# **Toboggan Creek**

# **Watershed Restoration Project**

Level 1 and 2 Detailed Assessment

Contract #: CSK 3087

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For Watershed Restoration Program
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Skeena Region

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# **Toboggan Creek Watershed Restoration Project**

### **Executive Summary**

The Toboggan Creek Watershed Restoration Project, Level 1, was undertaken in the Fall/ Winter of 1997/98. The Project was funded by Forest Renewal British Columbia through the Ministry of Environment, Lands and Parks. The project was composed of three phases, the first phase involved historical review of the watershed, the second involved a field survey of the area and the final phase compiled all information gathered to prepare a photo-mosaic of the area and a final report.

The historical review found that Toboggan Creek and its tributaries have been the focus of a number of studies. Overall, the studies found that the Toboggan Creek Watershed is a highly productive system which is facing several different impacts including transportation corridors, logging and agricultural practices. In 1978 it was hoped the creek would be developed into a demonstration site for salmonid enhancement. In 1984 a hatchery, working to enhance salmon stocks was established on Toboggan Creek.

The second phase of the project completed a field analysis of the watershed. This included a two hour helicopter flight in which 1:5,000 scale air photos were taken of the Toboggan Mainstern and Glacier Gulch tributaries for compilation into an air-photo mosaic. This flight provided a useful overview of the area as well as demonstrating the extent of development along the stream bank.

The field component demonstrated that the creek faced a multitude of impacts. The primary impacts occur in the upper reaches which then have a cascading effect throughout the whole system. The creek mainly faces a lack of pool habitat due to sedimentation and a lack of large woody debris input throughout the system due to loss of riparian vegetation.

There are ample opportunities for restoration works throughout out the watershed. As the severest impacts occur as a result of cumulative effects originating in the upslope areas, prescriptions in these regions have been given the highest priority.

In the third phase of the project, a meeting was held with the Toboggan Creek Farmers Association. A summary of the events and a response from this meeting are presented in Appendix A. It is felt that a working relationship between agencies and local landowners should be developed such that the focus can be turned to fish and fish habitat protection and restoration.

#### Introduction

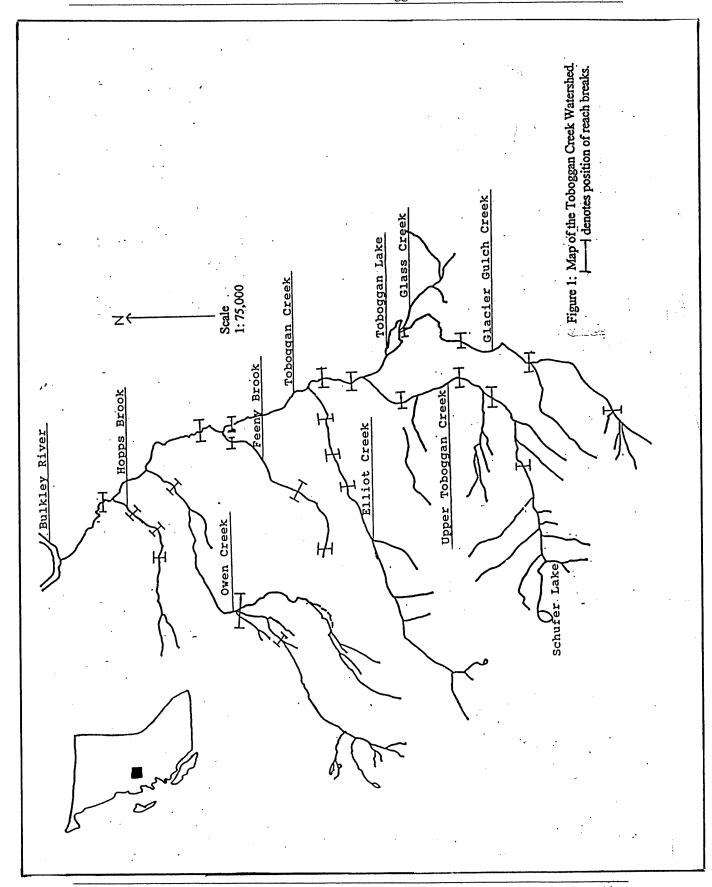
The Toboggan Creek Watershed Restoration Project for 1997/1998, was initiated in September of 1997 through contract #CSK 3087 between Ministry of Environment, Lands, and Parks and Nortec Consulting. The contract was to do the Level 1 Overview of the stream and riparian assessment in the Toboggan Creek Watershed (Watershed Code (w.c.) 46-2400).

This project was funded by Forest Renewal British Columbia's Watershed Restoration Program to the Ministry of Environment, Lands and Parks as the proponent and Nortec Consulting was hired as the contractor.

The 1997/98 contract was designed to complete an assessment of the watershed to determine the level of impact to the creeks and to determine sites of impacts which may benefit from further works.

The objectives of the Watershed Restoration project are to: "protect, restore and maintain fisheries, aquatic and forest resources that have been adversely impacted by past forest practices, and otherwise require decades to recover; provide community-based employment, training and stewardship opportunities; and help bridge past and current forest harvest practices under the new Forest Practices Code." (Soto, 1994)

Toboggan Creek is 17 km long, the mouth of which is located 23 km North-Northwest of Smithers, B.C. The watershed drains an area of approximately 112 km<sup>2</sup>, and flows into the Bulkley River (Hatlevik, 1978) at UTM coordinates 6089400, 607460 (see Figure 1). There are two small lakes located on Toboggan Creek, Schufer Lake is at the headwaters, and Toboggan Lake is located mid-way down the creek where the gradient flattens out (Tredger, 1979).



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The stream is fed by five principal tributaries, Glacier Gulch Creek, Glass Creek, Elliot Creek, Feeny Brook and Owens Creek. Watershed codes have previously been assigned to four of the six creeks. Toboggan Creek- 46-2400, Owens Creek- 46-2400-010, Elliot Creek- 46-2400-020, and Glacier Gulch Creek 46-2400-030. Both Feeny Brook and Glass Creek were assigned watershed codes during the study; these are 46-2400-015 for Feeny Brook, and 46-2400-025 for Glass Creek.

These watershed codes, the UTM coordinates for their confluence with Toboggan Creek, and that of Toboggan Creek confluence with the Bulkley River are summarized in Table 5 in Section 3.1 of this report.

Fish presence has been reported in each of the above creeks and include the following species; Rainbow/ Steelhead Trout (*Oncorhynchus mykiss*), Cutthroat Trout (*Oncorhynchus clarki clarki*), Dolly Varden Char (*Salvelinus malma*), Mountain Whitefish (*Prosopium williamsoni*), Coho Salmon (*Oncorhynchus kisutch*), Pink Salmon (*Oncorhynchus gorbuscha*), Kokanee (*Oncorhynchus nerka*) and Lamprey (*Lamptera spp.*) (Tredger, 1979 & SKR, 1996). Further, Toboggan Creek Hatchery has been located on the system, 13 km north-northwest of Smithers since 1984 and works to increase Coho populations within the system by releasing fry. The hatchery also works to produce Chinook for release in the Bulkley and Skeena systems, and until 1989 produced Steelhead fry for release to other systems (Toboggan Creek Salmonid Enhancement Society, annual reports 1987-1997).

Toboggan Creek originates from twin glaciers on Hudson Bay Mountain and follows a generally Northeasterly course down the mountain at which point it turns to flow North until its confluence with the Bulkley River (Tredger, 1979).

The Toboggan Creek watershed is located within two biogeoclimatic zones. The higher elevation portions of the reaches are in the Englmann Spruce-Subalpine Fir, wet very cold (ESSFwv) biogeoclimatic zone, while the lower elevation reaches are in the Interior Cedar-Hemlock moist-cold (ICHmc) zone. The ESSFwv zone occurs on the leeward side of the coast mountains and as such receives snowy winters with minimal ground freezing and a moist growing season. The dominate tree species in the ESSF

zone is subalpine fir (*Abies lasiocarpa*), with lesser amounts of mountain hemlock (*Tsuga mertensiana*), hybrid white spruce (*Picea engelmannii X glauca*) and western hemlock (*Tsuga heterophylla*).

The ICH is a zone of transition between coastal and interior forests. The climate in this area is characteristically warm and moist in the summer, cold and wet in the fall, and cold in the winter with a variable snowpack. The plants characteristic of this zone are feathermosses (*Pleurozium schreberi*) and shrubs, including devils club (*Oplopanax horridus*) in wetter sites.

While the defining characteristics of these zones are evident in the Toboggan Creek watershed, it should be remembered that the majority of the land in this watershed has been cleared, both historically and in the present, and thus not all areas will reflect the natural plant conditions of these zones (Banner et. al., 1993).

The Toboggan Creek watershed has faced a number of impacts since the early 1900's; starting with the construction of the railway in 1910, followed by land clearing for agriculture and most recently logging in the upslope regions of this watershed. The cumulative effects of these impacts are currently evident.

There are two sections to this report. The first section deals with a historical review of the system, including fish presence, brief summaries of studies conducted within the Toboggan Creek watershed, historic instream works, and previously identified impacts within the system. The second section of this document reports on the 1997 season field work. Five of the six streams were surveyed intensively and the results of these surveys are reported in this section, including current impacts and specific prescriptions.

#### **Methodologies**

There were four components to this contract. The first and fourth component were comprised of office work, both in compiling historic information and in writing the report. The second component of the project was the field work aspect and the third

component was to photograph the watershed and compile an air-photo mosaic. Brief methodologies for all components are presented below.

#### **Component 1: Historical Information**

Historical information was compiled from the Ministry of Environment, Lands and Parks library and files, and the Department of Fisheries and Oceans files. All previous reports were read and summarized and all loose files were read and the salient points incorporated into the report. Historic air photos, kept at the Ministry of Forests office in Smithers, were examined both to assist in determining tentative reach breaks and in looking at historical channels and recent changes.

## **Component 2: Field Work Methodologies**

The field work aspect of the contract was started by examining 1:20,000 scale maps and assigning tentative reach breaks. The mainstem and a large portion of the tributaries were then walked to ground-truth the reach breaks and to observe the terrain as well as to map out fish habitat. At the end of each reach Stream Inventory Summary System (SISS) cards were filled out (complete SISS forms are attached in Appendix B). Channel widths and wetted widths were measured using hip chain, depths were measured using a meter stick. Gradients were measured with a Suunto clinonmeter and Large Woody Debris (LWD) was either counted or estimated along a reach. Notes were also kept on the riparian vegetation and any other relevant features, these notes were then incorporated into the final text. As most of the land surrounding Toboggan Creek and its tributaries is private, efforts were made to ensure permission was granted before crossing the properties.

#### **Component 3: Air Photo Mosaics**

Air photos were taken from a Bell 206 helicopter, hired out of Canadian Helicopters of Smithers. A 35mm camera with a motordrive was mounted though the Plexiglas floor which allowed the lens to be even with the floor. The aperture was set on

Starting at the confluence of Toboggan Creek and the Bulkley River the helicopter proceeded upstream, with photographs being taken every six seconds. At the end of a roll of film the helicopter would circle to allow the film to be changed and the new roll would begin slightly downstream of the end of the previous roll, to ensure the photographs overlapped. The photographs encompass all of the Toboggan Creek mainstem, including the upper reaches and Glacier Gulch creek, including Toboggan Lake.

# **Component 4: Report Writing**

The final component of the contract was to write up a final report, presenting the findings and conclusions. The draft report on the Toboggan Creek Watershed Restoration Project was completed and submitted in mid-January to the staff at the Ministry of Environment, Lands and Parks. The report was reviewed by several people including Mr. J. Lough, and Mr. R. Keim and comments were returned to Nortec Consulting by mid-February. These comments were then incorporated into the final report.

# Section 1: A Historical Look at the Watershed

Toboggan Creek is known as both a locally accessible creek and a high value fish producer. For these reasons it has been of interest to both the local fishermen and to various government ministries (Hatlevik, 1978; Tredger, 1979; Toboggan Creek Salmonid Enhancement Society, Annual Reports, 1987-1997; SKR, 1996).

### 1.1 Historical Review of Studies Conducted on the Toboggan Creek Watershed

In this section previous studies of Toboggan Creek are listed and brief summaries of these studies are presented.

The Toboggan Creek watershed has been of interest since 1978 when a baseline study was conducted by the Resource Analysis Branch (RAB) of the Ministry of Environment, with the intention to develop the creek into a "demonstration site" under the Salmoid Enhancement Program as the creek is a highly visible and accessible system (Tredger, 1979). Before this date the Federal Fisheries Department had kept escapment figures starting in 1951 as part of a larger program to estimate spawning escapment in the region (Tredger, 1979).

A hatchery was built in 1984/85 and continues to operate. During this time the facility has produced annual reports documenting the number of fry produced and released, brood egg capture, catch statistics and run sizes for the various waterways of the Bulkley- Morice river system. Further, since 1993 the Toboggan Creek Enhancement Society has enumerated the Toboggan Creek Steelhead run and published the results in separate reports (Toboggan Creek Salmonid Enhancement Society, 1993-1997).

Studies conducted in the Toboggan Creek watershed include:

A) Between 1974 and 1979 Feeny Brook was intensively surveyed and documented by MoELP (see Feeny Brook file, MoELP records, Smithers). This was a direct result of a large gully failure in the upslope region of this creek. All the studies revolved around the damage done to downstream properties, the cause of the failure, and remedial work on

the downstream properties. This gully failure is discussed in Section 2.4 of this report. Remedial works occurred between 1976 and 1980.

- B) In 1978 the Bulkley Valley Steelhead Society reported the results of their fish fence enumeration in which they had erected a temporary fish fence for 57 days in Sept./ Oct. 1978. The primary goal of this group was to enumerate Steelhead. A total of 164 Pink Salmon, 817 Coho and 8 Steelhead were counted through the fence. The project was deemed a success and an aid in fisheries management. The group suggested that the project be continued in the next year and that Steelhead be tagged to determine fish overwintering sites.
- C) In 1979, D. Tredger of the Ministry of Environment published the study "An evaluation of fish habitat and fish populations in Toboggan Creek near Smithers, relevant to Steelhead enhancement opportunities." This study evaluated the Toboggan Creek watershed in terms of enhancing Steelhead stocks within the system. The study utilized ecological diagnosis methodology to evaluate the habitat in the system. Following the habitat assessment intensive fish sampling was done in representative habitat types. The results of this study was that a variety of habitats were found and juvenile Coho Salmon, Steelhead Trout and Dolly Varden were found to be the principal species utilizing the system. Mr. Tredger estimated that Toboggan Creek could support a smolt output of approximately 13,230 Coho and 1,130 Steelhead in a year. Finally, this stream was recommended as a Salmonid Enhancement Project demonstration site and enhancement measures were discussed.
- D) In 1982, D. Coombes and D. Jaesson completed a survey of Toboggan Lake. This study documented the physical features, wildlife usage, plant species and chemical nature of the lake. The study concluded that the lake is probably an important rearing habitat for juvenile salmonids.

- E) In 1995/96 SKR Environmental Consultants conducted a smolt enumeration in Toboggan Creek for DFO. The aim of this study was to estimate the number of wild Coho smolts leaving the system. The study found that there were fewer wild Coho in 1996 than 1995 and that wild Coho tended to migrate out of the system over a longer period of time than did hatchery fish.
- F) J.A. Taylor conducted a "Synoptic survey of juvenile Coho populations and associated habitat characteristics in selected lakes and streams within the Skeena River Watershed, British Columbia" in 1996 for the Department of Fisheries and Oceans (DFO). This study included Toboggan Creek as one of the watersheds considered in the study. The study was performed to assess and monitor Coho population levels within the Skeena River drainage. Within the Toboggan Creek watershed the author set Gee traps in Toboggan Lake for 156 hrs and caught 156 Coho, 2 Rainbow Trout, 12 Dolly Varden and 1 Cutthroat Trout. This is consistent with the escapement reports from DFO and the hatchery.
- G) In 1996 and continuing in 1997 Brenda Donas of DFO has conducted a water quality study within the Toboggan Creek watershed. She has kindly provided access to her 1996 data. This data has been analyzed as part of this study and these results are presented in Section 1.4.1 of this report.
- H) In 1997, Nortec Consulting prepared a report entitled "Riparian and in-stream assessment of the Bulkley River system". Again the Toboggan Creek watershed was considered in this report which looked at non-forestry related impacts along the watershed. This study found that 20 km of high value fish habitat throughout the watershed was impacted.
- I) A Roads, Hillslope and Gullies Assessment was prepared for Pacific Island Resources in 1997. This assessment was presented in two studies. The first "Trout Creek/

Moricetown Watershed Assessment Project Integrated Watershed Restoration Plan, Roads, Hillslopes and Gullies" by the Sterling Wood Group Inc (1997) was completed and intended for use as a starting point for future investigations leading to prescriptions and works on problem areas. The report summarized the existing information and then grouped the blocks and road segments into high, moderate or low risk of road erosion, washouts, gully failures, or slides. In the Toboggan watershed the report found that 3 blocks were in high risk, 4 at moderate risk, 11 low risk and only 3 problem areas were identified for future review. The first problem area was located on the Glacier Gulch road where a road related slide had occurred. This slide originates from a mining road that runs along the south side of Glacier Gulch Creek. The second problem area was a debris torrent originating from block 084-91 Glacier Creek Gully. The final problem is centered on the Toboggan Creek Road (Silvern Lakes Road North) and is identified as having an unstable road bed.

The second report of the Road, Hillslopes and Gullies assessment, written by Kelly Eakins (Madrone Consultants) (1997) is titled "Interior Watershed Assessment Procedure Trout/ Toboggan/ Moricetown Watersheds Smithers, B.C. Level 1". The two goals of this study were 1. to assess the cumulative effects of past forest practices on the hydrology and aquatic resources in the Trout/ Toboggan/ Moricetown Watershed and 2. to assess what potential impact future development may have on the hydrology and aquatic resources. Overall the study suggested that forestry related development has had a limited potential impact on the area. The study did note that 764 ha of timber in the watershed has been harvested and that 151 additional has are proposed for development. These figures are strictly based on forestry related clearing and did not take into account riparian zone land clearing for non-forestry related practices (e.g. Hydro- right of way or agriculture).

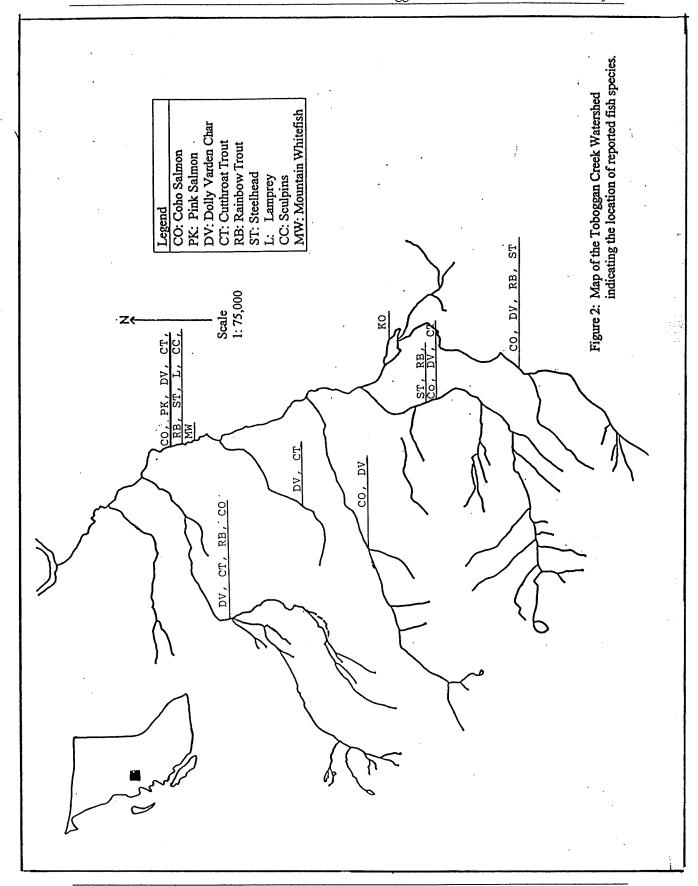
The significant gully failure of Feeny Brook which occurred in the mid 1970's was not discussed in either report.

### 1.2 Review of Fish, Fish Habitat and Sample Sites.

Most of the work done on Toboggan Creek revolves around fish presence and fish habitat potential. The following is a summary of the assessment work done in the Toboggan Creek watershed.

The Stream Summary Catalogue (FHIIP, 1991) indicates that fish are distributed throughout the watershed as follows; Coho Salmon, Pink Salmon, Rainbow/ Steelhead Trout, Cutthroat Trout, Dolly Varden Char and Lamprey throughout Toboggan Creek; Cutthroat Trout, Kokanee Salmon, Mountain Whitefish, Sculpins (Cottus spp.) and Lamprey in Toboggan Lake. Elliot Creek is reported to have Coho Salmon and Dolly Varden char. Finally, Coho Salmon have been reported in Glacier Gulch Creek (see Figure 2). Chinook (Oncorhynchus tshawytscha) have been recorded from Toboggan Creek, however only in low numbers and in 1995 SKR Environmental Consultants reported a single smolt migrating out. It is assumed that these fish are either escapees from the hatchery or adult fish that have strayed from the upper Bulkley as Toboggan Creek does not have a historical Chinook run and has not been stocked with this species.

A temporary fish fence was erected in the fall of 1978 by members of the Steelhead Society. While in place Coho and Pink Salmon were enumerated and Steelhead incidentally documented. In 1988 a permanent fish fence was installed 2.5 km upstream from the mouth of Toboggan Creek and operated by hatchery staff. The fence currently enumerates Coho and Steelhead. It is important to note the Steelhead escapment data are only for those fish spawning above the fence, although it is known that Steelhead do spawn in the lower reaches of Toboggan Creek and by its confluence with the Bulkley River mainstem (M. O'Neill, G. Wadley, Pers. Obs).



Escapment data from the baseline study conducted by MOE (RAB) and DFO is presented in Table 1.

Table 1:	MOE (RA	B) and DFO	escapment data.
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Year	Coho	Pink	Year	Coho	Pink	Year	Coho	Pink
1951	1100		1960	200		1969	400	
1952	750		1961	200		1970	1000	
1953	650		1962	1500	400	1971	1700	1000
1954	600		1963	450	1000	1972	2000	100
1955	700		1964	250	300	1973	2000	1800
1956	750		1965	500		1974	500	
1957	200		1966	200		1975	100	
1958	400		1967	150		1976	300	
1959	25	750	1968	200		1977	1010	

Tredger (1979), completed a habitat potential survey and estimated that Toboggan Creek could support 13,000 Coho and 1,100 Steelhead, which would result in estimated adult escapments of 900 Coho and 50 Steelhead. However, this is known to be an underestimate as the permanent fish fence has shown adult escapments of several thousand Coho and several hundred Steelhead (Table 2).

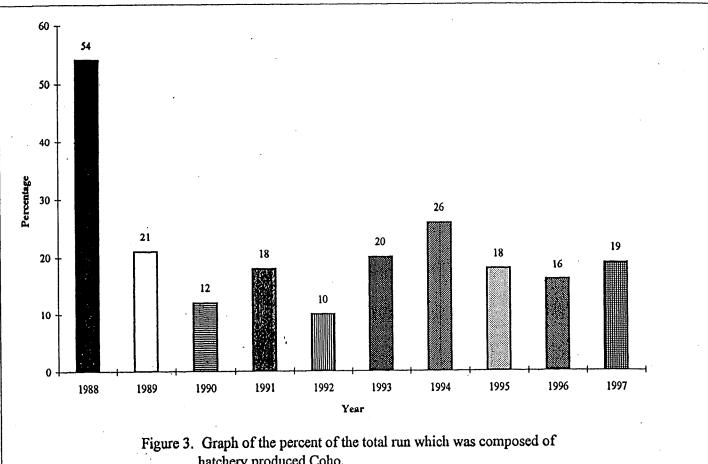
Fence data from the Steelhead Society's 1978 fence is as follows: 164 Pink Salmon, 817 Coho and 8 Steelhead migrated through the fence.

