2006

AQUATIC LIFE SAMPLING AND TESTING PROGRAM FOR THE ANVIL RANGE MINE SITE, ROSE AND VANGORDA CREEK WATERSHEDS, FARO, YUKON

TO MEET THE REQUIREMENTS OF WATER LICENSE QZ03-059

Conducted: During August, 2006

Prepared for Delloite and Touche Inc.

December, 2006

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1.0 Introduction

The following report details the results of the third consecutive year of field investigations conducted under the *Aquatic Life Sampling and Testing Program* for the Anvil Range Mine Site at Faro, Yukon, as required under water license QZ03-059. Field investigations for this project were conducted during August, 2006 under the authority of License to Collect Fish No. 06-15, issued by the Department of Fisheries and Oceans, Canada.

The primary goal of these investigations has been to annually sample watersheds potentially affected by the Faro and Vangorda Plateau mine sites. Specific sites within the Rose and Vangorda Creek watersheds have been investigated for three years to track the presence, relative abundance and condition of fish. From each sampling site, flesh samples from slimy sculpin (*Cottus cognatus*) and Arctic grayling (*Thymallus arcticus*) were taken and analyzed to determine the level of metals in fish tissue.

This investigation also continued the collection of quality data on fish habitats and fish utilization for use in long term monitoring. The sampling methodology used in 2006 was constant with that used in previous investigations to allow comparison between annual data sets.

2.0 Study Area

Investigations were conducted within the Rose and Vangorda Creek watersheds in potentially affected waters as well as on control (unaffected) sites on Anvil and Blind Creeks. Sample sites for the 2006 investigation were all previously established sites with the exception of site R6. Sampling during the 2006 investigations was not conducted at R6, instead sampling was conducted upstream on Anvil Creek at site R8, a direct distance of 800 meters upstream to provide more distinction between the Anvil and Rose Creek sites as well as for better fishing ability and a safer work site. The following sites were sampled during the investigation:

Sample sites associated with Rose Creek (Figure 1):

R1 South Fork of Rose Creek immediately upstream of the confluence of North and South Fork of Rose Creek;
R2 The mixing zone downstream of the intersection of Rose Creek and the tailings pond discharge channel;
R4 Rose Creek just upstream of the confluence with Anvil Creek; and
R8 Anvil Creek upstream of the confluence with Rose Creek (control site).

Sampling sites associated with Vangorda Creek (Figure 2):

V8 Lower Vangorda Creek below the town of Faro access road; and
B1 Blind Creek near the lower bridge (control site)

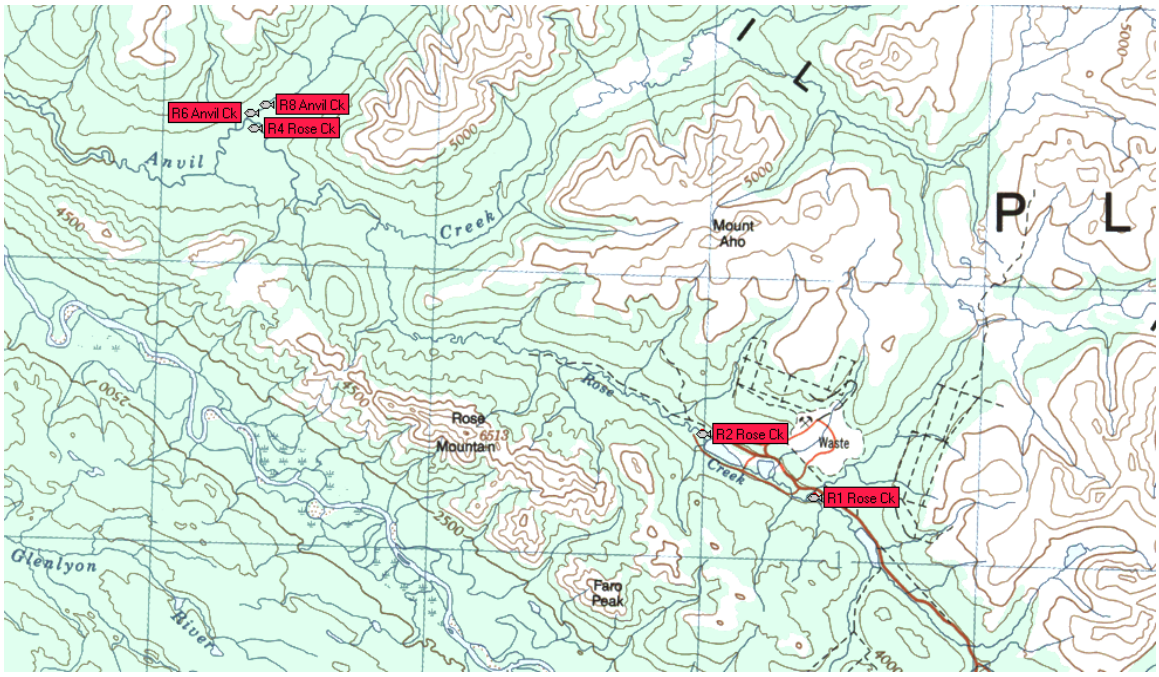

Figure 1: Sample sites associated with Rose Creek from 1:250,000 105K *Tay River* topographic map.

