AN ASSESSMENT OF FISH HABITAT AND FISH UTILIZATION WITHIN NORTH FORK, ROSE CREEK

ANVIL RANGE MINE SITE
FARO, YUKON
June and August 2005

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1.0 INTRODUCTION

The North Fork of Rose Creek, a major tributary to Rose Creek, enters Rose Creek upstream of the Faro mine site. Fisheries information from the North Fork of Rose Creek is required for the development of the mine closure plan.

The following report details the findings of field assessments conducted to assess the extent of fish utilization and the availability of fish habitats within the North Fork of Rose Creek at Faro, Yukon. Field assessments were conducted on two separate occasions during 2005; the first between May 31 and June 2 and the second between August 16 and 18.

The North Fork of Rose Creek has 3 distinct reaches each divided by man made structures associated with the Faro mine (Figure 1). The reaches are; 1) below the main mine access road to the confluence with the South Fork of Rose Creek, 2) between the main access road and the Vangorda haul road, and 3) above the haul road. Fish passage was interrupted during 1987 at the haul road where a Rock or French Drain (barrier to fish passage) was constructed as a part of the haul road. The North Fork of Rose Creek has a drainage basin area of 102 sq km, 98% of the drainage basin is up stream of the Rock Drain.

The field assessments focused on fish habitats and fish utilization adjacent to the rock drain (both the upstream and downstream sides) and in the upper reaches of the creek. A priority of this investigation was to determine if fish populations continued to exist in the alienated habitats upstream of the Rock Drain.

2.0 PREVIOUS FISHERIES INVESTIGATIONS

An assessment of fish utilization on the North Fork of Rose Creek prior to the construction of the Rock Drain was conducted in 1986 (Leverton et al, 1986). Leverton reported that during August of 1986 Arctic grayling fry were present in the upper reaches of the creek between a set of beaver ponds and adult Arctic grayling were observed in the ponds. Leverton suggested the pond area contains suitable substrates for grayling spawning and over wintering habitat. Leverton also investigated the headwater pond areas (above the beaver dams) and found low pH (2-3) and shallow water during November of 1985 and determined that area was not over wintering habitat.

Subsequent investigations into fish utilization after the construction of the Rock Drain on the North Fork of Rose Creek were made during 1988 and 1992 (Harder 1988 and Harder 1992). In June of 1989 Harder observed significant numbers of adult Arctic grayling during helicopter surveys in the same beaver pond areas as sightings made by Leverton. Harder also captured slimy sculpin in minnow trap sets in the beaver ponds.

Investigations conducted by Harder in 1992 indicated that numerous Arctic grayling adults were present on both the up and down stream sides of the Rock Drain. Fish tagging programs conducted at this time concluded that the Rock Drain was a barrier to fish passage as no tagged fish were recorded as having moved through the drain.

