for first 20 m from lake
Channel:	4:1 pool : riffle
Photos:	Plates 37, 38
Comments:	shelf ice along creek edge, good cover and habitats in lowest 20 m before lake
Fish:	Lake trout fry, slimy sculpin, and burbot

Site:	**TWV3**
Location:	outlet to Wolverine Lake u/s for 40m
Date:	29/07/97
Average Depth:	0.4 m
Average Width:	1 m
Average Velocity:	< 0.25 m/s
Temperature:	4.7 °C
Substrate:	silt/sand
Channel:	100% glide below 40 m, pool / riffle 1:1 above 40m
Fish:	lake trout fry and slimy sculpin captured

Site:	**TWV3**
Location:	outlet to Wolverine Lake u/s for 40 m
Date:	17/09/97
Temperature:	1.0 °C, Wolverine Lake temp. 8.5 °C
Fish:	14 Arctic grayling juveniles, 1 burbot juvenile, and 6 slimy sculpin.

Table 1 Seine Netting Results from the Wolverine Lake Area, 1997

DATE (d/m/yr)	SITE	TEMP (^{o}C)	EFFORT (m^2)	CATCH						COMMENTS / COORDINATES
				AG	LT	SS	BB	DV	LNS	
23/06/97	TW1	10.2	42	6	0	0	0	0	0	
23/06/97	TW1	10.2	56	23	0	1	0	0	0	
25/06/97	WO	13.2	100	300+	1	0	0	0	0	
26/06/97	TWV3	1.1	49	0	3	4	1	0	0	
30/07/97	TW1		21	3	0	5	0	0	0	
30/07/97	TW1		6	0	0	1	0	0	1	
30/07/97	TN10 (@ Nougha)		28	0	0	0	0	0	0	
30/07/97	TN10 (@ Nougha)		28	1	0	0	0	0	0	
30/07/97	TWV1 (in lake)		84	4	0	0	0	0	0	
30/07/97	TWV1 (in lake)		70	68	16	0	0	0	0	
29/07/97	WO		77	144	0	0	0	0	0	
29/07/97	WO		40	13	0	0	0	0	0	
29/07/97	TWV3		49	3	0	0	0	0	0	
30/07/97	TWV1 (in lake)		70	3	2	0	0	0	0	
14/09/97	N-TN10		45	11	0	0	0	0	0	
14/09/97	WLVLK		105	19	0	2	0	0	0	
14/09/97	WLVLK		84	9	1	0	0	0	0	
16/09/97	M		90	0	0	6	0	0	0	
16/09/97	M		84	0	0	0	0	0	0	
16/09/97	M		42	0	0	0	0	0	0	
16/09/97	M		56	0	0	0	0	0	0	
16/09/97	M		60	0	0	2	0	0	0	
16/09/97	M		40	0	0	1	0	0	0	
16/09/97	M5		224	0	0	1	0	0	0	
16/09/97	M		70	0	0	0	0	0	0	61.18.42; 130.01.18
16/09/97	M		105	0	0	0	0	0	0	61.18.42; 130.01.18
16/09/97	M		63	0	0	0	0	0	0	61.18.42; 130.01.18
16/09/97	M		98	0	0	0	0	0	0	61.18.42; 130.01.18
16/09/97	M		60	0	0	0	0	0	0	61.23.13; 129.54.31
16/09/97	M		40	0	0	0	0	0	0	61.23.13; 129.54.31
16/09/97	M		50	0	0	0	0	0	0	61.23.13; 129.54.31
16/09/97	M6		21	0	0	0	0	0	0	
16/09/97	M5		30	0	0	0	0	0	0	
16/09/97	M5		66	0	0	0	0	0	0	
16/09/97	M		98	0	0	0	0	0	0	
16/09/97	M		60	0	0	0	0	0	0	
16/09/97	M		40	0	0	0	0	0	0	

* Species code: AG= Arctic grayling, LT= lake trout, SS= slimy sculpin, BB= burbot, DV= dolly varden/bull trout
LNS= longnose sucker.

Table 2 Summary of Results from Minnow Trapping in the Wolverine Lake Area, 1997

DATE SET (d/m/yr)	SITE	TIME SET	TIME PULLED	EFFORT (hrs)	CATCH *	
					DV	SS
14/09/97	TWLV1	16:25	18:30	50	0	0
15/09/97	G-1	10:16	9:20	23	0	0
15/09/97	G-2	10:20	9:20	23	0	0
15/09/97	G-3	10:25	9:25	23	0	0
15/09/97	G-4	10:30	9:25	23	0	0
15/09/97	G-5	10:37	9:25	23.2	0	0
15/09/97	M1	10:45	9:10	22.5	0	0
15/09/97	M2	10:45	9:10	22.5	0	0
15/09/97	M3	11:15	9:35	22.3	0	0
15/09/97	M4	11:20	9:35	22.25	0	0
15/09/97	M5	11:30	9:40	22.2	0	0
15/09/97	M6	11:45	10:00	22.25	0	0
15/09/97	M7	11:55	10:05	22.2	1	0
15/09/97	M	12:00	10:15	22.25	0	0
15/09/97	M	12:15	10:20	22	0	0
15/09/97	M	12:20	10:20	22	0	0
15/09/97	M	12:25	10:20	22	1	0
15/09/97	M	12:30	10:30	22	0	0
15/09/97	M	12:35	10:35	22	0	0
15/09/97	M	12:40	10:15	21.5	0	0
16/09/97	CkM4	15:40	9:40	42	0	0
16/09/97	CkM4	15:50	9:45	42	0	0
16/09/97	CkM4	15:50	9:45	42	0	0
16/09/97	CkM4	15:55	9:50	42	0	0
16/09/97	M4	16:00	9:50	41.8	0	0
16/09/97	M4	16:05	9:55	41.8	0	0
16/09/97	M4	16:10	9:55	41.75	0	0
16/09/97	M4	16:15	10:00	41.75	0	1
16/09/97	M4	16:20	10:00	41.6	0	0
16/09/97	M4	16:25	10:00	41.6	0	0
16/09/97	M4	16:25	10:05	41.6	0	0
16/09/97	M4	16:30	10:05	41.6	0	0
16/09/97	M4	16:35	10:10	41.5	0	0
16/09/97	M4	16:40	10:10	41.5	0	0
16/09/97	M4	16:45	9:35	40.8	0	0
16/09/97	M4	16:45	9:35	40.8	0	0