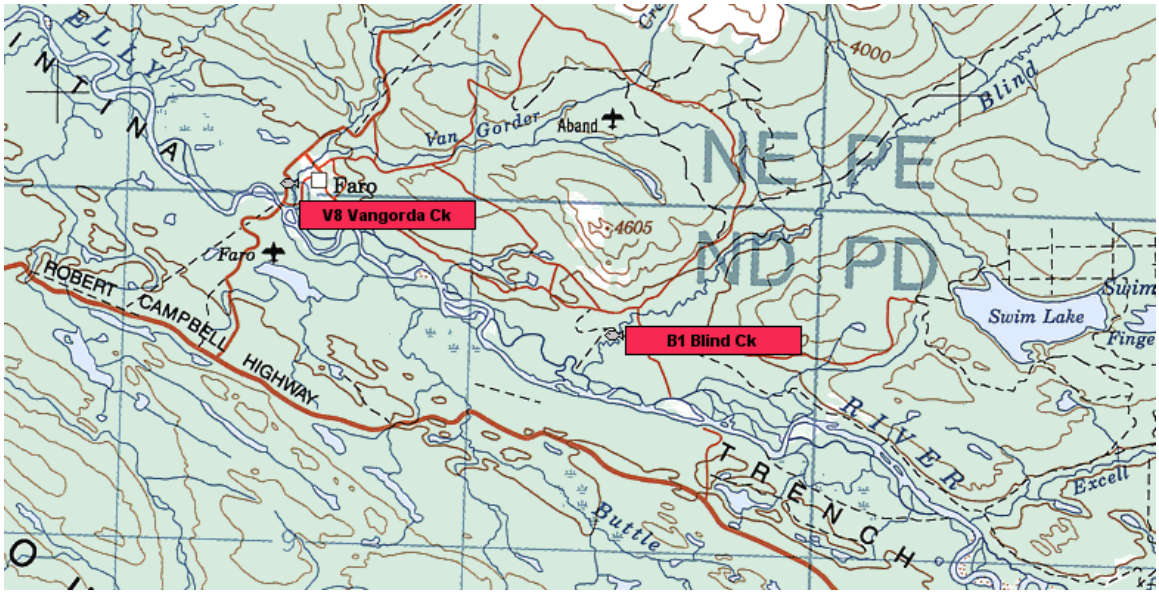

Figure 2: Sampling sites associated with Vangorda and Blind Creeks from 1:250,000 105K *Tay River* topographic map.

3.0 Methods

Field investigations were conducted between August 15 and 19, 2006 when water levels were stable and fish distribution was at its seasonal peak. This timing corresponds with the previous investigations which were also conducted during mid August.

Each site sampled corresponded to the locations sampled during previous years with the exception of site R6. Instead of R6 a new site, R8, located 800 meters upstream of R6,

was sampled. The two sample sites near the confluence of Rose and Anvil Creeks were accessed with a helicopter; all other sample sites were accessed by road.

The general description of fish habitat compiled in past years was re-evaluated at each site, including; flow parameters consisting of velocities (floating object method), depth, wetted and channel width, substrates, channel configuration, bank stability, water temperature, riparian vegetation and an assessment of available fish cover. Photographs representative of each site were taken.

The principle fish collection technique used was electro-fishing. Secondary techniques included minnow trapping, angling, and beach seining. Crew members wore polarized glasses at all times to enhance fish viewing abilities and all visual observations of fish were recorded.

Electro-fishing was conducted with a Smith-Route POW type 12A battery powered, back pack electro-fisher. The electro-fisher operator was accompanied by 2 crew members with dip nets. Each site was investigated using a single pass technique with sampling effort similar to that of previous years. Each site was sampled by moving in an upstream direction and sweeping from side to side through each reach; all shoreline areas were fished and attempts at covering all mid-stream habitats were made. Mid channel sampling can be difficult and dangerous in flows exceeding 1 meter per second with a depth greater than 0.8 meters and sites with these conditions were not sampled. Effort extended by electro-fishing in 2006 ranged from 859 to 1,280 seconds of shocking time per site. Electro-fishing results have been converted to the number of fish recorded per 100 seconds of shock time to allow comparison between sites and different years.

Minnow trapping was conducted with “Gee type” minnow traps (¼” mesh). Traps were baited with salmon roe (Yukon River origin) suspended in the trap in a perforated plastic bag, and were set in a variety of habitat types at each site. Traps were set for an overnight period with soak times ranging from 13.5 to 27 hours. Minnow trap results have been expressed as number of fish captured per site per 24 hour period.

Beach seining was only conducted to collect metal analysis specimens from Blind Creek. Catch per unit effort from seining was not calculated as the effectiveness of seine pulls varied due to such factors as shoreline configuration, bottom substrates, water depth and velocity. Area seined and seine catches were recorded in a field note book.

Angling was conducted with light spin casting gear and a variety of small lures. Effort was recorded as minutes fished and all fish captured or observed were recorded.

All fish captured were handled delicately to allow for live release after sampling. Anaesthetics were not used. All fish captured or observed were identified as to species and general life stage (fry, juvenile, sub-adult, adult), a sub-sample was measured for fork length (±1 mm) and then released unharmed as near as possible to the location from which they were sampled. All fish captured or observed were recorded into a field book and the information was later entered into an excel data base.

3.1 Metal Sample Collection and Analysis

Fish samples for metal content analysis were collected during the course of general field assessments. A maximum of 5 Arctic grayling and 5 slimy sculpins samples were collected from each site for analysis of metals in tissue. Extra effort by electro-fisher or

angling was conducted to collect Arctic grayling from several of the sites and extra seine and minnow trap effort was conducted at Blind Creek to procure slimy sculpin samples.

Arctic Grayling with a fork length >200 mm were selected for tissue sampling and sculpins 80 mm or longer were selected when possible. At sites where less than 5 sculpins over 80 mm in length were caught, a composite sample of 2 or more individual sculpins was utilized.

Specimens collected for metal sample analysis were placed into labeled zip loc baggies immediately after capture. The collected specimens were sampled later in a controlled environment. For sacrificed Arctic grayling, internal and external observations of fish health, sex and maturity, diet, fork length and round weight was recorded. From each grayling a tissue sample weighing approximately 50 grams was taken from the caudal area and placed in separate labeled bags and then frozen. Stomach contents were analyzed at the time of sampling. Sample data and stomach content analysis from Arctic grayling was entered to an excel data base format at the completion of the field season.

For slimy sculpins sacrificed, the total length and round weight for each specimen was recorded, including the individuals from composite samples. Each sculpin sample was bagged and labeled separately; each composite sample was bagged and labeled as a single sample, the samples were then frozen.

The frozen tissue samples were submitted to Norwest Labs for metals analysis. Metal analysis included microwave acid digest for ICP metals and metals semi trace in tissue. The metal results were expressed as ug/gram. The lab technique used to analyze the 2006 was the same as for the 2005 samples which was an upgrade from the process used in 2004.

4.0 Results

The sample sites showed little physical variation from conditions observed in previous years and fish habitats remained stable at all sample locations. In general, water levels were slightly higher in 2006 than in either of the previous two years. An updated general description of fish habitats and a representative photo from 2006 for each site has been presented in Appendix 1.