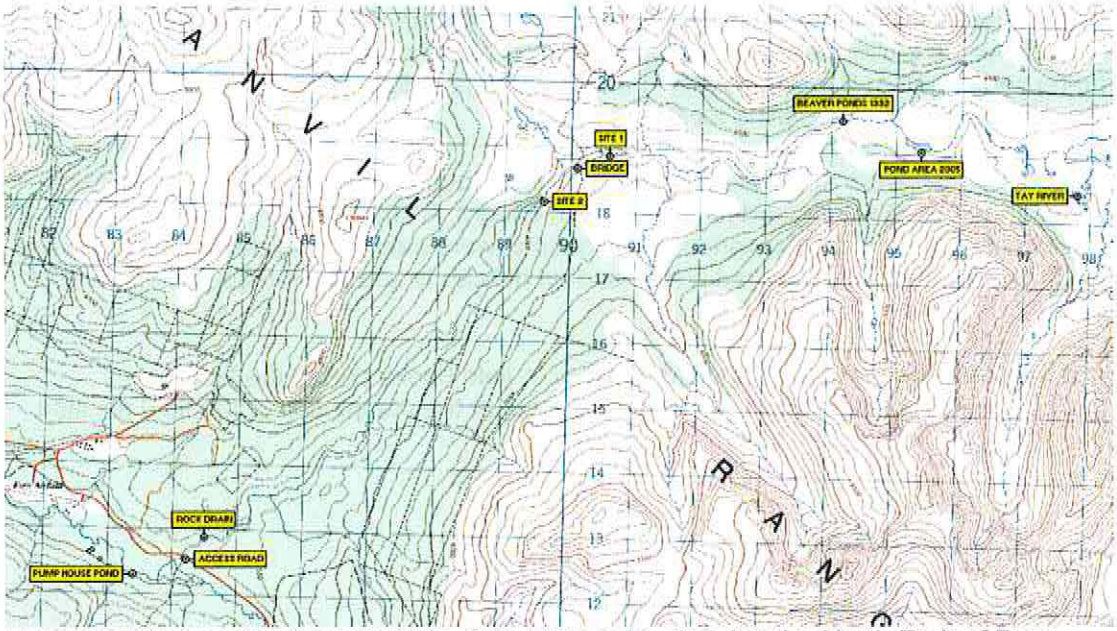

Figure 1: Topographic map 105K06, 1:50,000 scale, showing the North Fork of Rose Creek and sample locations from June and August, 2005 investigations (*image has been reduced by* 50%, *for computer viewing view at 200%*).

3.0 METHODS

A license to collect fisheries information was obtained from DFO prior to conducting the evaluations. The investigations were conducted under the authority of License to Collect Fish No. 05-18.

Investigations were conducted during spring and summer. The spring investigation, conducted during late May and early June was designed to determine; the extent of Arctic grayling access, over-wintering potential and to denote Arctic grayling spawning sites. The summer investigation, conducted during August, was designed to determine the extent of mid summer utilization by all fish species.

A variety of fish sampling gear was utilized to capture fish during field investigations, these included; electro-fishing, angling, gill netting, seining, minnow trapping (baited with Yukon River origin Chinook salmon eggs), and visual observations. Electro-fishing was not conducted during the spring investigation as it was unknown if gravid Arctic grayling were in the area.

Sites sampled were;
Reach 1: immediately downstream of the rock drain,
Reach 2: immediately upstream of the rock drain through the pond area upstream into the flowing channel reach for 1 km, and
Reach 3: the upper reaches of the creek at three separate locations (Figure 1); the bridge site (spring), site 1 and site 2 (summer)

Sampling locations upstream of the haul road were accessed by helicopter on June 2, and again on August 17. During the flights, visual inspections of fish habitats and visible

aggregations of fish in the upper portion of the creek were conducted. Ground inspections were conducted in the upper reaches of the creek at the bridge location during spring and at 2 locations (site 1 and 2) during summer. Suitable helicopter landing sites limited potential sampling locations.

All fish collected were identified to species and the total numbers were recorded. Data on length (±1 mm) was recorded for each fish caught. A sub-sample of adult Arctic grayling captured during the spring investigations were sacrificed to determine spawning condition. All other fish captured were handled delicately and live released at the site of capture.

All information was recorded on field forms or in field books during the field assessments, and transferred to computer format at the completion of the field session.

4.0 RESULTS

4.1 Reach 1. Downstream of Rock Drain

4.1.1 Spring

During the spring investigation in June, flows issued from the base of the Rock Drain for a distance 58 meters along the rock face, before converging into the natural channel 40 meters down stream (Photo #1). The average wetted width of the natural channel was 10 meters and it was bank full. Some of the outflow from the Rock Drain flooded the alder covered riparian zone of the left bank. The flow through the vegetation entered the creek channel as rivulets along the creek bank. The average depth of the creek at this site was 0.4 meters with pools 0.7 meters in depth. Pools with depths greater than 2 meters were common in the native channel below the Rock drain face. The water temperature at the time of investigation (@1720 hrs) was 6.6°C.