* Species code: SS= slimy sculpin, DV= dolly varden/bull trout

Table 3. Summary of Electro-fishing Results, Wolverine Lake Area - 1997

DATE	SITE	EFFORT (sec)	CATCH *						COMMENTS
			AG	LT	SS	BB	LNS	DV	
25/06/97	VB1	868	0	0	0	0	0	0	
25/06/97	TVB1	81	0	0	0	0	0	0	
25/06/97	TW2	174	5	0	0	0	0	0	AG = subadult
25/06/97	TN1	63	0	0	0	0	0	0	
25/06/97	TW2	87	5	0	0	0	0	0	
25/06/97	TN3	99	0	0	0	0	0	0	
25/06/97	TN3	59	1	0	1	0	0	0	downstream of trib
25/06/97	TN3	85	100+	0	0	1	0	0	upstream of trib
25/06/97	TN2	148	100+	0	0	0	1	0	upstream of trib
25/06/97	TN2	319	0	0	1	0	2	0	upstream of trib
26/06/97	TWV3	458	0	0	11	0	1	0	
26/06/97	TWV1	99	0	0	2	0	0	0	
23/06/97	TW1	260	7	0	0	0	0	0	
23/06/97	TW1	250	125+	0	0	0	0	0	
24/06/97	TN7	285	1	0	0	0	0	0	
24/06/97	TN8	106	0	0	0	0	0	0	
24/06/97	TN9	35	0	0	0	0	0	0	waterfall @ mouth = barrier
24/06/97	TN10	202	0	0	0	0	0	0	
30/07/97	TWV1	50	0	0	1	0	0	0	
30/07/97	TLW1	20	3	0	0	0	0	0	below beaver dam
30/07/97	TLW1	60	0	0	0	0	0	0	above beaver dam
30/07/97	TLW2	170	0	1	5	1	0	0	Campbell creek
30/07/97	TLW3 (IN LAKE)	74	0	0	3	0	0	0	at margin of creek apron into lake
30/07/97	TW1	481	75	0	0	0	0	0	
30/07/97	TW1	111	18	0	0	0	0	0	
30/07/97	TN9 (mouth Nougha)	106	4	0	1	0	0	0	Nougha creek at mouth of TN9
30/07/97	TN10	102	0	0	0	0	0	0	mouth u/s 15m
30/07/97	TN10 (mouth Nougha)	108	1	0	1	0	0	0	Nougha creek at mouth of TN10
29/07/97	TWV3	283	0	2	7	0	0	0	
29/07/97	TN3	60	0	0	0	0	0	0	1 unidentified fish
29/07/97	TN3	58	0	0	0	0	0	0	
29/07/97	TN3 (in Nouga)	61	(75-90)	0	0	0	0	0	
29/07/97	TN1	31	0	0	0	0	0	0	
29/07/97	TN1	18	0	0	0	0	0	0	
31/07/97	TW2	275	5	0	3	0	0	0	
31/07/97	TW2	20	0	0	0	0	0	0	
31/07/97	TVB1	511	0	0	0	0	0	0	
31/07/97	TVB1	122	0	0	0	0	0	0	
14/09/97	TVB	515	0	0	0	0	0	0	
14/09/97	TVB1	109	0	0	0	0	0	0	
14/09/97	TN10	135	0	0	0	0	0	0	
15/09/97	M	1044	0	0	69	0	0	4	
15/09/97	M4	170	0	0	0	0	0	0	
15/09/97	M4	127	0	0	2	0	0	2	
15/09/97	MONEY	171	0	0	1	0	0	0	upstream of site M4
17/09/97	WO	256	32	0	9	4	0	0	
17/09/97	WO	64	30	0	1	0	0	0	
17/09/97	TN1	30	0	0	0	0	0	0	
17/09/97	WO	358	10	0	0	0	0	0	
17/09/97	TWL3	148	14	0	6	1	0	0	
17/09/97	TN3	75	0	0	0	0	0	0	
17/09/97	TN3	73	2	0	1	0	0	0	
17/09/97	TN3	119	8	0	0	0	0	0	
17/09/97	WO	64	10	0	1	0	0	0	
17/09/97	WO	135	5	0	7	5	0	0	

* Species Code: AG= Arctic grayling, LT= lake trout, SS= slimy sculpin, BB= burbot, LNS= longnose sucker, DV= dolly varden/bull trout

Fisheries Study of Proposed Road Access Alignments, Wolverine Property

prepared for:
Yukon Zinc Corp.

prepared by:
Gartner Lee Limited

reference:
GLL 40772

date:
February 2005

distribution:
3 Yukon Zinc Corp.
1 Gartner Lee Limited

Gartner Lee

Gartner Lee Limited

February 2, 2005

Mr. Jason Dunning
Yukon Zinc Corp.
701 – 475 Howe Street
Vancouver, BC V6C 2B3

Dear Sir:

Re: 40772 – Fisheries Study of Proposed access Road Alignments, Wolverine Property

Please find enclosed three (3) copies and a CD with both a Word version and a PDF version of our final report for this study.

We have provided Mr. Himmelright with a copy of a memo by Laberge Environmental Services summarizing the work involved in the installation of the HOBO Weather Station and the water level recorders.

Please feel free to contact us if we can be of any further assistance on this project or if you have any questions regarding this report.

Yours truly,
GARTNER LEE LIMITED

Bruce S. Ford, MRM, R.P. Bio
Senior Environmental Biologist

BSF:gc

(40772 Fish Report Final 2-Feb-2005.doc)

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Table of Contents

List of Figures

List of Tables

1. Introduction

Expatriate Resources Ltd. is currently conducting a Feasibility Study for the development of the Wolverine Project. The project is located in the southeastern Yukon Territory, midway between the communities of Ross River and Watson Lake immediately west of the Robert Campbell Highway (Figure 1). The current project under consideration includes an underground mine (production capacity 1,250 tpd), mill, tailings storage, ancillary buildings, and an access road connecting to the Robert Campbell Highway.

Expatriate is considering two options for developing the access road from the Robert Campbell Highway into the mine site. These alignments are referred to as the Ridge Route and the Money Creek Route. The routes share the same alignment for the first 8 km, heading south from the Robert Campbell Highway at which point the route enters into the Money Creek watershed. The Ridge Route branches to the west climbing the slope into the alpine and the Money Creek Route generally follows a bench above the west side of the Money Creek valley (Figure 2). The overall distance for the Ridge Route is 25 km and the Money Creek Route is 35 km long.

Gartner Lee was contracted by Expatriate Resources to collect fish and fish habitat information along the proposed route alignments. This survey work focused on those sections of creek in the vicinity of significant proposed crossings to collect initial information on fish habitat and to determine fall and overwintering usage of those areas by fish.

2. Methodology

2.1 Aquatic Assessment

2.1.1 Habitat

The field program was based on a field map prepared from information provided in Expatriate's request for proposals circulated September 2, 2004 (Figure 2). Eleven sites along the proposed alignments were identified for detailed physical characterization using standard techniques for inventory of stream habitat (Fisheries and Oceans Canada 1997). Over an average distance of 200 m within the vicinity of the proposed crossings, habitat was qualitatively and quantitatively assessed. A habitat card was completed at each site to ensure consistency of the data collected. Stream gradient was measured with a Suunto

0 20 40 80 120 160

Kilometers

1:5,000,000

DATA SOURCES AND DISCLAIMERS:

Government 1:1 million topographic data

Projection: Yukon New Albers
Created By: PW
Reviewed By: SH
Date Issued: December, 2004
Project Number: 40-772
File Name:
P40772_B2_04kNov12_Fig1_Loc_Map.mxd
Revision: 0

Project: Wolverine Road Alignment Study
Location: Wolverine Lake, Yukon Territory
Client: Expatriate Resources

LOCATION MAP

Gartner Lee

Figure No.
1

Figure 2: Fisheries Study of Proposed Road Access Alignments

Oversize map available upon request

clinometer, depth and width were measured with a meter stick, and velocity was established by measuring the time taken for a float to travel a fixed distance. *In situ* values for water quality, including pH, conductivity and temperature were taken with handheld meters, and all sites were photographed. Stream discharge was calculated by multiplying the average stream velocity (obtained using the Floating Object Method) by the wetted width, mean depth and a correction factor, 0.75.

2.1.2 Fish

Historical fish distribution information was compiled prior to going into the field in order to delineate expected fish distribution and to establish sampling areas most likely to produce fish and/or clarify fish distribution within the study area. The previous studies, in particular those completed before 1998, reported the char in the study area to be Dolly Varden (*Salvelinus malma*). Subsequent DNA analysis of fish from this portion of Liard River drainage have determined these fish to be bull trout (*Salvelinus confluentes*) (pers. comm. Arron Foos, Fisheries Biologist, Yukon Government, Department of Environment). Therefore, in this report we will refer to any *Salvelinus* sp. as bull trout even if identified as Dolly Varden in the original report.

Limited information was available for the creeks affected by the proposed routes. Previous studies have been carried out on Go, Hawkowl and Money Creeks. Both Go and Hawkowl Creeks are directly influenced by the proposed road alignments, while Money Creek is not. However, Money Creek is the receiving body for several creeks influenced by the proposed road and as such, fish present in Money Creek may move into these tributary creeks.

This study included sampling at eleven sites from October 1-5, 2004. Sites are identified in Figure 2 as R1, R9, R10, R18, R19, M1 U/S, M1 D/S, M3, M16, M17 and M18. All sites were electrofished with a Smith-Root LR24 electrofisher for an average of 500 seconds at 200-400 volts. Baited minnow traps were set overnight in a variety of habitats throughout each reach at all sites except R1 and M16. All fish caught were identified and sampled for length and weight before returning them to the creek of origin. Other proposed crossings as identified on base mapping provided by Expatriate were surveyed from the air to confirm channel location and determine if flowing water is present in the fall.

3. Results

3.1. Habitat Assessment

The following is a description of the fish habitat at each of the sample sites. Table 1 provides a summary of habitat conditions at each stream crossing and the standardized field data collection cards are provided in Appendix A.