Fish distribution and utilization varied between each site; a summary of electro fishing results for 2006 has been presented in Table 1 and a comparison of all three years electro-fishing data in Table 2. A summary of minnow trapping results comparing all three years data has been presented in Table 3 with a complete listing of all minnow trapping results for 2006 presented in Appendix 4. Angling records comparing all three years data has been presented in Table 4.

Juvenile chinook salmon (jcs) were not recorded in the Rose/ Anvil drainage during 2006. Jcs were captured at B1 and V8; however numbers of jcs captured at these sites were considerably lower than those recorded during previous years (Tables 2 and 3).

Arctic grayling adults were present at all sites. At site R2 grayling were dispersed and very visible, angling for metal samples required covering almost 1 km of creek downstream of the site sample area. At site R6 grayling were abundant however very hard to catch. Slimy sculpin were uncommon and difficult to capture at Blind Creek, were uncommon at site V8, and common and easily captured at the other sites.

A total of 27 Arctic grayling were taken for metal analysis, only four grayling were captured at site R2 and only 3 were obtained from R8, a complete set of five Arctic grayling were taken from each of the other sites. Lengths ranged from 227 to 385 mm. A complete listing of sample information for specimens collected has been presented in Appendix 3.

Stomach content analysis from all Arctic grayling sampled in 2006 consisted of 33% Tricoptera compared with 55% in 2005 and 64% in 2004, this clearly indicates that Trichoptera is the primary food source for Arctic grayling at these sites at this time of year. The next most common food item was chinook salmon eggs at 25% however all of the grayling that had salmon eggs came from Blind Creek. Unidentified terrestrial insects comprised 21% of the diet and slimy sculpin 3%. Other food items included snails, caterpillars, rose hips, bastard toad flax seeds and larvae. Bees and wasps were noticeably absent from the 2006 diet.

Sample information for Arctic grayling stomach content analysis has been presented in Appendix 3 in conjunction with all other sample information for the fish sacrificed for metal sample analysis.

Slimy sculpin taken for metals analysis ranged in length from 36 to 108 mm. The weights of the single fish sculpin samples ranged from 5.7 to 11.8 grams. A total of 17 whole fish samples and 4 composite samples were taken. No sculpin samples were captured at Vangorda Ck, only a single composite sculpin sample was captured at blind creek and each of the other sites had a complete set of five sculpin samples.

Metal content in fish flesh was generally lower in 2006 than in any of the previous years Tables 5 and 6). The only exception to this was a slight rise in manganese content in slimy sculpin from site B1. The highest zinc levels for sculpins came from site R2. Zinc levels in grayling were highest at V8 and R2. A complete analytical reporting of all metal content analysis is presented in Appendix 2.

During 2006 Aluminum levels in slimy sculpin typically ranged between 1 and 19 ug/g. No unusually high aluminum values were recorded in 2006 as had been recorded in 2005.

4.1 Site Summary: R1 Rose Creek

4.1.a Fish Habitat and Utilization

Adult and sub-adult Arctic grayling were both present at this site but were dispersed as habitat for larger grayling remains limited. A single Arctic grayling juvenile was recorded during minnow trapping. Slimy sculpin adults continue to be common. Juvenile chinook salmon were not recorded at this site during 2006 investigations and were only recorded during the 2004 investigations. Burbot, sub adults, were captured at this site during both 2004 and 2005 and not during 2006. The only physical alteration to this site was new, small deposits of fine sand in small boulder eddies, the sand likely originated a direct distance of more than 1 km upstream in the dewatered reservoir basin.

Electro-fishing consisting of 859 seconds of effort was conducted through the 100 meter reach. Fish recorded by electro-fishing consisted of 15 slimy sculpin adults (Table 1), significantly fewer species were recorded during 2006 than in previous years (Table 2).

Minnow trapping at site R1 consisted of 9 traps set for an average soak time of 16.5 hours each. The total catch from minnow trapping consisted of 1 slimy sculpin and 1

arctic grayling juvenile. This catch represents a small decrease in the numbers of both sculpin and grayling in comparison with past years (Table 3).

Angling effort at site R1 for 190 minutes produced a catch of 9 Arctic grayling consisting mostly of sub-adults (Table 3). Grayling were dispersed in the study area and were difficult to catch.

4.1.b Metal Samples

Samples taken for metal analysis included; 5 Arctic grayling, 2 adults and 3 sub adults, and 5 slimy sculpin adults, all single fish samples.

The Arctic grayling samples ranged in length from 281 to 337 mm, and in weight from 214 to 380 gms. The samples, 3 males and 2 females, all mature fish, were considerably larger than those taken from this site in previous years. Stomach contents consisted of 48% Tricoptera, 36% ants, 20% terrestrial insects and 4% snails.

The individual sculpin samples ranged in length from 83 to 101 mm and in weight from 7.1 to 11.8 gms and were of similar size to previous years samples.

Concentrations of most metals in Arctic grayling and slimy sculpin taken from R1 in 2006 (Tables 5 and 6) were slightly lower than recorded during either 2004 or 2005 and were similar levels to most of the other sample sites. Zinc levels in slimy sculpin were similar to those of 2005 and lower than those recorded during 2004; however Zinc levels in Arctic grayling were significantly lower than in 2005 and slightly lower than in 2004.

4.2 Site Summary: R2 Rose Creek

4.2.a Fish Habitat and Utilization

This site provides a wide variety of stable habitats, including riffles, rapids, glide areas and deep corner and side pools. Adult Arctic grayling were more common in 2006 than in 2005 investigations but still less common than in 2004. Slimy sculpin were less abundant than in previous years. Jcs were absent during 2006 but were recorded during 2004 and 2005. A distinct reduction in fish numbers of all species has occurred at this site since 2004.

Electro-fishing consisting of 859 seconds of effort conducted through most of the 100 meter reach downstream of the tailings pond channel, a deep corner pool in the middle of the reach could not be shocked due to depth (Table 1). Slimy sculpin were not common and only 15 adults were recorded by electro-fishing. This catch represents a steady decrease in abundance of 50% from 2005 catches which were 30% lower than 2004 catches (Table 2). A small group of about 20 juvenile Arctic grayling were observed in the slow water of the discharge channel 10 meters upstream of Rose Creek. A single sub adult burbot was also recorded during 2006 electro-fishing.