Data from the Toboggan Creek fish fence are presented in Table 2.

Table 2: Escapment data from the hatchery fish fence, compiled from Toboggan Creek Salmonid Enhancement annual reports. Only Coho and Steelhead are estimated total run sizes (presented in Bold type). Chinook and Pink prior to 1990 and Steelhead prior to 1992 are given as the number seen passing through the fence.

Year	Coho	Steelhead	Chinook	Pink
1987	412			
1988	447			
1989	4500	1	1	26
1990	3240			
1991	3600		5	2000
1992	2200	8	4	
1993	1690	435	1	
1994	2416	237	2	
1995	1762	305		
1996		115		
1997	394			

The hatchery works to supplement Toboggan Creek Coho stocks and Skeena River Chinook stocks and has been successful in this endeavor. Since 1988 the hatchery has kept statistics on the percentage of the run that was hatchery produced. Hatchery produced fish comprised 54% of the run in 1988, 21% in 1989,12% in 1990, 18% in 1991, 10% in 1992, 20% in 1993, 26% in 1994, 18% in 1995, 16% in 1996 and 19% 1997 (see Figure 3). 1988 was the first year hatchery reared fish returned to Toboggan Creek. The high percentage of hatchery fish in this run is a reflection of the low Coho runs prior to hatchery enhancement (prior to 1988) and demonstrates the important role hatchery enhancement has played in reviving this stock.



hatchery produced Coho.

Originally, the hatchery also attempted to rear Steelhead fry for release into other systems including the Suskwa and Copper Rivers and Trout Creek. Fry were produced and released between 1985 and 1987. There was no Steelhead enhancement in 1988, but in 1989 and 1990 Steelhead yearlings were released. No direct stocking of the Toboggan Creek run has ever occurred. Due to funding cuts the hatchery was unable to continue enhancing Steelhead stocks past this date.

In the 1990/1991 annual report for Toboggan Creek Hatchery it is stated that Steelhead, Coho and Chinook native to the Skeena River system have been impacted by commercial, native and sports fisheries and since this date the hatchery has maintained statistics on the proportion of the Toboggan Creek run caught by the various user groups. These statistics are presented in Table 3.

Table 3: Break down of the human use of the Toboggan Creek Coho run (1990-1995). Percent harvested by fishing sector.

Year	% B.C.	% Alaskan Commercial	% Native Food	% Sport
	Commercial			
1990	37	20.3	11.5	2.4
1991	25	23.8	16.3	1.4
1992	22	33	11	
1993	18.1	20.5	13.3	1.7
1994	20.6	30.4	9.7	7.3
1995	14	16.9	8.3	3.8

#### 1.3 Historic In Stream Works

The majority of the land surrounding Toboggan Creek and its tributaries is privately owned. Some works, such as rip-rapping the banks, building fords and bridges across the creeks, and to a lesser degree placement of weirs and diversions has been undertaken by individual land owners. Major works to the system include;

- A) Construction of a large berm across the valley floor for railway development in the early 1900's.
- B) Approximately 50 years ago Toboggan Creek was Diverted into a historic channel, this changed the location of the confluence between Toboggan Creek and Glacier Gulch Creek to below Toboggan lake, whereas prior to the channelization the confluence was above the lake.
- C) Large scale remedial works were performed on Feeny Brook (see Section 2.4) in the early 1970's. These works were done after a large gully failure in the upslope region of this creek. Works included extensive channeliztaion, and some large woody debris and boulder placement.
- D) Placement of four stream gauges to monitor the relationship between water level and discharge in 1978 by the Water Rights Branch.
- E) Stream and bank restoration works in 1979. These works included reverse gravel spawning pads and placement of boulders in mainstem Toboggan.
- F) Construction of the Toboggan Creek Hatchery including construction of rearing channels connected to Toboggan Creek, and diversion of The Brook (Section 2.5) away from the CNR tracks to allow placement of a water intake pipe. Some remedial stream works were also performed along hatchery property.

### 1.4 Impacts Within the Watershed

Several studies have looked at impacts within the watershed. These are summarized in this section.

- A) In 1978, it was felt that the major factor causing in-stream habitat degredation was the use of adjacent land for agriculture and pasture. This could result in the grazing of bank cover by livestock and subsequent bank slumping. Further, run-off from cultivated fields might lead to siltation of the Toboggan mainstem and tributaries. Proposed solutions to these concerns include long-term fencing along the creek bank and the placement of interceptor ditches to allow for sediment settling above the creek (Tredger, 1979). At the time of the 1997 field season it did not appear as if these solutions were implemented.
- B) Also in 1978 the regional fisheries biologist commented that the Department of Highways had been approached to do some remedial works on the culvert immediately upstream of the Bulkley- Toboggan confluence. The Department of Highways solution was to place rock at the bottom of the culvert outflow (Whately, 1978).
- C) Again in 1978, it was noted that a small tributary, Feeny Brook, north of Elliot Creek, flowed through an upslope gully failure and is a major contributor of silt to the mainstem. This impact is discussed in section 2.4 of this report.
- D) In 1997, a Nortec Consulting report (Mitchell, 1997) on the Bulkley River riparian assessment found that the riparian areas of Toboggan, Elliot, Glacier Gulch, and Owen creeks have all been heavily impacted by non-forestry related sources. On Toboggan Creek the impacts include, eight stream crossings by roads, railways and powerlines. In addition the creek has suffered from extensive land clearing. It is suggested that these impacts could lead to bank slumping, increased sediment loading, increased nutrient

loading from agricultural practices, an increase of stream temperature, and a decrease of large woody debris recruitment in cleared areas.

Owen Creek is impacted by three crossings of roads, railways and powerlines, and land clearing. The effects of these impacts include increased stream temperatures and braiding in some reaches.

Elliot Creek has also been impacted by land clearing and two crossings by road and powerline. This has resulted in increased stream temperatures, a lack of large woody debris recruitment and lateral channel movement at the powerline crossing.

Glacier Gulch Creek is the least impacted of the systems. The impacts on this system include railway, road and powerline crossing, land clearing and the water diversion to Kathlyn Lake. This has resulted in increased stream temperatures and increased sediment loading due to erosion.

Overall the Nortec report estimated that 20 km of streams in this watershed were impacted by non-forestry related land use practices.

# 1.4.1 Water Quality data analysis

Limited water quality surveys were done by DFO in 1996 at six stations within the Toboggan Creek watershed (Glass Creek, CNR bridge, Evelyn bridge, Hatchery outflow, fish fence, Highway culvert). From the perspective of WRP, nutrients (phosphorous and nitrogen) and turbidity are the most significant water quality parameters in Toboggan Creek. Nutrients are essential to the energy flow of streams but excess loading can result in detrimental effects such as algal blooms and increased Biological and Chemical Oxygen Demand (BOD and COD). High values of turbidity may reflect high concentrations of silt/sediment transport which has implications on the substrate of the stream by causing infilling of gravels and compaction, thus reducing quality of spawning gravel and smothering benthic invertebrates. The results of the 1996 water quality survey are summarized below.

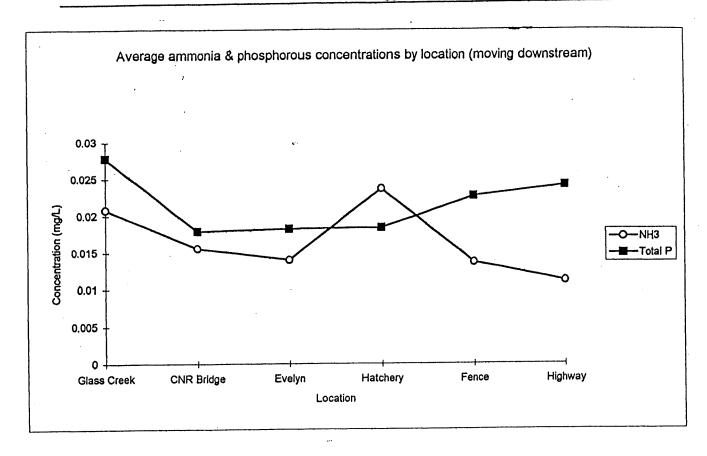
# i) Phosphorous

Within Toboggan Creek total phosphorous is highest in Glass Creek and lowest at the CNR bridge crossing and hatchery outflow. Downstream of the hatchery phosphorous concentrations rise again, almost to the high levels recorded at Glass Creek (Figure 4). Temporally, these concentrations are highest in the spring (early April) and decrease throughout the summer. In 1996, phosphorous concentrations peaked again in September at all stations then returned to low levels (Figure 5). Table 4 presents values of total phosphorous in Toboggan Creek, "natural" environmental concentrations and water quality guidelines/criteria. Phosphorous levels in general are not elevated to a level of concern (i.e. they are in the lower end of the range of "natural" environmental conditions).

The increase in phosphorous moving downstream of the hatchery is probably a result of the agriculture and grazing land adjacent to the stream. Higher nutrient levels are expected due to fertilization and land use by livestock. The peaking phosphorous concentration in the spring is probably a result of the spring flush as the runoff from all of the surrounding agriculture/grazing land carries the nutrients from the previous autumn and winter into the stream. The high phosphorous concentration in Glass Creek is attributable to the large expanse of cleared land surrounding this creek increasing the volume and rate of release of phosphorous laden runoff. The September peak is more difficult to explain. At this point it is uncertain whether it was only this single year that this occurred or whether this is a regular pattern. Further sampling is required.

#### ii) Nitrogen

Nitrogen is constantly undergoing chemical transformations in situ depending upon physical and chemical conditions. The forms which it converts to and from are ammonia (NH<sub>3</sub>), ammonium (NH<sub>4</sub><sup>+</sup>), nitrate (NO<sub>3</sub><sup>-</sup>), nitrite (NO<sub>2</sub><sup>-</sup>) and molecular nitrogen  $(N_2)$ . In surface waters the most important forms are nitrates, nitrites and ammonia.



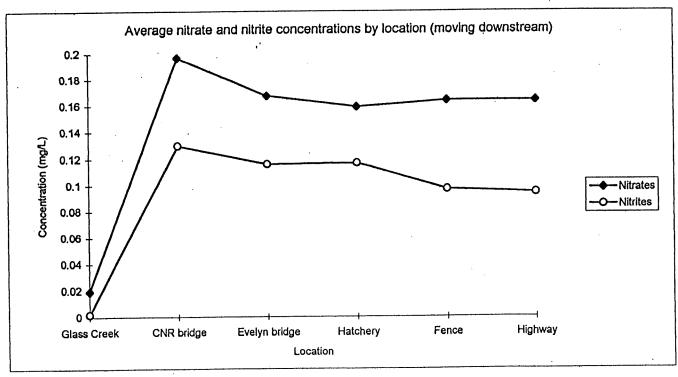
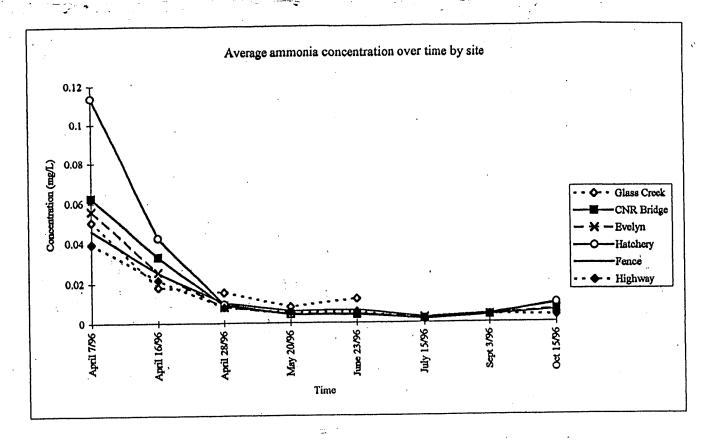


Figure 4: Average parameter concentrations by sample site along Toboggan Creek (April-October, 1996)

Nortec Consulting



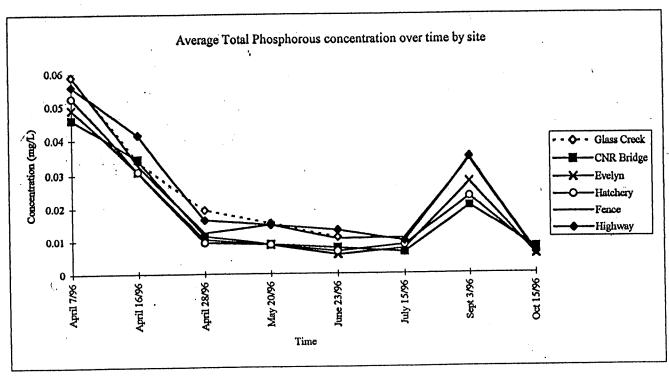


Figure 5: Average parameter concentrations by sample date and location for Toboggan Creek, (April-October 1996)

## Nitrate

The maximum recorded nitrate concentration (0.52 mg/L) in Toboggan Creek in 1996 occurred at the CNR bridge on April 28 and the maximum average concentration is also at this location (Figure 4). The maximum nitrate concentration within Toboggan Creek appears to be well within environmental concentrations and Provincial criteria (Table 4).

## Nitrite

The maximum nitrite concentration in Toboggan Creek in summer 1996 also occurred at the CNR bridge, (May 20). The federal guideline and provincial criterion (0.06 mg/L) was exceeded at all stations downstream of Toboggan Lake on this day but not in Glass Creek. However, these results are based on only four sampling periods (April 7, 16, 28, May 20) so it is unknown how the concentrations behave over the summer. During the other three sampling periods (April 7, 16, 28) nitrite concentration was consistently < 0.005 mg/L throughout the creek.

It is unknown what caused the nitrite peak, but it appears to be related to the lake drainage as Glass Creek remained below 0.001 mg/L and the concentration decreases progressing downstream (Figure 4). Further sampling is required to determine spatial and temporal concentrations, and the cause of the elevated nitrite.

#### Ammonia

Within Toboggan Creek ammonia concentrations are generally highest in Glass Creek. There is a peak in ammonia concentration at the hatchery outflow (Figures 4 & 5) but this may be misleading as this represents a single event (April 7). The very high values (0.113 & 0.114 mg/L) measured on this date inflate the mean measure, removing these outliers drops the average at all other times to 0.014 mg/L. This single high reading at the hatchery outflow is probably due to two factors - the very high density of fish producing wastes and that the measurement was made in the outflow itself prior to entry into Toboggan Creek. Due to this selection of measuring location there has not been any

dilution of this high concentration. Ammonia concentrations through the stream peak in early Spring then decrease steadily over the remainder of the year (Figure 5).

At no time, even at the hatchery outflow, was the maximum ammonia guideline or criteria approached, and the "normal" concentration in Toboggan Creek appears to be in the lower bounds of environmental concentrations (Table 4). However, concentrations of ammonia in excess of the guidelines have been recorded in previous years (B. Donas, pers. comm.).

# iii) Turbidity

In the sampling of 1996 turbidity was measured and ranged from zero to 50 Jackson Turbidity Units (JTUs). The mean for all stations between April 7 and October 15 (n=8 dates) was 16.4 JTU's, the 90th percentile was 40 JTUs and the maximum recorded was 50 JTUs (Table 4). The environmental range recorded in the Pacific Region (B.C. and Yukon) is from 0.12-360 JTUs (based on 1449 samples between 1980 and 1985, CCME 1992), suggesting that turbidity in 1996 was well within natural range. However, conclusions are tenuous as the JTU is not practical below 25 units because of the limits of the measuring device (Thurston et al 1979). Thus, these data are not definitive. Sampling using the Nephelometric Turbidity Units (NTUs) is required to increase precision in the lower range and to allow comparison with provincial criterion, also in NTUs.

Table 4: Parameter values, water quality guidelines/criteria and "natural" environmental concentrations in Toboggan Creek 1996.

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74.44	Mean	Percentile	Maximum	Guideline	Criteria	Concentration
Parameter	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)*
Phosphorous	0.021	0.047	0.064	None	None	0.0013-1.76
(total)						
Nitrate	0.155	0.395	0.52	None	40 (avg.)	0.002-6.6
$(NO_3^-)$					200 (max.)	
Nitrite	0.092	0.445	0.517	0.06	0.06	< 0.002-0.01
$(NO_2)$					(max.)	
Ammonia	0.016	0.046	0.114	0.16	0.68	<0.001-0.49
$(NH_3)$					(max.)	
Turbidity"	16.4	40	50	None	see below	0.012-360
(NH <sub>3</sub> )				**		

<sup>\*</sup> Environmental concentrations from CCME 1992

BC criteria from Nagpal et al 1995

#### iv) Conclusions

Based on limited sampling within Toboggan Creek phosphorous, nitrate and ammonia did not appear to be elevated in 1996. However, peak nitrite concentrations may pose a significant problem to aquatic life, and this parameter may be linked to the lake drainage. Unfortunately, there is insufficient data to draw conclusions. The timing of sampling (individual samples separated by up to 3 weeks between them) prevents knowledge of what is occurring in the time intervals between samples. Further sampling is required.

<sup>!</sup> Ammonia guidelines & criteria dependent upon pH and temperature - values derived from "typical" Toboggan Creek pH (7-9) and temperature (0.5-18°C) values.

<sup>!!</sup> Turbidity values recorded in JTUs (Jackson Turbidity Units), provincial criteria is 1 NTU (Nephelometric Turbidity Unit) for drinking water; there are no turbidity criteria for the protection of aquatic life.

# Section 2: Field Assessment of Watershed

This section of the report deals with the findings of the field work. Each reach on each system, will be described in terms of habitat type (physical features and riparian condition), gradient, channel type, substrate, impacted sections, and prescriptions for impact mitigation. While steam features are briefly summarized in these sections, complete SISS cards and summarized information on Forms 3, 4 and 6 can be found in Appendices B and D respectively.

The field assessment of the Toboggan Creek Watershed occurred between October 8th and October 27th, 1997. Throughout this time the water discharge was at a moderate level. As the study started, only a few Coho had moved passed the Toboggan Creek fish fence, but the peak migration date occurred on October 15, 1997, and the majority of the run had passed through by October 16th, 1997.

### **Overview**

Toboggan Creek is facing several types of impacts including berming along the channels, agricultural land clearing, upslope logging and channelization. All of these impacts are interrelated and have led to cumulative detrimental effects. The first impact to the system was the placement of the railroad along the valley bottom. This created a berm down the length of the valley and impacted the natural drainage off Hudson Bay Mountain. Watercourses that flowed off the steep sides of the mountain historically fanned out across the valley (making good agricultural land), however with the placement of the railroad these watercourses hit the berm and were channelized along it with fewer crossing points. This channelization allowed forced the water to back up behind it creating a wetland of increasing size.

After the railroad went in, large scale land clearing took place. The clearing was used both for agricultural purposes as well as timber for small local mills. The portions of land that were cleared but not used for agriculture grew back in as alder, willow and aspen groves which have attracted and sustained large beaver populations. This beaver activity has contributed to the wetland nature of the area.

Following the clearing of the valley logging continued in the upslope regions of the watershed, this increased the amount of sediment coming off the mountain through the watercourses. Large sediment loads have come down both as single large events and as small continuous amounts. A prime example of the former sediment loading is the slide which occurred into Feeny Brook in the spring of 1975 (see Section 2.4). The latter type of sediment loading continues today as exhibited by the large amounts of gravels and fines deposited at the confluence of Toboggan Creek Tributaries and the mainstem. The increased amount of sediment loading has led to infilling of existing and forming pools resulting in an overall lack of pool presence. A concurrent problem on these systems is the lack of riparian protection. Riparian loss has resulted in a decrease of Large Woody Debris (LWD) recruitment, as well bank destabilization and erosion, leading to an increased sediment load.

Within the entire watershed there is continued bank erosion and destabilization because of upslope channel aggradation, lateral channel movement and the lack of riparian structure, this is further aggravated by livestock trampling at some sites. This livestock tramping leads to further bank failures and increased sedimentation.

The combination of lack of pools, less large organic debris recruitment and increased sediment loading has led to extensive loss of fish habitat both for adult holding, stable spawning habitat and juvenile rearing. This is seen both within the Toboggan tributaries as well as on the Toboggan mainstem. Only areas with higher gradients (approximately 3-4%) are able to flush the increased sediments and maintain anadromous fish habitat suitable for spawning.

Creek assessments are presented in order starting at the mouth of Toboggan Creek and progressing to the headwaters. As such the Toboggan Creek mainstem is presented first, followed by Hopps Brook, Owen Creek, Feeny Brook, the Brook/ Brant Creek, Elliot Creek, Glacier Gulch Creek, and finally Glass Creek. Representative pictures of the creeks are presented at the end of the last reach of each creek, followed by prescriptions for that creek. Before the first set of prescriptions, those for Toboggan Creek, a map of all prescription sites on all creeks, Figure 7, is presented.

### 2.1. Toboggan Creek Mainstem

The headwaters of Toboggan Creek are at Toboggan Glacier, from here water flows in a Northerly direction into a small, high elevation (1394 m) lake (Shufer Lake). From Shufer Lake the creek flows West down the side of the mountain for approximately four kilometers where there is a left bend in the creek such that it continues to flow to the Northwest for approximately one kilometer. At roughly five km from the headwaters the creek bends to the left again and joins Glacier Gulch Creek below Toboggan Lake.

Historically Toboggan Creek flowed across a fan above the lake and the confluence of Glacier Gulch and Toboggan Creeks was above the lake. Approximately fifty years ago Toboggan Creek was diverted and channelized into a historic channel, such that the confluence of Toboggan and Glacier Gulch Creeks presently occurs below the lake. The date of exactly when this was done or the reasons behind this change are unknown as there are no records or air photos that date back that far.

The Toboggan Creek mainstem was surveyed by Nortec Consulting on several dates in 1997, covering a distance of 17 km. From these surveys the mainstem has been broken up into nine reaches, with reach breaks at 2 km (2037m), 4.7 km (4743m), 5.5 km (5543m), 7.9 km (7943m), 8.5 km (8543m), 10.1 km (10143m), 11.9 km (11943m) & 16.1 km (16143m). Reaches are numbered from the mouth and extend to the headwaters.

#### Toboggan Creek: Reach 1

This reach is 2,037m long. The channel runs though previously cleared areas and farm fields. Some riparian areas have been left intact, while other areas have been completely cleared. The riparian areas that do exist consist of alder (Alnus spp.), aspen (Populus tremuloides), cottonwood (Populus balsamifera), spruce (Picea spp.), subalpine fir, willow (Salix spp.), prickly rose (Rosa acicularis), various grasses, hardhack (Spiraea douglasii spp.), and highbush cranberry (Viburnum edule).

The average channel width is 11m with an average wetted width of 6m. It was noted that there was considerable bank erosion in this area, suggesting that there is considerable lateral channel movement. Banks are composed of mainly fines and

compacted clays, materials that are easily erodable. On average the gradient along this reach is 1.5%. As would be expected in this low gradient, the habitat consists mainly of riffle run sequences. This is partly explained by the substrate which is primarily composed of a boulder-cobble mix. However, there was a fine coating of sand and silt along the channel bed. In terms of fish habitat there is a general lack of cover in this area (composing about 25% of the total area), with the main source of cover being boulder.

This reach shows the effects of the cumulative impacts experienced by the rest of the watershed. The creek bed was covered in a fine layer of silts that coated the rocks, which is probably a result of heavy sediment loading both from the large number of slope failures along this reach, as well as high water events carrying organics from beaver dams along the mainstem and the tributaries. A second impact of bank sloughing is the result of a positive feed back loop of increasing sediment loading and bank erosion. When the stream experiences an increased sediment load, pools are filled and bars formed which results in lateral channel movements. This causes the water to erode banks further downstream, adding more sediment to the water, resulting in further aggradation, lateral channel movement and bank erosion downstream. In this system the cycle progress downstream, down the length of Toboggan Creek until the stream reaches its confluence with the Bulkley River, at which point the channel is highly aggraded with a bouldercobble substrate.