3.1.1 Proposed Ridge Route

R1

This site is located at the first crossing south of the junction with the Robert Campbell Highway. Here the channel is 1.5 m wide, is 0.42 m deep, has a 2% gradient and an estimated discharge of 0.1 m^3/s at the time of the survey. There is substantial cover provided by overstream vegetation and the banks are occasionally unstable. Habitat is good for rearing juvenile fish (see Photo 1, Section 5 of this report).

R9

This site is located 1 km west of the northern junction of the proposed routes. The channel is 2.4 m wide, 0.21 m deep, has a gradient of 4% and had a discharge of 0.4 m^3/s. Cover is high and is composed of overstream vegetation with few cutbanks and boulders. Stream banks are steep and relatively stable. In the vicinity of the proposed crossing habitat is marginal for fish due to high flows and lack of refuge (see Photo 2, Section 5).

R10

R10 is located upstream of R9 on a small tributary. The channel is 1.5 m wide, 0.18 m deep, has a 25% gradient and had a discharge of approximately 0.2 m^3/s. Cover is moderate, composed mostly of overstream vegetation with little cutbank, boulder, deep pool and trace LOD (large organic debris). The channel is relatively stable and habitat is negligible do the shallow and steep nature of the creek (see Photo 3, Section 5).

R18

This site is located on Hawkowl Creek, 2 km southeast of the airstrip. Here the channel is 1.6 m wide, with a wetted width of 1 m, an average depth of 0.4 m, a gradient of 6%, and the approximate discharge was 0.1 m^3/s. Cover is significant and is composed mostly of overstream vegetation with some LOD, deep pool, boulder and cutbank. Stream banks are moderately unstable and riparian vegetation is well

established and dense. Habitat is marginal for rearing fish, and instream refuge is lacking, as illustrated in Photo 4, Section 5 of this report. Previous studies found no fish in Hawkowl Creek.

R19

R19 is located on a tributary to Hawkowl Creek, 1.5 km southeast of the airstrip. This creek has a channel width of 2.3 m, a wetted width of 2.2 m, an average depth of 0.17 m, an 8% gradient and the discharge was approximately 0.2 m^3/s. There is significant cover provided primarily by overstream vegetation with some deep pools, boulders and cutbanks. Stream banks are moderately unstable and riparian vegetation is well established and dense. Habitat is similar to that found in R18; marginal for rearing fish, and instream refuge is lacking (see Photo 5, Section 5). Previous studies found no fish in Hawkowl Creek.

3.1.2 Proposed Money Creek Route

M1

Site M1 is the most northerly crossing along the Money Creek route and crosses a tributary to Money Creek. Recent and extensive beaver activity in the area has altered the hydrology in this area and the presence of several large beaver dams necessitates dividing the area into two sections: M1 upstream (U/S) and M1 downstream (D/S) (Figure 2).

Upstream
At the upper extent of this reach is a 3.5 m high beaver dam, as identified on Figure 2 (Photos 6 and 7, Section 5). In the reach below the dam, the channel is 4.9 m wide with a wetted width of 3.6 m, an average depth of 0.33 m, a gradient of 3% and an approximate discharge of 0.9 m^3/s. Cover is high, 45%, and composed mostly of LOD and deep pools with some overstream vegetation, cutbanks and few boulders. Riparian vegetation is well established and fish habitat is varied and suitable for various life stages.

Downstream
This site is on a meandering channel located downstream of a 2 m high beaver dam. It is 3.4 m wide, has a wetted width of 3.3 m, is 0.42 m deep, has a gradient of 3% and the discharge was estimated to be 0.9 m^3/s. Stream banks are fairly unstable and as such, cutbanks, along with deep pools, some LOD and overstream vegetation and trace boulders provide good fish habitat (see Photo 8, Section 5).

M3

M3 is located 1 km south of M1. The channel is 3.2 m wide with a wetted width of 2.7 m, a gradient of 5% and had an approximate discharge of 0.2 m^3/s. Stream banks are relatively stable and cover is

moderate, provided mostly by cutbanks. Habitat is varied and sufficient for rearing and resident fish (see Photo 10, Section 5).

M16

This crossing is located approximately midway along the proposed Money Creek route, where the road turns northwest towards the existing airstrip. Here the channel is 2.5 m wide, with a wetted width of 2.2 m, a depth of 0.21 m, a gradient of 8% and had discharge of approximately 0.3 m^3/s. Stream banks are relatively stable and habitat is moderate wherein cover is provided primarily by overstream vegetation (see Photo 11, Section 5).

M17

M17 is located on Pup Creek, south of the airstrip. Here, the channel is 1.12 m wide, 0.18 m deep, has a gradient of 3% and had a discharge of 0.1 m^3/s. Habitat is moderate and cover is provided mostly by overstream vegetation. Habitat quality diminishes in the upper extent of the creek as the channel narrows and is overgrown with dense willow. Accordingly, instream refuge for fish is lacking as water levels decrease (see Photo 12, Section 5).

M18

This site is located on lower Hawkowl Creek and is the last crossing encountered along the Money Creek route before arriving at the airstrip. The channel is 2.6 m wide, 0.2 m deep, has a gradient of 4% and had a discharge of approximately 1.0 m^3/s. Stream banks are moderately stable and riparian vegetation is well established. There is significant cover providing varied, good fish habitat (see Photo 13, Section 5).

3.1.3 Aerial Survey

Creeks not surveyed on the ground were investigated from the air to determine if flowing water was present in the approximate locations of the proposed crossings. An established channel and flowing water was observed at: R2, R11, R14, R15, R16, R17, M4, M6, M7, M12 and M14. Channels were observed but appeared dry at R12 and R13, while the crossing at M5 appeared to be in the vicinity of a boggy area with an intermittent channel. No channels were observed at the following locations: R3, R4, R5, R6, R7, R8, M8, M9, M10, M11, M13 and M15. In addition, M2 was observed both on the ground and from the air to have flowing water, but was not surveyed due to time constraints (Photo 9, Section 5).

Table 1. Habitat Details for Potential Creek Crossings, Wolverine Project, 2004

Site	Channel Width (m)	Wetted Width (m)	Average Depth (m)	Discharge (m^3/s)	Gradient (%)	Substrate (% Composition / Substrate)[1]	Morphology (% Composition / Substrate)[2]	Temperature (^oC)	Conductivity (µS/cm)	pH	Riparian Vegetation
R1	1.5	1.5	0.42	0.1	2	50**S**15**C**15**Si**10**B**10**G**	70**R**15**Ri**15**P**	2	370	8.4	Willow, spruce grass, moss
R2	Aerial survey: flowing channel										
R3	Aerial survey: no visible channel										
R4	Aerial survey: no visible channel										
R5	Aerial survey: no visible channel										
R6	Aerial survey: no visible channel										
R7	Aerial survey: no visible channel										
R8	Aerial survey: no visible channel										
R9	2.4	2.4	0.21	0.4	4	45**B**30**C**15**G**10**S**	60**R**40**Ri**	1.9	210	8.5	Willow, spruce, grass, moss, birch, fireweed, Labrador tea, kinnikinnick
R10	1.5	1.50	0.18	0.2	25	80**B**20**C**	40**Ra**30**Ri**30**R**	1	170	8.3	Spruce, willow huckleberry, grass and moss
R11	Aerial survey: flowing channel										
R12	Aerial survey: dry channel										
R13	Aerial survey: dry channel										
R14	Aerial survey: flowing channel										
R15	Aerial survey: flowing channel										
R16	Aerial survey: flowing channel										
R17	Aerial survey: flowing channel										
R18	1.6	1.0	0.4	0.1	6	45**B**40**C**15**G**	50**Ri**30**R**20**P**	1.5	128	8.4	Willow, juvenile fir, grass
R19	2.3	2.2	0.17	0.2	8	60**B**30**C**10**G**	60**Ri**25**R**15**P**	1.8	120	8.4	Willow, juvenile fir, cinqfoil
M1 U/S	4.9	3.6	0.33	0.9	3	50**C**25**G**15**S**10**B**	60**R**25**Ri**25**P**	2	180	8.3	Willow, spruce and grass
M1 D/S	3.4	3.3	0.42	0.9	3	45**C**25**G**20**B**10**S**	40**R**35**Ri**25**P**	1.1	210	8.3	Spruce, willow, fir, Labrador tea, huckleberry, crowberry and grass

[1] **B**: Boulder **G**: Gravel **C**: Cobble **S**: Sand **Si**: Silt I.E. 80**B**20**C** = 80% boulder and 20% cobble.
[2] **Ri**: Riffle **R**: Run **Ra**: Rapids **P**: Pool **S**: Step.