Minnow trapping at site R2 consisted of 9 traps set for an average soak time of 17.5 hours each. The total catch from the minnow trapping consisted of 1 adult slimy sculpin and 1 Arctic grayling juvenile (Table 2). The minnow traps set at R2 during 2006 were all set downstream of the confluence of the tailings pond channel with Rose Creek.

Angling for 180 minutes downstream of the tailings pond channel captured 4 Arctic grayling (Table 3). Extensive effort covering more than 1 km of creek was required to capture the fish. Visibility into the water was excellent at the time of fishing and all fish captured were observed prior to capture and no other grayling were observed.

4.2.b Metal Samples

Samples taken for metal analysis consisted of 5 single slimy sculpin adults and 4 adult Arctic grayling. All of the sculpin came from an area of Rose Creek immediately downstream of the confluence with the tailings pond channel and the grayling from as far as 1 km downstream.

The Arctic grayling samples ranged in length from 315 to 353 mm, and in weight from 311 to 408 gms. The three individual sculpin samples ranged in length from 89 to 105 mm and in weight from 5.7 to 9.2 gms. The two composite sculpin samples were both composed of 2 sculpins with combined weights of 9.6 and 8.5 gms.

Metal content in Arctic grayling flesh from R2 was similar to that found at all other sample sites.

Metal content in sculpins from R2 showed significant decreases for most metals from 2005 levels. Zinc levels, however, remained similar to the 2005 levels and were the highest of all sites sampled (Table 6). The 2004 samples from R2 had the lowest zinc levels of the sample sites other than B1.

4.3 Site Summary: R4 Rose Creek

4.3.a Fish Habitat and Utilization

Fish utilization of site R4 was higher than in 2005 but similar to 2004. Slimy sculpins of all sizes were abundant. Arctic grayling adults were occasional, dispersed and difficult to capture except in the area immediately upstream of the sample site. Jcs and burbot were not recorded at this site during 2006.

Electro-fishing was conducted through all areas of the 110 meter reach and 980 seconds of effort recorded a total of 82 slimy sculpin adults, 50 sculpin fry and 1 juvenile Arctic grayling (Tables 1 and 2).

Minnow trapping at site R4 consisted of 9 traps set for an average soak time of 23 hours each. No fish were captured with minnow traps at this site in 2006 (Table 3).

Angling for 50 minutes in a large corner pool immediately upstream of the actual sample reach captured 4 adult and 2 sub adult Arctic grayling (Table 4).

4.3.b Metal Samples

A complete sample of 5 Arctic grayling adults were taken from R4. The grayling ranged in length from 305 to 375 mm, in weight from 278 to 605 gms and consisted of 2 adult males, two mature females and one immature male. The stomach contents from Arctic grayling consisted of 43% Trichoptera, 40% terrestrial insects, 10% larvae and a few ants.

All five slimy sculpin samples were whole fish ranging in length from 83 to 93 mm and in weight from 6.3 to 9.3 gms.

Arctic grayling flesh from 2005 showed significantly lower metal levels than from both 2004 and 2005 (Table 5). The levels of manganese at this site, was significantly lower in 2006 than in 2005 but similar to that of 2004.

Concentrations of metals in slimy sculpin (Table 6) were also slightly lower than in past years. Manganese levels remained higher than 2004 levels but were slightly less than in 2005.

4.4 Site Summary: R6 Anvil Creek

4.4.a Fish Habitat and Utilization

Flows in Anvil Creek during 2006 were slightly higher than in 2005 and it was impossible to work at site R6 at the confluence. A new site, R8, located 800 meters in a direct line upstream of original site was established and sampled. The new site offers greater separation from site R4 on Rose Creek, provides more diverse fish habitats, has better benthic collection opportunities and is a safer work environment.

Slimy sculpins were common and Arctic grayling adults were abundant in the deeper water areas. Burbot were the only other species recorded.

Electro-fishing, conducted by moving back and forth across the entire width of the creek to cover the entire 100 meter reach was not possible. Shoreline shocking was conducted along both banks and in the shallow side flow on the right bank. A total of 779 seconds of effort recorded 49 adults and 10 fry slimy sculpin and 2 sub adult burbot (Tables 1 and 2). This represents an increase in catch from site R6; however the increase can be attributed to better habitats and ability to electro-fish.

Minnow trapping at site R6 consisted of 9 traps set for an average soak time of 23 hours each. The total catch from the minnow trapping was 2 adult slimy sculpin (Table 3).

A total of 50 minutes of Angling effort in the large corner pool at the bottom of the reach and in the deep channel upstream of the sample reach captured 3 Arctic grayling. Arctic grayling were observed to be abundant in both of these locations; however the fish were obviously well fed and were difficult to hook (Table 4).

4.4.b Metal Samples

Arctic grayling samples taken for metal analysis at site R8 consisted of 2 adult females and an immature female. The Arctic grayling samples ranged in length from 291 to 385 mm, and weight from 260 to 462 gms. Stomach contents consisted of 63% terrestrial insects, 25% Trichoptera and 13% ants.

Slimy sculpin samples consisted of 4 individual fish samples and 1 composite of 2 fish. The whole fish ranged in length from 88 to 108 mm and in weight from 7.1 to 14 grams. The composite sample of 2 fish had a combined weight of 10.5 grams.

The concentrations of metals in both grayling sculpin tissue from R8 taken in 2006 were lower than in previous years from R6 and were slightly lower than those from sample sites within Rose Creek (Tables 5 and 6).

4.5 Site Summary: V8 Vangorda Creek

4.5.a Fish Habitat and Utilization

Fish habitats at the Vangorda Creek sample site were again slightly modified at the downstream end of the sample reach by bridge construction. The sample site extends

upstream from the location of the Town of Faro sewage force main. Modifications to the bridge abutment adjacent to the sewer line had recently been completed at the time of sampling. Water levels in Vangorda Creek were the highest and most turbid of the past sampling periods.

The reach of Vangorda Creek investigated had extensive utilization by several fish species. Jcs were the most abundant although were less common than in previous investigations. Arctic grayling sub- adults and juveniles were occasional and slimy sculpin were uncommon, no other fish species were recorded during 2006.