A third impact on this reach concerns the culvert placement at the Highway 16 crossing. This is not a new concern as there is evidence that the Fisheries Branch of the Ministry of Environment approached the Ministry of Highways in 1978 to do some remedial works on the culvert, the outcome of which was to place some rock at the base of the culvert (Whatley, 1978). While the culvert has not proven to be an obstacle to Coho and Steelhead, it may be an obstacle to Pink Salmon, especially at low flows. There have been no Pink Salmon found in Toboggan Creek since 1991 (Mike O'Neil, 1997, Pers. Com.). One possible explanation for the lack of Pink Salmon in the system is that the culvert became impassable to them in 1991. It is possible that the flow of water and the drop from the culvert had eaten away at the channel bed, causing a higher drop to

the culvert, and Pink Salmon being the weakest swimmers of the Pacific salmon (Dane, 1978), may not be able to leap the higher drop. This should be investigated and more remedial works may be needed.

A number of sections along this lower reach have been rip-rapped in an attempt to protect against lateral channel movement and bank erosion. Several of these sections showed evidence of overland flows either through the rip rapped sections or around the rip-rap. In at least one section this overland flow has carved a channel at the downstream end of the rip-rap, this creates a continuing problem of nutrient enrichment from agricultural runoff, sediment transport and bank destabilization. This area should be investigated to determine the extent of the flow, and to suggest mitigation measures.

## Toboggan Creek: Reach 2

The second reach extends for 2,706m. The lower half of Reach 2 has good riparian cover which decreases progressively upstream towards the Toboggan Creek Fish Fence. This reach is considered to be of high value to fish, both for rearing and spawning. The riparian area is very similar to Reach 1, but also includes black twinberry (Lonicera involucrata), alder, cow-parsnip (Heracleum lanatum), snowberry (Symphoricarpos albus), willow, red-osier dogwood (Cornus stolonifera) and thimbleberry (Rubus parviflora). The gradient in this section is 1% on average, and the habitat is mainly composed of riffle-run-pool complexes. The average channel width is about 9m with a wetted width of 7m. The substrate is mainly made up of a mix of gravels and fines and cobble is evident in small amounts throughout the reach. While there is boulder presence at the lower end of the reach, this tapers out progressively upstream. The banks continue to be low and composed of fines. Some beaver influence was found at the upper end of the reach which provides good fish rearing habitat; however, cover in this reach is still low, the majority coming from deep pool. There are two large tributaries to this reach; the first is Hopps Brook (w.c. 46-2400-005) and the second is Owens Creek (W.C. 46-2400-010), see Sections 2.2 and 2.3 of this report for discussions of these tributaries.

Impacts to this reach include the lack of a riparian cover, affecting the input of large woody debris which could act as structure and cover in the stream. There was also evidence of livestock trampling.

Prescription to this area may include riparian planting, large woody debris placement, and fencing the creek off from livestock.

## Toboggan Creek: Reach 3

The third reach is a short section of 800m. This reach is heavily influenced by beaver, with at least one large dam. On average the gradient is less than 1 %, which is conducive to slow moving water. The riparian area, similar to that of Reaches 1 & 2, is fairly intact. The riparian area extends along 80% of the reach, however, it only provides about 10% crown closure (as opposed to 5% in Reach 1). Key species in this riparian area are alder and willow, both species serve to attract beaver activity and help maintain the beaver flats which act as an important juvenile fish rearing habitat. This reach also contains sections of high quality spawning habitat and fish, both Coho and Dolly Varden, were seen using the area to build redds.

The average channel width of this reach was approximately 11m with a wetted width of 9.5m. 40% of this reach consisted of side channel, a result of the beaver activity. Approximately 60 % of this reach contains cover, consisting of deep pool and large organic debris. Some cutbank was also evident in this reach. The channel habitat type consisted of pool-run complexes. Banks composed of fines and gravels were approximately half a meter in height and 45% of them were deemed unstable. The major tributary entering Toboggan Creek in this reach is Feeny Brook (W.C. 46-2400-015)

Beaver activity in the area has caused extensive flooding in some areas. There has been both past and recent beaver activity in the area, and around these sites the channel has braided such that the main channel is undefined. The prescription for this area would be to look at beaver control methodologies.

### Toboggan Creek: Reach 4

This reach of 2,400m, runs through fields as well as slightly wooded areas. This reach also encompasses the Toboggan Creek fish hatchery. Tributaries to this reach include The Brook/Brant Creek (W.C. 46-2400-017), which is a groundwater fed creek, and Elliot Creek (W.C. 46-2400-020). Previous bank stabilization and stream restoration works have occurred in this reach in 1979. The bank stabilization methods appear to be effective to date, some cobble has built up against the large woody placement and has added to its protective nature. Of the restoration works, only remnants of the boulder placement remained and any large woody debris placed has been displaced down stream. It is believed that this section was also the recipient of reverse gravel spawning pads, however no evidence of their presence remains. This section contained limited spawning habitat and only a few fish were seen in the area. However, it should be noted that spawning habitat improved just above this area, below and beside the Toboggan Creek fish hatchery, and more fish were seen utilizing the upper section of the reach.

On average the gradient of this reach is between 0.5-1%. The channel width varies between 5-15m with an average of 9m and a wetted width of roughly 8m. There is some evidence of stream channelization through this reach but in general the channel is only occasionally confined. The confinement through the channelized sections, followed by sections of relative unconfinment, could be condusive to lateral channel movements at high flows. Channel substrate is composed mainly of gravels and fines, while the banks are composed of fine sediments and organics. Average bank height is half a meter and approximately 60% of banks are unstable. This reach of Toboggan Creek provides good cover for fish (approximately 60% of reach area), with most of this cover in the form of deep pool and cutbank.

The other limiting factor in terms of stream meander are the CNR tracks, which parallel the stream on the left hand side and prevent meander in this direction.

The primary impacts along this reach are the lack of riparian for large woody debris recruitment and livestock access to the creek. Livestock trampling and excrement were found in the creek along this reach, which as mentioned previously, increases the

sediment and nutrient loading to the creek. Bank failures continue to be evident in this area and some bank protection methodologies have been used, including rip-rap and log deflectors. Some of the bank failures may also be attributed to livestock trampling. A limited amount of beaver activity and flooding has also occurred in this section. Finally, crews found part of an old bridge deck in the creek at 730m from the start of the reach. The decking is in a slow moving portion of the creek and is currently acting as cover for fish, however it is also accumulating sediment and may become more of a problem in the future. These are the considerations that must be weighed in deciding whether or not to remove the bridge decking from the creek.

### Toboggan Creek: Reach 5

Reach 5 extends 600m along the CNR tracks. At the downstream end of the reach the creek crosses under the tracks, this juncture is also the beginning of a long ditch line on the south side of the tracks, which extends from this point to the CNR bridge crossing at Elliot Creek.

On average the channel width in this area is 15m with a wetted width of 5m. The gradient throughout the reach is about 1%. The average low bank is about half a meter and composed of fines and gravels. It was deemed that approximately 60 % of them are unstable. The channel throughout this reach remains mainly unconfined on a small scale. although large scale meanders cannot take place to the west due to the railway tracks (i.e. it is confined on a large scale). There is a large number of bars found throughout the reach and a high percentage (60%) of the area is side channel. The reach is composed mainly of riffle-pool complexes with a small amount of run (10%). The substrate is mainly fines and small gravels, however all other groups except boulder are represented. In terms of fish habitat only 20% of the area contains cover, although the cover is diverse, including deep pool, large organic debris, over stream vegetation and cutbank.

The major impact along this reach is the lack of riparian cover. This and the low erodable banks have allowed the creek to braid out into multiple channels. This reach was also found to have only moderate spawning gravels.

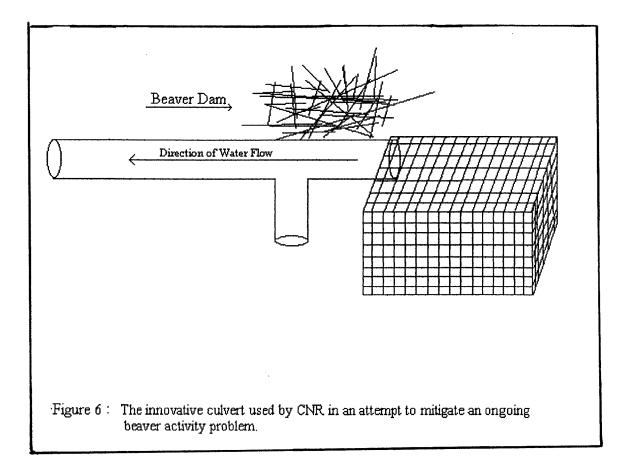
At the lower end of this reach the smell of raw sewage was detected, as if a septic tank/ field had overrun. This is a problem of concern as untreated sewage can promote pathogenic bacterial and viral populations as well as increasing the nutrient loading to the stream.

### Toboggan Creek: Reach 6

Reach 6 is 1,600m long and runs along cleared fields, with thin strips of riparian forest in some places. Reach 6 also encompasses the confluence between Toboggan and Glacier Gulch creeks; this area is composed of multiple channels. Approximately 160m upstream of this confluence the creek crosses the powerline right-of-way where the clearing of the riparian area has allowed the creek to widen and braid out to form the multiple channels which join Glacier Gulch Creek. As the creek continues to scour the banks around the powerline right of way, this section will be a continual source of sediment loading. Immediately downstream of the confluence there is a major beaver complex. During the time frame of this contract, CNR breached part of the dam and installed a caged culvert designed to allow water to flow through and fish to move upstream despite ongoing beaver activity on the dam (see Figure 6). The final third of this reach runs through cleared fields, with a thin strip of riparian on either side.

The creek channel is 15m wide with a wetted width of 6m. The channel is unconfined, made up of a pool, riffle, run series. The gradient along this reach averages 1.5 %. The stream bed is made up of gravels, while the banks are made of fines and larges. It is estimated that half of the banks are unstable. About 40% of this reach contains cover, consisting of deep pool, over-stream vegetation and cutbank. Overall this reach is considered to have good spawning and rearing habitat. It was found that this section has numerous bank failures. A large bank avulsion occurs at 965m up from the start of the reach, this avulsion is 30 m high and extends for 40m. This is only one example of the many bank failures along this reach which are contributing sediments to the creek.

Along this reach a small iron rich tributary enters the mainstem. This input of iron, while natural, may have a deleterious impact on the surrounding area. Iron in high



concentrations may affect salmonid egg survival and can be toxic to aquatic invertebrates which would affect juvenile salmonids by decreasing their food supply.

### Toboggan Creek: Reach 7

This reach extends 1,800m. Here the creek runs through wooded areas and there is a drastic riparian change from a mainly deciduous community below this reach to mainly coniferous through this reach.

The average channel width remains 15m with a wetted width of 6m. The gradient along this reach increases from the lower reach to between 2 to 2.5%. The substrate also changes such that it consists of cobble and boulder on average, whereas Reach 6 consists mainly of gravels. The high quality fish habitat continues in this reach, with cover consisting of deep pool, cutbank, boulder and large organic debris. The number of debris jams increased substantially in this reach from all previous reaches. This increase in large organic debris is reflected in an increase in cover for fish.

This reach can be considered relatively unimpacted.

### Toboggan Creek: Reach 8

No fish were seen in this reach, however the lower section of this area was highly aggraded and the channel in this section did not hold enough water to allow fish passage. holding or spawning activity. The channel in the upper section of this reach is characterized by sediment wedges and small falls and cascades. The lower portion of this reach contains multiple channels that run through the surrounding forest. This is the legacy of a bridge wash-out upstream. Upstream of this bridge washout the water begins to fall over a series of sediment wedges.

The eighth reach extends just over a kilometer. Throughout the reach the channel width is about 28m with a wetted width of 3.5m. The gradient is approximately 2% and the channel consists mainly of riffle. The amount of overall cover in this area is low. found in approximately 30% of this reach, however the cover that was present was diverse, consisting of pool, large organic debris, boulder, overstream vegetation and cut

bank. Throughout the reach the channel was unconfined and had low banks of 0.3 m, composed of fines and gravels. Channel substrate was broken up as follows; boulder and cobbles equated 50%, gravels composed about 35% and fines made up 15%.

The old bridge wash-out and subsequent aggradation in the lower portion of this reach is the main impact along this section. In some places cobble was piled up half a meter, while the aggradation extended for 30m. It is obvious that the old bridge decking once obstructed the creek such that the creek jumped its banks and flowed down the Toboggan Creek Road/ Silvern Lake Road North for 360m before turning to rejoin the main creek channel. Portions of the bridge decking continue to divert water down the road during moderate and high flows and continues to be a problem. It is likely that the channel would have remained moderately confined had it not been diverted by the bridge decking. Finally, the newly constructed motorized vehicle trail bridges may also be too low, if similar high flows or debris torrents occur again.

Prescriptions for this reach include: removing the old bridge decking from the creek and placing structures to ensure water does not flow down the road. The third prescription involves ensuring the new motorized vehicle trail bridges are high enough to allow high flows to pass under them, and if not, to raise them to an appropriate level.

### Toboggan Creek: Reach 9

This reach extends from the bridge washout to the headwaters at the Toboggan Glacier. Only a small portion of this reach was surveyed (approximately 260m). At 255m there is an impassable chute with a falls of approximately 6m.

The channel in this section is frequently confined, approximately 30m wide with a wetted width of 4m. Banks are mostly composed of gravels and larges. However some sections were bordered by bedrock. The channel is mainly composed of riffle-cascade with sections of pool run complexes. The gradient along the lower section of this reach is about 5%, however there are sections of higher gradients which would prove an obstacle for fish passage. Cover also remains a low percentage of the reach and consists of pool, large organic debris and boulder. The channel is composed of bedrock and

cobble but a large bank failure has contributed a significant amount of sediment. Above the chute the channel width narrows to between 10 to 20m with a wetted width of 4 to 5m. The channel gradient above the chute averages 7%, with increasing gradient towards the glacier. The water above the chute falls over a series of old sediment wedges and step pools. There are a few minor slope failures on the upper section and there is some sediment input off the old logging/mining road.

A prescription for this reach would be to add water bars to the Silvern road, especially if the intention is to keep the road open for summer recreational use. During wet times of the year some very large pools of water develop and water bars would help eliminate them. As well some sections of this road show signs of water running down the road, causing erosion.



Photo Number: Toboggan 1

Stream Name: Toboggan Creek

Location: Reach 1: 120m upstream from the confluence of Toboggan Creek and the Bulkley River.

Comments: While this culvert is not an obstruction to Coho Salmon it may be an obstruction to Pink Salmon, despite being baffled. The gradient through the culvert is 2 % and there is a 0.6m drop at the outflow.

Prescription (Y/N) & Number: Y, Toboggan 1

Date Taken/Photographer: October 24, 1997 / G. Wadley



Photo Number: Toboggan 2

Stream Name: Toboggan Creek

Location: Reach 1: Approximately 600m upstream from the Bulkley Confluence.

Comments: A large bank avulsion in the first reach of Toboggan Creek. The avulsion is 47m long and 25m high. Large bank avulsions, and slumps are common at the lower end of Toboggan Creek

Prescription (Y/N) & Number: N

Date Taken/Photographer: October 08, 1997 / L. Gibson



Photo Number: Toboggan 3

Stream Name: Toboggan Creek

Location: Reach 1: 681 m upstream of the Toboggan-Bulkley confluence.

Comments: There are several old road crossings on the lower end of Toboggan Creek.

Prescription (Y/N) & Number: N

Date Taken/Photographer: October 08, 1997 / L. Gibson



Photo Number: Toboggan 4

Stream Name: Toboggan Creek

Location: Reach 2, Toboggan Creek Fish Fence located 2.5 km up from Bulkley confluence.

Comments: This permanent fish fence was erected in 1988, the fence operates in the spring to enumerate Steelhead runs and in the fall to enumerate salmonid runs. The fence can be lowered at high flows to prevent damage to the structure.

Prescription (Y/N) & Number: N

Date Taken/Photographer: October 08, 1997 / G. Wadley



Photo Number: Toboggan 5

Stream Name: Toboggan Creek

Location: Reach 2, Site of historic stream restoration works.

Comments: Throughout the lower reach several areas have had logs cabled into the bank in an attempt to stabilize them. Past restoration included bank stabilization, boulder placement and constructed of reverse gravel spawning pads. Only some of the cabled logs and boulder remains.

Prescription (Y/N) & Number: Y, Toboggan 3

Date Taken/Photographer: October. 27th, 1997/ G. Wadley



Photo Number: Toboggan 6

Stream Name: Toboggan Creek

Location: Reach 3, Immediately downstream of Owen Creek confluence.

Comments: This picture shows extensive bank failures and lack of riparian cover. It also documents a large bar of gravels, on the right, there are numerous similar gravel bars throughout the lower reaches of Toboggan Creek.

Prescription (Y/N) & Number: Y, Toboggan 7

Date Taken/Photographer: October 24, 1997 / G. Wadley



Photo Number: Toboggan 7

Stream Name: Toboggan Creek

Location: Reach 5, 250 m downstream of Toboggan Creek Fish Hatchery.

Comments: The railroad runs along the left hand side of this picture (top of berm), and the extensive amounts of rip-rap are evident.

Prescription (Y/N) & Number: N

Date Taken/Photographer: October 27, 1997/ G. Wadley

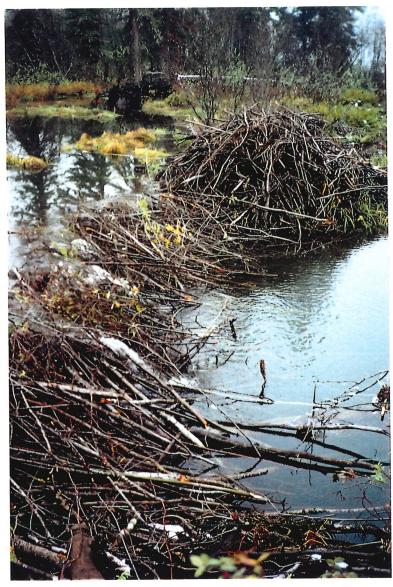


Photo Number: Toboggan 8

Stream Name: Toboggan Creek

Location: Reach 6, Immediately downstream of the Toboggan and Glacier Gulch Creek confluence.

Comments: Throughout lower Toboggan Creek there are several sections of beaver flats, areas with a riparian zone of alder and willow which is attractive to beaver.

Prescription (Y/N) & Number: Y, Toboggan 10

Date Taken/Photographer: October 14, 1997/ L. Gibson



Photo Number: Toboggan 9

Stream Name: Toboggan Creek

Location: Reach 6, Immediately downstream of the confluence between Toboggan and Glacier Gulch Creeks.

Comments: During the 1997 field season CNR employees breached this dam and installed this large culvert, the upstream end has a T junction in it as well being surrounded by a wire cage (see Figure 6). It is an innovative attempt to deal with a long standing problem.

Prescription (Y/N) & Number: Y, Glacier 1

Date Taken/Photographer: October 13, 1997/ G. Wadley



Photo Number: Toboggan 10

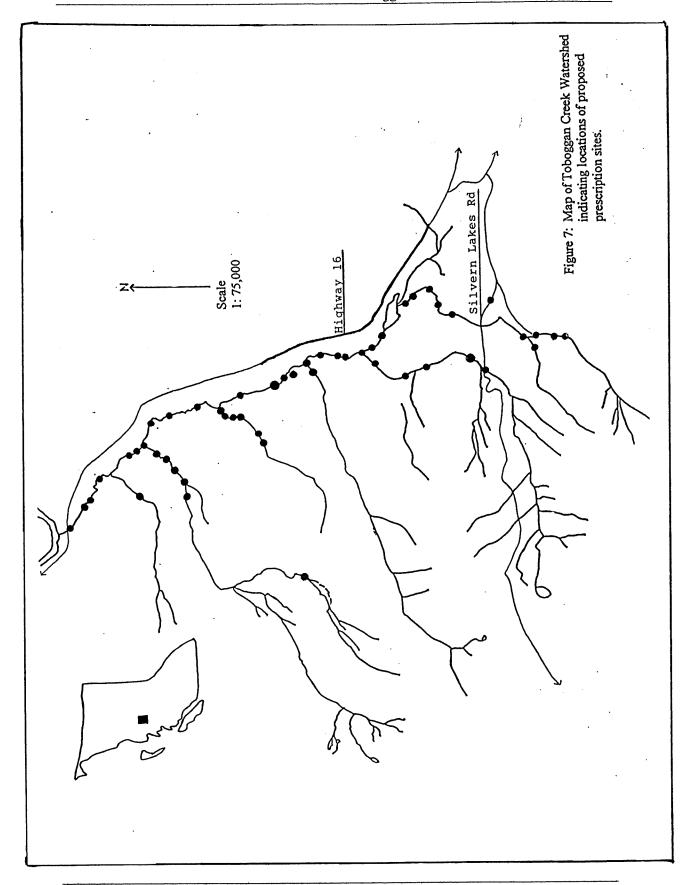
Stream Name: Toboggan Creek

Location: Reach 8, 3 km upstream of the Toboggan Creek confluence with Glacier Gulch Creek.

Comments: These pictures show the extensive aggradation of the creek and deposition of sediments through the timber. Both these situations are common throughout Reach 8.

Prescription (Y/N) & Number: Y, Toboggan 16

Date Taken/Photographer: October 24, 1997/ G. Wadley



Prescription Number: Toboggan 1

Location of Prescription Site

Stream: Toboggan Creek mainstem

Reach: 1

UTM Coordinates: 6089200, 607500

Description of Impact: 0.6m drop out of culvert.

#### Works Prescribed:

- Build up plunge pool, through large rip-rap placement. Assess baffles for
- One option for this site would be to remove the culvert and replace the crossing with a bridge.

#### Anticipated Benefits:

· Facilitate fish access (Pinks and juveniles) from Bulkley River

#### Schedule:

- Low summer flows (e.g. End of July or early August)
- Winter works is also optional

Comments: Should be Ministry of Highways responsibility. Refer to Department of Fisheries and Oceans.

#### Requirements

Manpower: 1 environmental monitor, 1 operator

Machinery: 1 day hoe, 1 day technicians

Materials: Rip-rap

Land Owner: Crown Land, administered by Ministry of Highways

Approvals Required: Ministry of Highways, Ministry of Environment, Lands and Parks (MoELP), Department of Fisheries and Oceans (DFO)

Prescription Number: Toboggan 2

Location of Prescription Site

Stream: Toboggan Creek mainstem

Reach: Reach 1

UTM Coordinates: 6088920, 607780

Description of Impact: Cumulative impacts of sediment transport

Works Prescribed:

• Placement of a series of large woody debris system

Anticipated Benefits:

Scouring of new pools, accumulation of spawning gravels and will provide adult and juvenile holding.

Schedule:

Summer Low Flows

Comments: Specific sits to be determined with landowners and agencies

Requirements

Manpower: 2 men for 4 days Machinery: 1 machine for 1 day Materials: Large woody debris

Land Owners: Mr. Butz

Approvals Required: Landowners, MOE, DFO

**Priority: Moderate** 

Prescription Number: Toboggan 3

Location of Prescription Site

Stream: Toboggan Creek mainstem

Reach: Reach 1

UTM Coordinates: 6089900, 607820

Description of Impact: Old Road Crossing and off channel development

### Works Prescribed:

• Site survey and Design for large woody debris placement and weir construction for bank stabilization.

### Anticipated Benefits:

- Scouring of new pools, accumulation of spawning gravels
- Will provide adult and juvenile holding

#### Schedule:

• Low summer flows

Comments: There are numerous unstable slopes in area. Develop potential off channel habitat

### Requirements

Manpower: 2 men for 2 days

Machinery: No Materials: No

Land Owner: Mr. Butz

Approvals Required: Landowners, MOE, DFO

**Priority: Moderate** 

Prescription Number: Toboggan 4

Location of Prescription Site

Stream: Toboggan Creek mainstem

Reach: Reach 1

UTM Coordinates: 6088380, 608460

Description of Impact: Slope Failure

Works Prescribed:

Stabilize right bank through stream bank engineering techniques, e.g. wattling and

**Anticipated Benefits:** 

• Stabilizing the banks will help control siltation and sediment input to the system.

Schedule:

• Low summer flows (e.g. End of July or early August)

Comments: If successful could be applied to numerous other locations in Reach 1.

Requirements:

Manpower: 4 men for 3 days

Machinery: No

Materials: Whips, other materials on site.

