Fisheries and Oceans | Pêches et Océans

MEMORANDUM NOTE DE SERVICE

To
A

File:
- **Clinton Creek FCSAP**
- **Clinton Creek stream file**
- **CRE-06-07 file**

From
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RRB OHEB
Y&TBR Area
Fisheries and Oceans Canada

Security Classification - Classification de sécurité	
Our file - Notre référence	
Your File - Votré référence	
Date	**Dec 23, 2007**

Subject
Object

Clinton Creek, tributary to the Fortymile River, Yukon River North Mainstem sub-basin – record of 2007 activities

Introduction

The Clinton Creek Asbestos Mine receives funding under the Federal Contaminated Sites Action Plan (FCSAP). Fisheries and Oceans Canada (DFO) serves as an Expert Department under FCSAP. In the summer of 2005, DFO Oceans, Habitat and Enhancement (OHEB) commenced fish utilisation and habitat investigations at the minesite and in receiving waters. These were to support understanding of the potential long term effects of the mine site and related infrastructure. In 2006 we continued to monitor fish and fish habitat in the area of the mine site and in potentially affected waters. Our 2006 sampling also served to monitor and evaluate the Dawson District Renewable Resource Council's pilot Stream Stewardship project. This project allowed juvenile Chinook salmon to utilise high quality rearing habitat near and within the mine site.

Sampling continued in 2007. Fish sampling was conducted on three occasions during the open water period: July 10 – 11; August 9 - 11; and September 14 - 15. Stations sampled varied depending on the objectives of the sampling

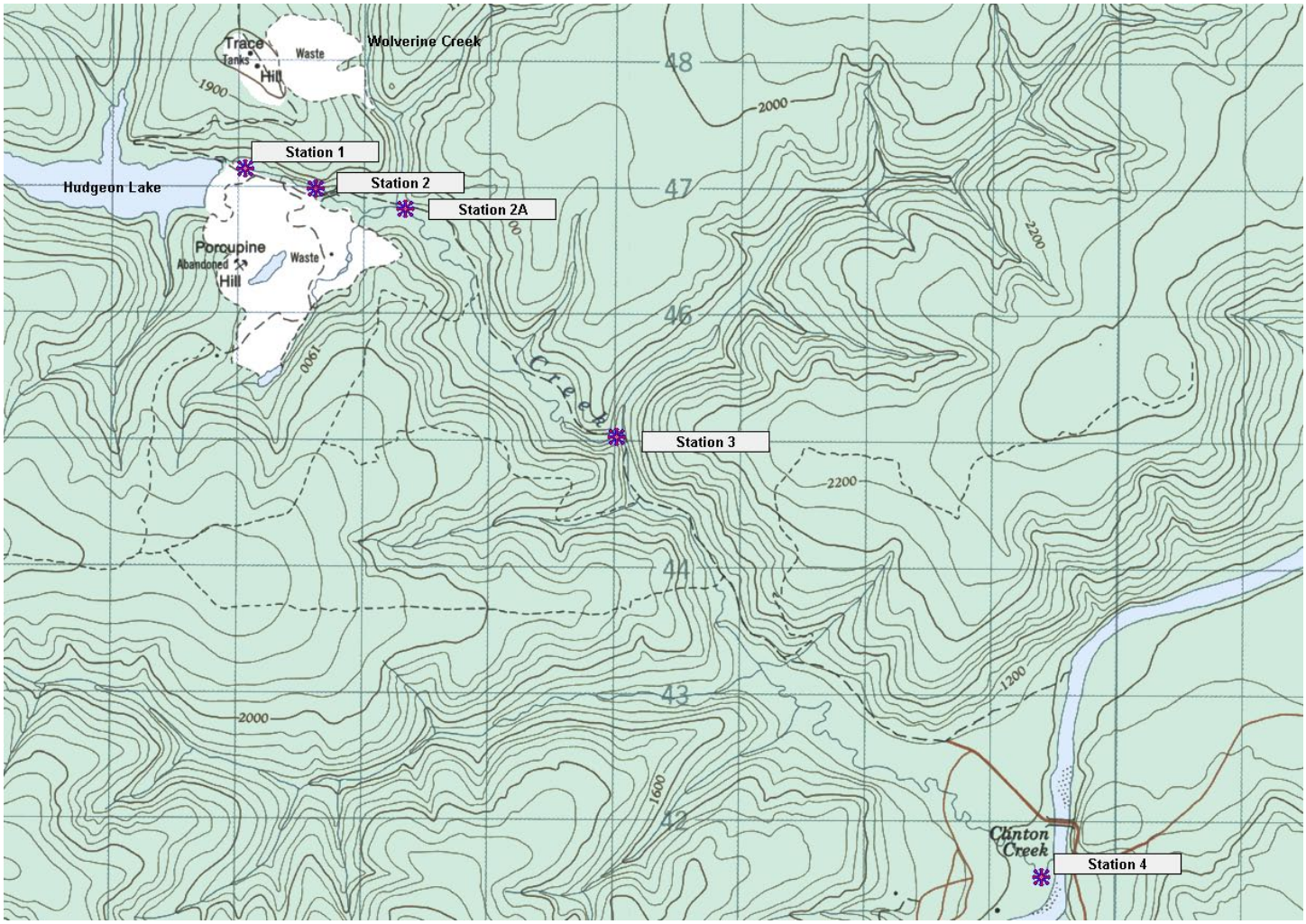
The Dawson District Renewable Resource Council (DDRRC) Stream Stewardship crew comprised of Ted Hunter and Pait Johnson supervised by Chris Clarke collaborated in the July DFO sampling. Subsequently, they captured 2070 juvenile Chinook salmon 8 below the furthest downstream beaver dam and returned them to Clinton Creek at Station 2A at the mouth of Wolverine Creek between July 18 and August. Sonja Foss volunteered her much appreciated assistance in August sampling.