Electro-fishing was conducted for a total of 782 seconds through the entire 120 meter reach however was hampered by the high levels of turbidity and strong flows (Tables 1 and 2). Fish recorded included 2 slimy sculpin adults, 39 jcs, 8 small sub-adult Arctic grayling and a burbot sub adult. Additional electro fishing for 250 seconds covering 140 meters downstream of the bridge was extended to capture Arctic grayling and slimy sculpin for metal samples. Shocking was conducted moving downstream at the speed of the current and recorded a further 6 sub adult Arctic grayling.

Minnow trapping at site V8 consisted of 9 traps set for an average soak time of 22 hours each. The total catch from the minnow trapping consisted of 98 jcs, representing only 60% of the 2005 catch and only 16% of the catch made in 2004 (Table 3).

Angling in Vangorda Creek was attempted but the small channel and extensive vegetation limit angling opportunities. Angling for 5 minutes in the only available location produced zero fish (Table 4).

4.5.b Metal Samples

A complete set of 5 Arctic grayling samples were taken, 4 were small and immature and the fifth was a small mature male. They ranged in length from 226 to 268 mm, and in weight from 96 to 176 gms. Stomach analysis indicated a diet consisting of 48% Tricoptera, 24% rose hips, 16% ants and the remainder consisting of traces of caterpillars, beetles and bastard toad flax seeds.

No slimy sculpin samples were obtained from Vangorda Creek, the 2 sculpins recorded during electro-fishing both escaped.

Concentrations of metals in fish tissue for grayling from V8 decreased in 2006 from levels recorded in 2005 and 2004 (Tables 5 and 6). Zinc levels in grayling from the 2006 sample were slightly lower than the 2004 sample and were much lower than the 2005 sample.

4.6 Site Summary: B1

4.6.a Fish Habitat and Utilization

Electro-fishing was not and has not been conducted on Blind Creek at the request of the Department of Fisheries and Oceans due to the presence of spawning adult chinook salmon. A chinook salmon enumeration weir located 50 meters downstream of the bridge was removed just prior to the time of sampling. Adult salmon were observed below the bridge and active redds were within the study area.

Arctic grayling were in groups throughout the study area, with most aggregated in deep pools near the active redds. Slimy sculpin were uncommon even near salmon redds. Jcs

were less significantly less abundant than in previous years. Similar numbers of jcs 1+ to past years were recorded.

Extra minnow traps for the capture of slimy sculpin for metal samples were set as in 2005, a total of 25 minnow traps were set for an average soak time of 14 hours each (Table 3). The catch consisted of 135 jcs (0+) and 5 jcs (1+). Catch per unit of effort in 2006 was only 16% of the 2005 catch and 12% of the 2004 catch (Tables 1 and 2).

Seining effort was exerted on Blind Creek to procure a suitable sample of slimy sculpin for metal analysis. Seining effort was conducted both upstream and downstream of the bridge. A total of 18 seine pulls were made, 5 were ruined by logs, the catch from the other hauls consisted of 12 small adult and 40 fry slimy sculpins, 11 juvenile round whitefish and 60 jcs.

Angling effort at Blind Creek, both upstream and downstream of the bridge for 240 minutes captured 4 Arctic grayling adults and 1 sub adult (Table 4). Grayling were well fed on salmon eggs and hard to entice to the hook.

Metal Samples
A complete set of 5 Arctic grayling samples were taken for metals analysis, they ranged in length from 291 to 325 mm, and in weight from 230 to 315 gms. The sample consisted of 2 mature males, 2 mature females and a single immature female. Stomach contents consisted of 66% salmon eggs, 18% Tricoptera and 9% slimy sculpin, 3% dragon fly, 3% beetles and 1% ants.

A single composite sample of 10 small slimy sculpin that ranged in length from 32-50 mm and had a combined weight of 7.1 gms was taken.

Concentrations of metals in fish flesh from Blind Creek remained lower for most metals than in fish from the other sites investigated, although similar to site R8, and were lower than in previous years (Tables 5 and 6).

Table 1: Summary of electro-fishing results for all sites sampled during August of 2006,.

Sample Site	Date Sampled	Sample Effort (seconds)	Sample Effort (area)	Arctic Grayling	Slimy Sculpin	Burbot	Juvenile chinook salmon	Round W.fish
R1	Aug. 17	859	100 m	0	15 ad	0	0	0
R2	Aug. 18	1,280	100 m.	0.	54 ad 7 fry	1 sub ad.	2	0
R4	Aug. 17	980	110 m.	1 juv.	82 ad 50 fry	0	0	0
R6/ R8	Aug. 17	779	120 m.	0	49 ad 10 fry	2 sub ad	0	0
V8	Aug. 18	782	120 m.	8 sub ad.	2 ad	1 sub ad	39	0

Summary of abbreviations: ad= adult, juv.= juvenile, sub. ad.= sub adult Round W. fish= round whitefish

Table 2: Summary of electro-fishing results conducted during August of, 2004, 2005 and 2006. Catches have been expressed by unit of effort as the number of fish recorded per 100 seconds shocking time.

SITE	YEAR	grayling sub ad. & adult	grayling juvenile	sculpin adult	sculpin fry	Burbot	C.salmon juvenile	R.whitefish
R1	2004	0.36	1.80	3.47	0	0.24	0.36	0.12
	2005	0	1.53	4.83	0	0.24	0	0
	2006	0	0	1.75	0	0	0	0
R2	2004	0.27	0	15.65	1.10	0.27	0	0
	2005	1.81	0.11	8.60	0.79	0.79	0.23	0
	2006	0	0	4.22	0.55	0.08	0	0
R4	2004	0.11	0	2.86	0	0	0	0
	2005	0.57	0	4.31	0.58	0	0	0
	2006	0	0.10	8.37	5.10	0	0	0
R6	2004	0.11	0	2.86	0.11	0	0	0
	2005	0	0	4.21	0.10	0	0	0
	2006	0	0	6.29	1.28	0.26	0	0
V8	2004	1.08	0.59	0.69	0	0	16.60	0
	2005	0.30	0	0.49	0	0	18.62	0
	2006	1.02	0	0.26	0	0.13	4.99	

Table 3: Summary of minnow trapping catch per unit of effort results for the years 2004, 2005 and 2006. Catch per unit of effort has been expressed as the number of fish per trap per 24 hrs. A complete data set of minnow trapping results for 2006 is presented in Appendix 2.