Land Owner: Mr. & Mrs. Utz

@ Hanns

Approvals Required: Landowners, MOE, DFO

Prescription Number: Toboggan 5

Location of Prescription Site

Stream: Toboggan Creek mainstem Reach: Reach 2 at fish fence

UTM Coordinates: 6087580, 609080

Description of Impact: Sediment input

### Works Prescribed:

Stabilize left bank through stream bank engineering techniques, e.g. wattling and fascines and or rip-rap, or through other possible measures, e.g. placement of round hay bales.

### Anticipated Benefits:

- Reduce silt and sediment input to stream
- Stabilize channel

#### Schedule:

· Low summer flows

Comments: Recent channel changes have increased the sediment load to stream channel

### Requirements

Manpower: 2 men for 2 day Machinery: 1 machine for 1 day

Materials: Rip-rap and Large woody debris

Land Owner: Mr. Landrock

Approvals Required: Landowners, MOE, DFO

**Priority: Moderate** 

Prescription Number: Toboggan 6

Location of Prescription Site

Stream: Toboggan Creek mainstem

Reach: Reach 2

UTM Coordinates: 6087420, 609020

Description of Impact: Bank sloughing and sediment input into the stream

Works Prescribed:

• Large woody debris placement throughout the area and possibly rip- rap some areas.

Anticipated Benefits:

Bank stabilization

Schedule:

• Summer low flows

Comments: Some downstream rip-rap is already in place, but upstream rip-rap needs to be placed to maintain meander.

Requirements

Manpower: 2 men for 2 days Machinery: I machine for 1 day

Materials: Large woody debris, and rip-rap

Land Owner: Mr. Hopps

Approvals Required: Landowners, MOE, DFO

Prescription Number: Toboggan 7

Location of Prescription Site

Stream: Toboggan Creek mainstem

Reach: Reach 2

UTM Coordinates: 6087380, 609240

Description of Impact: Bank slumping and sediment input

#### Works Prescribed:

Bank stabilization through wattling and other bank stabilization engineering techniques

### Anticipated Benefits:

- Bank Stabilization
- Decrease siltation and sedimentation to stream

#### Schedule:

Spring/ Summer/ Fall

Comments: None

### Requirements

Manpower: 4 men for 3 days

Machinery: No Materials: Local

Land Owner: Mr. Hopps

Approvals Required: Landowner, MOE, DFO

Prescription Number: Toboggan 8

Location of Prescription Site

Stream: Toboggan Creek mainstem

Reach: Reach 2

UTM Coordinates: 6086120, 609900

Description of Impact: Lack of riparian cover

Works Prescribed:

• Riparian planting

Anticipated Benefits:

• Bank stabilization and stream shading

Schedule:

• Spring

Comments: None

Requirements

Manpower: 2 men for 1 day

Machinery: No

Materials: Trees and Whips

Land Owner: Mr. Booth

Approvals Required: Landowners, MOE, DFO

**Priority: Moderate** 

Prescription Number: Toboggan 9

Location of Prescription Site

Stream: Toboggan Creek mainstem

Reach: Reach 3

UTM Coordinates: 6084880, 610700

Description of Impact: Lack of Riparian cover and livestock trampling. Lack of pool presence

#### Works Prescribed:

Riparian Planting and fencing

Restore pool presence through placement of large woody debris

### Anticipated Benefits:

• Will reduce sediment input to the system

• Provide cover for Adults and Juvenile fish

#### Schedule:

• Low summer flows

Comments: Requires Landowner co-operation

### Requirements

Manpower: 3 men for 4 days Machinery: 1 machine for 1 day

Materials: Trees or Whips, Large woody debris, fence posts and fencing materials

Land Owners: Mr. Lychacks

Approvals Required: Landowners, MOE, DFO

**Priority: Moderate** 

Prescription Number: Toboggan 10

Location of Prescription Site

Stream: Toboggan Creek mainstem

Reach: Reach 3

UTM Coordinates: 6084820, 610820

Description of Impact: This is in an active beaver area which has led to lateral channel movement and braiding.

#### Works Prescribed:

- Survey and Design and Works
- · Large woody debris placement and bank stabilization engineering techniques

### Anticipated Benefits:

- Reduce sedimentation to the stream and lateral channel movement
- Increase spawning and rearing habitat

#### Schedule:

· Low summer flows

Comments: None

#### Requirements

Manpower: Survey and design; 2 men for 2 days. Works; 2 men for 4 days

Machinery: 1 machine for 2 days

Materials: Large Woody Debris, Other materials on site

Land Owner: Toboggan Creek Enhancement Society

Approvals Required: Landowners, MOE, DFO

Prescription Number: Toboggan 11

Location of Prescription Site

Stream: Toboggan Creek mainstem

Reach: Reach 3

UTM Coordinates: 6084440, 610860

Description of Impact: Old road crossing

### Works Prescribed:

• Site survey and design for large woody debris placement and weir construction

### Anticipated Benefits:

- Stabilize channel
- Increase available spawning and rearing habitat

#### Schedule:

• Low summer flows (e.g. End of July or early August)

Comments: None

Requirements

Manpower: 2 men for 2 days

Machinery: No Materials: No

Land Owner: Toboggan Creek Enhancement Society

Approvals Required: Landowners, MOE, DFO

Prescription Number: Toboggan 12

Location of Prescription Site

Stream: Toboggan Creek mainstem Reach: Reach 4 (Toboggan ditchline) UTM Coordinates: 6083200, 611440

Description of Impact: The ditchline lacks riparian cover and structure.

### Works Prescribed:

• Add riparian cover and structure, possibly add cover as low relief structure in the ditch

### Anticipated Benefits:

- Increase available cover
- Improve fish habitat and overhead protection

### Schedule:

Summer and Fall

Comments: Requires CNR Cooperation

### Requirements

Manpower: 3 men for 3 days

Machinery: CNR for Transportation

Materials: Wood

Land Owner: CNR

Approvals Required: CNR, MOE, DFO

Prescription Number: Toboggan 13

Location of Prescription Site

Stream: Toboggan Creek mainstem

Reach: Reach 5

UTM Coordinates: 6083080, 611460

Description of Impact: Lack of riparian cover and in-stream structure

Works Prescribed:

• Add low relief structure

Anticipated Benefits:

• Increase the amount of available cover

Increase the amount of fish habitat and overhead cover

Schedule:

• Summer/ Fall

Comments: In channelized section and would requires CNR transportation

Requirements

Manpower: 3 men for 3 days Machinery: CNR for transportation

Materials: Wood and CNR for transportation

Land Owner: CNR and Mr. Storey

Approvals Required: CNR, Landowner, MOE, DFO

**Priority: Moderate** 

Prescription Number: Toboggan 14

Location of Prescription Site

Stream: Toboggan Creek mainstem

Reach: Reach 6 (Toboggan-Glacier confluence)

UTM Coordinates: 6082200, 611520

Description of Impact: The water flows through multiple braided channels

Works Prescribed:

• Site survey and design to reestablish a single main channel

**Anticipated Benefits:** 

- Restore the natural drainage pattern by building a single channel
- Increase salmonid access
- Decrease sediments and siltation and avulsions through field.

#### Schedule:

Low summer flows

#### Comments:

### Requirements

Manpower: Electroshocking crew 2 men for 1 day, works 2 men for 4 day

Machinery: 1 machine for 2 day

Materials: Large woody debris, electroshocker

Land Owner: B.C. Hydro and Mr. Johnson

Approvals Required: Landowner, B.C. Hydro, DFO, MOE

Prescription Number: Toboggan 15

Location of Prescription Site

Stream: Toboggan Creek mainstem Reach: Reach 6, at the powerline crossing UTM Coordinates: 6082260, 611280

Description of Impact: Lack of riparian structure

### Works Prescribed:

- Add large woody debris
- Plant riparian cover (low bushy plants).

### Anticipated Benefits:

• Reestablish long term large woody debris

#### Schedule:

• Low summer flows

Comments: To be completed concurrently with Prescription Toboggan 14

#### Requirements

Manpower: 2 men for 2 days Machinery: 1 machine for 2 days Materials: Large woody debris, whips

Land Owners: B. C. Hydro

Approvals Required: B.C. Hydro, Landowner, MOE, DFO

Prescription Number: Toboggan 16

Location of Prescription Site

Stream: Toboggan Creek mainstem

Reach: Reach 7

UTM Coordinates: 6081280, 611060

Description of Impact: Lateral channel movement and bank erosion

### Works Prescribed:

- Stream bank stabilization
- Monitor this reach for anadromous fish access

### Anticipated Benefits:

• Decrease silt and sedimentation to high value fish habitat

#### Schedule:

· Low summer flows

Comments: The area contains four active clay bank failures

#### Requirements

Manpower: 4 men for 3 days

Machinery: No Materials: On Hand

Land Owner: Mr. Johnston

Approvals Required: Landowner, MOE, DFO

Prescription Number: Toboggan 17

Location of Prescription Site

Stream: Toboggan Creek mainstem

Reach: Reach 8

UTM Coordinates: 6080160, 611260

Description of Impact: The bridges on the new trail from the Silvern Estates are too low to accommodate high flows, and may become an obstruction at these times.

Works Prescribed:

Survey the area to ensure bridges can accommodate high flows and where insufficient jack the bridges up

Anticipated Benefits:

• Prevention of future impacts

Schedule:

Low summer flows

Comments: This needs to be coordinated with the trail owners and users.

Requirements

Manpower: 1 man for 2 day

Machinery: No Materials: No

Land Owner: Unknown at this date

Approvals Required: Landowner, Trail users, MOE, DFO

Prescription Number: Toboggan 18

Location of Prescription Site

Stream: Toboggan Creek mainstem

Reach: Reach 8

UTM Coordinates: 6079600, 611220

Description of Impact: Lateral channel movement and sedimentation

### Works Prescribed:

- Remove the old bridge decking
- Build a proper ford

## Anticipated Benefits:

• Prevention of further erosions and channel aggradation

### Schedule:

• Low summer flows

Comments: The lateral channel movement is the result of the bridge decking collapsing into the creek.

### Requirements

Manpower: 2 men for 2 days Machinery: 1 machine for 1 day

Materials: No

Land Owner: Crown Land

Approvals Required: MOF, MOE, DFO

Prescription Number: Toboggan 19

Location of Prescription Site

Stream: Toboggan Creek mainstem

Reach: The two main active beaver areas, Reaches 2 and 6 UTM Coordinates: 6087080, 609900 & 6082180, 611620

Description of Impact: Extensive beaver dams may be blocking anadromous fish access

### Works Prescribed:

- Talk to the landowner and local trapper for beaver trapping and/ or removal.
- Monitor for fish access and use through electroshocking and gee trapping in beaver dam area.

### Anticipated Benefits:

· Maintain anadromous fish access

### Schedule:

Spring, Summer, Fall

Comments: Should be part of an ongoing program considering options and developing strategies for Beaver Control

### Requirements

Manpower: 2 men for 2 days

Machinery: No

Materials: Gee Traps and Electroshocker

Land Owner: Mr. Booth, Mr. Benjamin, Mr. Johnstone, Mr. Storey

Approvals Required: Landowerns, MOE, DFO

Prescription Number: Toboggan 20

Location of Prescription Site

Stream: Toboggan Creek mainstem

Reach: Reach 3, Benjamin and Booths property

UTM Coordinates: 6085880, 610240

Description of Impact: This area supports active beaver activity

### Works Prescribed:

• Document the extent of off channel rearing in beaver dam complex

### Anticipated Benefits:

· Enhanced rearing capabilities and access for salmoinids

### Schedule:

Spring, summer, fall

Comments: Should be part of an ongoing program considering options and developing strategies for Beaver Control

### Requirements

Manpower: 2 men for 3 days

Machinery: No

Materials: Electroshocker, Gee Traps and hand tools

Land Owner: Mr. Benjamin and Mr. Booth

Approvals Required: Landowners, MOE, DFO

Prescription Number: Toboggan 21

Location of Prescription Site

Stream: Toboggan Creek mainstem Reach: Reach 5, above Elliot confluence UTM Coordinates: 6083620, 611580

Description of Impact: Lack of riparian cover

Works Prescribed:

• Planting of riparian cover through the beaver flats. Species planted should include black spruce, cottonwood and red-osier dogwood.

Anticipated Benefits:

• Stream shading and bank stabilization

Schedule:

• Spring, summer, fall

Comments: Enhancement of wetland area

Requirements

Manpower: 2 men for 2 days

Machinery: No Materials: Trees

Land Owner; Mr. Storey

Approvals Required: Landowner, MQE, DFQ

**Priority: Moderate** 

## 2.2. Hopps Brook

Hopps Brook is a small creek approximately 3.6 km long of which 3.4 km were surveyed. This creek generally flows in a Northeasterly direction, and joins the Toboggan mainstem at UTM coordinates 6088040 and 608740. The creek is ephemeral in nature. A large portion of Hopps Brook runs though private land belonging to Mr. Hopps(Owen Creek Cattle Co.), and has been cleared to provide grazing land. The upslope regions of this creek have been cleared by logging. This creek has a small tributary (w.c. 46-2400-005-010) entering towards the mouth of the creek. Both of these creeks lack riparian cover. Hopps Brook has been broken up into four reaches, with reach breaks placed at 800m, 2200m, and 2600m.

## Hopps Brook: Reach 1:

This reach extends 800m from the mouth of the creek to the road crossing. The creek in this region is heavily channelized and runs through fields of tall grasses. The upper section of this reach shows sign of beaver activity and flooding (which may be part of the reason for the deep channelization; to help ensure the creek stays in the channel at high flows). The riparian in this area includes grasses, sedges, red osier dogwood, willow, sub-alpine fir, and spruce.

The average channel width in this reach is 2m with a wetted width of 1m. Throughout the reach the gradient remains about 1%. Banks are generally low, at about 0.3m, again with the exception of the channelized sections where the banks averaged 1-1.5 m. Banks are composed of fines and gravels, and approximately 75% of banks are considered unstable. Bank composition is very similar to the channel substrate composition of mainly gravels, 60%. Fines compose 25% of the channel substrate while cobbles make up the remaining 15%. Approximately 45% of the reach is considered cover, this includes deep pool, over stream vegetation and cutbank. The reach is composed of a series of riffle- run sequences interspersed with pools.

As mentioned, the main impact to this reach is the lack of riparian vegetation and large woody debris. A second problem is sedimentation and bank erosion due to livestock trampling.

Prescriptions for this reach include riparian planting and large wood debris placement, as well as fencing to protect banks. It is important to note that livestock would still need limited access to the creek, for watering and crossings. However this could be accomplished by having a few fording points or by excavating small channels off the main creek, which livestock could have access to.

## Hopps Brook: Reach 2

The second reach of Hopps Brook shares some similarities with the first reach, it is heavily channelized as it runs through a field and it lacks over-stream cover. Sections of the stream which are not channelized show a regular meander pattern through the field. The riparian through this area includes alder, red osier dogwood, devils club, snowberry, various grasses and birch.

The channel through this reach is approximately 4m wide, with a wetted width of 1.5m. The channel is composed mainly of riffle and run sequences, and showed a lack of pool presence and cover. The cover that is present is made up of over-stream vegetation, pool, cutbank, and large organic debris, in decreasing order of amounts. The lack of riparian and overstream vegetation is reflected in the lack of debris, which was found in only 2% of the reach. Banks are composed of fines and gravels and are about 80% unstable. The low bank height was approximately 0.2m but bank height is highly variable throughout the reach due to channelization. The channel remains unconfined throughout the reach. Bed material is primarily composed of gravels, and there is a high percentage of bars throughout the channel. Numerous bank failures are found, the majority of which were associated with the point bars, this is because the point bars are causing lateral channel movement that are eroding the banks on the opposite side.

Continuing impacts through this reach include lack of overstream vegetation and large woody debris, bank failures associated with lateral channel movements and channel aggradation. There is also some evidence of livestock trampling of the banks. Bank failures occur almost continuously throughout this reach. Finally, there is a road crossing at the bottom of this reach and it was noted that sediment laden water ran down this road and into the creek.

## Hopps Brook: Reach 3

This reach extends for 400m. The channel now runs past an old cutblock on the right hand side and forested sections of the left. Riparian in this reach includes spruce, sub-alpine fir, birch, willow, cottonwood, devils club and red osier dogwood.

In parts the channel is deeply entrenched by bedrock banks. The average channel width is 5m with a wetted width of 1.8m. The bed material is mainly composed of cobble and boulder, with gravels being of secondary importance. The channel runs down a series of step pool- sediment wedge formations connected by cascade, riffle, run sequences. Where not flanked by bedrock, banks are composed of fines, of which 60% are thought to be unstable. Several bank failures are found along this section with one notable slump occurring at 432m upstream of the powerline. These bank failures are probably harvesting related as their is evidence of logging on the right creek bank. There is an increase of both cover and large woody debris in this reach, approximately 60% of the stream now contains cover in equal amounts of deep pool, large organic debris, boulder, over-stream vegetation and cutbank. The large organic debris in this reach covers approximately 60% of the reach. There is a marked increase in blowdown through this section adding to the numerous small debris jams.

Impacts along this section of creek include the bank failures which contribute sediments to water flow and, as previously mentioned have a cumulative effects downstream.

## Hopps Brook: Reach 4

The fourth reach extends for approximately 1,400m from above the powerline to the headwaters of the creek. The channel in this section runs between two cutblocks, one of which was logged to the creeks edges and the second of which starts approximately 150m away from the edge of the creek. The riparian community throughout this reach includes spruce, sub-alpine fir, birch, devils club, alder, cow parsnip, stinging nettle (Urtica dioica), thimbleberry (Rubus parviflorus), black twinberry and lady fern (Athyrium filix-femina).

The average channel width through reach is 2.5m, of which the wetted width occupied 2m. The gradient throughout is 2.5 % and there are no major fish obstructions; however no fish were seen. Channel bed material is equally composed of fines and gravels containing patches of cobble boulder substrate. Channel habitat is broken up into 30% run, 30% pool and 40% riffle. Cover is found in the form of overstream vegetation, deep pool, cutbank, boulder and large organic debris, however total cover only accounted for about 30% of the stream. Banks are composed of fines with approximately 60% of them being unstable.

This reach is highly aggraded, containing a large quantity of gravels and fines, which has probably resulted from a decrease in bank stability due to logging above the creek banks.

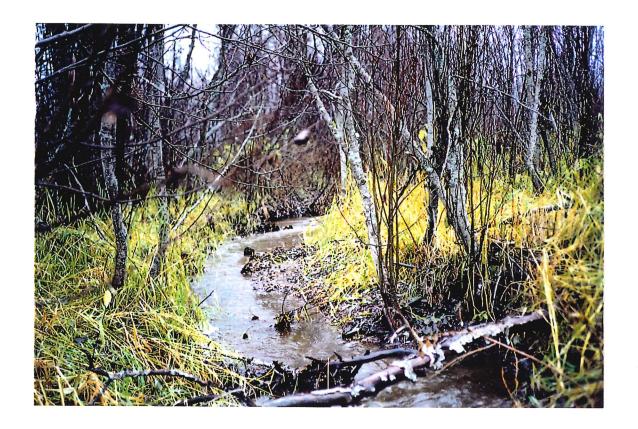


Photo Number: Hopps 1

Stream Name: Hopps Brook

Location: Reach 1

Comments: This shows the typical channel and channel habitat in the lower section of Hopps Brook. Note the lack of large woody debris, channel structure, pool presence and in-stream cover.

Prescription (Y/N) & Number: N

Date Taken/Photographer: October 24, 1997/ S. Mitchell



Photo Number: Hopps 2

Stream Name: Hopps Brook

Location: Reach 2

Comments: This section of Hopps Brook has a lack of riparian cover, large woody debris and channel structure. Banks throughout this reach are slumping and some livestock trampling is evident.

Prescription (Y/N) & Number: Y, Hopps 1

Date Taken/Photographer: October 24, 1997/ S. Mitchell

Prescription Number: Hopps 1

Location of Prescription Site

Stream: Hopps Brook Reach: Reach 2

UTM Coordinates: 6087600, 608620

Description of Impact: Extensive bank failures, and lack of riparian cover

### Works Prescribed:

- Riparian planting and fencing
- Bank stabilization
- Ensure access to upper reaches for juveniles

## Anticipated Benefits:

• Enhance juvenile rearing potential

#### Schedule:

· Spring, summer, fall

Comments: Require cooperation with landowner

## Requirements

Manpower: 4 men for 3 days Machinery: Small hoe for 1 day

Materials: Fence posts and fencing and Large Woody Debris

Land Owner: Mr. Hopps

Approvals Required: Landowner, MOE, DFO

**Priority: Moderate** 

### 2.3. Owen Creek

Owen Creek is a major tributary to Toboggan Creek, extending for 7 km of which 5.4 km were surveyed. 4.500m were surveyed on the mainstem up from its confluence with Toboggan Creek and 894m surveyed on the tributary to the upper reaches of this creek. Owen Creek has been broken up into four reaches starting at the confluence of Owen and Toboggan Creeks. The first reach break occurs at 1,800m, the second at 4,400m, and the third at 5,800m. Owen Creek flows in a Northerly direction from its headwaters, then turns and continues flowing in a primarily North Easterly direction, to join the Toboggan Creek Mainstem at UTM coordinates 6087400 and 609300. There are five closely clustered cutblocks on the upper reaches of Owen Creek and the lower section of the creek runs through farm land. During the survey, Owen Creek discharged approximately 0.741 m<sup>3</sup>/s into the Toboggan mainstem. Fish, including Dolly Varden Char, Cutthroat Trout, Rainbow Trout and Coho Salmon, were present in Owen Creek during the study period, with the creek being used both for spawning and rearing.

## Owen Creek: Reach 1

This first reach of Owen Creek runs mainly through agricultural fields and slightly wooded areas. Some areas show obvious signs of berming and channelization. While signs of an older channel running through the fields exists, the present channel has been in place for an estimated 50 years. Riparian vegetation in this reach includes cottonwood, aspen, willow, alder, devils club, red raspberry (Rubus idaeus), and red osier dogwood.

The average channel width in this reach is 5m with wetted width of 3.5m. In the upper end of this reach the channel has carved out a small floodplain which varies in width between 5 to 20m, with a high water channel outside the rooted vegetation. The bed material is composed primarily of larges and gravels, with increased aggradation at the lower end of the reach toward the mouth. The banks are generally low, composed of fines and between 20-75% stable, becoming less stable towards the mouth. Habitat type is mainly riffle interspersed with stretches of run and pool. About half the reach could be considered cover, which encompasses cut bank, pool, large organic debris, over-stream vegetation, and boulder.

Impacts along this reach include lack of riparian community and large woody debris. The lower section of this reach is heavily aggraded, and has numerous bank failures. The upper section is crossed by four bridges and one ford, of which only one old bridge requires removal. Impacts to this reach occur due to the powerline and the railway/ road crossing. At the powerline right of way there is visible sediment transport.

Prescriptions for this site include the one bridge removal, placement of large woody debris, and bank stabilization to help decrease the sediment input. It might also be a good idea to brush around the cottonwoods to provide a long term large woody debris source.

### Owen Creek: Reach 2

This reach extends for 2,600 m upstream of the powerline crossing. The creek here runs through a slightly wooded area and along a cutblock. The riparian in this section consists of spruce, sub-alpine fir, hemlock, cottonwood, birch, knights plume (Ptilium crista-castrensis), step moss, huckleberry, alder, willow, thimbleberry, black twinberry, devils club and red osier dogwood. The riparian in the lower section of this reach consists principally of the deciduous vegetation, attractive to beavers and beaver activity is obvious in this area with at least on large beaver complex. The main dam in this complex is 3m in height, and downstream from this dam there is series of smaller dams that divert the creek through the forest for approximately 400m downstream. One effect of the beaver complex is that there is some flooding on the grazing land of Mr. Hopps and onto the Mott's property.

The average channel width of this reach is 5 m with a wetted width of 4m, composed primarily of a series of riffle cascades. The gradient through this reach ranges between 2-5%. Cobble and boulder make up the majority of the bed material while the banks are composed of larges and fines. It is estimated that approximately 40% of banks are unstable. The channel is confined throughout the majority of the reach.