Seven minnow traps were set across the face of the Rock Drain for an overnight period with a soak time of approximately 16.5 hours each. None of the traps captured any fish (Table 2). Three seine pulls, all within 100 meters of the rock face captured 3 slimy sculpin fry (12-15 mm). Two Arctic grayling adults were observed (not captured) during the seining. Angling for 20 minutes produced a single adult male Arctic grayling and another was observed (Table 3).

The angled Arctic grayling was sampled and was found to have vestigial milt and had recently completed spawning. This fish may have recently moved into the area as no evidence of grayling spawning was observed in the area. No large aggregations of Arctic grayling were observed and potential spawning habitats (pea gravel) was very limited and occurred only as small patches in turbulent flow conditions.

4.1.2 Summer

During August sampling, flows issued forth from the base of the rock drain in the same 58 meter reach observed during June investigations, although flows were much reduced and contained within well established channels. The natural channel below the imported blast rock had an average width of 6 meters, an average depth of 0.5 meters and a maximum depth of 1.5 meters in a corner pool. Banks were abrupt and often undercut rising 0.5 to 0.8 meters above flow levels. Wet areas on the left bank of the creek were

fed by upwelling of ground flow and several small rivulets enter the creek between 60 and 100 meters from the blast rock along the left bank.

Three distinct zones of fish habitat occur along the face of the drain.
1) Along the face of the drain water wells up from deep interstitial spaces between the blast rock in a strong and turbulent manner.
2) For 20 meters downstream of the face an altered channel with some blast rock and converging channels.
3) The natural channel unaffected by the drain materials

Significant numbers of fish were found in all three of these zones during summer investigations; however species composition varied between zones (see Photo #2). Both minnow trapping and electro-fishing showed the base of the drain to be extensively utilized by one year old Arctic grayling and for very large slimy sculpin (Tables 1 and 2). The largest sculpin captured at this site was 147 mm and is one of the largest sculpin specimens the investigators have ever encountered. The significant numbers of large sculpin found along the edges of the Rock Drain implies the habitat may provide over winter habitat for slimy sculpins and potentially for juvenile Arctic grayling.

The altered reach immediately down stream of the Rock Drain face had very few slimy sculpin (Tables 1 and 2), large groups of Arctic grayling adults were observed (Table 4) and electro-fishing recorded several Arctic grayling 1 year olds.

The natural channel below the Rock Drain was well utilized by Arctic grayling adults and sub adults as well as all age classes of slimy sculpin.

4.2 Reach 2. Immediately Upstream of Rock Drain

4.2.1 Spring

At the time of investigation, the pond on the upstream side of the Rock Drain was approximately 250 meters long and 115 meters wide. The average depth was recorded as >4.0 meters with a maximum depth of 5.2 meters. The pond habitats appear stable with the banks well vegetated although the water level was above the vegetated margin. The water temperature was 5.3°C (1.3°C colder than on the down stream side). A significant amount of large woody debri has come to rest against the face of the Rock Drain. The origin of the woody debri is likely from the pond area. Above the Rock Drain pond area the creek banks are stable limiting the potential for further large woody debri to enter the flow and be swept into the pond is low.

A ganged gillnet set consisting of 3 panels (2", 2.5" and 1" monofilament net) with a total length of 40 meters was set in the pond on May 31. The net was stretched across the inlet of the pond at a slight angle to the current and was checked after 45 minutes. No fish were captured. The net was left in the water and re-checked and lifted after a further 40 minutes. No fish were captured.

No fish were observed surfacing in the pond and angling for 40 minutes with 2 rods failed to capture any fish (Table 3). No fish were observed during a visual inspection of the creek channel conducted by walking the shoreline of the creek from the pond and working upstream for a distance of 1 km. Visibility into the water was excellent except in deep water areas where angling was used, no fish were captured during 20 minutes of

angling. Mergansers, a noted fish eating duck, were observed in the creek channel immediately upstream of the pond indicating the site may be a grayling spawning area.