Sample Site	Year	Slimy Sculpin	Arctic Grayling	Burbot	Juvenile chinook salmon	1+ chinook salmon
SITE						
R1	2004	0.49	0.16	0	0.16	0
	2005	0.30	0.29	0	0	0
	2006	0.16	0.16	0	0	0
R2	2004	0.15	0	0.15	1.68	0
	2005	0.34	0	0.67	0.84	0
	2006	0.15	0.15	0	0	0
R4	2004	0	0	0	0.51	0
	2005	0.31	0	0	0	0
	2006	0.28	0	0	0	0
R6	2004	0.71	0	0	0	0
	2005	0.21	0	0	0	0
	2006	0.20	0	0	0	0
V8	2004	0	0	0	79.28	0
	2005	0	0	0	17.9	0
	2006	0	0	0	11.78	0
B1	2004	0.13	0	0	75.76	0.53
	2005	0.32	0.11	0	55.90	0.32
	2006	0	0	0.21	9.36	0.34

Table 4: Comparison of angling efforts and catches from investigations conducted during 2004, 2005 and 2006 in the Faro area.

Sample site	Year	Effort	Catch	Comment
R1	2004	30 minutes	2 Arctic grayling	
	2005	45 minutes	4 Arctic grayling	
	2006	190 minutes	9 Arctic grayling	Ag mostly sub. ad
R2	2004	30 minutes	7 Arctic grayling	caught u/s and d/s of discharge
	2005	105 minutes	0	observe 0 Ag
	2006	180 minutes	5 Arctic grayling	well dispersed
R4	2004	10 minutes	0	
	2005	30 minutes	5 Arctic grayling	
	2006	50 minutes	6 Arctic grayling	u/s of site
R6	2004	30 minutes	2 Arctic grayling	
	2005	50 minutes	1 Arctic grayling	
(R8)	2006	50 minutes	3 Arctic grayling	
V8	2004	no angling		
	2005	15 minutes	0	poor angling location
	2006	5 minutes	0	no angling room
B1	2004	40 minutes	5 Arctic grayling	
	2005	70 minutes	7 Arctic grayling	lost 5 Ag
	2006	240 minutes	5 Arctic grayling	Ag well fed on roe

Table 5: Summary of average concentrations for key metal (expressed as ug/g) from Arctic grayling tissue taken in August of 2004, 2005 and 2006

METAL	YEAR	R1	R2	R4	R6	V8	B1
Copper	2004	0.68	0.74	0.96	0.77	0.53	0.50
	2005	0.76	*no sample*	0.80	0.71	0.67	0.59
	2006	0.35	0.5	0.37	0.27	0.29	0.25
Lead	2004	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	2005	<0.5	*no sample*	<0.5	<0.5	<0.5	<0.5
	2006	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	2004	<2	<2	>2	<2	<2	<2
	2005	8.3	*no sample*	10.41	2.76	2.76	1.88
	2006	0.83	1.38	0.84	0.52	0.26	0.30
Zinc	2004	9.37	7.74	9.44	8.29	8.09	6.49
	2005	13.10	*no sample*	12.36	17.68	17.68	10.60
	2006	6.23	6.71	6.35	5.13	6.78	6.12
Cadmium	2004	0.015	0.097	<0.005	<0.005	0.033	0.032
	2005	0.05	*no sample*	0.83	<0.05	0.167	0.09
	2006	<0.02	<0.02	<0.02	<0.02	0.03	<0.02

Table 6: Summary of average concentrations for key metal (expressed as ug/g) from slimy sculpin tissue taken in August of 2004, 2005 and 2006.

METAL	YEAR	R1	R2	R4	R6	V8	B1
Copper	2004	0.57	1.20	0.88	0.93	0.79	0.87
	2005	1.12	1.25	0.96	0.98	0.95	1.12
	2006	0.72	0.564	0.41	0.56	no sample	0.61
Lead	2004	0.41	0.24	0.22	0.13	0.16	0.075
	2005	0.57	1.02	0.56	<0.5	<0.5	<0.5
	2006	<0.1	<0.1	<0.1	<0.1	no sample	<0.1
Manganese	2004	28.10	31.70	30.8	30.80	6.70	9.17
	2005	24.96	38.78	47.72	26.42	7.37	8.67
	2006	16.66	19.70	36.96	8.23	no sample	11.10
Zinc	2004	53.1	39.3	57.6	41.0	55.14	31.27
	2005	30.06	51.76	49.94	39.1	45.66	26.06
	2006	33.04	49.62	44.52	27.22	no sample	23.7
Cadmium	2004	0.011	0.051	0.062	0.072	0.184	0.108
	2005	0.05	<0.05	<0.05	0.076	0.18	0.085
	2006	0.04	0.03	0.04	0.058	no sample	0.06

5.0 DISCUSSION

The new site on Anvil Creek, site R8, worked well as a sample site during 2006. Site R6 with a slight increase in water levels was completely unworkable. The new site has easy helicopter access, can be reached on foot from site R6, and provides excellent and safe fishing opportunities even with the higher flows experienced during 2006 sampling.

The distinct reduction in the level of fish utilization at site R2 may be due in part to bank erosion immediately upstream of the tailings discharge channel. The bank referred to does contain significant amounts of tailings likely from the 1973 tailings spill and may be causing an avoidance reaction by fish.

Low chinook salmon juveniles numbers in Blind and Vangorda Creeks as well as the total absence in the Rose/ Anvil system likely relate to the low escapement of adult chinook salmon in 2005. Poor spawning success was recorded in most areas of the Yukon River drainage during 2005. Escapement during 2006 was slightly higher than in 2005 and an increase in jcs numbers at all the sample sites can be anticipated for 2007.

APPENDIX 1
GENERAL SITE DESCRIPTIONS

SITE: R1 Rose Creek

UTM: Down stream end 05 83 739 E, 69 12 390 N
Site Location: reach starts 10 meters upstream of the confluence of the north and south forks of Rose Creek and extends upstream for 110 meters.
Date Sampled: August 17 and 18, 2004
August 13 and 14, 2005
August 16 and 17, 2006

CHANNEL CHARACTERISTICS:

Surveyed Length:	110 m
Average Channel Width:	4 meters
Average Wetted Width:	4 meters
Average Depth:	0.3 meters
Average Velocity	1.5 meters per second
% Pool, Riffle, Run / Glide:	65% riffles through boulders, 25% run and 10% small boulder and side pools
Cover	Dominant cover is boulder pools and perched boulders
Overhead vegetation	10% overhanging
Riparian Vegetation	Willow, dwarf birch, cinquefoil, with spruce adjacent

BED MATERIAL:

70% boulder, 20% cobble, 5% gravel, 5% sand with occasional bedrock outcrop in lower part of reach

BANK CHARACTERISTICS: Well defined channel with bedrock confining the channel on the left bank, the right bank has an open flood plain above an abrupt bank rise of 0.4 meters.