Site	Channel Width (m)	Wetted Width (m)	Average Depth (m)	Discharge (m^3/s)	Gradient (%)	Substrate (% Composition / Substrate)[1]	Morphology (% Composition / Substrate)[2]	Temperature (^oC)	Conductivity ($\mu S/cm$)	pH	Riparian Vegetation
M2	Aerial survey: flowing channel										
M3	3.2	2.65	0.19	0.2	5	45**C**30**B**20**G**5**S**	60**Ri**30**R**10**P**	0.9	110	8.5	Willow, birch, fir, spruce, fireweed
M4	Aerial survey: flowing channel										
M5	Aerial survey: intermittent channel										
M6	Aerial survey: flowing channel										
M7	Aerial survey: flowing channel										
M8	Aerial survey: no visible channel										
M9	Aerial survey: no visible channel										
M10	Aerial survey: no visible channel										
M11	Aerial survey: no visible channel										
M12	Aerial survey: flowing channel										
M13	Aerial survey: no visible channel										
M14	Aerial survey: flowing channel										
M15	Aerial survey: no visible channel										
M16	2.5	2.2	0.21	0.3	8	70**B**20**C**5**G**5**S**	30**S**30**P**25**Ri**15**R**	2	90	8.3	Willow, spruce, fireweed, cinqfoil, cranberry, kinnikinnick, birch and grass
M17	1.1	1.12	0.18	0.1	3	60**C**30**B**10**G**	65**Ri**30**R**5**P**	2	120	8.4	Willow, fir, huckleberry, equisetum, cinqfoil, birch
M18	2.6	2.6	0.21	1.0	4	40**C**35**B**25**G**	60**Ri**25**R**15**P**	2	110	8.4	Willow, grass, moss

[1] **B**: Boulder **G**: Gravel **C**: Cobble **S**: Sand **Si**: Silt I.E. 80**B**20**C** = 80% boulder and 20% cobble.

[2] **Ri**: Riffle **R**: Run **Ra**: Rapids **P**: Pool **S**: Step.

3.2 Fish Sampling

Previous studies found that Go Creek supports bull trout (*Salvelinus confluentes*), Arctic grayling (*Thymallus arcticus*) and slimy sculpin (*Cottus cognatus*) (Westmin Resources Ltd., 1996). Previous studies also found no fish in Hawkowl Creek or in the reaches of Go Creek upstream of the confluence with Hawkowl Creek (Gartner Lee Ltd. 2001). Money Creek has been found to support bull trout, slimy sculpin, bull trout, Arctic grayling and northern pike (*Esox lucius*) (Westmin Resources Ltd. 1996; White Mountain Environmental Consulting 1997).

Sampling during the fall 2004 field program found fish to be present in three locations: R1, M1 and M3, where M1 and M3 are located along the Money Creek Route and R1 is located on the section common to both routes, near the Robert Campbell Highway. The most numerous fish caught was Arctic grayling young of the year from site R1 (see Photo 13, Section 5). No fish were captured from sites sampled along the Ridge Route. Fishing effort and results are summarized in Table 2, while fish sampling results are summarized in Table 3.

Table 2. 2004 Fish Collection Summary, Wolverine Property

Location	Species	Date	Sample Method	Effort (soak time)
M1 U/S	1 BT[3]	Oct 4, 2004	EF	972 sec.
M1 U/S	-	Oct 4, 2004	MT	4 traps - overnight
M1 D/S	-	Oct 3, 2004	EF	1,267 sec.
M1 D/S	-	Oct 3, 2004	MT	6 traps - overnight
M3	1 BT	Oct 2, 2004	EF	820 sec.
M3	-	Oct 2, 2004	MT	4 traps - overnight
M16	-	Oct 5, 2004	EF	540 sec.
M17	-	Oct 1, 2004	EF	487 sec.
M17	-	Oct 1, 2004	MT	4 traps - overnight
M18	-	Oct 1, 2004	EF	1,365 sec
M18	-	Oct 1, 2004	MT	4 traps - overnight
R1	6 AG[4]	Oct 5, 2004	EF	658 sec.
R9	-	Oct 3, 2004	EF	619 sec.
R9	-	Oct 3, 2004	MT	4 traps - overnight
R10	-	Oct 3, 2004	EF	239 sec.
R10	-	Oct 3, 2004	MT	4 traps - overnight
R18	-	Oct 1, 2004	EF	533 sec.
R18	-	Oct 1, 2004	MT	4 traps - overnight
R19	-	Oct 1, 2004	EF	788 sec.
R19	-	Oct 1, 2004	MT	4 traps - overnight

[3] Bull trout (*Salvelinus confluentes*).

[4] Arctic grayling (*Thymallus arcticus*)

In addition to the records provided in Table 2, one unidentified salmonid was observed at M1 Upstream.

Table 3. 2004 Fall Fish Sampling Results, Wolverine Property

Location	Species	Date	Fork Length (mm)	Weight (g)
M1 U/S	BT	Oct 4, 2004	165	36
M3	BT	Oct 2, 2004	160	34.9
R1	AG	Oct 5, 2004	45	0.5
R1	AG	Oct 5, 2004	46	0.7
R1	AG	Oct 5, 2004	57	1.3
R1	AG	Oct 5, 2004	56	1.4
R1	AG	Oct 5, 2004	51	1.2
R1	AG	Oct 5, 2004	64	2.1

4. Discussion

Fish habitat conditions at the proposed Money Creek Route road crossings are generally good, with varied instream features providing suitable habitat for most life stages of fish species expected to inhabit the area. Money Creek is known to support fish and during the October 2004 sampling effort bull trout were collected within the Money Creek watershed (see Photo 14, Section 5). No significant barriers have been noted on Money Creek so fish from that system can potentially be present in all the tributaries to Money Creek. However, many of the first order tributaries flow over a steep section between the proposed alignment and Money Creek, which could impede fish movement within the Money Creek system. Previous studies have reported fish from sites further upstream suggesting fish can be found throughout the watershed in the larger tributary systems such as Go Creek.

The 2004 field program identified significant and recent beaver activity around the area of the M1 crossing. The beaver activity has altered the hydrology of the area and the available base mapping is no longer representative of field conditions. The preliminary road alignment developed on the basis of the base mapping would cross the stream in several locations. If this route is selected, existing field conditions will need to be considered and road alignment adjusted accordingly to minimize stream crossings.

Based on field observations at four locations along the proposed Ridge Route, these higher elevation streams provide marginal fish habitat. Cover is provided primarily by overstream vegetation and instream refuge for fish is limited. Further, fish presence in streams investigated from the air is unlikely due to the presence of high gradient sections (16–23%) that may impede fish migration. However, further ground-based field studies will be required to confirm fish presence in these streams. No fish were collected or

observed at any of the stream crossings along this route during fall sampling. However, the third order stream crossing at R9 could support fish, based on its size and proximity to fish-bearing waters downstream and should be sampled further.

As the study area is located within the Liard River basin that drains south into northern BC, fish windows for the study area are based on those established for the Liard drainage (BC Zone 8) in the *Land Development Guidelines for the Protection of Aquatic Habitat* (Fisheries and Oceans Canada 1993). Accordingly, the instream construction window for waters supporting bull trout is June 1 to August 31, for Arctic grayling, June 15 to March 31, and for northern pike it is July 1 to April 30. As such, in order to ensure that impacts to all species potentially encountered are minimized, the most suitable working window is July 1 to August 31.