4.2.2 Summer

During summer investigations, the water level within the pond on the upstream side of the rock drain was 3 meters lower than during the spring investigation and the pond had changed shape and was less than 50% of the size observed in early June (Photo #3).

Arctic grayling were abundant throughout the pool and were easily observed from on top of the haul road when they surfaced to feed (Table 4). Arctic grayling were abundant and easily angled in the pond and especially near so near the face of the Rock Drain (Table 3). Angled grayling ranged in size from 280 to 445 mm in length and included adults and sub-adults.

4.3 Reach 3. Upper North Fork Rose Creek

4.3.1 Spring

A helicopter was used to access the upper reaches of the North Fork of Rose Creek and a visual assessment from the air for the presence of Arctic grayling was conducted. Visibility in the uppermost reaches of the creek in areas of ponding was excellent. No fish were observed in the ponds. These ponds were the same ponds that Arctic grayling were observed during 1989 (Harder, 1989). Visibility into the creek channels in the upper reaches was very poor due to the depth of the channels. The channels are deeply entrenched with large boulder substrates. Boggy ground near the creek made landing the helicopter difficult and ground evaluations were not possible in most of the upper reaches of the creek.

The North Fork of Rose Creek originates in a wetland area that drained in two directions at the time of investigation, linking North Fork Rose Creek to an unnamed tributary of the Tay River. The potential for fish from the Tay River system to enter the North Fork does exist during high water events such as observed during this investigation.

A ground assessment was conducted at the site of an exploration road bridge crossing, this site is named Bridge site (Figure 1). The channel at this location is deeply entrenched with velocities exceeding 1 meter per second and depths of 2 to 3 meters in a channel less than 5 meters wide. At the time of investigation the water was turbid and turbulent resulting in poor visibility. Angling at this site for 20 minutes did not capture any fish; however a single sub adult Arctic grayling was observed (Table 3).

4.3.2 Summer

Two sites in the upper reaches of the North Fork of Rose Creek were investigated for the presence of fish during the summer investigations (Figure 1, sites 1 and 2). The Bridge site evaluated during the spring investigation was not re-investigated as it was not possible to land the helicopter.

Site 1 is located at the down stream end of a set of beaver ponds documented by past investigators (Harder 1989 and Leverton et al, 1986). The beaver pond areas noted in the 1986 and 1989 investigations have since washed out resulting in the pond areas greatly reduced in size from those shown in photographs by Harder in 1992. The area of discussion has been identified in Figure 1 as "beaver ponds 1992.

Electro-fishing at site 1 was conducted for 283 seconds through pond edge habitats and in the narrow channels that link the small ponds. Water depth and the size of the ponds restricted the effectiveness of electro-fishing and limited available sampling areas. None the less recorded numerous slimy sculpin, a single burbot sub adult and a single round whitefish adult were captured (Table 1). Angling did not capture any fish (Table 3).

Site 2 is located approximately 700 meters downstream of the bridge site and consists of a broad area of the creek. The channel has some braiding and flows as a wide flat glide over large boulders with deep interstitial spaces. Some pooling occurs near shore edges and near very large boulders. Depths vary between 0.2 and 0.8 meters and velocities ranged causing rapids, riffles and glides to occur within the same reach (Photo #4). Visual observations of juvenile Arctic grayling accompanied by electro-fishing results (Tables 1 and 4) indicated that the site was well used by several year classes of rearing grayling. Angling effort showed that arctic grayling sub adults and adults were also present (table 3).

Both Harder and Leverton investigated the small lake at the head of a tributary that enters the North Fork Rose Creek a short distance downstream of the Bridge site, (Leverton, 1986 and Harder, 1988). Both investigators recorded an absence of fish in this lake and described the access to the lake by the creek as steep and non passable to fish. This investigation confirmed access to this lake remains non-passable to fish.

5.0 DISCUSSION

Fish habitats within the North Fork of Rose Creek continue to support significant numbers of Arctic grayling as well as populations of burbot, slimy sculpin and round whitefish. This species composition is consistent with other fish populations found in adjacent drainages (Sparling, 2004). Fish utilization near the Rock Drain remains similar to that reported in 1992 (Harder, 1992).