CHANNEL MORPHOLOGY CHARACTERISTICS: Uniform channel with a mostly flat bottom, some contour is provided by small pools near submerged bedrock along the left bank and boulders causing small cascades. A small island exists at the top of the reach. Flows within the South Fork of Rose Creek at site R1 were slightly greater in 2006 than both previous years.

Photo 1:, Rose Creek looking upstream at Site R1 from near the bottom of the sample reach, 2005.

SITE: R2 Rose Creek

UTM: down stream end 05 79 401 E, 69 14 972 N
Site Location: reach starts at the confluence of the tailing pond discharge channel with Rose Creek and extends downstream for 110 meters through the mix water zone.
Date Sampled: August 18 and 19, 2004
August 15 and 16, 2005
August 15 and 16, 2006

CHANNEL CHARACTERISTICS:

Surveyed Length:	110 meters
Average Channel Width:	14 meters
Average Wetted Width:	8 meters
Average Depth:	0.6 meters
Average Velocity	0.8 meters per second
% Pool, Riffle, Run / Glide:	30% pool, 30% riffle, 40% glide
Cover	Large woody debri, undercut banks and deep pools
Overhead vegetation	No overhead vegetation
Riparian Vegetation	Willow, dwarf birch and dead spruce

BED MATERIAL:

30% cobble, 50% gravel, 20% sand with sand and gravel increasing in deeper pools and exposed point bars mostly sand and gravel.

BANK CHARACTERISTICS: Sand and gravel point bars opposite of mud cut banks that rise 1.5 to 2.5 meters to an open flood plain.

CHANNEL MORPHOLOGY CHARACTERISTICS: Meandering channel with corner pools, small riffles and point bars adjacent to cut banks. Water levels were approximately .3 meters deeper during 2005 investigations than during 2004 investigations.

Photo 2: The tailings pond discharge channel just prior to entering Rose Creek at sample reach site R2.

Photo 3: The upstream section of the sample reach at site R2. The tailings discharge channel is visible in the upper right corner of the photo.

SITE: R4 Rose Creek

UTM: down stream end 05 67 827 E, 69 21 736 N
Site Location: reach starts 80 meters upstream of the confluence of Rose Creek and Anvil Creek and extends upstream for 110 meters.
Date Sampled: August 12, 2004
August 17 and 18, 2005
August 16 and 17, 2006

CHANNEL CHARACTERISTICS:

Surveyed Length:	110 meters
Average Channel Width:	20 meters
Average Wetted Width:	16 meters
Average Depth:	0.3 meters
Average Velocity	> 1.0 meters per second
% Pool, Riffle, Run / Glide:	60% riffle, 15% boulder pool and 25% run
Cover	Boulder pools and overhead vegetation
Overhead vegetation	20% coverage
Riparian Vegetation	Alder and willow with spruce behind

BED MATERIAL:

5% large boulder, 20% boulder, 30% cobble, 40% gravel, 5% sand.

BANK CHARACTERISTICS: Open flood plain with gentle rise adjacent to well defined stepped banks that rise to a maximum of 2 meters to an open flood plain.

CHANNEL MORPHOLOGY CHARACTERISTICS: Mostly flat channel with one side typically deeper than the opposite side. Some exposed large boulders and a large side pool exists near the bottom of the reach. Water levels were 0.3 meters higher during 2005 sampling than during the 2004 investigations and were a further 0.1 meters higher in 2006.

Photo 4: Boulder habitats and side pool in the sample reach at site R4, August 17, 2006.

SITE: R6 Anvil Creek

UTM: down stream end 05 67 917 E, 69 21 804 N
Site Location: reach starts 100 meters upstream of the confluence of Anvil Creek with Rose Creek and extends upstream a further 100 meters.
Date Sampled: August 12, 2004
August 17 and 18, 2005

Anvil Creek just upstream of the confluence with Rose Creek (control site).
This reach is located at and begins 150 meters upstream of the confluence and then extends upstream for 100 meters

CHANNEL CHARACTERISTICS:

Surveyed Length:	100 meters
Average Channel Width:	15 meters
Average Wetted Width:	14 meters
Average Depth:	0.4 meters
Average Velocity	1.5 meters per second
% Pool, Riffle, Run / Glide:	15% rapid, 45% riffle, 20% run, 20% boulder pool
Cover	Turbulence, perched boulders and cobbles, and limited undercut and cut banks.
Overhead vegetation	< 5% cover
Riparian Vegetation	Willow with a sedge fringe and spruce adjacent

BED MATERIAL:

5% large boulder, 50% small boulder, 30% cobble, 15% sand

BANK CHARACTERISTICS: Well defined and stable banks rise to even 2 meter height on 50% slope.

CHANNEL MORPHOLOGY CHARACTERISTICS: Channel mostly flat but the mid channel areas are elevated with deep flows occurring towards the banks. Water levels in Anvil Creek were 0.5 meters deeper during 2005 investigations than those of 2004 and 0.2 meters higher again in 2006. This site was not sampled in 2006.

Photo 5: Looking upstream to the top of the sample reach at site R6, from the downstream end, 2005.

SITE: R8 Anvil Creek

UTM: down stream end 05 68 768 E, 69 21 412 N
Site Location: reach starts 1.35 km by creek channel (800 meters direct) upstream of the confluence of Anvil Creek with Rose Creek and extends upstream a further 100 meters.
Date Sampled: August 16 and 17, 2006

Anvil Creek upstream of the confluence with Rose Creek (control site).