Approximately 60% of the reach contains cover, the majority of which was in the form of overstream vegetation, large organic debris and boulder.

The major impacts on this reach result from the beaver complex. These dams should be breached to allow fish passage and to control flooding at high water. A second impact along this reach is the result of a collapsed bridge, the bridge decking is not yet in the creek but will become an obstacle in the next few seasons. This bridge should be removed. Adjacent to the cutblock there is a large number of debris jams, which could potentially block fish access. Finally, a tributary that enters in this reach, runs through three cutblocks and is aggraded in nature, a survey of this creek should be conducted to determine its impact on the system. A short section of this tributary was surveyed and is discussed in the following section.

## Reach 3 and 4

These reaches are 1,400m and 1,200m long respectively. There was no ground survey conducted of these reaches. The terrain in these reaches rises steeply in elevation towards the headwaters of Owen Creek. Part of the creek in Reach 3 runs along a large cut block.

## Tributary to Owen Creek (w.c. 46-2400-010-050)

894m of the upper reaches of this creek were surveyed on October 16, 1997. This creek runs through three cutblocks, and contains sections where the creek banks were logged. The average channel width and wetted width is 2.5 m. The channel is made up of a series of sediment wedges and falls. Approximately 15% of the channel contains pools of which the maximum depth is 80 cm. Three quarters of this section contain cover, primarily as deep pool, large organic debris and over stream vegetation. The bed material was composed of gravels and larges while the banks were composed of gravels and fines. Only about 30% of the banks were considered unstable and the channel is considered to be confined.

Impacts to this section of creek are the result of logging; there is an old road that crossed the creek a number of times, and the creek around these crossings is aggraded and carries sediments downstream.

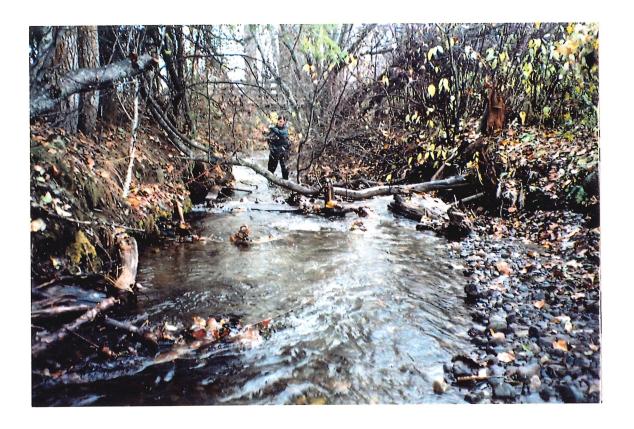


Photo Number: Owen 1

Stream Name: Owen Creek

Location: Reach 1 of Owen Creek

Comments: This is typical of the lower section of Owen Creek. This pictures shows several debris jams composed of small woody debris. This type of debris jam is prevalent throughout the lower end of this creek.

Prescription (Y/N) & Number: N



Photo Number: Owen 2

Stream Name: Owen Creek

Location: Reach 1, 40m upstream of Owen Creek road crossing.

Comments: The bridge at the top of this picture is facing imminent failure and it should be removed. The red ribbon at the bottom left of this picture shows the placement of a Gee Trap. Coho Salmon, Rainbow Trout, Cutthroat Trout and Dolly Varden were found in this area.

Prescription (Y/N) & Number: Y, Owen 2



Photo Number: Owen 3

Stream Name: Owen Creek

Location: Reach 1: Beside the Mots property

Comments: This large bank erosion is caused by the large sediment input at the powerline right-of-way, which has caused pool in filling, lateral channel movement and subsequent bank erosion. Direction of streamflow is away from photographer.

Prescription (Y/N) & Number: Y, Owen 2



Photo Number: Owen 4

Stream Name: Owen Creek

Location: Reach 2, 1400m upstream of powerline right-of-way.

Comments: This picture shows an old bridge crossing which has collapsed and is presently forming debris jam.

Prescription (Y/N) & Number: Y, Owen 5

Date Taken/Photographer: October 22, 1997/ S. Mitchell

Prescription Number: Owen 1

Location of Prescription Site

Stream: Owen Creek Reach: Reach 1

UTM Coordinates: 6087040, 609480

Description of Impact: Livestock trampling and lack of riparian cover

Works Prescribed:

Riparian planting and fencing

Anticipated Benefits:

• Increased bank stabilization

· Decreased silt and sedimentation input

Schedule:

Spring, summer, fall

Comments: Requires landowners cooperation

Requirements

Manpower: 2 men for 3 days Machinery: 1 small hoe for 1 day Materials: Fence posts and fencing

Land Owner: Mr. Hopps

Approvals Required: Landowner, MOE, DFO

Prescription Number: Owen 2

Location of Prescription Site

Stream: Owen Creek Reach: Reach 1

UTM Coordinates: 6087040, 609560

Description of Impact: Lack of pool presence and lack of channel structure

Works Prescribed:

• Large woody debris placement

Anticipated Benefits:

· Pool development and juvenile rearing habitat

Schedule:

• Low summer flows (e.g. End of July or early August)

Comments: High value juvenile rearing for all species presence

Requirements

Manpower: 2 men for 3 days Machinery: 1 machine for 1 day Materials: Large Woody debris

Land Owner: Mr. Motts

Approvals Required: Landowner, MOE, DFO

**Priority: Moderate** 

Prescription Number: Owen 3

Location of Prescription Site

Stream: Owen Creek

Reach: At break between Reach 1-2, Hydro line crossing

UTM Coordinates: 6086360, 608300

Description of Impact: Bank erosion and lack of channel structure, pool presence

### Works Prescribed:

· Bank stabilization techniques,

• Large woody debris placement for pool development and bank stabilization

### Anticipated Benefits:

· Decrease bank erosion and sediment transport

• Increase fish habitat

### Schedule:

• Low summer flows (e.g. End of July or early August)

Comments: Requires landowners cooperation

## Requirements

Manpower: 3 men for 2 days

Machinery: 1 day

Materials: Large woody debris

Land Owner: BC Hydro/ Mr. Motts

Approvals Required: BC Hydro, MOE, DFO

Prescription Number: Owen 4

Location of Prescription Site

Stream: Owen Creek Reach: Reach 2

UTM Coordinates: 6086240, 608140

Description of Impact: Active beaver area causing channel movement and flooding.

#### Works Prescribed:

- · Beaver Control and development of the area into grazing land in order to remove the attraction of the area to beaver.
- Site survey and design to reestablish old channel

### Anticipated Benefits:

- Decrease sedimentation and siltation due to beaver induced channel movement.
- Improve access for salmoids '

### Schedule:

• Part of ongoing program

Comments: Should be part of an ongoing program to monitor and control beaver activity. Requires landowners and trapper cooperation

### Requirements

Manpower: 2 men for 2 days

Machinery: No Materials: Hand tools

Land Owner: Mr. Hopps

Approvals Required: Landowner, MOE, DFO

Prescription Number: Owen 5

Location of Prescription Site

Stream: Owen Creek

Reach: Reach 2, old bridge site UTM Coordinates: 6086240, 607920

Description of Impact: Bridge is causing a debris jam

Works Prescribed:

Remove old bridge

Anticipated Benefits:

• Reduce channel movement and downstream channel aggredation

Schedule:

• Summer low flows

Comments: None

Requirements

Manpower: 2 men for 2 days Machinery: 1 machine for 1 day

Materials:

Land Owner: Unknown at this date

Approvals Required: Landowner, MOE, DFO

Prescription Number: Owen Creek Trib 1

Location of Prescription Site

Stream: Owen Creek Tributary (w.c. 46-2400-010-)

Reach: Unknown at this date

UTM Coordinates: 6083340, 606440

Description of Impact: Has not been surveyed

Works Prescribed:

• Survey and design and monitor for future works

Anticipated Benefits:

• Develop future prescriptions and works

Schedule:

• Spring, summer, fall

Comments: None

Requirements

Manpower: 2 men for 2 days

Machinery: No Materials: No

Land Owner: Crown Land

Approvals Required: MOE, DFO

## 2.4. Feeny Brook

Fenny Brook was surveyed on the 27th of October, 1997. The first reach, of 3 km, was surveyed in full. This tributary to Toboggan Creek has generated considerable interest since the early 1970's, at this time there was a large logging related gully failure which contributed large quantities of sediment into the system, which in turn caused an extensive degree of bank erosion and property damage. In order to help control the property damage and bank failures, the Ministry of Environment undertook a number of restoration works, which included extensive channelization. The gully failure is still evident and continues to fail and add sediments to the system. Further, there is a small stream that continues to run down the failure, cutting into the clays and fines. 300m below the failure there is a set of falls that are 7m in height.

Feeny Brook originates above the cutblocks (polygon number 275 on map 93L 084), and flows in a Northwesterly direction. Based on the field work and maps, Feeny Brook was broken up into four reaches, with reach breaks at 2,600m, 4,400m and 5,800m. The mouth of Feeny Brook is located at UTM coordinates 6085580 and 610100. This creek is ephemeral in nature in years of extremely low flows (Mr. Glass, 1997, Pers. Com.).

## Feeny Brook: Reach 1

This reach is 3000m long and winds though three different farms. Over 80% of this section is channelized due to historical restoration works and the CNR tracks. Where the channelization ends the creek braids out into a number of channels, causing aggradation over a wide swath of property. Feeny Brook runs through farm land and throughout the reach there is a lack of riparian cover and large woody debris. It should be noted that the only riparian along this reach was found at the lower end towards the mouth of the brook.

The average channel width is 10m and contains a wetted width of 2m. The channel is confined throughout the Raufer and Glass properties as well as along the railroad tracks. However, through the Hussman property the channel is less confined and

there are continued bank erosions and failures. The majority of the channel consists of riffle, followed by equal amounts of pool and run. Only 5% of this section contains debris and only half of that is stable. There is a moderate amount of cover in the reach, most of which is made up of pool, over-stream vegetation and cutbank. Stream bed material is primarily composed of gravels (50%), followed by cobble (30%), fines (15%) and a trace of boulder. The majority of banks are man made, composed of fines and gravels and ranged in height from 0.5 to 1.5m. Apart from where the creek runs through the Raufer and CNR properties the banks are unstable.

Because of the channelized nature of the creek, there is a lack of structure within the reach. This lack of structure in turn leads to a lack of pool presence. There is also continued bank erosion along some sections of the creek. The creek is culverted at several points, including the Owen Road, the power line right of way and at the CNR bridge. All of these culverts show signs of being inadequate. At the Owen Road crossing the culvert is filling with sediments and restricting the flow of water, the power line crossing has a culvert with a 5% gradient which may restrict fish access, and the CNR crossing is inadequate as it has a 3.5% gradient over a 30-40m stretch which might prove to be a barrier to fish. The CNR culvert is also filling in with sediments. It is suggested that the powerline culvert be replaced by a ford and riparian planting take place along the powerline and CNR culvert areas.

Towards the mouth of the brook there is one small beaver dam half a meter in height that although not an obstruction, is contributing to the channel braiding in this area. Immediately upstream of the dam an old bridge is submerged in the stream which is causing further braiding of the channel.

Prescriptions for this reach will be broken up by property. Prescriptions for the Huissman property include large woody debris placement, riparian planting and fencing along the farm yard. Above and below the powerline bank stabilization measures should be undertaken. Works in the Raufer property should include riparian planting and building and maintaining access to the rock falls. Large woody debris placement and

pool development should occur along the Glass property. The prescriptions for the Lychak and Benjamin properties are to re-establish the main channel in both these areas.

The channelization done by the Ministry of Environment did not follow the original course of Feeny Brook, the new channelized section is long, indirect and lacks in large woody debris and riparian. However, the old channel is still visible and the prescription is to survey for a possible diversion back into this channel. The old channel runs through land belonging to Toboggan Creek Hatchery and could be used as a demonstration site, as well as provide better habitat to fish. Following this prescription might also limit the prescription needed on the above private properties.

## Feeny Brook: Reaches 2,3,4

With the exception of the gully failure the second, third and fourth reaches were not ground surveyed, due to contract constraints and because they were of lower priority. However, reach breaks were placed due to gradient changes on the map. It is in the second reach that the gully failure occurs, the failure is 100m long by 20m wide. As mentioned above the failure has not been stabilized, and continues to contribute sediments to the stream. Further a small amount of water continues to flow down the failure, further destabilizing it. Prescription for this area include slope stabilization through wattling, faggots, ect.



Photo Number: Feeny 1

Stream Name: Feeny Brook

Location: Reach 1, 70m downstream of the powerline right-of-way.

Comments: This is the only section of stream that is not channelized in the lower reaches. The creek meanders through this section and the habitat contains pool and riffle complexes. This was the only section of stream in which fish were observed.

Prescription (Y/N) & Number: N



Photo Number; Feeny 2

Stream Name: Feeny Brook

Location: Reach 1, Huismans Property

Comments: This photo is typical of the reaches within the cleared lands. There is continued bank erosion and lateral channel movement in these areas due to the upstream impacts. There is a continued lack of riparian cover and in-stream structure throughout the channelized sections.

Prescription (Y/N) & Number: Y, Feeny 6



Photo Number: Feeny 3

Stream Name: Feeny Brook

Location: Reach 2, Raufers Property

Comments: This is a photo of one of a number of rock falls that occur along this property. This may be an obstruction to the upstream migration of juvenile fish.

Prescription (Y/N) & Number: N

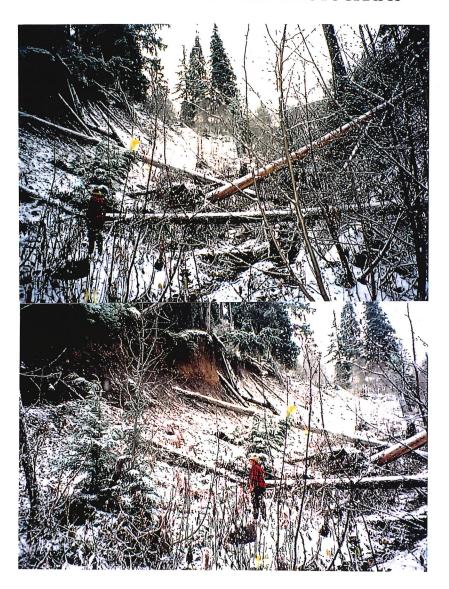


Photo Number: Feeny 4

Stream Name: Feeny Brook

Location: Reach 2

Comments: The Feeny Brook gully failure. This is an extensive failure that continues to contribute significant quantities of sediments to the Feeny Brook system and subsequently the Toboggan mainstem.

Prescription (Y/N) & Number: N

Prescription Number: Feeny 1

Location of Prescription Site

Stream: Feeny Brook Reach: Reach 1

UTM Coordinates: 6085620, 610560

Description of Impact: Lack of off channel habitat, and sever channel braiding

### Works Prescribed:

• Survey and Design to develop off channel habitat and re-establish channel

### Anticipated Benefits:

- Developing off channel habitat
- Increase access for juvenile rearing
- Decrease siltation through aggradeded area

### Schedule:

· Spring, summer, fall

Comments: Works can be coordinated with Prescription Feeny 2

### Requirements

Manpower: 2 men for 2 days

Machinery: No Materials: No

Land Owner: Mr. Benjamin and Mr. Lychack

Approvals Required: Landowner, MoE, DFO

**Priority: Low** 

Prescription Number: Feeny 2

Location of Prescription Site

Stream: Feeny Brook Reach: Reach 1

UTM Coordinates: 6083060, 607620

Description of Impact: Bridge is across the channel/underwater causing an obstruction

### Works Prescribed:

- Remove bridge
- Use large woody debris to stabilize the banks

## Anticipated Benefits:

- Bank stabilization
- Improve access and restore natural flow pattern and downstream braiding

### Schedule:

• Low summer flows (e.g. End of July or early August)

Comments: High value fish access

Requirements

Manpower: 2 men for 2 days Machinery: 1 machine for 1 day

Materials: No

Land Owner: Mr. Benjamin

Approvals Required: Landowner, MOE, DFO

Prescription Number: Feeny 3

Location of Prescription Site

Stream: Feeny Brook

Reach: Reach 2, Throughout the Reach UTM Coordinates: 6084240, 609840

Description of Impact: Livestock trampling and lack of riparian cover

Works Prescribed:

• Riparian planting and fencing

Anticipated Benefits:

• Improve cover and decrease siltation

Schedule:

· Spring, summer, fall

Comments: Part of an ongoing problem since gully failure in 1970's

Requirements

Manpower: 2 men for 3 days Machinery: 1 machine for 1 day

Materials: fence posts, fencing materials and trees

Land Owner: Mr. Huismman

Approvals Required: Landowner, MOE, DFO

Prescription Number: Feeny 4

Location of Prescription Site

Stream: Feeny Brook Reach: Reach 1

UTM Coordinates: 6085140, 610340

Description of Impact: Unstable channel

#### Works Prescribed:

 Site survey and design to rechannel a portion of Feeny brook into it's old channel and to develop the old channel

#### Anticipated Benefits:

- · Increased salmonid rearing
- Reduce downstream impact to Reach 1

#### Schedule:

• Low summer flows (e.g. End of July or early August)

Comments: Requires cooperation between landowners CNR, MOE, DFO

# Requirements

Manpower: 2 men for 2 days

Machinery: No Materials: No

Land Owner: Mr. Hussimen, CNR, Toboggan Creek Enhancement Society

Approvals Required: Landowner, MOE, DFO

Prescription Number: Feeny 5

Location of Prescription Site

Stream: Feeny Brook

Reach: Reach 1, Glass, Huissman, Raufer properties

UTM Coordinates: 6083840, 609540

Description of Impact: Lack of riparian cover, unstable banks

#### Works Prescribed:

- Large woody debris placement and pool development
- Riparian Planting
- Bank stabilization above and below powerline

#### Anticipated Benefits:

• Cover and bank stability

#### Schedule:

• Low summer flows

Comments: On going problem since road related gully failure related to forest activity.

# Requirements

Manpower: 4 men for 3 days Machinery: 1 machine for 2 days

Materials: Large woody debris, some on site

Land Owner: Mr. Glass, Mr. Huissman, and Mr. Raufer

Approvals Required: Landowners, MOE, DFO

Prescription Number: Feeny 6

Location of Prescription Site

Stream: Feeny Brook

Reach: Reach 1, Lychack, Benjamin property

UTM Coordinates: 6085500, 610400

Description of Impact: Channel braiding throughout properties due to aggredation of fines and small gravels.

Works Prescribed:

• Establish main channel and bank stabilization

Anticipated Benefits:

· Improve fish access

Schedule:

• Low summer flows

Comments: On going problem since road related gully failure related to forest activity. Requires cooperation with landowners

Requirements

Manpower: 2 men for 4 days Machinery: 1 machine for 1 day

Materials: Materials for bank stabilization

Land Owner: Mr. Lychack, Mr. Benjamin

Approvals Required: Landowner, MOE, DFO

## 2.5 The Brook / Brant Creek

798m of this stream were surveyed on the 23rd of October, 1997. Brant Creek is a small groundwater fed stream approximately 800 m in length. The majority of this creek runs through a forested area, with the riparian containing aspen, black twinberry, birch, cottonwood, willow, rose, red osier dogwood, and cow parsnip. The creek appears to originate in the boggy area around the powerline crossing; at this upper end the riparian cover is lost due to clearing for pasture. There is only one reach on this creek. At the lower end The Brook runs through private property belonging to Mr. Greengrass. This section of creek is especially well kept with a series of weirs, deflectors and other structures placed in the stream to enhance pool and fish presence. In the past fish have been seen utilizing the lower 150m of the creek.

The channel width of this brook is about 0.7m with a wetted width of 0.5m. Throughout the reach the channel is small, shallow, and generally unconfined. It should be noted that the mouth of the creek has been channelized for about 150m, this section also lacks riparian cover. At the upper end the creek could easily spread out over the flats during high flows. About 60% of this reach contains cover, mainly in the form of overstream vegetation. Fines and gravels dominated the bed material, with fines being more prevalent at the upper reaches of the creek. Banks throughout the reach are generally low and made of fines. Three quarters of the banks on this creek are unstable.

While this is not a high priority fish stream, its occasional use by fish and its use as a water supply by the Toboggan Creek Hatchery makes The Brook of concern. Efforts should be made to ensure this creek remains unimpacted. The structures on the private property should be examined for stability and effectiveness, and as the land owner is keen on this type of work, he should be given as much encouragement as possible. It might be worthwhile to plant a few shrubs, to provide cover, through the channelized section on the Toboggan Creek Hatchery land. Finally, approximately 300m upstream from the mouth an old culvert which is rusted and deformed is in the channel and should be removed.

Prescription Number: Brant 1

Location of Prescription Site

Stream: The Brook / Brant Creek

Reach: Reach 1

UTM Coordinates: 6084120, 611220

Description of Impact: Lack of riparian cover and structure

#### Works Prescribed:

• Riparian planting

• Boulder and structure placement

#### Anticipated Benefits:

• Improve fish habitat for juvenile rearing

#### Schedule:

· Spring, summer, fall

Comments: None

Requirements

Manpower: 2 men for 1 day

Machinery: No Materials: No

Land Owner: Toboggan Creek Enhancement Society

Approvals Required: Landowner, MOE, DFO

**Priority: Moderate** 

#### 6. Elliot Creek

Elliot Creek is approximately 8.2 km in length from its headwaters to its confluence with Toboggan Creek. Of this, 4.1 km were surveyed on several dates. The lower section of this creek runs through lightly forested areas and farmland. Above the farmland the creek runs through a wooded area for 1,500m before it runs between two cutblocks. Elliot Creek has been broken up into three reaches. The first reach extends up from the mouth to the upper end of the farmland, while the second extends through the wooded areas to just below the cutblocks, the final reach was made as there was a significant gradient change, which extended to the headwaters. Reach breaks are at 1,800m, 2,400m and 4,000m. The upper two reaches flow in a East to Southeast direction, while the first reach flows in a Northeasterly direction. Elliot Creeks confluence with the Toboggan Creek mainstem occurs at UTM coordinates 6083440 and 611460.

# Elliot Creek: Reach 1

The mouth of Elliot Creek is located just upstream of the Evelyn bridge. The creek at this juncture is wooded and there is a small foot path that runs along the right hand bank. At the lower end of this reach, with the exception of the power line and railway crossings, there is riparian cover on both sides of the creek, mainly composed of deciduous trees and bushes. Near the mouth there is a long ditch line, which starts near the confluence of Toboggan and Glacier Gulch creeks and runs alongside the railway, the water in this ditchline flows into Elliot Creek at the CNR bridge crossing. For several years now fish have been seen spawning in this ditch. While no fish were seen spawning in this area this year, it was noted that the water appeared iron rich which may act as a deterrent to spawning fish. At the upper end of this reach the creek meanders through working farm fields, in this section there are large gaps in the riparian area.

The average channel width throughout this reach is 10m with a wetted width of 3 m. The majority of the reach is composed of riffle-pool complexes. Throughout the reach the channel meanders and is only occasionally confined. The average gradient

throughout is 1%. The channel bed is made up as follows; 60% gravels, 20% fines and 20% cobbles. Only 35% of the reach contains cover in the form of pool, over-stream vegetation and cutbank. There is a general lack of large woody debris in the lower reach, which in turn limits pool presence and good spawning gravels. There are a couple of small unstable debris jams, providing limited channel diversity and limited pool abundance. Banks are generally low and unstable, composed of fines and gravels.

This reach suffers from a lack of large woody debris and pool presence. There is also some bank sloughing occurring throughout this reach, the addition of large woody debris would help contribute to bank stabilization and pool development.

Future impacts may result from three small foot bridges that cross the creek. At high water theses bridges may be flooded or washed out contributing to lateral channel movement and bank erosion and therefore they should be removed.

Since in the past there have been fish spawning in the railway ditchline it may be of some value to add large woody debris to this area to provide structure, cover and possibly to help provide pool presence and/ or trap spawning gravels. Coho and Dolly Varden were observed spawning in Reach 1 during the field survey.