Fish habitats in the upper reaches of the creek have changed since 1992 and ponding created by beaver dams now exists in a much reduced state to that of 1992. Spawning habitats in the current configuration were not positively identified, although several potential areas for grayling spawning do exist, primarily near the pond areas in the upper reaches and within the deep channel areas near the ponds. Potential spawning sites also exist at the mouth of the pond created by the Rock Drain, however no fish were observed at this location during spring evaluations.

Over-wintering habitats in the upper reaches of the creek probably do exist and likely consist of areas with winter ground flows. The pond created on the up stream side of the Rock Drain may provide the most significant over-wintering habitats. The Rock Drain itself likely provides over-winter habitat for slimy sculpin as witnessed by the presence of fry during June investigations, other species may also use the Rock Drain for winter habitat.

The Rock Drain likely may impede passage to some species and or life stages however may not restrict fish passage entirely as large spacing between boulders is obvious from both the upper and lower side faces (Photo #5). The distance through the drain likely precludes all but accidental fish passage.

During spring flows the pond area at the very upper limit of North Fork Rose Creek was observed to flow in two directions, into North Fork Rose and into a small tributary of the Tay River. This water bridge may provide limited amounts of fish movement between the Rose and Blind Creek drainages.

The lowest reach of the North Fork of Rose Creek, between the mine road and the confluence with the South Fork of Rose Creek were investigated as a component of a separate project (Sparling 2005). The ponds (man made) that comprise most of this reach were utilized by Arctic grayling for spawning during late May of 2005. During the same investigation the Pump House Pond inlet was also identified as a major spawning area for Arctic grayling. The grayling that utilize these spawning habitats likely disperse throughout Rose Creek below the confluence and up the South Fork of Rose Creek. Adult grayling were observed moving up the North Fork of Rose Creek in June after spawning, however habitat is limited in this area and it is unlikely that more than a few fish remain in the North Fork after spawning in the lower reaches.

Table 1: Electro-fishing record for effort extended on North Fork Rose Creek during Summer (August 17-19) field investigations, 2005.

Date	**Location**	**Effort secs**	**Catch by species* with lengths**	**Comments**
Aug 19	D/S side Rock Drain	148	7 Ag 95-125 mm 5 SS 110,114,147,135,128 mm	in blast rock area, deep cover in crevices >2m depth
Aug 19	D/S side Rock Drain	352	41 SS 45-110 mm 9 SS fry 14-20 mm	natural channel
Aug 17	Upper reach Site 1	283	32 SS 45 110 mm 1 BB 180 mm Obs 1 RWF, est. 300 mm	deep pool edges and deep channel areas, lg. bldrs
Aug 17	Upper reach Site 2	326	39 SS 40-115 mm 1 Ag 39 mm 1 Ag 95 mm	wide braided chan. bldr and cob subs

*Fish Species Codes: SS= slimy sculpin, Ag= Arctic grayling, BB= burbot, RWF= round whitefish.

Table 2: Minnow Trap Record for traps set on North Fork Rose Creek on the downstream side of the Rock Drain during Spring (May 31/June 1) and Summer (August 18/19) field investigations, 2005.