For context, the following description of the drainage basin and the characteristics of the stream channel within the mine site are taken from our 2005 memo report:

> "Clinton Creek has a drainage area of 206 sq. km., a length of about 22 km. and a total relief of 760 m. From the mouth, the creek crosses valley bottom deposits that function as an alluvial fan. The valley narrows to a "V" shape and maintains this form until just downstream of the mouth of Wolverine Creek, when it widens. The creek has a low to moderate gradient. South-

facing slopes are dry and permafrost, if present, is deep. North facing slopes are moist and appear to have near surface permafrost.

The obvious direct effects of the mine start just downstream of the mouth of Wolverine Creek, with deposits of fine materials on the banks. Above this is the beaver dammed wetland area, which appears to be associated with ground water discharges from the minesite, and particularly from the infilled Porcupine Creek valley. Above the wetlands is an aggrading alluvial fan, over which the ford to the minesite crosses. Further upstream is the canyon. This is bounded on the south by the waste rock dump and to the north by the valley wall. Importantly, the canyon is in the process of incising into bedrock for much of it's length. At the head of the canyon is the lake outlet gabion structure, and beyond that Hudgeon Lake."



Map 2007 – 1. Long term sampling stations are shown. Stations C-1 – C5 were located between Stations 1 and 2.

2007 investigations

Methods:

Sampling was mainly conducted at stations established in 2005. The principal stations are shown on Map 1. Additional stations were established in 2007. Stations C1 through C5 were established approximately equidistantly between the upstream end of the canyon (C1) and the downstream end of the canyon (C5). These stations were sampled in August to determine the upstream migration of salmon from Station 2A. Stations G1 and G2 were established at the base of the first and second (from the bottom) gabion structures. They were sampled in September to determine the 2007 upstream limit of jcs migration.

Gee-type minnow traps were used. Baiting and deployment was in accordance with the DFO "Protocol for the baiting of G-type minnow traps for the capture of juvenile Chinook salmon in the Yukon River Drainage Basin". This method targets juvenile Chinook salmon, a socially, economically and culturally significant species, and slimy sculpin, a sentinel species. Few other fish are captured. Numbers of traps set varied between sampling events. The entrances of the traps were modified to a diameter of ~40mm to allow the capture of larger fish.

Catch per Unit Effort (CPUE) was calculated on the basis of jcs captured per trap per hour and averaged by station. As juveniles may both enter and leave the traps, the CPUE values imply rather than establish densities.

Flows were not measured. Observations of stage were made at the gabion structures, which function as over-flow/through-flow weirs. Digital images were taken at each sampling event and are saved to H:HEB Photo library/Watersheds/Yukon River North Mainstem/Fortymile River/Clinton Creek.

Funding was not available for an overflight of the creek to determine the extent or intensity of beaver activity. Observations were made from the access road and at the sampling Stations.