The information collected for this report represents fish and fish habitat conditions in the fall of the year. Water temperatures were low, between 0.9 and 2^{o} C, suggesting fish would be less active and harder to catch, and in the case of Arctic grayling, the fish may have moved to different areas to overwinter. Based on observed water levels in the creeks the discharge was moderate to high, up to 1 m^3/sec. A second field program is recommended to collect fish information during warmer conditions when fish may be utilizing different habitats. The information used from this study can be used to focus the sampling on sensitive sites and those where fish information is uncertain (i.e., no fish caught in October 2004, but could be present under different conditions).

5. References

Department of Fisheries and Oceans. 1993. Land Development Guidelines for the Protection of Aquatic Habitat.

Department of Fisheries and Oceans. 1997. Stream Survey Field Guide. Fish Habitat Inventory and Information Program. Vancouver, BC.

Photos

Photo 1. R1, section of proposed route common to both routes

Photo 2. R9, proposed Ridge Route

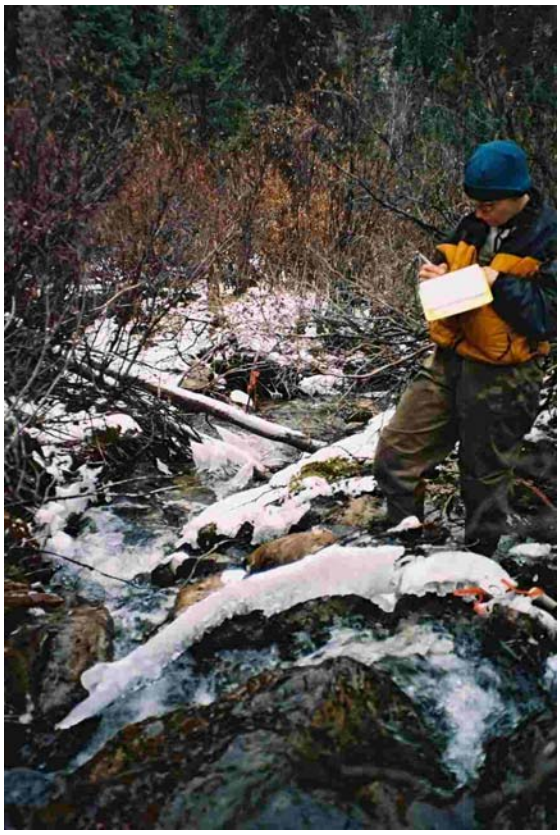

Photo 3. R10, proposed Ridge Route

Photo 4. R18, proposed Ridge Route

Photo 5. R19, proposed Ridge Route

Photo 6. Beaver dam at M1 Upstream, proposed Money Creek Route

Photo 7. Beaver dam at M1 Upstream, proposed Money Creek Route

Photo 8. Beaver dam at M1 Downstream, proposed Money Creek Route

Photo 9. M2, proposed Money Creek Route

Photo 10. M3, proposed Money Creek Route

Photo 11. M16, proposed Money Creek Route

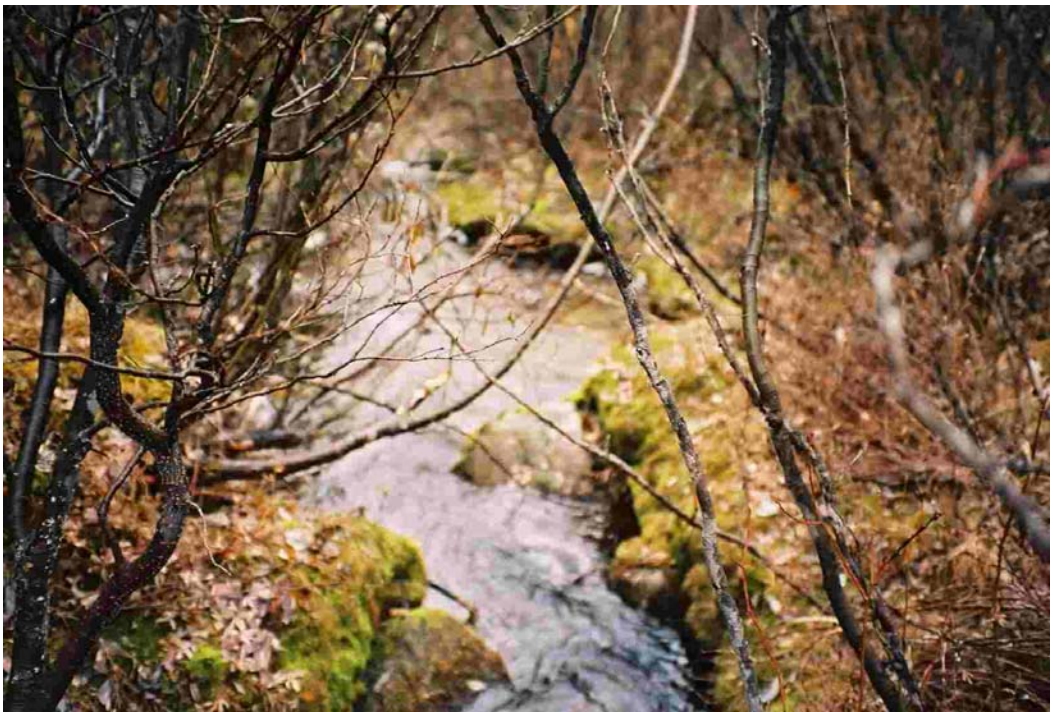

Photo 12. M17, proposed Money Creek Route

Photo 13. M18, proposed Money Creek Route

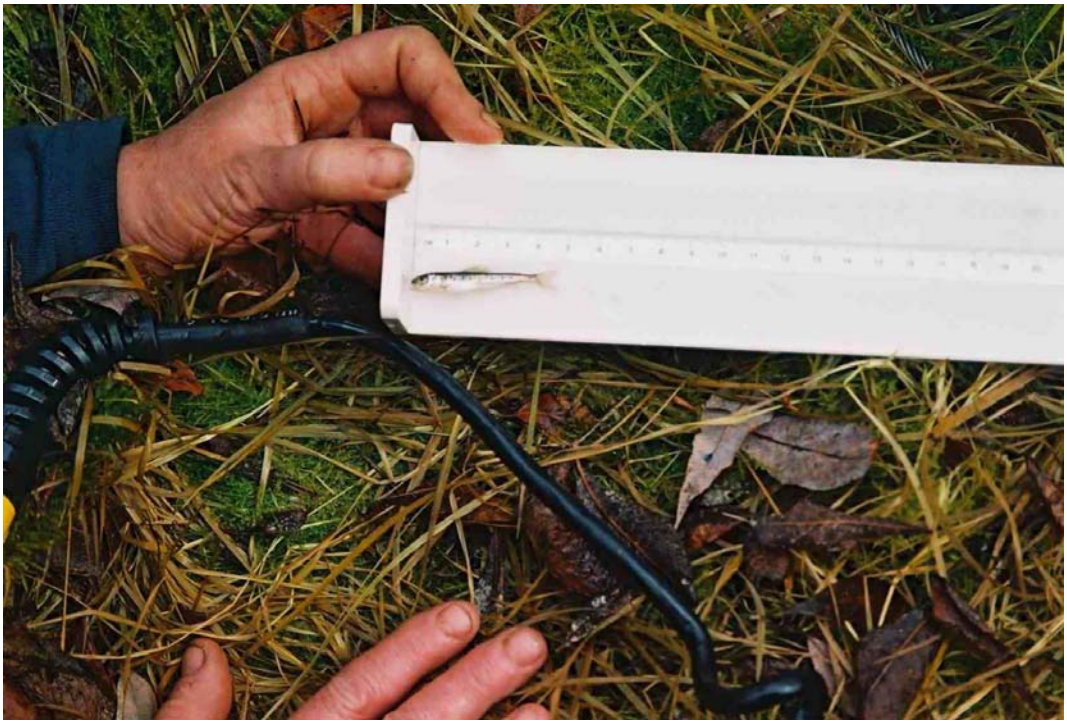

Photo 14. Arctic grayling caught at R1

Photo 15. Bull trout caught at M3

Appendix 7.8-3 Metals Levels in Fish Tissue

JACQUES WHITFORD LTD.