	Lift Date	Location	Soak Time (hrs)	Catch by species* with lengths	Comments
1	June 1	1 m d/s OL, RB	16.5	0	Lg bldrs, v=0.7
2	June 1	5m d/s OL, RB~15m	16.5	0	bldr pool grass bank, v=0.7
3	June 1	at OL, LB~25m	16.5	0	blast rock at outlet, v=0.5
4	June 1	at OL, mid chan	16.4	0	blast rock, gravel subs, grass bank, v=-0.25
5	June 1	5m from OL, LB~15m	16.4	0	bldr pool eddy, v=0.5
6	June 1	20m d/s OL, mid chan	16.5	0	blast rock, gravel subs, v=0.8
7	June 1	25m d/s OL, LB~15m	16.5	0	side flow entry, sub willow over gravel subs, mud bank, v=0.5
1	Aug 18	35m d/s OL, RB	21.3	1 SS 72 mm	over sub log, v=0.5
2	Aug 18	20m d/s OL, junct of LB channels	21.3	2 SS 101,111 mm	eddy pool, v=0.5
3	Aug 18	15m d/s OL, LB	21.3	4 SS 138,115,98,115 mm	side channel, v=0.3
4	Aug 18	10m d/s OL, centre channel	21.2	1 Ag 122 mm, 1 SS 67 mm	slow side flow, v=0.2
5	Aug 18	at OL, LB	21.1	0	blast rock and turbulent flow
6	Aug 18	at OL, RB	21.4	1 SS 72 mm	blast rock, v= >0.5

*Fish Species Codes: SS= slimy sculpin, Ag= Arctic grayling

Table 3: Angling Record for effort exerted on North Fork Rose Creek during Spring (June 1) and Summer (August 17-19) field investigations, 2005.

Date	Location	Effort	Catch by species* with lengths shown	Comments
May 31	Pond u/s R drain	60 min	0	no recent evidence of fish
May 31	Ck chan u/s of R drain pond	40 min	0	no recent evidence of fish
June 1	d/s R drain	20 min	1 Ag 360 mm	recently spent male, immigrant
Aug 19	u/s face of R drain	52 min	11 Ag, 280- 405 mm	many large fish near the drain face, angle from boat and shore, total for 3 fishermen
Aug 19	60m d/s of R. drain	25 min	7 Ag,	excellent fishing in first deep water below drain, inexperienced fisherman
Aug 17	upper reach Site 1	20 min	0	deep slow pools
Aug 17	upper reach site 2	20 min	3 Ag 225,235,265mm	throughout riffles and bldr pools

*Fish species code Ag= Arctic grayling

Table 4: Summary of visual observations of fish made in the North Fork of Rose Creek during Spring (May 31/June 1) and Summer (August 18/19) field investigations, 2005.

Location	Date	Observation
within 20 meters of Rock Drain Outlet	August 18	>20 Arctic grayling adults
Glide reach 20 to 50m d/s of Rock Drain outlet	August 18	>20 Arctic grayling sub-adults
Upstream side of Rock Drain, at rock face	August 19	numerous adult and sub adult Arctic grayling
Pool on u/s side of Rock Drain, viewed from road	August 19	numerous fish surfacing throughout the pond
Upper reach, site 2	August 17	several small Arctic grayling sub adult

Literature Cited

Harder, P. 1992. *Fish Sampling Summary Report*, August 31,1992. From DFO, Whitehorse Stream Files, sample permit compliance report.

Harder, P. 1988. *Rose Creek Fisheries Study, Interim Report No. 2, October, 1988*. P. Harder and Associates Ltd. with D. Bustard and Associates for Curragh Resources Ltd.. November, 1988.

Leverton et al. 1986. *Preliminary Investigations of the Fisheries Resources of the North Fork of Rose Creek*. Prepared for Curragh Resources Ltd. 11p.

Sparling, P. 2004. *Aquatic Life Sampling and Testing Program for The Anvil Range Mine Site, Rose and Vangorda Creek Watersheds, Faro, Yukon*. Conducted: August, 2004. Prepared for Deloitte and Touche Inc. by White Mountain Environmental Consulting. October, 2004.

Appendix 1

Photo #1. Reach 1, North Fork Rose Creek. The base of the Rock Drain on the Down Stream side during August sampling

Photo #2: Downstream of the Rock Drain the channel converges into the natural channel within 40 meters of the rock face. This photo shows all 3 sample zones during August flow conditions.

Photo #3: The pond on the up stream side of the Rock Drain during August was 3 meters lower than observed during June investigations.

Photo #4: Site 2 in the upper reaches of the North Fork.

Photo #5: Large spaces between the boulders used to construct the Rock Drain may allow accidental fish passage and does create potential over-winter habitat.