All fish captured were anaesthetized, identified to species and measured to the nearest millimeter: total length (tl) for Slimy sculpin and burbot, fork length (fl) for all others.

Observations of the bio/physical environment were made at each onsite.
Initially, Tidbit v1 data loggers were deployed and recorded water temperatures hourly. The data loggers were attached to bricks and placed in shallow, flowing water. They were not shielded from the sun. Model v2 Tidbits replaced the v1 Tidbits during the September sampling. They were placed in deep water, protected locations. This was to increase the potential that they would remain in water throughout the winter and would not be washed away in the spring.

Sampling

July 10 - 11

The objectives of the sampling were to:

- determine whether 1+ jcs remained in Clinton Creek at the mine site;
- determine whether 0+ jcs had entered Clinton Creek from the Fortymile River in sufficient numbers to justify the start of the DDRRC project;
- determine the implied density of captured jcs;
- Provide training to the DDRRC staff in sampling juvenile fish;
- Make general observations of the bio-physical environment; and
- Deploy a data logger to measure stream temperatures at Station 1.

Effort and Captures were:

Station 2A (mouth Wolverine Creek) – 4 - 1/4" minnow traps

- 4 long nosed sucker (lns)
- 12 slimy sculpin (ss) tl 55 – 88

Station 4 (lowest reach, downstream all beaver dams) – 3 - 1/4" minnow traps

- 53 juvenile Chinook salmon (jcs), mean fl 61.302; range fl 54-69; CPUE 0.609 jcs trap/hr
- 3 lns

Notes & observations;

- a data logger was deployed downstream of the gabion structures;
- the 0+ jcs in-migration to Clinton Creek had commenced;
- no grayling were seen or captured at any site;
- the eagle feeding site at Station 1 was vacant;
- Water flowed over all gabions structures & was considered medium high;
- The lower gabion structures were streaming green algae.

August 8 - 9

The objectives of this sampling were to:

- determine the extent to which jcs released by the DDRRC had migrated upstream;
- determine the implied density of the jcs in stations sampled;
- determine the implied growth of captured jcs in stations sampled;
- Make general observations of the bio-physical environment;
- Deploy a data logger to measure stream temperatures downstream of Station 2A

Effort and Captures were:

Station C-1 (corresponds to Station 1) 2 – ¼ " minnow traps

- 1 jcs – 76 mm; CPUE 0.021 jcs trap/hour

Station C-2 2 – ¼ " minnow traps

- 2 jcs - mean fl 71mm; range 70-72 mm; CPUE 0.042 jcs trap/hr

Station C-3 2 – ¼ " minnow traps

- 4 jcs – mean fl 71.25 mm; range 66-75 mm; CPUE 0.084 jcs trap/hr

Station C-4 2 – ¼ " minnow traps
- 4 jcs – mean fl 71.5 mm; range 69-75 mm; CPUE 0.084 jcs trap/hr

Station C-5 2 – ¼ " (at downstream end of the canyon) minnow traps
- 12 jcs – mean fl 71.417; range 62-79; CPUE 0.25 jcs trap/hr.
- 10 SS – range tl 78 – 102 mm
- 3 LNS – range fl 88 – 126 mm

Notes & observations;
- one jcs had ascended to the downstream end of the gabions;
- no grayling were seen or captured at any site;
- the eagle feeding site at Station 1 continued to be vacant;
- a data logger was deployed about 30 meters downstream of the mouth of Wolverine Creek on creek left;
- water flowed through most gabion structures;
- the left canyon wall was active, with one ~5 cubic meter rock fall overnight;
- the green algae in the gabion structures had increased since July;
- green algae was present through the canyon, but much less so than in the gabion structures.

September 14 – 15

The objectives of this sampling were to:
- determine whether jcs had ascended beyond the first gabion structure;
- determine the implied density of the jcs at Stations 1, 2, 2A and 4;
- determine the implied growth of captured jcs at Stations 1, 2, 2A and 4;
- Make general observations of the bio-physical environment;
- Retrieve the v1 data loggers and set v2 data loggers where they would survive expected freshet flows;
- Make general observations of the bio-physical environment

Effort and Captures were:

Station G – 2 – at base of second gabion structure (from bottom). 2- ¼" minnow traps
- No captures

Station G – 1 – upstream of the cross-channel row of gabions below the furthest downstream structure. 2- ¼" minnow traps
- 3 jcs – mean fl 97; range 95 - 101; CPUE 0.058 jcs trap/hr