Maxxam Job #: A531875 Client Project #: YUKON ZINC-1000261

Maxxam ID		891243	891244	891107		892182	892190	892192	
Sampling Date		8/6/2005	8/3/2005	8/6/2005		8/3/2005	8/3/2005	8/3/2005	
COC Number		22989	22989	22989		22989	22989	22989	
	Units	**MONEY CR D/S OF GO CR**	**MONEY CR U/S OF GO CR**	**LOWER GO @ MONEY CR**	**DL**	**LOWER GO-DRY**	**MONEY CR D/S-DRY**	**MONEY CR U/S-DRY**	**DL**
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	<10	<10	63	10	246	<100	<100	100
Total Antimony (Sb)	mg/kg	<0.01	<0.01	<0.01	0.01	<0.1	<0.1	<0.1	0.1
Total Arsenic (As)	mg/kg	<0.02	<0.02	0.56	0.02	2.2	<0.2	<0.2	0.2
Total Barium (Ba)	mg/kg	2.21	3.17	4.15	0.01	16.2	9.9	12.4	0.1
Total Beryllium (Be)	mg/kg	<0.01	<0.01	0.02	0.01	<0.1	<0.1	<0.1	0.1
Total Bismuth (Bi)	mg/kg	<0.01	<0.01	<0.01	0.01	<0.1	<0.1	<0.1	0.1
Total Cadmium (Cd)	mg/kg	0.027	0.018	0.029	0.005	0.11	0.12	0.07	0.05
Total Calcium (Ca)	mg/kg	7420	7440	6000	10	23500	33300	29000	100
Total Chromium (Cr)	mg/kg	0.3	0.3	5.7	0.1	22.5	2	1	1
Total Cobalt (Co)	mg/kg	0.03	0.04	0.93	0.03	3.6	<0.3	<0.3	0.3
Total Copper (Cu)	mg/kg	0.38	0.26	0.72	0.05	2.8	1.7	1	0.5
Total Iron (Fe)	mg/kg	13	20	1270	10	4960	<100	<100	100
Total Lead (Pb)	mg/kg	<0.01	<0.01	0.09	0.01	0.3	<0.1	<0.1	0.1
Total Magnesium (Mg)	mg/kg	249	212	2280	10	8890	1110	827	100
Total Manganese (Mn)	mg/kg	5.67	6.06	17.2	0.02	67.3	25.4	23.7	0.2
Total Mercury (Hg)	mg/kg	0.019	0.022	0.02	0.005	0.08	0.08	0.09	0.05
Total Molybdenum (Mo)	mg/kg	0.01	<0.01	0.04	0.01	0.2	<0.1	<0.1	0.1
Total Nickel (Ni)	mg/kg	0.34	0.39	21.7	0.08	84.7	1.5	1.5	0.8
Total Phosphorus (P)	mg/kg	5390	5130	4130	1	16100	24100	20000	10
Total Potassium (K)	mg/kg	1290	1130	1020	10	3980	5790	4390	100
Total Selenium (Se)	mg/kg	0.7	0.34	0.51	0.05	2	3.1	1.3	0.5
Total Silver (Ag)	mg/kg	<0.005	<0.005	<0.005	0.005	<0.05	<0.05	<0.05	0.05
Total Sodium (Na)	mg/kg	685	634	573	10	2240	3070	2470	100
Total Strontium (Sr)	mg/kg	4.33	5.52	3.94	0.01	15.4	19.4	21.5	0.1
Total Thallium (Tl)	mg/kg	<0.005	<0.005	<0.005	0.005	<0.05	<0.05	<0.05	0.05
Total Tin (Sn)	mg/kg	<0.01	<0.01	<0.01	0.01	<0.1	<0.1	<0.1	0.1
Total Titanium (Ti)	mg/kg	0.2	0.3	0.3	0.1	1	1	1	1
Total Vanadium (V)	mg/kg	<0.2	<0.2	0.4	0.2	<2	<2	<2	2
Total Zinc (Zn)	mg/kg	12.1	11.9	12.2	0.1	47.8	54.1	46.3	1
Total Zirconium (Zr)	mg/kg	<0.05	<0.05	<0.05	0.05	<0.5	<0.5	<0.5	0.5

Appendix 7.8-4 2005 Fisheries Baseline Photos

Appendix 7.8-4 2005 Fisheries Baseline Photos

Photo 1: Light Creek 1 looking upstream on August 6, 2005.

Photo 2: Light Creek 1 looking upstream on August 6, 2005.

Photo 3: Light Creek 1 looking upstream on August 6, 2005.

Photo 4: Perched culvert at the Robert Campbell Highway on Light Creek 1, August 6, 2005.

Photo 5: Light Creek 2 looking upstream on August 4, 2005.

Photo 6: Light Creek 2 looking downstream on August 4, 2005.

Photo 7: Light Creek 3 looking upstream on August 4, 2005.

Photo 8: Light Creek 3 looking downstream on August 4, 2005.

Photo 9: Light Creek 4 looking upstream on August 7, 2005.

Photo 10: Light Creek 4 looking downstream on August 7, 2005.

Photo 11: Site 4 looking upstream on August 4, 2005.

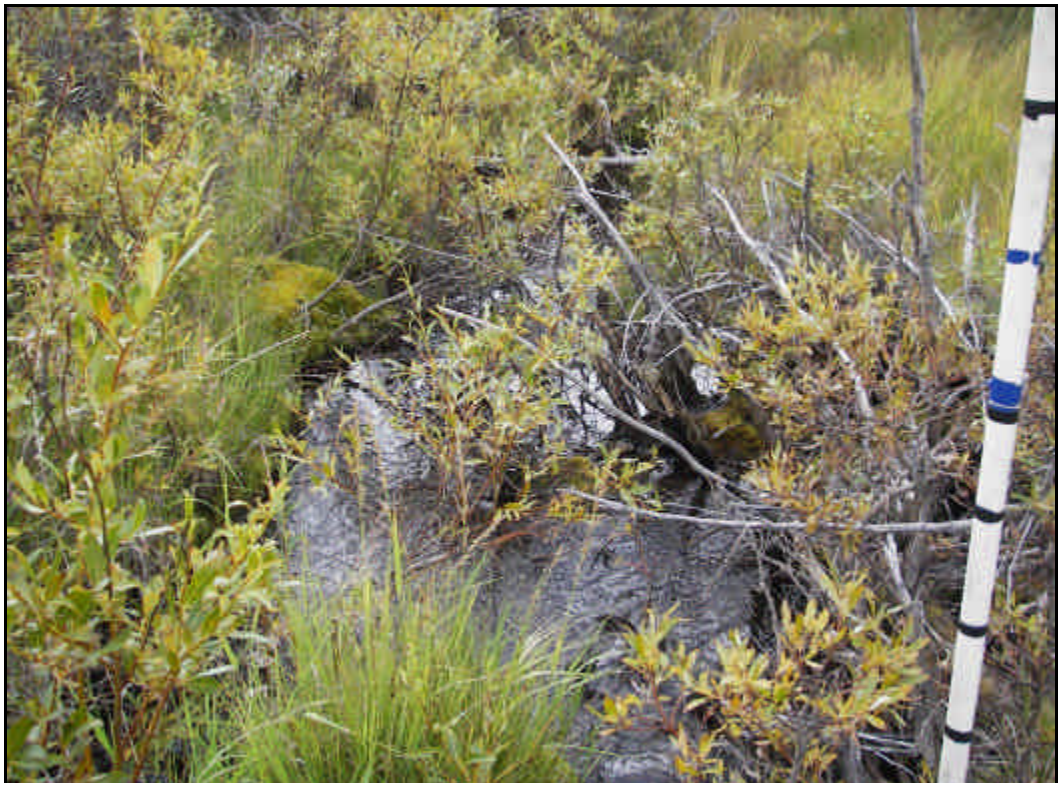

Photo 12: Site 4 looking downstream on August 4, 2005.

Photo 13: Bunker Creek 1 looking upstream on August 5, 2005.

Photo14: Bunker Creek 1 looking upstream on August 5, 2005.

Photo 17: Bunker Creek 2 looking upstream on August 5, 2005.

Photo18: Bunker Creek 2 looking downstream on August 5, 2005.

Photo 19: Bunker Creek 3 looking upstream on August 5, 2005.

Photo20: Bunker Creek 3 looking downstream on August 5, 2005.