At the upper end of this reach the creek runs through farm fields and in this area there is a lack of riparian vegetation, and some livestock trampling has occurred.

Riparian planting and fencing might help alleviate some of these problems.

At about 500m downstream from Lychaks bridge the creek runs through a channelized section, below which a debris jam has built up. This has caused the creek to widen out and braid, causing aggradation over a wide area, and is allowing the creek to move laterally and undercutting the banks.

### Elliot Creek: Reach 2

This second reach extends from the Elliot road bridge up to immediately below the cutblocks. The creek is wooded on both sides and the riparian community consists of spruce, devils club, cottonwood, alder, willow, red osier dogwood, black twinberry and birch. Throughout this reach the valley becomes narrower, going from a valley-channel

ratio of 5-10 in the first reach to 2-5 in the second. At the lower end of this reach the creek continues to meander, although the channel is now frequently confined. At the top of the valley on the left side there is a Forest Service Road that leads into the cutblocks, as well as a large gravel pit operated by the Ministry of Highways. The right hand side of the creek is bordered by several farm fields, which has again led to the partial clearing of the riparian area in these sections.

The channel width along this reach averages 3.5m which contains a wetted width of 3m. Throughout the reach there is a series of cascade-falls over sediment wedges and debris jams, between these the reach is composed of riffle and pool; it should be noted that there is no run throughout this section. Banks are low, composed of fines and larges, and are mainly stable. Approximately one-half of the reach contains cover, which is primarily of large organic debris, over stream vegetation, pool and boulder. The bed material is broken up as follows; 45% boulder, 35% larges, 10% gravels, and 5% each of fines and bedrock. The gradient throughout the reach averages about 5%, with lower gradient found at the lower end and higher gradients towards the upstream end of the reach. Numerous blowdown are located throughout this reach.

#### Elliot Creek: Reach 3

This reach runs through a previously cleared, wooded area. Again the valley narrows, from a valley channel ratio of 2-5 in the second reach to 0-2 in this third reach. The riparian forest in this reach contains spruce, sub-alpine fir, cottonwood, alder, huckleberry, and stinging nettle, but is primarily composed of devils club. Running along a large portion of the right hand bank is an old skid trail, that has grown over with alder and devils club. At one point the skid trail slopes steeply upwards, this has caused a large bank failure, which continues to fail to this day, and which is depositing debris at the bottom of the valley.

The channel width ranges between 3 to 3.5m, while the wetted width ranges between 2.5 to 3m. The majority of the bed material is composed of boulder and cobble interspersed with gravels, and throughout the reach the gradient is high ranging between

11 and 12 percent. The amount of debris increases as the reach progresses upstream, covering about 35% of the area in the lower portion of the reach and 70% of the area in the upper end of the reach. Roughly 65% of the reach contains cover, mainly in the form of deep pool, large organic debris and boulder. The low bank in this reach is approximately one meter and is composed of fines and gravels at the lower end of this reach, and fines and larges at the upper end. Further, the banks become more stable at the upper end of the reach.

At the lower end of this reach there are a number of bank failures associated with lateral channel movement. At one point a dirt road ends at the creeks edge, here a number of boulders have been placed in the creek while the end of the road/ stream banks (approximately a meter and a half in height) have been sandbagged, suggesting a problem at high flows.

There are a number of bank failures throughout this reach. As the valley becomes narrower, more debris and blow down is found sliding down the steep valley sides from the cutblocks which flank the creek above, some of this debris and blowdown is found in the creek, causing aggraded and braided sections.

#### Elliot Creek: Reach 4

While their was no field survey was done for this reach, observations done from the juncture between Elliot Creek and its tributary suggested that the main channel appeared very similar to that of the tributary, which is discussed below. The similarities included a steep gradient, over 25%, a channel bed composed mainly of boulder, and numerous debris jam- sediment wedge complexes. Further, evidence from the map suggested that the gradient throughout the reach rises sharply toward the headwaters.

# Elliot Creek Tributary (w.c. 46-2400-020-050)

3.8 km upstream from the mouth of Elliot Creek a small high gradient tributary flows into Elliot Creek from the right hand side. 200m of this creek was surveyed, as it flowed beside the right hand cutblock. The creek flows down a narrow gully, such that

the channel is fairly confined. Both sides of the creek are wooded, however the blowdown is more extensive on the right hand side of the channel. The riparian community through this section is primarily composed of alder and devils club.

The average channel width is 20m, containing a wetted width of 1.5m. The gradient throughout the surveyed section is 30% and over. Banks are low, unstable and composed of fines and larges. Just over half the channel contains debris, while 45% of the stream contains cover. The bed material was composed of 50% boulder, 20% cobble, 15% gravels, 10% fines and 5% bedrock. At the time of survey the creek carries a visible sediment load and cobble and angular boulders(i.e. non-fluvial origin) were obviously being carried out of the system. At roughly 200m upstream there is a large slide originating from the cutblock. The slide is 30m wide by 30m high and is contributing a significant amount of fines and gravels to the system.

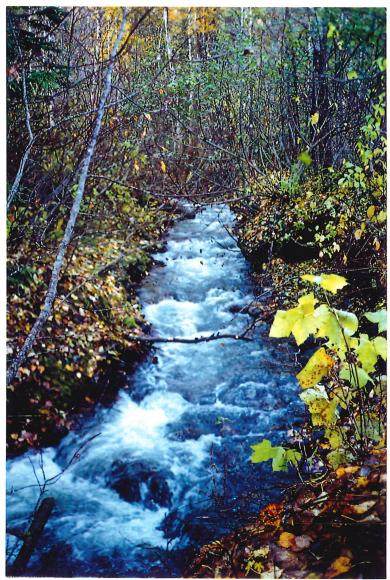


Photo Number: Elliot 1

Stream Name: Elliot Creek

Location: Reach 3, Lower end of Elliot Creek

Comments: This picture shows the 'typical' channel habitat that is found along the lower reaches of Elliot Creek. Note the lack of large woody debris structure and pool presence.

Prescription (Y/N) & Number: N

Date Taken/Photographer: October 26th, 1997/ L. Gibson

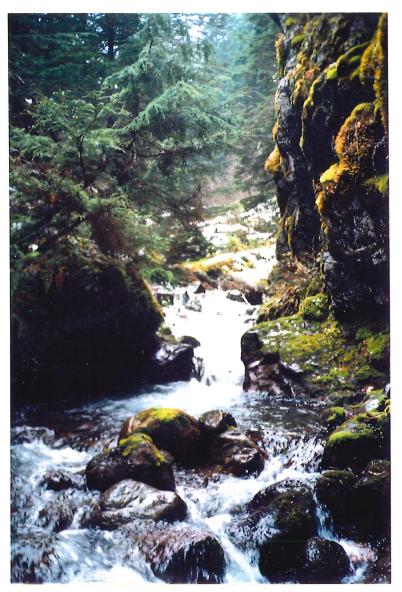


Photo Number: Elliot 2

Stream Name: Elliot Creek

Location: Reach 3

Comments: This photo shows the typical habitat of the upper reaches of Elliot Creek. Note that the channel is more confined due to bedrock banks and the presence of large boulders. Upstream of this point the gradient rises sharply.

Prescription (Y/N) & Number: N

Date Taken/Photographer: October 20, 1997/ L. Gibson

Prescription Number: Elliot 1

Location of Prescription Site

Stream: Elliot Creek

Reach: Reach 1, at the creek mouth UTM Coordinates: 6083440, 611460

Description of Impact: Bank sloughing

#### Works Prescribed:

- Jack up foot bridge at Elliot Creek mouth
- Stabilize banks along walking trail

#### Anticipated Benefits:

• Prevention of future impacts

#### Schedule:

• Low summer flows (e.g. End of July or early August)

Comments: Coordinate with users

#### Requirements

Manpower: 2 men for 1 day

Machinery: No Materials: Hand tools

Land Owner: Mr. Veenstra

Approvals Required: Landowner, MOE, DFO

**Priority: Moderate** 

Prescription Number: Elliot 2

Location of Prescription Site

Stream: Elliot Creek Reach: Reach 1

UTM Coordinates: 6083680, 611080

Description of Impact: Lack of channel structure

#### Works Prescribed:

 Large woody debris placement for pool presence and to promote retention of spawning gravel's

# Anticipated Benefits:

• Improve fish habitat

#### Schedule:

• Low summer flows

Comments: None

# Requirements

Manpower: 3 men for 3 days Machinery: 1 machine for 2 day Materials: Large woody debris

Land Owner: Mr. Veenstra

Approvals Required: Landowner, MOE, DFO

#### 2.7 Glacier Gulch Creek

Glacier Gulch is perhaps one of the better known creeks in the area as its surrounding lands on the upper reaches are heavily used for recreation. It is approximately 8.6 km in length including Toboggan Lake and ending at the outflow of Toboggan Lake and the confluence with Toboggan Creek (UTM coordinates 6082200 and 612880). Historically the confluence between Glacier Gulch and Toboggan Creeks occurred above Toboggan Lake, however extensive channelization has moved Toboggan Creek such that it now joins Glacier Gulch creek below the lake. 6.9 km of Glacier Gulch Creek have been surveyed and based upon this field survey, air photos and topographic maps, the creek was divided into six reaches. The first reach begins at the confluence with Toboggan Creek, which occurs at the outflow of Toboggan Lake. Reach breaks occur at 1.4 km, 3.6 km, 4.0 km, 4.8 km and 7.6 km above the confluence.

# Glacier Gulch Creek: Reach 1

The first reach of Glacier Gulch Creek encompasses Toboggan Lake, bordered by the CNR tracks on the left side and by farm land on the right. The lake has a surface area of 148,700 m<sup>2</sup>, a volume of 160,000 cubic meters and a maximum depth of 1.9m (Coombs and Janesson, 1982). Recently it has been suggested that it may be infilling and expanding in size (Mr. J. Storey, Pers. Com.). Fish species reported from the lake include Cutthroat Trout, Coho Salmon and Dolly Varden char, Mountain Whitefish, Lamprey, and Kokanee (Tredger, 1979). It is also used extensively by waterfowl, including mergansers (*Mergus spp.*), Canada geese (*Branta conadensis*), and swans (*Cygnus spp.*) (Coombs and Jensson, 1982). Most of the areas surrounding the lake lack riparian cover as it cleared agricultural or pasture land, however at the South East end of the lake an alder swamp flourishes through which multiple channels flow. The major tributary to Reach 1 is Glass Creek (w.c. 46-2400-25), which flows into the South East end of Toboggan Lake. Glass Creek is briefly discussed Section 2.8. This reach ends at the upstream end of the alder flats, above which is a field, with evidence of old channels.

Toboggan Lake encompasses the majority of this reach, so the average channel width was taken just below the lake at the confluence between Toboggan and Glacier Gulch creeks, above the lake through the alder swamp and along the railroad tracks. At the lower end of the lake the average channel width is about 12m, with the same for wetted width, while at the top end of the lake the average channel width is 3-5 m with a wetted width of 2.5 to 4 m. The section at the upper end of the lake has recently been channelized. Channel bed material is primarily composed of fines and gravels, as are the creek banks, over half of which were unstable. This section was used extensively for spawning by Coho during the field season in 1997. The majority of the cover in this reach occurs in and around the lake as overstream vegetation and deep pool. The gradient throughout the reach averaged 1 %, with it being a little higher in the channelized section.

Throughout this reach the major impact is the lack of riparian cover and structure in and along the creek. The primary prescription along this reach is to add structure and cover to the channelized section above the lake.

# Glacier Gulch Creek: Reach 2

The beginning of the second reach briefly (600m) runs in a Northwesterly direction between farm fields and the railway tracks, before crossing the track and turning to flow in a northerly direction. The creek then turns again to flow in a Northeasterly direction. The riparian community throughout this reach is fairly intact, composed of a mix of deciduous and coniferous trees including alder, birch, cottonwood, spruce, and sub-alpine fir. The surrounding area throughout this reach is wet and marshy containing large pools of standing water, some of which may have been contributed to by beaver activity. The reach extends to just above the powerline right away of way.

The average channel width is 3m with a wetted width of 2.5m. The channel is composed mainly of riffle and pool but there is also a small amount of cascade. Cover throughout the reach is evenly split between deep pool, large organic debris, boulder and cutbank. Bed material is composed of 45% gravels, 25% fines and 30 % cobble and

boulder. The channel is occasionally confined but shows no signs of braiding through this reach. Fish have been observed using this reach for spawning.

## Glacier Gulch Creek: Reach 3

This reach is quite short, encompassing the powerline crossing and extending only 430 m upstream. Through the powerline right-of-way the channel widens to about 7m due to the lack of riparian structure and large woody debris. There is a small debris jam at the upstream end of the powerline, but this is not a barrier to fish. The riparian community above the powerline contains, mountain hemlock, cottonwood, spruce, subalpine fir, birch, and devils club. Historically, fish have been seen spawning in this reach, but due to aggradation and obstructions at the upper end of this reach, fish are not currently able to progress any further upstream into Reach 4.

The average channel width through this reach is 7m and contains a wetted width of 4.5m. The channel is unconfined and braided in some sections. The habitat is distributed as 40% pool, 35 % riffle, 20% run and 5% cascade/ falls. 60% of this reach contains debris and there were approximately 19 pieces of large woody debris in 500m in the stream, although only 45% of it is stable.

The channel bed is composed of 50% gravels, 45% fines and 5% small cobbles. Banks are generally low, made of fines and just under half of them are unstable.

The main impact on this reach is the powerline right of way; the lack of riparian in this section has led to bank instability, channel widening, and a lack of structure in this 50m stretch. The prescription for this area would be to add large woody debris and stabilize the banks. It would be beneficial to plant low growing shrub such as red osier dogwood and willow to provide over-stream cover while not interfering with the powerline.

## Glacier Gulch Creek: Reach 4

This reach extends for 800m. This entire reach is heavily impacted, although the nature of the impact changes. The lower end of the reach contains multiple narrow, shallow anastomosing channels. Through the remaining section the channel braids such that no main channel is identifiable. This area is highly impacted and possesses no fish habitat, despite a low gradient of 0.5%. The shallow water in this reach serves as an obstruction to fish passage. The average channel width, taken across several of these multiple channels, was one meter and these multiple channels were spread for at least 20m across the floodplain. The wetted width ranges between 0.3 to 0.5 m, in the multiple channels and there is no channel depth greater than 4 cm. The substrate through this section was composed of 80% fines, 15% gravels, and 5% small cobble. The area surrounding this diffuse water has previously been cleared and has regrown as alder, cottonwood, highbush cranberry, prickly rose, club moss and extensive areas of devils club.

Through the upper reach a main channel is identifiable, and has an average width of 15m and a wetted width of 3m. Despite this main channel, there continues to be numerous shallow side channels. Further, the main channel in this area remains unconfined and braided, and all channels remains heavily aggraded. It is obvious that the main channel has jumped on multiple occasions. The substrate is composed as follows; 60% gravels, 20% larges, and 15% fines. Banks are low, composed of gravels and larges and more than 50% of the banks are unstable. The gradient in this section of the reach is 3.5%. The riparian community in this area is a mix of deciduous and coniferous species.

The impacts along Reach 4 have diffused the water such that no fish could make it though this reach. At the upper end of this reach the creek flow is subsurface through a heavily aggraded section. Because of the multiple channels the flow through this reach may be picking up more iron due to the increased area in contact with the ground compared to a single channel.

The prescription for this reach is to conduct extensive survey and design work.

One possible impact mitigation measure would be to connect the two single channel

above and below this reach. To this channelized section large woody debris and boulder could be added, and quick growing plants (e.g. willow, alder, aspen, cottonwood) could be planted along the banks to provide a more stable riparian area.

# Glacier Gulch Creek: Reach 5

The fifth reach extends for 2,800m. This reach runs through a forested area, although some sections show evidence of previously being logged. This reach is also heavily used for recreational purposes. The Glacier Gulch Forest Service Recreation Site is located at the upper end of this reach, this recreation site encompasses a hiking trail which leads to the base of the Toboggan glacier and a mountain biking trail. Further, the Toboggan FSR at the lower edge of this reach which leads to Silvern Lakes has been designated as a summer motorized vehicle trail. Located mid-way along this reach is a diversion withdrawing water to Lake Kathlyn from Glacier Gulch Creek. The riparian forest in this reach includes mountain hemlock, alder, spruce, sub-alpine fir, cottonwood, and devils club.

The average channel width along this reach is 25m, however the wetted width is only 4.5m. Throughout the reach the channel is braided and contains numerous midchannel bars over approximately 90% of the area, despite being confined by a narrow valley. The bed material is 80% larges, 15% gravels, and 05% fines, banks are composed of glacial till. The channel is composed of a series of cascade-pool, sediment wedge complexes and there is no run present along this reach. The average gradient through this reach is 9%, however, there are isolated sections of gradient over 12%. Slightly lower gradients were found at the lower end of the reach. 60% of the reach contains cover as deep pool, large organic debris and boulder, however, as noted in the last reach no fish could progress this far upstream. It is possible that a resident population of Dolly Varden occur in the area, however no sampling was undertaken in this area in this field season. There is a considerable amount of blowdown, 10-12 pieces over 100m, through this reach, but very little of it acts as debris in the stream.

Sections of the channel are heavily aggraded with boulder and cobble. 70% of the banks are considered unstable as evidenced by the several large slides and numerous smaller bank erosions along the reach. It is obvious that at high flows the water tears through the channel, moving objects and redefining its banks.

# Glacier Gulch Creek: Reach 6

This reach encompasses Twin Falls and the headwaters of Glacier Gulch Creek.

Twin Falls is a drop of approximately 300m, by two waterfalls originating off the glacier.

No survey of this reach was completed.

## Main Glacier Gulch Trib. W.C. 46-2400-30-20

This main Glacier Gulch tributary originates slightly below the glacier. 400m of this tributary were surveyed, upstream from the point at which this tributary crosses the Toboggan Creek FSR. The creek is broken up into two reaches, one below the road and one above the road.

# Glacier Gulch Tributary: Reach 1

This reach runs below the road, and the channel runs through a clear-cut and along side a large slash pile. This reach is heavily impacted from recent logging.

The average channel width is 9 m and contains a wetted width of 2m. The bed material is composed as follows: 40% larges, 30% each of fines and gravels. The channel is occasionally confined, heavily braided and contains multiple mid-channel bars. The gradient throughout this reach averages 2%.

The lower section of this reach is aggraded with multiple channels and there is a lack of riparian forest throughout the reach. Logging has taken place right to the edge of the stream, which has allowed the channel to braid and the diffusion of water results in the multiple channels containing less water and being shallower. There is a high degree of lateral channel movement throughout this reach. The reach has very low potential for fish habitat.

# Glacier Gulch Tributary: Reach 2

This reach is upstream of the road. While this reach also shows evidence of previously being logged to the edge of the creek, it has remained in better shape. Despite being confined by a narrow valley, and having a higher gradient; 5% or more. The average channel width is 4m with a wetted width of 2m. The channel substrate is equally composed of gravels and fines with only 20% fines through this reach. Banks remain low, composed of fines and gravels and unstable. There is more debris in this reach and much of it appeared stable, being covered in a thick carpet of moss. Nonetheless this reach contained only moderate fish habitat, being limited by gradient and velocity.

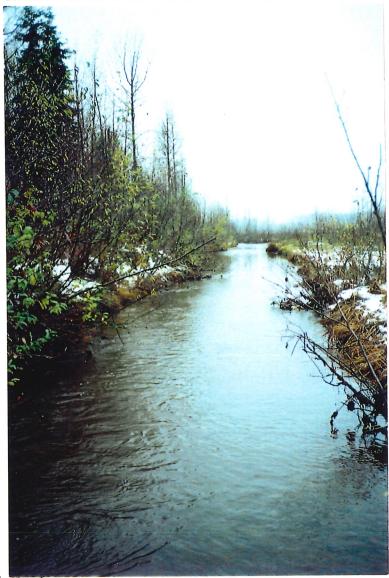


Photo Number: Glacier 1

Stream Name: Glacier Gulch Creek

Location: Reach 1, Immediately upstream of Toboggan Lake.

Comments: The creek along this reach is heavily channelized, shows a lack of riparian cover, large woody debris and channel structure. This is typical of the lower reaches of Glacier Gulch Creek.

Prescription (Y/N) & Number: Y, Glacier 2

Date Taken/Photographer: October 14, 1997/ L. Gibson



Photo Number: Glacier 2

Stream Name: Glacier Gulch Creek

Location: Reach 4, Below Silvern Lake Road North.

Comments: The creek through this reach is highly aggraded. Sediments have been deposited through the wooded areas.

Prescription (Y/N) & Number: Y, Glacier 7

Date Taken/Photographer: October 17, 1997/ L. Gibson



Photo Number: Glacier 3

Stream Name: Glacier Gulch Creek

Location: Reach 4, Immediately downstream of the Silvern Lake Road North

Comments: Water flow in the main Glacier Gulch Creek channel is subsurface at this point. This is due to the heavy sediment deposition. Note size of substrate, transport requires high discharge.

Prescription (Y/N) & Number: Y, Glacier 7

Date Taken/Photographer: October 23, 1997/ L. Gibson



Photo Number: Glacier Tributary 1

Stream Name: Main Glacier Gulch Creek Tributary

Location: The crossing of the Glacier Gulch Tributary and the Silvern Lakes road north.

Comments: This tributary to Glacier Gulch Creek flows through a cutblock and beside a slash pile. Through this area the channel braids a number of times and each channel is shallow. As this photograph shows there is an extreme lack of riparian structure.

Prescription (Y/N) & Number: Y, Glacier Trib 1

Date Taken/Photographer: October 24, 1997/ L. Gibson



Photo Number: Silvern 1

Stream Name: Silvern Lakes Road

Location: The crossing of Glacier Gulch Creek tributary by Silvern Lakes road north.

Comments: This road crosses four creeks including this one. All creeks are crossed by fords. There are numerous large puddles on the lower section of the road and the road shows evidence of water damage including washboards at several points.

Prescription (Y/N) & Number: Y, Silvern 1

Date Taken/Photographer: October 24, 1997/ L. Gibson.

Prescription Number: Glacier 1

Location of Prescription Site

Stream: Glacier Gulch Creek

Reach: Reach 1

UTM Coordinates: 6082180, 611980

Description of Impact: Beaver dam activity has blocked fish access

Works Prescribed:

• Monitor the effectiveness of the CNR culvert for fish access

Anticipated Benefits:

• Ensure fish access

Schedule:

• Summer, fall

Comments: Should be part of an ongoing beaver control and monitoring program

Requirements

Manpower: 2 men for 2 days

Machinery: No Materials: No

Land Owner: CNR

Approvals Required: CNR, Landowner, MOE, DFO

Prescription Number: Glacier 2

Location of Prescription Site

Stream: Glacier Gulch Creek

Reach: Reach 1

UTM Coordinates: 6081660, 612380

Description of Impact: Lack of riparian cover and in-stream structure through channelized section

Works Prescribed:

• Large woody debris placement for adult cover and pool development

Anticipated Benefits:

 Improved adult holding and cover, juvenile rearing, bank stabilization and high value spawning area

Schedule:

Low summer flows

Comments: This area sees heavy use by spawners

Requirements

Manpower: 2 men for 4 days Machinery: 1 machine for 2 days Materials: Large woody debris

Land Owner: Mr. B. Storey

Approvals Required: Landowner, MOE, DFO

Prescription Number: Glacier 3

Location of Prescription Site

Stream: Toboggan Creek mainstem

Reach: Reach 2

UTM Coordinates: 6080540, 612540

Description of Impact: Beaver activity has caused the creek to move laterally and braid

#### Works Prescribed:

• Set up a beaver control program

#### Anticipated Benefits:

• Development of off channel rearing habitat, channel stabilization

#### Schedule:

• Spring, summer, fall in an ongoing program

Comments: Should occur in consultation with Landowners and trappers

#### Requirements

Manpower: 2 men for 4 days

Machinery: No

Materials: Electroshocker, Gee traps, Hand Tools

Land Owner: Mr. Storey

Approvals Required: Landowner, MOE, DFO

Prescription Number: Glacier 4

Location of Prescription Site

Stream: Glacier Gulch Creek

Reach: Reach 2

UTM Coordinates: 6080120, 612400

Description of Impact: Channel has braided in the area of the power line crossing

#### Works Prescribed:

- · Reestablish a single channel
- Riparian planting

# Anticipated Benefits:

• Improve access for adult and juveniles

#### Schedule:

• Summer, spring, fall in an ongoing manner

Comments: Should be part of an ongoing monitoring program to deal with beaver control and monitoring

#### Requirements

Manpower: 2 men for 3 days

Machinery: No Materials: On hand

Land Owner: B.C. Hydro

Approvals Required: Landowner, MOE, DFO

Prescription Number: Glacier 5

Location of Prescription SIte

Stream: Glacier Gulch Creek

Reach: Reach 3

UTM Coordinates: 6079840, 612040

Description of Impact: Bridges may be too low to accommodate high flows and may be a future obstacle

Works Prescribed:

Survey new bridges and jack up any that require it

Anticipated Benefits:

• Prevention of future impacts

Schedule:

• Low summer flows

Comments: This is to be coordinated with trail owners and users. Should be completed in conjunction with prescription Toboggan 17

Requirements

Manpower: 1 man for 2 days

Machinery: No Materials: No

Land Owner: Mr. T. White

Approvals Required: Landowner, MOE, DFO

Prescription Number: Glacier 6

Location of Prescription Site

Stream: Glacier Gulch Creek

Reach: Reach 4

UTM Coordinates: 6078840, 611940

Description of Impact: At the lower end of the reach the channel braids out to become shallow anastamosing channels. Upstream the water flow is subsurface and throughout the reach the creek has deposited large quantities of sediment though the wooded areas

Works Prescribed:

Survey and design

Anticipated Benefits:

- Increase access for salmoids and rearing habitat
- Decrease the amount of downstream channel impacts

Schedule:

· Spring, summer fall

Comments: None

Requirements .