Station 1 . 2- ¼" minnow traps
- 13 jcs – mean fl 99.77; range 91 - 111; CPUE 0.25 jcs trap/hr

Station 2 . 2- ¼" minnow traps
- 18 jcs – mean fl 93.39; range 88 - 100; CPUE 0.34 jcs trap/hr; 2 SS, tl 96 & 105;

Station 2A . 2- ¼" minnow traps
- 126 jcs – mean fl 80.82; range 70 - 93; CPUE 2.52 jcs trap/hr; 2 SS tl 79 & 95

Station 4 . 3 - ¼" minnow traps
- 58 jcs – mean fl 70.71; range 58 - 82; CPUE 0.81 jcs trap/hr

Notes & observations

- no salmon were captured upstream of the furthest downstream gabion structure;
- no grayling were seen or captured;
- I walked up the center of the pool between the top of gabion structure 1 and the base of gabion structure 2. The algae was starting to brown and break off. The bottom was soft, fine grained material at the downstream end and then became more coarse as the base of structure 2 was approached. The stream bottom near structure 2 was composed primarily of sorted gravels of the same colour and texture as the material in the gabions;
- the majority of the salmon were recaptured in the area where most had been released, at the mouth of Wolverine Creek;
- a beaver dam had been broken on upper Wolverine Creek by maintenance staff immediately before the sampling. The resulting sediment plume extending downstream into Clinton Creek indicated that the data logger had been measuring water temperatures within the plume;
- large lumps were noticed on 5 jcs from Station 2A. The jcs were retained and submitted to the DFO Pacific Biological Station for analysis;
- replacement data loggers were set in deep water, protected sites, and were anchored by blue clothes line to trees on the shore;
- Water flowed over most gabion structures in September;
- A new beaver dam had been constructed at Station 4, and further downstream than any noted previously.

Discussion

Beaver

In 2006 seventeen beaver dams across the Clinton Creek channel were observed during an overflight between the mouth and the confluence with Wolverine Creek. No flight was conducted in 2007.

Beaver dams were observed in most places where the channel was visible from the mine access road.

A new dam was built at Station 4, and the large beaver dam complex at the confluences of Porcupine, Wolverine and Clinton Creek was active throughout the summer.

It is likely that the degree of affect on Clinton Creek from the beaver activity in 2007 was similar to that in 2006.

Flows

Flows appeared to be higher in 2007 than in 2005 or 2006.

Temperature

A Tidbit v1 data logger was deployed at Station 1 from July 11 to Sept 14, and another at Station 2A from August 9 to September 15. The loggers were set in shallow water areas and were not shaded from the sun. There is a possibility that the daily high temperatures recorded were not accurately measured, as the data loggers could have been affected by direct sunshine. The logger at Station 1

was at most risk of this effect, as it was in an entirely open channel. The logger at Station 2A had some overhanging vegetation. Both loggers were in the main flow of the creek.

With this qualification, the water at Station 1 was well mixed and represented the temperature of Clinton Creek at the site. The location of the logger at Station 2A was within the mixing zone of cooler Wolverine Creek water and warmer Clinton Creek water. It therefore did not represent the temperature of Clinton Creek either up- or downstream of the measuring point.

The data logger at Station 1 recorded hourly readings exceeding 20 C on a total of 485 occasions, and had an extreme high temperature reading of 26.85 C. With the exception of July 16th, every day in July during which measurements were made had at least one hourly reading in excess of 20 degrees. Eleven days in August also had at least one hourly reading above 20 degrees. Temperatures remained high into the fall, with temperatures not dipping below 10 C until Sept 11. The lowest temperature measured was 9.68 C on Sept 12.

The Tidbit v1 data logger at Station 2A recorded a maximum temperature of 18.87 for a three hour period on August 17. Temperatures dipped below 10 C on August 29. The lowest temperature measured was 7.25 C on September 12.

The high maximum temperatures recorded at Station 1 in July, while qualified, are beyond the generally accepted maximum temperatures for juvenile Chinook salmon. It is critical, however, to note that the temperatures were measured in the main flow of the creek and did not reflect potential thermal heterogeneity at the site or in adjacent up- and downstream areas. Thermal heterogeneity is associated with ground water seeps, still water areas within the boulder substrate, hyporheic flows, etc. The value of thermal refugia may be scaled to the sizes of individual fish, an important consideration as many of the discharges, and the interstices of the substrate are small. It is notable that, despite the high water temperatures at least one jcs had migrated virtually to the limit of upstream migration by August 9 and others were present throughout the canyon.