Photo 21: Aerial view of a beaver dam at Bunker Creek 3.

Photo 22: Bunker Creek 4 looking upstream on August 4, 2005.

Photo 23: Bunker Creek 4 looking downstream on August 4, 2005.

Photo 24: Aerial view of a beaver dam at Bunker Creek 4.

Photo 25: Bunker Creek 5 looking upstream on August 4, 2005.

Photo 26: Bunker Creek 5 looking downstream on August 4, 2005.

Photo 27: Aerial view of a beaver dam at Bunker Creek 5.

Photo28: Bunker Creek 6 looking upstream on August 5, 2005.

Photo 29: Bunker Creek 6 looking downstream on August 5, 2005.

Photo 30: Site 5 looking upstream on August 4, 2005.

Photo 31: Site 5 looking downstream on August 4, 2005.

Photo 32: Site 13 looking upstream on August 4, 2005.

Photo 33: Site 13 looking downstream on August 4, 2005.

Photo 34: Aerial view of Money Creek on August 3, 2005.

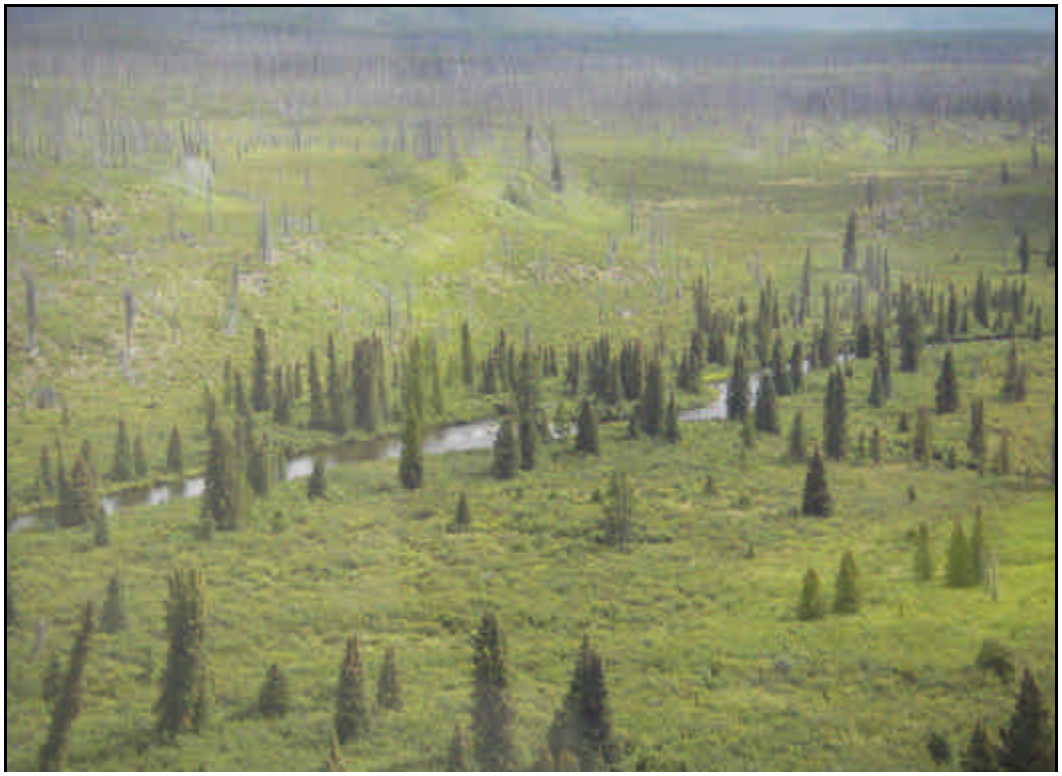

Photo 35: Aerial view of Money Creek on August 3, 2005.

Photo 36: W14 looking upstream on August 3, 2005.

Photo 37: W14 looking downstream on August 3, 2005.

Photo 38: W11 looking upstream on August 3, 2005.

Photo 39: W11 looking downstream on August 3, 2005.

Photo 40: W13 looking upstream on August 3, 2005.

Photo 41: W13 looking downstream on August 3, 2005.

Photo 42: W12 looking upstream on August 3, 2005.

Photo 43: W12 looking downstream on August 3, 2005.

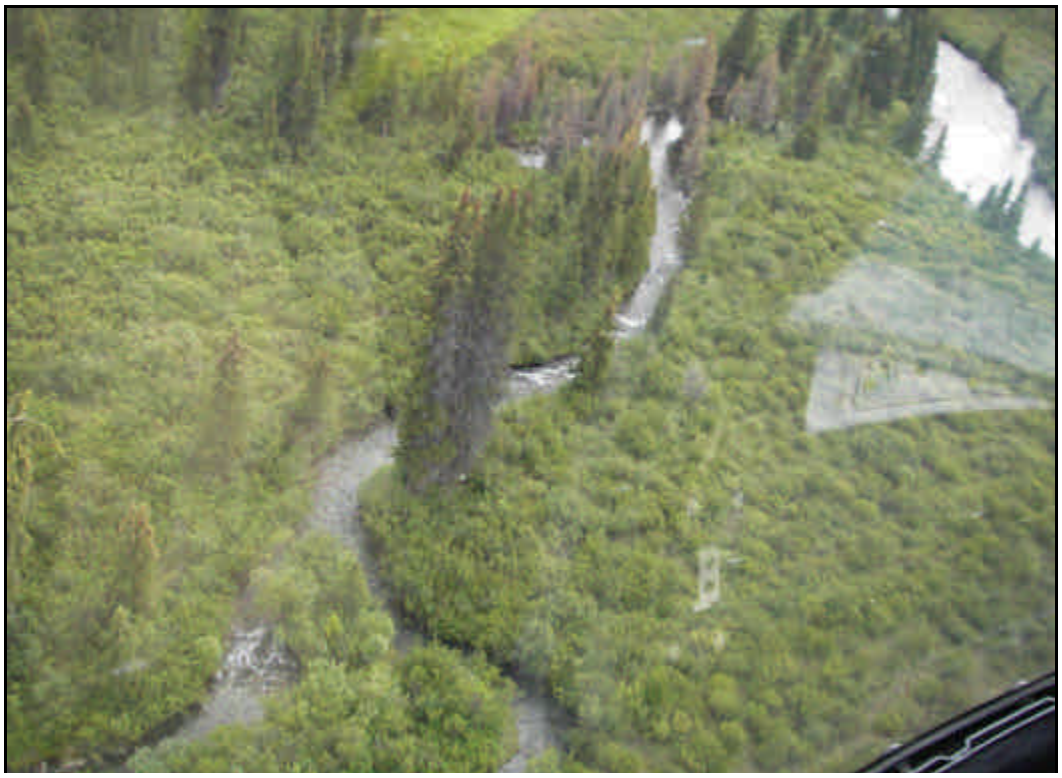

Photo 44: Aerial view of lower Go Creek on August 3, 2005.

Photo 45: Aerial view of an impasse at Go Creek on August 3, 2005.

Photo 46: Beaver dam at lower Go Creek (not an impasse) on August 3, 2005.

Photo 47: Barrier at Go Creek 1 on August 3, 2005.