Manpower: 2 man for 2 days

Machinery: No Materials: No

Land Owner: Crown Land

Approvals Required: Landowner, MOE, DFO

Prescription Number: Glacier 7

Location of Prescription Site

Stream: Glacier Gulch Creek

Reach: Reach 4

UTM Coordinates: 6078440, 612020

Description of Impact: Collapsed bridge has caused lateral channel movement

Works Prescribed:

• Bridge debris removal and ford construction

Anticipated Benefits:

• Decrease ongoing impacts

Schedule:

• Low summer flows

Comments: None

Requirements

Manpower: 2 men for 2 days
Machinery: 1 machine for 1 day

Materials: No

Land Owner: Crown Land

Approvals Required: MOE, DFO, MOF

Prescription Number: Glacier 9

Location of Prescription Site

Stream: Glacier Gulch Creek

Reach: Reach 5

UTM Coordinates: 6077440, 611520

Description of Impact: A high narrow slide originating off the mining road/ deactivation.

Works Prescribed:

• Survey and Design along mining road

Anticipated Benefits:

• Decrease ongoing impacts

Schedule:

Spring, Summer, and Fall

Comments: None

Requirements

Manpower: 1 person, 1 day

Machinery: No Materials: No

Land Owner: Crown Land

Approvals Required: Landowner, MOE, DFO, MOF

**Priority: Moderate** 

Prescription Number: Glacier 10

Location of Prescription Site

Stream: Glacier Gulch Creek

Reach: Reach 4

UTM Coordinates: 6077940, 611940

Description of Impact: Creek is moving laterally

Works Prescribed:

• Site survey and design

Anticipated Benefits:

• Decrease ongoing impacts

Schedule:

• Spring, summer and fall

Comments: None

Requirements

Manpower: 2 men for 2 day

Machinery: No Materials: No

Land Owner: Crown Land

Approvals Required: MOE, DFO, MOF

Prescription Number: Glacier Tributary 1

Location of Prescription Site

Stream: Glacier Gulch Creek Tributary

Reach: Reach 4

UTM Coordinates: 6078660, 611880

Description of Impact: Logged over tributary impacted by harvesting and road building, causing extensive channel movement and braiding causing increased sedimentation and siltation loading.

#### Works Prescribed:

· Reestablish stream channel and build a proper ford

# Anticipated Benefits:

- Establish channel integrity
- Minimize future impacts and enhance fish use

#### Schedule:

· Spring, summer, fall

Comments: To be conducted concurrently with old bridge removal on Toboggan and Glacier Creeks

#### Requirements

Manpower: 2 men for 3 days Machinery: 1 machine for 1 day

Materials: On site

Land Owner: Crown Land

Approvals Required: MOE, DFO, MOF

#### TOBOGGAN CREEK WRP PRESCRIPTION

Prescription Number: Silvern 1

Location of Prescription Site

Location: Silvern Lakes Road Reach: All of the Road.

UTM Coordinates: Not Applicable

Description of Impact: Road is becoming impassable due to large puddles, stream crossing and road bed erosion.

#### Works Prescribed:

- Deactivate to 2 wheel drive, placement of water bars, to stop water running down road and placement of cross ditches, ditch blocks
- Deactivate roads in existing cutblock areas

#### Anticipated Benefits:

- Reduce sediments and silts transport off road
- Improve road stability

#### Schedule:

Spring, summer, fall

Comments: None

#### Requirements

Manpower: 1 man for 1 day Machinery: 1 machine for 1 day

Materials: No

Land Owner: Crown Land

Approvals Required: MOE, DFO, MOF

**Priority: High** 

### 2.8 Glass Creek.

Glass Creek is 4.2 km long and has one major tributary. No field surveys of Glass Creek were done this season. However air photos and the helicopter overview showed that this creek ran through farm fields and exhibits a lack of riparian cover. Prescriptions for this area include site survey of the area and riparian planting of cottonwood trees.

### TOBOGGAN CREEK WRP PRESCRIPTION

Prescription Number: Glass 1

Location of Prescription Site

Stream: Glass Creek

Reach: All

UTM Coordinates: Unknown at this date

Description of Impact: Runs though farm fields and lacks riparian cover

Works Prescribed:

• Riparian planting of cottonwood

Anticipated Benefits:

• Provide cover to stream

Schedule:

• Spring

Comments: None

Requirements

Manpower: 2 men for 1 day

Machinery: No Materials: Trees

Land Owner: Mr. Storey

Approvals Required: Landowner, MOE, DFO

**Priority: Moderate** 

#### TOBOGGAN CREEK WRP PRESCRIPTION

Prescription Number: Glass 2

Location of Prescription Site

Stream: Glass Creek

Reach: All

UTM Coordinates: Unknown at this date

Description of Impact: Was not surveyed

Works Prescribed:

Survey and design to asses flow of lower tributary

Anticipated Benefits:

• Prescribe future works

Schedule:

• Spring, summer, fall

Comments: None

Requirements

Manpower: 2 men for 2 days

Machinery: No

Materials: Electroshocker

Land Owner: Mr. Storey

Approvals Required: Landowner, MOE, DFO

**Priority: Moderate** 

### **Section 3: Summary and Conclusions**

The field component of the Watershed Restoration Project, Level 1 found that the Toboggan Creek watershed is moderately impacted with some highly impacted sections. The creek is impacted through various factors, including harvesting, agriculture and transportation corridors. The survey found that the recent impacts are primarily the result of upslope disturbance and roading and, as per watershed restoration priorities, deactivation of the upslope area roads is required to minimize future downstream impacts. Throughout the system pools are infilling and there is a lack of suitable and available substrate for spawning due to sedimentation by small gravels and fines.

Restoration potential exists throughout the watershed and priorities are listed in the text of the report. Restorations should concentrate on riparian development and protection, bank stabilization/ bank protection, and pool development. These prescriptions should take place following upslope stabilization. Prescription sites should focus on high value mainstem and lower tributary habitat as these areas promote the highest value fish habitat.

For watershed restoration and habitat protection to be effective in this area a cooperative relationship must be fostered between the land owners and the agencies; this would facilitate the establishment of restorative priorities and completion of works. Further fostering of a better understanding of fish and fish habitat needs through the region, directed toward the land owners and land users, could facilitate the aims of Watershed Restoration.

The importance of Toboggan Creek as a producer of Coho, Steelhead, and other species affirms that efforts be made to protect, restore and wherever possible enhance habitat for these species.

Table 5. Summary of UTM coordinates for Creek mouths, reach breaks, and prescription sites.

A) Creek Mouths		
Creek	UTM	Coordinates
Toboggan Creek	6089320	607500
Hopps Brook	6088040	608740
Owen Creek	6087400	609300
Feeny Brook	6085580	610100
The Brook/ Brant Creek	6084040	611240
Elliot Creek	6083440	611460
Glacier Gulch Creek	6082200	611880
Glass Creek	6081760	612560
B) Reach Breaks		
Creek, Reach Break	UTM	Coordinates
Toboggan Creek		
Reach 1/2	6088320	608660
Reach 2/3	6086120	610100
Reach 3/4	6085240	610440
Reach 4/5	6083700	611580
Reach 5/6	6083820	611430
Reach 6/7	6081000	610880
Reach 7/8	6080300	611380
Reach 8/9	6079580	610860
<b>I</b>		

Table 5: UTM coordinates

Hopps Brook		
Reach 1/2	6087690	608220
Reach 2/3	6087100	607740
Reach 3/4	6087160	607380
Owen Creek		
Reach 1/2	6086360	608300
Reach 2/3	6085220	606320
Reach 3/4	6084180	605200
Feeny Brook		
Reach 1/2	6083240	609370
Reach 2/3	6083060	607620
Reach 3/4	6083380	606500
Elliot Creek		
Reach 1/2	6083360	607800
Reach 2/3	6082640	608860
Reach 3/4	6082200	609900
Glacier Gulch Creek		
Reach 1/2	6081560	612500
Reach 2/3	6079740	612240
Reach 3/4	6078500	611980
Reach 4/5	6076610	610540

Table 5. UTM Coordinates of approximate prescription sites

C) Creek and Prescription	UTM	Coordinates
Site		
Toboggan 1	6089200	607500
Toboggan 2	6088920	607780
Toboggan 3	6089900	607820
Toboggan 4	6088380	608460
Toboggan 5	6087580	609080
Toboggan 6	6087420	609020
Toboggan 7	6087380	609240
Toboggan 8	6086120	609900
Toboggan 9	6084880	610700
Toboggan 10	6084820	610820
Toboggan 11	6084440	610860
Toboggan 12	6083200	611440
Toboggan 13	6083080	611460
Toboggan 14	6082200	611520
Toboggan 15	6082260	611280
Toboggan 16	6081280	611060
Toboggan 17	6080160	611260
Toboggan 18	6079600	611220
Toboggan 19 A)	6087080	609900
В)	6082180	611620
Toboggan 20	6085880	610240
Toboggan 21	6083620	611580

Table 5 (Con't):

Creek and Prescription	UTM	Coordinates
Hopps 1	6087600	608620
Owen 1	6087040	609480
Owen 2	6087040	609560
Owen 3	6086360	608300
Owen 4	6086240	608140
Owen 5	6086240	607920
Owen Creek Trib 1	6083340	606440
Feeny 1	6085620	610560
Feeny 2	6083060	607620
Feeny 3	6084240	609840
Feeny 4	6085140	610340
Feeny 5	6083840	609540
Feeny 6	6085500	610400
The Brook/ Brant Creek 1	6084120	611220
Elliot 1	6083440	611460
Elliot 2	6083680	611080

Glacier 1	6082180	611980
Glacier 2	6081660	612380
Glacier 3	6081420	612480
Glacier 4	6080540	612540
Glacier 5	6080120	612400
Glacier 6	6079840	612040
Glacier 7	6078840	611940
Glacier 8	6078440	612020
Glacier 9	6077440	611520
Glacier 10	6077940	611940
Glacier Tributary 1	6078660	611880

Table 5 (Con't).

Glass 1	Unknown at this Date	
Glass 2	Unknown at this Date	
Silvern 1	Not Applicable	_

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# Toboggan Creek

Watershed Restoration Project

Appendices

# Appendix A: Summary of Landowners Meeting and Written Response from Toboggan Creek Farmers Association

#### 1) Summary:

On January 05th, 1998, Nortec Consulting was invited to a meeting with the Toboggan Creek Landowners Association. The meeting was held in the Evelyn Community Hall between 7:30 and 11:00 PM. It was attended by the majority of Landowners along Toboggan Creek, including Mr. B. Storey, Mr. J. Storey, Mr. M. Storey, Mr. Storey, Mr. A. Booth, Ms. Utz, Mr. Hopps, Mr. Lychack, Mr. D. Lychack, Mr. & Mrs. Benjamin, Mr. Johnstone, Mr. O. Huissman, Mr. M. Duperrault (CN Track Supervisor), Mr. K. Landrock, and Mr. Hinchcliff, as well as three members of the Nortec Staff, Mr. G. Wadley, Ms. L. Gibson and Mr. S. Mitchell.

The meeting began with a discussion of what the contract involved, its objectives and where the contract had come from. We gave an overview of the contract, explaining that there had been three phases, the first being a literature search through the Ministry Libraries to find and compile relevant studies and information on the Watershed (see Section 1.1, of this document). The second phase of this study was to do the field work to determine the present impacts along the watershed (Section 2, of this report). The third phase of this project involved writing the report and compiling photographs. The meeting with the Landowners Association had been discussed with several landowners on an individual basis throughout the project.

The Nortec staff brought a copy of the photo mosaics, a draft copy the report and various maps of the area, as well as a short video presentation of their findings. Once these items were discussed and the video presented the floor was opened for questions.

The result of this meeting are summarized below;

1) There is an obvious lack of trust by the each of the landowners towards the government and they are reluctant to enter into any agreement with the government, as

they feel that they are being asked to take on more and more responsibility while the government is able to change the rules whenever they have a problem with the individual. The requirements of the bureaucracy before works in and about streams can be carried out is too onerous while the landowners are open to legal charges for anything related to riparian impacts such as cows in the creek, fords, etc.

- 2) The landowners are concerned about the long term responsibility and liability of works (such as riparian planting and fencing) undertaken on their property and that any owner cooperating in restoration would open themselves up to further persecution from MOE or DFO.
- 3) There was discussion regarding increased conflicts with respect to CNR, beaver dams, etc... which is thought to originate from the Toboggan Creek Hatchery.
- 4) The landowners primary focus centered around the infilling of Toboggan Lake and the problem beaver area just below the lake outflow. They felt this beaver dam had serious impact potential, such as if it were to breach suddenly at high flows, or flood the area around the CNR tracks. Further, they felt that talks with government concerning this area had been less than progressive.
- 5) There was a general discussion regarding the nature of impacts from natural and anthropogenic causes and how it affects fish habitat.

Finally it was suggested that we undertake an "Open House" at the Evelyn Community Hall for a day, so that their concerns could be addressed on a more individual basis. This open house would also allow us to progress further with Survey and Design aspects to be undertaken on private property.

In summary there was a good exchange of information which may assist in opening lines of communication and cooperation with agency and land owners should a more constructive forum be put in place for restoration and protection of fish habitat.

Follow up from the meeting included:

Provided a copy of the draft report, prescriptions, DFO handouts, and FRBC outline of land based programs to the Landowners association.

2) Letter of Response from the Toboggan Creek Farmers Association.

TOBOGGAN CREEK FARMERS ASSOC. R.R. #I, Smithers, B.C. VOJ 2NO T'elephone 250 847 - 2158 January 30, 1998.

NORTEC CONSULTING, c/o GORD WADLEY, SMITHERS, B.C. VOJ 2NO

Dear Sir:

RE: TOBOGGAN CREEK WATERSHED PROPOSED RESTORATION PROJECT

We would like to thank you for sharing your report with the Farmers and asking for our input.

Many of the farms along Toboggan creek were established about 1920. So some of our members have a lot of history on this creek. Our attention is drawn to several facts in this report that are confusing to many of us.

Cattle began arriving here in the 1920's, sawmilling and logging a few years later, during this time, long time members of the farming community claim there was an abundance of fish in this system, that began to decline in the 1980's. We feel that it is unfair to start pointing fingers at the railway, established in 1914, the farmers and loggers, as they lived in harmony with the creek and fish thrived for well over 50 years.

It has always been common knowledge to those of us that farm along this creek, that because it is fed directly from two mountain glaciers, the hotter the weather, the colder the water temperature, with more ice melting in the hot weather. The biggest thing that warms the water is when it is spread out behind beaver dams in shallow pools. To plant shade trees, to keep the water temperature from rising in these areas as suggested in the report, only gives beavers more feed and wood to build their dams with.

Until about 20 years ago, farmers spent many hours working on toboggan creek, riprap erosion areas with rock and logs, also trapping beaver and removing dams. In some cases channels that had filled with gravel and debris on flood years were dredged. This was basically done to protect farm lands, but it was well known that the fish were also benefiting. With more regulations being introduced and permits required this practice has since stopped.

The toboggan creek fish hatchery still opens dams every fall for about 3 weeks to allow the spawners to get upstream. It is my understanding they are paid by way of a grant for this now, called beaver control. Of course once they stop, dams are built up again.

As a group we all would like to see a program that benefits Fish, Farmers and Railway and know it is possible if we all take a practical approach. We also know it is not a one time fix, rather an ongoing program as beavers move and floods do happen in certain years.

NORTEC CONSULTING Page 2 January 30, 1998

On January 28<sup>th</sup>, 1998, our members voted unanimously to support a program that would undertake the following projects:

#### WORKS ON TOBOGGAN CREEK ONLY, FOR 1" YEAR:

- Repair erosion areas on creek with riprap, logs, etc., Re: properties of Utz; Landrock; Hopps; Booth and the C.N.R.
- Remove some problem obstacles in the creek that are making the creek change course. Re: properties of Booth; Benjamin and Lychak.
- Remove beavers and problem beaver dams
  Re: properties of Benjamin, Lychak, Storey, Johnson and the C.N.R.
- Open some low areas with trenches that leave water on farmers land and strand Fingerlings after high water receeds, often happens in June.
- No fencing of creeks at this time.
- Possible works on other creeks, 2<sup>nd</sup> year.

We sincerely believe that the above works would be a win - win situation for environment, the farmers and the railway.

Yours truly

BOB STOREY, President,

Toboggan Creek Farmers Association.

Copies to: C. N. R.

Federal Fisheries;

Toboggan Creek Hatchery;

B.C. Environment:

All members of the

Toboggan Creek Farmers Association

## Appendix B: Copies of SISS forms

SISS cards were filled out for all surveyed sections of the Watershed. SISS forms will be placed in this appendix in the creek order as found throughout this report.

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DFO/MOE STREAM SURVEY FORM

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A AAAAAA AAAAA AAAAAAAAAAAAAAAAAAAAAAA	9.5	6E												
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COVER: Total %	60	GE	Larges	ige.cobble (128-	-256mm)	20 1		m		Dry	L	(M)	$\sim$	Flood
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Parameter Value	Method		Spec	ific Data				•		(Fish)				
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Mean Velocity (m/s)														
Discharge (m <sup>3</sup> /s)							Wid	ith,Valley:Channe	i,Slopel					(terial)
QP #18241										RE	VISED	DEC 87		SS1 87

STREAM/VALLEY CROSS (Looking Downstream)	S-SECTION D
No. Size Range (mm) Use Uthor 1/2 L PLANIMETRIC VIEW	
AND COLORS AND ADDRESS OF THE PROPERTY OF THE	( GY ( ) ) -
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AND	· ·
COMMENTS	
Channel Stability [1], Debris [7], Management Concerns [7], Obstructions [7], Riparian Zone [7], Valley Wall	Processes, Etc.
This section encorporates the fish hatchey	
Nice spawning and resums habitat	
	Oder
The of Marie and Comment with the second	
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Total of enosion of renes	
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NWD count 7B, pieces	Date Y M D:
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DFO/MOE STREAM SURVEY FORM

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SISS Cards for Toboggan Creek  $\overline{\psi}$ 

DFO/MOE

			-4		51R	EAM SU	HAFA	FOHM									
	remillane (gaz.)	log	gan		(lo	cal)							Acc	ess	F T	-	Method
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0	010 97/10	23	13:45	Applica	C-SBCIEW	RM/GI	W/	Photos		Air Ph	otos						
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	Ave.Max.Riffle Depth	(cm)	25	6E													
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	Tradition ;	(200.006)	2-2-2	\$ 5C		ED MATE			(6)		BANI	∢s		all and			
	30 W 40	33	0	65	THE PLAN	clay,sill,sand	(<2mm)	2		leight(m)	1.2 %	Unstab	* ST				
<b>M</b>	© 45 € C	10000	10 □ 20 B	60	A property	small (2-16n	nm)	20	T SEE	exture	(F)	G (1	, ) R	<b>**</b>			
	A011500□			65	Brief Co. L	large (16-64	mm)	20		Co	nfinemer	nt	EN C	) (FÇ	ОС	UC	.N/A
1	Stable %		60	60		sm.cobble (6	4-128mm	10	V	'alley: C	hannel F	Ratio	0-2	(2-5)	5-10	10+	N/A
趱	COVER: Total %		50 %	160	100	ige.cobble (1	28-256m	m) //			mr	17613	Dry	Ĺ	$\mathbf{W}$	共	Flood
	Comp. Dp Pool L.O.D.		In Veg Over Veg	Cutbank	how in the state of	boulder (>256		15	F	lood Si	gns Ht	(m)	.6	Braide	d (	Ŷ)	N
		10	10	20	Bedro	k (A)	State Of	***	В	lars (%)	5	<b>D</b>	рН		02	ppm)	
434	Cromi Giosara 70	30	Aspect	WE	D <sub>90</sub> (cm	150	Compact	ion LM	1 (SS) W	/ater Tem	p.(°C)	S Tu	rb.(cm)	1.2	Cond.(	25°C)	
***			DISC	HARGE					J		R	EAC	SYN	1BOL		***************************************	
Miles Lunia	Parameter	Value	Method		Spe	cific Data						,	(Fish)				
1	Wetted Width (m)																
***	Mean Depth(m)														-		
Va. t	Mean Velocity (m/s)																
-	Discharge (m³/s)							1	Width	,Valley:Ci	hannel,Si	ope)	1			Bed M	aterial)
QP	#18241			,									AE	VISED D	EC. 87		SS1 87

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	storin. DV	No.	5(SI; i SUM Size Range(mm)	No am	Uso SP.	i Imieriani Obs.	·, L		STREAM/VALLEY (Looking D PLANIMETRIC VII	)ownstream)		R
ke i	Co	j	450	PORT			- -			. **		<b>≯</b>
			·			•						
		_			$\vdash$		_					
		l	L					COMMENTS				
	Channe	Sta	bility . Debris	. Manage	emen	t Concerns	Obs	tructions [], R	iparian Zone 🔙 Val	lley Wall Processes	☐; Etc.	
	ne	L~	· noun	bon	12-	loilu		and	ettensine	LWD b	lowdo	un
	- 40	to	chunn	ol.		0			0			
	Pale	ک	elent.	1 pars	<u>~</u>	ung .	₹1	earin	y Kubelal	? .		
	77	Le	ead ?	OAD	Λ.	liker	u	red 1				
	Ri	D	- mate	ue 1	92	Hw	52	will	ow Alder	devil es	lua, Por	£_
	$\lambda$	u	d Ossie	RS,			0//				/	
	2-	Des	mall ;	triles	a	enteri	<u>-</u> 1	from 1	-H Side	bank		
	<u>.</u>							<i>l</i>				
								<del></del>				
<b>***</b>											Edited by:	
<b>***</b>											Date YM D:	