The overall productivity of aquatic systems is related to water temperature. Degree-days were calculated for 10 day periods. The periods were based on the calendar year, starting with January 1. This was to remove the bias of sampling per week, as the total numbers of days since calendar (as in the start of the year on Jan. 1) or astronomical dates (such as solstice) remains the same regardless of the week day on which sampling occurs.

Degree-days for full periods of calendar days 151 - 160 through day 241 – 250 and partial periods to the data logger replacement dates are shown in Table 2007 - 1 The lower number of degree-days at Station 2A may be seen as in part a measure of the thermal heterogeneity mentioned above. While the primary reason was the logger's position in the plume of the cooler waters of Wolverine Creek, the entire basin where Clinton, Wolverine and Porcupine Creek join has multiple ground water discharge areas. Many or most of the discharge areas are associated with the waste rock, either as the original deposits or reworked materials from it.

Clinton Creek total degree days 2007		
Day since Jan 1	**Station 1**	**Station 2A**
191-200 July 11-20	168.20	
201-210 July 21-30	211.33	
211-220 July 30-Aug 8	202.11	
221-230 Aug 9-18	172.48	126.40
231-240 Aug 19-28	157.82	130.17
241-250 Aug 29-Sept 7	125.97	103.45
251--257 Sept 8-14	63.08	
251-258 Sept 8-15		62.87

Table 2007 - 1. Degree days at Station 1 and 2A for specified periods.

Fish

Sampling in July 2007 established that there were few if any 1+ jcs in the mine site area, and that 0+ Chinook had started to enter the creek from the Fortymile River.

The DDRRC started to return jcs to Clinton Creek at Station 2A on July 18. They chose to place the juveniles upstream of a recently constructed beaver dam immediately above the mouth of Wolverine Creek. Chris Clarke, the DDRRC supervisor, became concerned that the water was too warm at this location and consulted with me. I asked her to place the juveniles downstream of the beaver dam and near the culvert through which Wolverine Creek flows to enter Clinton Creek. A total of 2070 0+ jcs were returned to Clinton Creek.

Sampling in August established that jcs had migrated upstream to Station 1 and were present in low numbers throughout the canyon section located downstream of the gabion structures. The canyon has multiple minor falls, chutes, etc, but also has very coarse substrate. Individual boulders in excess of 2 cubic meters are common. It is possible that surface access routes are only a component of the overall number of opportunities for juvenile Chinook to migrate upstream. The jcs captured appeared healthy, with only 3 of the 23 captured having bodies which were concave below the lateral line.

A total of 157 jcs were captured at the minesite in September. It is possible that some had migrated upstream from the Fortymile River. However, I am of the opinion that the great majority, or all, of the jcs captured had been released by the DDRRC. If so, the recapture rate was 7.7% of the 2070 jcs released. The sampling effort was limited, implying a high survival rate.

Sampling in September established that the upstream migration from the mouth of Wolverine Creek to and beyond Station 1 had continued. Low numbers of salmon were captured upstream of the first, cross-channel row of gabions at the downstream end of gabion structure 1. Sampling above gabion structure 1 failed to capture any jcs, and I am of the opinion that this structure was a complete obstruction to the upstream migration of jcs under the conditions experienced in 2007.

	2005			2006			2007		
Station 1 - d/s of all gabions									
	n	jcs/tr/hr	fl	n	jcs/t/hr	fl	n	jcs/tr/hr	fl
7-Jul	0								
27-Jul	0								
9-Aug				0			1		76
14-Sep				0					
15-Sep							13	0.25	99.8
Station 2 - at ford									
7-Jul	0								
27-Jul	0								
15-Sep							18	0.346	93.4
Station 2-A - mouth Wolverine Cr.									
20-Jun				0					
11-Jul							0		
27-Jul	7		75						
9-Aug				43	0.135	75.3			
3-Sep	10	0.227	81.4						
14-Sep				11	0.494	88			
15-Sep							12 6	2.52	80
Station 3 - mouth Eagle Cr									
7-Jul	4	0.873	65.4						
27-Jul	10		77.3						
Station 4 - near mouth									
20-Jun				13	0.135	51.9			
11-Jul							53	0.609	71.3
9-Aug				17 5	2.011	64.9			
3-Sep	33	0.75	70.2						
14-Sep				12 0	2.069	70.1			
15-Sep							58	0.81	70.7

Table 2007-2. Juvenile Chinook salmon captures in Clinton Creek 2005 – 2007, showing numbers captured, numbers captured per trap hour, and mean fork lengths by date.