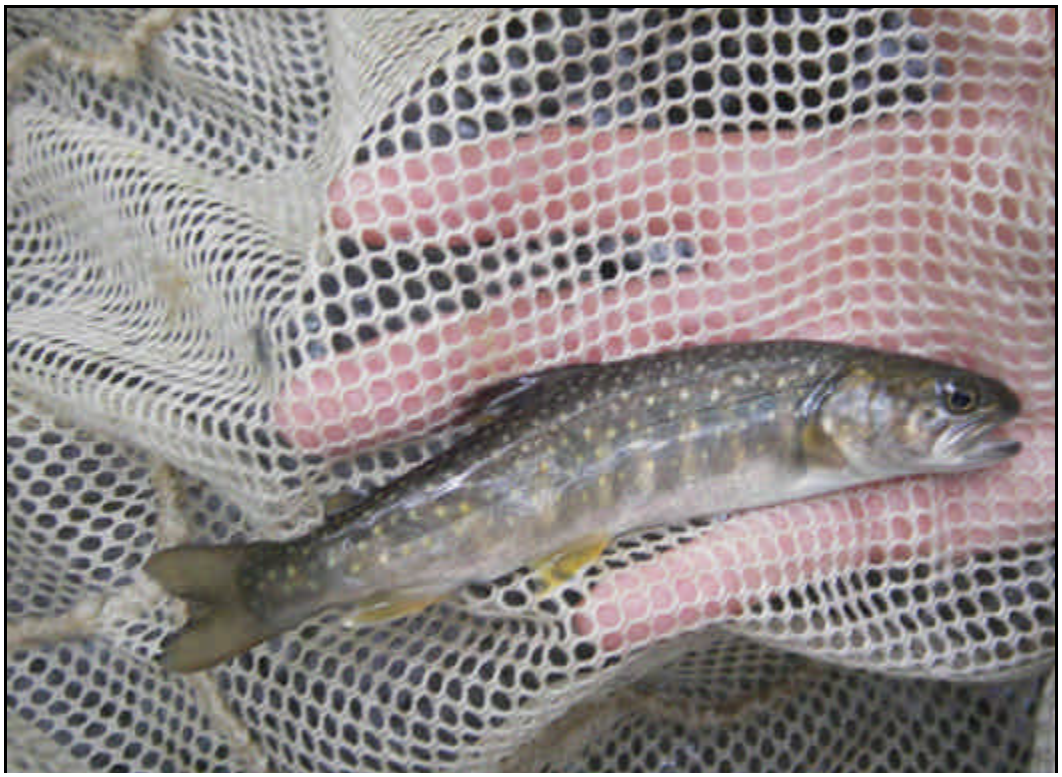

Photo 48: Bull trout at Go Creek 1 on August 3, 2005.

Photo 49: Go Creek 2 looking downstream on August 5, 2005.

Photo 50: Go Creek 3 looking upstream on August 6, 2005.

Photo 51: Go Creek 3 looking downstream on August 6, 2005.

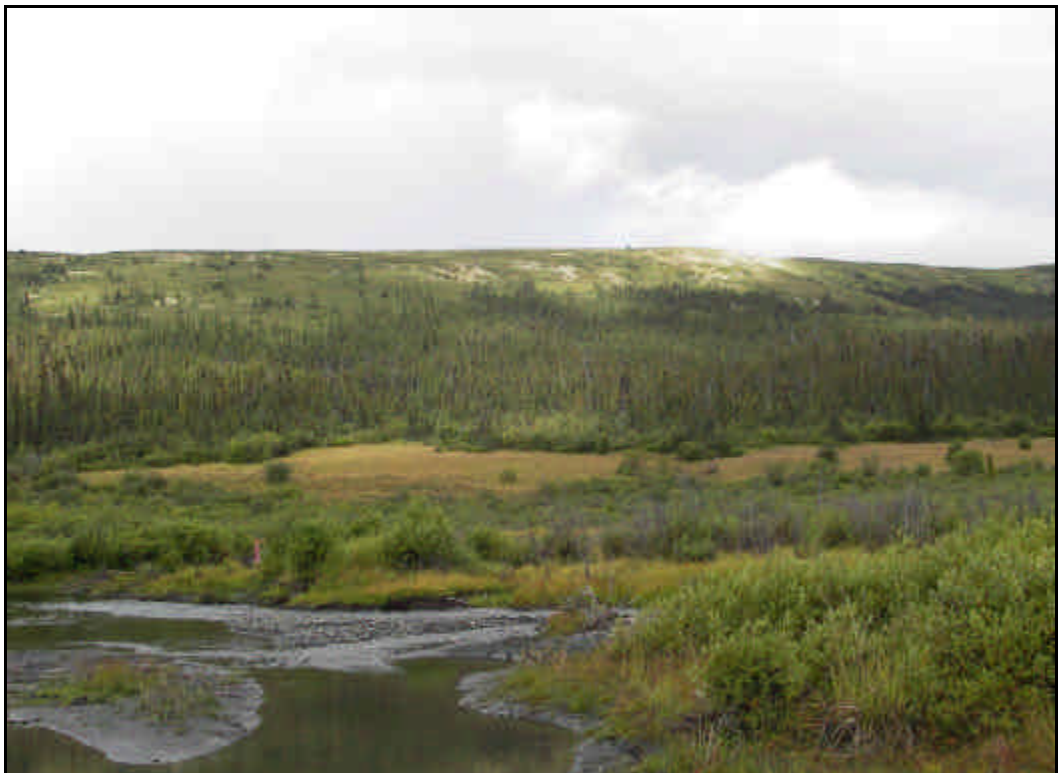

Photo 52: Go Creek 3 cross section on August 6, 2005.

Photo 53: W16 looking upstream on August 6, 2005.

Photo 54: W16 looking downstream on August 6, 2005.

Photo 55: W15 looking upstream on August 6, 2005.

Photo 56: W15 looking downstream on August 6, 2005.

Photo 57: W22 looking upstream on August 6, 2005.

Photo 58: W22 looking downstream on August 6, 2005.

Photo 59: W23 looking upstream on August 6, 2005.

Photo 60: W23 looking downstream on August 6, 2005.

Photo 61: W24 looking upstream on August 6, 2005.

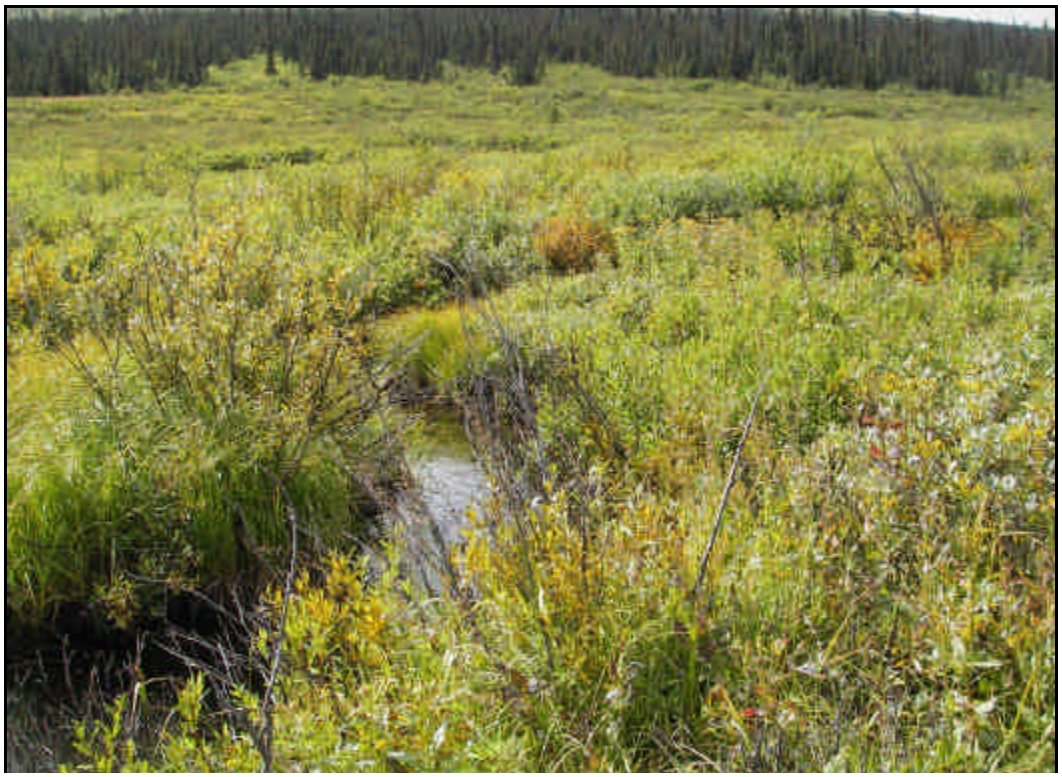

Photo 62: W24 looking downstream on August 6, 2005.

Photo 63: W9 looking upstream on August 3, 2005.

Photo 64: W9 looking downstream on August 3, 2005.

Photo 65: Site 14 looking upstream on August 7, 2005.

Photo 66: Site 14 looking downstream on August 7, 2005.

Photo 67: Wetland cross section at Site 14 on August 7, 2005.