CHANNEL CHARACTERISTICS:

Surveyed Length:	100 meters
Average Channel Width:	9.5 meters
Average Wetted Width:	9 meters
Average Depth:	0.7 meters
Average Velocity	>1 meter per second
% Pool, Riffle, Run / Glide:	10% rapid, 15% riffle, 20% run, 40% race, 15% pool
Cover	Large boulders, pools and LOD and undercut bank.
Crown Closure	< 5% cover
Riparian Vegetation	Alder, spruce, willow mix with grasses, sedge and cinquefoil

BED MATERIAL:

80% small boulder, 15% cobble, 5% gravel, with sand deposits at downstream point bar

BANK CHARACTERISTICS: Consistent well defined and stable banks rise abruptly 0.7 to 1.0 meter height.

CHANNEL MORPHOLOGY CHARACTERISTICS: The channel is partially entrenched by a small hill on the upper right bank, becomes confined and deep centered before spreading to over 50 meters wide at a small side channel in the lower portion of the reach on the right bank. The reach ends with a shoot rapid entering a deep corner pool with undercut banks.

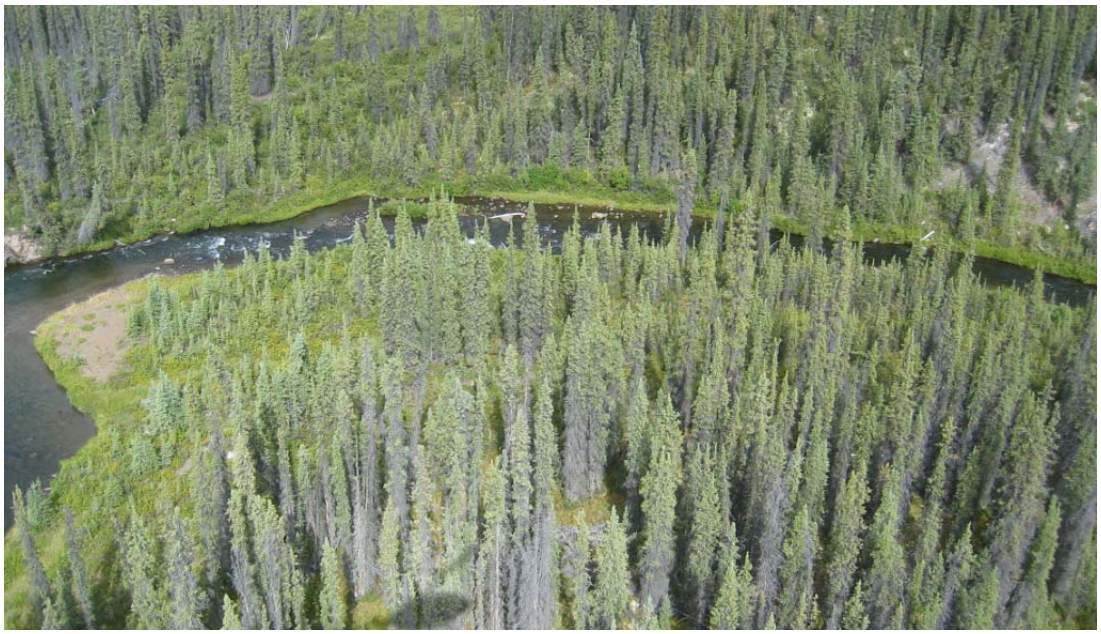

Photo 6: Reach R8 sample site, flowing right to left.

Photo 7: Reach R8 looking upstream from the lower riffle/rapid, August 17, 2006

SITE: B1 Blind Creek

UTM: down stream end 05 36 680 E, 68 96 005 N
Site Location: reach starts immediately upstream of the bridge and extends upstream for 100 meters/
Date Sampled: August 14 and 15, 2004
August 19 and 20, 2005
August 18 and 19, 2006

CHANNEL CHARACTERISTICS:

Surveyed Length:	100 meters
Average Channel Width:	15.5 meters
Average Wetted Width:	14 meters
Average Depth:	0.7 meters
Average Velocity	0.4 meters per second
% Pool, Riffle, Run / Glide:	100% glide
Cover	Fine organic debris, cut banks (up to 40%), small woody debris against shore and a beaver lodge
Overhead vegetation	10% cover
Riparian Vegetation	Alder, willow with some spruce, with high bush cranberry, raspberry and cinquefoil adjacent

BED MATERIAL:

Sand silt and organic debris overlaying 60% cobble, 40% gravel.

BANK CHARACTERISTICS: Shallow point bars occur opposite of cut and eroding banks near gentle corners. Cut banks rise between 1 and 2 meters to an open flood plain.

CHANNEL MORPHOLOGY CHARACTERISTICS: Uniform channel with a deep side opposite of a side of deposition. Flows in Blind Creek were slightly higher in 2006 than during 2005 sampling which were very similar to those encountered during 2004.

Photo 8: Blind creek downstream of the weir site and near active chinook salmon redds, August 19, 2006

SITE: V8 Vangorda Creek

UTM: down stream end 05 84 790 E, 69 00 606 N
Site Location: reach starts immediately upstream of a small foot bridge that crosses the creek at the site of the town of Faro sewage discharge pipe crossing and extends upstream for 100 meters
Date Sampled: August 14 and 15, 2004
August 17 and 18, 2005
August 17 and 18, 2006

CHANNEL CHARACTERISTICS:

Surveyed Length:	100 meters
Average Channel Width:	6.0 meters
Average Wetted Width:	3.3 meters
Average Depth:	0.5 meters
Average Velocity	1.5 meters per second
% Pool, Riffle, Run / Glide:	80% riffle (almost rapid), 20% eddy and side pools
Cover	Over head vegetation, large and small woody debri, flood washed shrubby vegetation and boulder pools
Overhead vegetation	20% cover
Riparian Vegetation	Alder and willow with occasional spruce and poplar

BED MATERIAL:

50% boulder, 20% cobble, 15% gravel, 15% sand with occasional bedrock outcrop in upper part of reach. Most substrates loosely consolidated and highly silted. Creek channel was heavily modified by a high water event this season.

BANK CHARACTERISTICS: Well defined channel with newly eroded, but stable, banks that rise gently to a maximum of 2 meters. A small area of bedrock confines the channel on the left bank at the upstream end of the reach.

CHANNEL MORPHOLOGY CHARACTERISTICS: Very little meandering in an entrenched valley, unconsolidated materials from 2004 have been washed out and boulders protrude in most of the channel.

Photo 9: Looking upstream at the sample reach from the new bridge crossing Vangorda Creek at site V8.