The jcs captured at Station G-1, 1, and 2 in September were extraordinarily large: 6 were in excess of the former maximum recorded length of a 0+ juvenile Chinook salmon in the Canadian portion of the Yukon River drainage, which was 100 mm fl. The largest captured in 2007 was 111 mm. All were heavy bodied, robust, and appeared to be in excellent condition. An example is shown in Image 2007-1. The CPUE increased with distance downstream while the mean fork length decreased.

It appears that the canyon section provided excellent, or at least highly productive, habitat for juvenile Chinook salmon in late summer 2007. This is despite much of the canyon having water temperatures which should have been stressful or lethal to jcs through much of July and parts of early to mid August. It is likely that there were thermal refugia throughout the canyon which individual jcs were able to utilise during high water temperature periods. These jcs may have made feeding excursions or have continued their upstream migration during lower temperature periods. As the temperature cooled in August, the salmon would have been well placed to utilise food organisms that had developed swiftly during the high temperature period. It is also likely that the jcs had limited or no competition from other fish species in the canyon. No grayling were seen or captured and slimy sculpin were only captured at the downstream end of the canyon in August.

The jcs captured at Station 2A in September had a mean fork length a full 13.4 mm less than those captured at Station 2, but had an implied density 7 times higher. This may have been a result of the beaver dam just upstream of Wolverine Creek partially or totally obstructing their upstream passage. The jcs at Station 2A appeared to be in relatively good condition, with 23 of 126 with abdomens which were noticeably concave below the lateral line.

The jcs captured at Station 4, located near the mouth of Clinton Creek, had a mean fork length 9.3 mm less than those at Station 2A, and 29.1 mm less than those captured at Station 1. The apparent condition of the jcs captured was lower than any of the fish at the mine site, with 34 of the 53 having noticeably concave abdomens below the lateral line. An example is shown in Image 2007-2.

Image 2007-1. Juvenile Chinook salmon captured at Station 1 in September. Fork length is 109 mm. Note how deep and robust the body is.

Image 2007-2. Juvenile Chinook salmon captured at Station 4 in September. Fork length is 71 mm, and the lower abdomen sunken. The scale is similar to Image 2007-2.

Image 2007-3. Juvenile Chinook salmon with “lump” captured at Station 2A in September.

One of the jcs with lumps captured at Station 2A in September is shown in Image 2007-3. Five juvenile Chinook salmon were analysed by the DFO Histology Lab at the Pacific Biological Station in Naniamo. Findings are given below:

> “Inside each “tumour” or cyst there was a larval parasite…. There were many more cysts in the muscle than was seen in gross examination. In addition one fish had a similar “cyst” within the body cavity. The location of these cysts is consistent with the larval stage of Triaenophorus spp, a tapeworm that matures in carnivorous fish such as pike (S. Jones, pers. comm..). Also, the

location of the cyst within the body cavity of one fish indicates some type of “tapeworm”. The tissue within each cyst was in general necrotic and quite degraded.”

To the best of my knowledge, this was only the second time that lumps of this kind have been documented in the Yukon, and the first time that they have been analysed.

No arctic grayling were seen or captured in 2007. Arctic grayling fry, juveniles, and adults were common in 2005, with a large school (and closely attendant bald eagle) observed at Station 1. Juveniles were captured at all stations except Station 4. Lesser numbers of Arctic grayling fry and juveniles were captured in 2006, and only a few adults were seen at Station 1 (although the eagle continued his/her vigil).

Few slimy sculpin were seen or captured in 2007. The stream segment below 2A teemed with sculpin in 2005, had less in 2006, and only a handful were observed in 2007. Slimy sculpin were only captured at the downstream end of the canyon in August, and none were captured at Station 1 in September.

Recommendations for 2008

The following activities are recommended for 2008

- Overwintering success of juvenile Chinook salmon – conduct prefreshet sampling at the Minesite;
- Thermal heterogeneity – conduct investigation;
- Thermal regimes – continue deployment of data loggers;
- Summer sampling – follow same general schedule and sampling plan as 2007.