Nortec Consulting

		DFO/MOE	. =====				
	, <u> </u>	STREAM SURVE	FORM		Access F	out Met	hod
1900 (gaz.) Toboggan	Creek	Mocall UPPar TO	boggan		<del> </del>	7	
1916 21410				fine Ma 8	Length(km)		7
	vern Lakes	Road	934.084	All Control of the Co		TEN TO	_
Crossing		U.T.N			10.0		
010 11 917 10 10 10	Actority	S8 PM /LC/	Photos /e S	Air Photos	2000	્રાહ્યા માં	
The state of the s	LUE METH.		SPECIFIC DATA			Type Lo	
FANAMETER	8 60				2,356,51	1,750 5	
e de la companya del companya de la companya del companya de la co	15 60			160 nolso			
The second secon	cm co				200.5	+	
	7en ac		N. MCH	54111/0			
	90 56	BED MATERIAL	% C	BANKS			
15 10 65 10	10 at	clay, sitt, sand 1<2m	m) 15 15	Height(m) 0,3 %Unsta			
	277100 /	small (2-16mm)		Texture F G	L R	oc (oc)	N/A
	TIME CUT	(16-64mm)	20	Confinement	EN CO FC		N/A
STATE OF LAND	30	sm.cobble (64-128		Valley: Channel Ratio	0-2 2-5	_	100
**************************************	30	Larges   Ige. cobble (128-25	KARNKI T INGSTRA	Trin.	Dry L (		
200 T	Veg Over Veg Cutbank	boulder (>256mm)	TATE STORY	Flood Signs Ht(m)	Im Braided	<del>                                     </del>	
(A)	15 10	Bedrock (A) XX		Bars (%)	pН	O <sub>2</sub> (ppm)	
	Aspect NE		paction L M H			Cond.(25°C)	
Crown Closure % 10	DISCHARGE	- 90		REAG	CH SYMBOL (Fish)		
Parameter Value	Method	Specific Data					
1 4 4 4 4 4	Mounos						
Wetted Width (m)	-						
Mean Depth (m)					<b>\</b> .	(Bed Ma	at a ci
Mean Velocity (m/s)			(Wic	(th.Valley:Channel,Slope)	REVISED I		SSI
Discharge (m <sup>3</sup> /s)					HEVISED I		
QP #18241	. 50 1 1 2 1 1 1 1 1 1 1						_
्वसंदर्भवणात्रहरू			STREAM/VALLE	EY CROSS-SECTI Downstream)	on 🔼		
No. Size Range (mm)	ndini Use (trib)	Mini L				$\sim$	
			PLANIMETRIC '	VIEW		>	7
						No.	Œ
· .						A	
						[	$\mathbf{H}$
						lk 1	1
						28	H
			TOO P	000	SCOCC		_
		_		, ,			_
			•				
Ä		COMMENT	ş.				
Channel Stability . Debris .	Management Con	cerns, Obstructions 🖳	Riparian Zone 🔲; 🛝	alley Wall Processe	s 🔲 Etc.		
160 Dust 500	M 14 V1	Thing but	sed wed	ges and	Jul	20	
in son estine	section	~~~		0	V		
This restrict	م درد مدا	agraded a	ud cree	kkas	cut .		
600000000000000000000000000000000000000	2.4D 7 +2.	130 r	1				
MAGAS	myn 10		<u> </u>	4			
Mose see	en.				······		_
7000	. 0 #	have sol.	dolo	to 0.5 m	h: n	n d	
A 400 D	e forest	The land	est los	30m.	nla	<u> </u>	
ay y was	for.				1		
					Edited by:		

Date YMD:

Racher C				DFO/MOE STREAM SURVEY	FORM					
Mario Inin (gaz.) 70	hace	······································	1016	(local) UPfer Tubo.	<del></del>	<u>`                                    </u>		Access	Foot	Method
	6 2 4		<u> </u>	11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	igan	Enre	No. Q.	Length(km)	17	<del>                                     </del>
windless UPstream	***************************************		<u> </u>	Les Pouce Maga	934.08			Elwagnest	155	HUN
Chossines	- 4	3/100	7 h	U.T.M.	73	Brit. W		N	SIDE X	207
917 /10/		1500	PANTA.	CS8 CON RM/LG/	Photos 1/2	Air Pho	otos		·	
PARAMETER			METH.	C2 Bloomstate In. 1 / Ow /	SPECIFIC I			( )	PER IVE	1(0))
ATTAINE TEN		30 ⊾	WE.					<b>3</b> 1	Ty	pe Loc'n
La kwaynayaman		4 m	aë.			· · · · · · · · · · · · · · · · · · ·			6m F	
Ave.Max.Riffle Depth	(cm)	12 cm	۷Ē			See no	tes	幾		
Ave.Max.Pool Depth (		45cm	LE							
Samum .		5%	SC	ON CHEBED MATERIAL	%	to	BANKS			
25 70 40	au 2 2		LE	clay,silt,sand (<2mm.			0, 2 %Unsta	ble <b>7</b> 5		
STOCKET DOOK	ALCOHOLD STATE	IN CONTRACTOR CONTRACTOR AND A TO	LE	56 94 small (2-16mm)	20 5	Texture	F (G)(	L) R		
100000000000000000000000000000000000000		i □ ši 🗹	UE	Gravels large (16-64mm)	1/5	Co	ntinement	EN CO FO	) oc (	JC N/A
Stable %		<b>6</b> 5	LE	sm.cobble (64 - 128mm		Valley: C	hannel Ratio	<u>(0-2)</u> 2-5	5-10 - 10	· N/A
COVER: Total %	¥	<sup>2</sup> ن	45-	lge. cobble (128-256n	ımı 62 £5		nt .	Dry L	(M) H	Flood
Comp. Dp Pool L.O.D.		Veg Over Veg		boulder (>256mm)	35	Flood Si	gns Ht(m)	/ Braid	led 🕜	N.
sum 100% 25 25	20			Bedrook (R)	W/5 /5	Bars (%)	10	ρН	Офрр	m)
Crown Closure %	0	Aspect	ENE	D <sub>90</sub> (cm) 95 Cm Compac		Water Tem	o.(°C) Ø3 T	urb.(cm) L	Cond.(25	(C)
		DISCI	ARGE				REAC	H SYMBOL		
Parameter	Value	Method		Specific Data				(Fish)		
Wetted Width (m)						]				_
Mean Depth(m)										İ
Mean Velocity (m/s)										1
Discharge (m <sup>3</sup> /s)						tWidth,Valley:C	hannel,Slope)	1		d Material)
QP #18241					,			REVISED	DEC. 87	\$\$187
Signatu No. Size Rad	it (SMM)	ms, ourstain	Use ()(i	nico (i) i		M/VALLEY CR (Looking Down ETRIC VIEW	OSS-SECT	TION 🖸	邻	
			$\vdash$					. /		
		<del> </del>					. /			
255		<del>                                     </del>		——————————————————————————————————————		Opp		7		
263 263			TT		A0000	60 0 C	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \			
		<b> </b>	++							
		<del> </del>	++							
		1		COMMENT		,				
Channel Stability	. Debris	Manac	ement	Concerns□, Obstructions ☑,	Riparian Ze	one 🔀 Valley	Wall Proces	sses [1] Etc	<del>).</del>	
Report A	0.0	<u></u>						· / /		
other = casca	0.	100 to	110	1 pad X-ma no	veral	sed. w	edze	olythu	die	<u> </u>
J/Low lhe	700	nd 10-	1, 20	was and deline	s in 5	elis re	act.			
oceur.	ww.	200	A.	aren the cree	h he	comes	very	agg	rod e	d.
tron th	<u> </u>	10 M.					[			
Vio fest	10	WV.					A			201
OP . Cra-	\. · · ·	1. 01	۱ ۵۰ .	( vellow tem	ock F	tet aspo	in, Kel	USS!	es, l	RKK-
the Later	_wo	17.C	0	se Birch Min	hle be	sig !				
uun der	4 H	-1140	7	1011		\				
								Edited b		
								Date Y	A D:	

### B) SISS Cards for Brant Creek

			O/MOE				
		STREAM	SURVEY FORM	<u> </u>	<del></del>		
Stario Stimp (gaz.)		(local) Z	ROOK / Brant CM	eeK	Access	PI	Method
MULTINES 146 214	1010 017			fr et 's	Length(km)		
	nt Tobous	a C. hentelian	Mrs 93108	4 310 36	417/11/417	<del>798</del>	He
Us & 798 m		7	U.T.M.	erc ins y (		Car 6	*1816
000 9 7/10 23	1330	MIN 58 King LA	SM/ Photos	3 Air Photos			
PARAMETER		ETH.	SPECIFIC (	DATA	OE		गुरुग्छ
Principal mentions.	,7 A	10			Ç.	PIGO Typ	e Loc'n
month matters	BEM 1	10					<u>  :   </u>
Ave.Max.Riffle Depth (cm)		15					
Ave.Max.Pool Depth (cm)	25 n	ns					
ingmes.	- 1	C O BED M	ATERIAL %	C BANKS	700		
W 15 N 75 N /	( Silver	Fine clay, silt	.sand (<2mm) 70 70	Height(m) 5 %Unsta	15 ible 75 iii		
São COM 2 7 DO SO			2-16mm) 32 20	Texture F G	L R		
W Lambado□W □	professor to garagest to	The state of the s	6-64mm) § 5	Confinement	EN CO FC		JC N/A
Stable %	7.7	THE PROPERTY OF THE PARTY OF	ble (64-128mm) 4	Valley: Channel Ratio	0-2 2-5	5-10 00	€ N/A
COVER: Total %			ble (128-256mm)	in in	Dry L	(M) H	Flood
2000		ulbank	(>256mm)	Flood Signs Ht(m)	Braide	•d 🔘	N
sum 100% 5 20 /	<del>                                     </del>		7 19 19 19 19 19 19 19 19 19 19 19 19 19	Bars (%) 5	рН	Olibbi	m)
Crown Closure % 70	1	D <sub>90</sub> (cm) 6	Compaction L)M H	Water Temp.(°C) 5	furb,(cm)	Cond.125*	C)
Grown Grossie is 17 2	DISCHA	Z 1002 1 V		REAC	CH SYMBOL		
Parameter Value		Specific Dat	la	1	(Fish)		i i
Wetted Width (m) A 2	-			1			
Mean Depth(m)							1
Mean Velocity (m/s)	<del></del>			1			
Discharge (m <sup>3</sup> /s)	<del> </del>			(Width, Valley: Channel, Slope)	1	(Be	d Material)
₽ #18241				-	AEVISED	DEC. 87	SS1 87
	BUNINAS.	· ·	STE	REAM/VALLEY CROSS-	SECTION [	7	
Storery No. Size Rang		Talled Herikoseiteld	1	(Looking Downstream		_	R
NO. Olze Hang	Jo Gillin Landau		_ / PL#	NIMETRIC VIEW	. [	]	
			1/1/5	•	, X		
(a)			11	1 1- A	X		
		<del>                                     </del>	N/ V	1 LLAX (	V/Kt		ينسنو
		<del></del>	X SOF H	1/26/2017	<b>M</b> , ),		
		<del></del>	117/ 12		V		
			1./		$\mathcal{A}$		
			Y	<u> </u>			
				\$			
		<del></del> [					
<b>***</b>	L		COMMENTS				
Channel Stability . [	Dahria . Mana	anment Concerne		n Zone . Valley Wall Pr	000000	Etc.	
	7,	·····			0003303	EIU.	····
· Smull Isha	,	minutes in swim	propring or	poverline			
of ish reported	4.1		0 -				
Very dittuse		1 1	neac-flest u	ret denve cont	,,,		
· Rowate pry	party out	ove hidden	excellent relied		m it Çi	WIR	Jeflede V
· Stream is	severely	montined i	y low bomb	s- weber con	angely	wes	céro
and spream	al into cipo	even					
TS 2	•						
	nberry, Bi	vch, papen, colle	nwood, can per	snip, NO Osies	vol dost	xw/	

### C) SISS Cards for Hopps Brook

DFO/MOE

				, 51 F	LEAM SC	JHVET	CHI	n				_					
Strayor (ren (gaz.)				(1	ocal) Hop	PS Bi	k ك	ς					Acc	ess	PT		lethod
Property L146	12,410	1010 90	5   1	لتلا		للنا		L	لـــا	(hrea	10	1	Leng	h(km)	3. 6	?	
	ino	in O	aien C	sh C	atle	inter	93 L.	09	4	Sur 16	l	4	PIST		101	0	HC
Ronch listel	156	1010N		5		U.T.M.				Oliver of	17.	Y	(3)			$\succeq_{i}$	
010 10 917/10/3	2 4 Time	Î	Agendy	€58 Cre	12m /5/	m/P	hotos	NO		Air Pho	tos						
PARAMETER			метн.				PECIF	C DA	ATA						STRU		
Proventing the		2	46											cleak	地位	Type	Loc'n
star attealieur up		<u>'</u>	46											200			
Ave.Max.Riffle Depth	(cm)	<u> </u>	Ms													·	
Ave.Max.Pool Depth (	cm)	70	MS				6.1	12	Market .					1000			
FILM J	entitle	1.0	50		BED MATE		7 % 72.73		C		BAN						
W Y DUNCY O	44	200	45	Pine			25	25		leight(m)			ble 75	7.23			
See Chars 4 Go Co			LE	erre	small (2 - 16			40	根据	exture	<u>(F)</u>	<b></b>	LA				L
WW/5(D)		因此口	45	ateur en e	large (16-6			20	A Care		nfinem		EN C		<u> </u>		N/A
Stable %		30	45		20	(64-128mm)		12	إلاه	∕alley: Cl			0-2	2-5	5-10	10+	N/A
COVER: Total %		45	اللي الله	- Inn	ige.cobble	(128-256mm	' \ S	3	ئى ئامىدە ئا ھىرەم	2198. 27	m,		Dry	L	<b>(B)</b>	H	Flood
Sign Sum	Boulder In	Veg Over Veg	Cutbank	a in divid	boulder (>2	56mm)	Parti		-12.02	Flood Si	<del>-</del>			Braid		$\sim$	N
100% 20/ 5		53	811	eno	ock (RI				2000	Bars (%)	1-4		pН			(ppm)	
	30	Aspect	ENE	D <sub>90</sub> (c	cm)	Compaction	n(1)n	л н	غدمتيون	Water Temp			urb.(cm)	4	Cond.	(25°C)	<u> </u>
		DISCI	HARGE									REAC	H SYN	<b>IBOL</b>			
Parameter Parameter	Value	Method		S	pecific Data												
Wetted Width (m)																	
Mean Depth(m)																	
Mean Velocity (m/s)											•		1			10.41	
Discharge (m <sup>3</sup> /s)			<u> </u>						Widt	h,Valley:Cl	nannei,	,5(ope)	B	VISED			SS187
QP #18241																	33107

					~~~~~
and the second	No. SI	FISITE (mm)		se Drungari	STREAM/VALLEY CROSS-SECTION (Looking Downstream)  PLANIMETRIC VIEW
			<u> </u>		COMMENTS
				0	. Obstructions ☑, Riparian Zone ☐, Valley Wall Processes ☑, Etc.
70	, ,	•			
(O)	Most of	Strekh	was ch	county sec	I relatively Coulded, bank height 206 m, Low bonk
أحدثن	13	O. S. w	•	-	he me is ad channels with 1-1.5 m
	somes	eilion	+ appea	4.2. W	he man made channels with 1-1.5 m
	perm	Tha	t fol	lows.	in the The stand to the
	Mean	dering	sect	ion is	and four me quear of week
5777	gas	ses	10	<u> </u>	I booding our at 850m US
E ST	of the	un i	marie de	la in	in That me carily cloved.
	770	1.12	1 7 h	1 10	Tim
	100			1000	BL. SV 111100111 Red OSSIET Edited by:
- In	Blat	beau	er da	me at	B60 m Date Y M D:
		·			

SISS Cards for Hopps Brook

•		MOE JRVEY FORM	-	•		f 1.
Harratting (gaz.)		gus Brook		Access		Method
"nont in 146240000		aus wroon	Strately for	2 Length(km)	3.8	
	field of Owen Crk	Mane 931.094		and the state of t	975	40
	tblock.	U.T.M.		Y) N C	Value V	2773
917/10/214	County C 58 Craw Rm/5		Air Photos			
PARAMETER VALUE	METH.	SPECIFIC DATA			HAPPINE !	(6))):
Property Materials Ca. A. A. A. A. D.	66				тира Тур	e Loc'n
The synerosis 11.5	66			2.11		7
Ave.Max.Riffle Depth (cm)	My		-			
Ave.Max.Pool Depth (cm)	ms			á s		
ar eliza	SED MAT	ERIAL % KE	BANK	- Charact		
5010000000	ac clay, sitt, sa	nd (<2mm)	Height(m) 2 %U	instable (		
Service North College	GE CYNNE Small (2-1)	6mm) 🦪 📆	Texture F	G) L R		
000000000000000000000000000000000000000	CLE   large 116-6	WAS CAN DESIGN	Confinemen		ος (i	N/A
Stable % 80	CE sm.cobble	(64-128mm) (64-128mm)	Valley: Channel R	atio 0-2 2-5	5-10 (10	3) N/A
COVER: Total %	45 Larges Ige. cobble	(128-256mm)	ind	Dry L	(M) ·H	
Comp. Dp Pool L.O.D. Boulder In Veg Over Veg	Cutbank boulder (>2	56mm) /	Flood Signs Ht(	m) Braid	ed Y	(M)
100% 15 116 / 65	10 Etrotorokulti)		Bars (%) 65	рН	OSlbbu	n)
Crown Closure % / / / Aspect	NE , Dao(cw)	Compaction ① M H	Water Temp.(°C)	Turb.(cm)	Cond.(25*	C)
DISC	HARGE	• •	RI	EACH SYMBOL		
Parameter Value Method	Specific Data			((15))		
Wetted Width (m)						_
Mean Depth(m)						
Mean Velocity (m/s)					40 - 4	4 44-4-4:411
Discharge (m <sup>3</sup> /s)	•	(Widi	h,Valley:Channel,Slo	REVISED		Material) SS187
QP #18241				1,21,025	DE0. 01	3310
- and the second second		STREAM/VALLE	Y CROSS-SEC	CTION IV		
Self Souwkie	Tribute and a strain	STREAM/VALLE (Looking	Downstream)	Ŀ		R
No. Size Range (mm) (Color) U	71	PLANIMETRIC V	'IEW	, □		
CO 3 70-120 J	G-trap			$\mathcal{J}\mathcal{A}$ .		_
				77		_
			1		,	$\dashv$
		. 1		ベイ	`	
		110 (1/1/4	1 110	/.	ha .	亅
	<del></del>		4		<u></u>	
4:A			—— <b>(</b> l⇒			
						$\dashv$
	COM	MENTS				
Channel Stability . Debris . Managen	nent Concerns : Obstruction		alley Wall Proce	esses 🔲, Etc.		
Channel Stability   Debits   Mailagen	Though of	ield and in	- deenl	y Chan	nelso	cd
Uses section runs	- Mary Constitution	The l	D-4 41 (	Jun of	real	~
- Jus section lo	ers violet			1		
vegeration.	10. 11.	Oure aluis	There	Pala	ral	
a allarge number	of sent fee	unes orus	7111			$\neg$
movement of a	A proceno	Put 1	B. B	irch.		
Nig- alder, Rad 95	sier, peuis	ad in san	roded	with		
Jus section rais	MA HUU W	and the				
fines						
V				Edited by:		
930				Date YMD:		

Nortec Consulting

### SISS Cards for Hopps Brook

	*.			DFO/MOE STREAM SURVEY	FORM		_	,	,		
1	Purro Inni (gaz.)	·		(local) flour	101.01		,	Access	FT	м	ethod
		400000	51.			JU 1.77 W.S.	3	Length(km)	3.8		
	from edge	of OW.		me to Man	931.094	M. M.	ລ	i livingini	55	7 /	4 C
	. /		1119	U.T.M.	<u> </u>	Phi भीक	Υ (	<b>め</b>	kinne	A. A.	
	1500 m U/S of 100 11 214	Time .		C55 COW PM/SM/	Photos NO	Air Photos					1
	C PARAMETER	VALUE	метн.		SPECIFIC DATA				BSTAL	(O) (I)	Ne
	ivereimwein die		46					<b>30</b>		Type	Loc'n
	The strength of the	1.8	CG		·						
	Ave.Max.Riffle Depth (cm)		MS		-						
	Ave.Max.Pool Depth (cm)	60	MS								
	E grapita :	5	SC	BEDMATERIAL	% 10		NKS .				
ĺ	1 Sem 2 4 Me 14 6 W	1 40001 /	CE	clay,silt,sand (<2mm)	10 10	Height(m)	%Unstab	te (20)			
٠.	Servicino.	10 40 30	WE	small (2-16mm)	5	Texture Œ		798.45			
Ì	DOT'S AND DOS	KIND IN ST	WE	(Gravet large (16-64mm)	90	Confiner		EN CO F	00	uc	N/A
!	Stable %	30	LE	sm.cobble (64-128mm	20	Valley: Chann	el Ratio	(5-2) 2-5	5-10	10+	N/A
į	COVER: Total %	60	WE	10e. cobble (128-256m	m) 76 30 1	int	6	Dry L	<u> (C)</u>	) н	Flood
		der in Veg Over Ver		boulder (>256mm)	20	Flood Signs	Ht(m)	Brai	ded	Y	<u>r)</u>
	sum 100% 201 20 20	1 20	20	entrone (A)	2 5	Bars (%)	15	рН	02	ppm)	
ì	Crown Closure %	1.000	ENE	D <sub>90</sub> (cm) Compac	tion L MH	Water Temp.(°C)	4 10	rb.(cm) _	Cond.	25°C)	
!	Crown Closure * 1	<i>D</i> 1	HARGE	wise. an   1   1000001		<del></del>	REACI	H SYMBO			
i	Parameter Val		1	Specific Data				(Fish)	`		
	Wetted Width (m)		<del> </del>								
į	Mean Depth (m)										
1	Mean Velocity (m/s)		<b>-</b>								
ì	Discharge (m <sup>3</sup> /s)		1		(Wi	dth,Valley:Chann	I,Slopel				lateriai)
:	OP #18241							REVISE	DEC 8		SS18
1	*		•	. •						<del>-,, ,,</del>	$\overline{}$
	) अर्थका स्थान	MAN.			TREAM/VALLE	Y CROSS-S Downstream)	ECTION		500	XT	K
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		<del></del>		COMMENTS							_
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	Channel Stability . Debris	, Managem	ent Con	cerns 🔲 Cobstructions 🔲 Ripa	arian Zone 🔲 ; 🛝	/alley Wall Pro	Cesses	Etc.			- 1
1.00	Channel Stability : Debris	: : Managem	ent Con	cerns	arian Zone 🔙 ় \	/alley Wall Pro	cesses	Etc.			
	Channel Stability . Debris	Managem	ent Con	cerns . Obstructions . Rips	with	Valley Wall Pro	ck	bonk	<u></u>		
	Channel Stability . Debris Other 2 cascade This section	. ☐. Managem	ent Cons	erns . Obstructions . Rips	weth	bed i	ck				
46	Channel Stability . Debris Other 7 coscuede  Miss selection  ion some	□ Managem	deep	erns Obstructions Rips	with	bed in	ck				
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	Channel Stability . Debris  Other 7 coscode  whis seletion  in some  Consuls of  Jobs of Blow	section of the po	deep ors.	ly entreach	with	railey Wall Pro	ck.	bork sed	s -	un	
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#### SISS Cards for Hopps Brook

DFO/MOE											
			STREAM SURVEY	FORM	<u> </u>		r				
Surfacility (gaz.)			(local) Hopps	Brook		Access	F7	Method			
	2,4,0,0,0,0	S		<del></del>	1	Length(km	3.8	1111			
enous From 1	500 m U	15 1	pur line MAR		Annual Control of the	AN C	1234	HC Sing			
To 2766m	U/S . 1	U	U.T.M	<del></del>	Air Photos						
917 162	y time	Agency	C58 RM/SM	Photos		! 2	as aluca	Tanna .			
C PARAMETER	VALUE	METH.		SPECIFIC D	AIA		flice Typ				
raysormann of	2.5	ac				100	177	1 200 11			
Tacamana	2	46				522					
Ave.Max.Riffle Depth (c		MS				202		++			
Ave.Max.Pool Depth (cr		Ms		ASSESSED A.	BANKS	5.3					
[ ] [emine ]	2.5	5	BED MATERIAL	23.200.00	23.537	abla / C					
30 40	3/	4E	clay,silt,sand (<2mr	n) 3/0 4/1	Height(m) %Unst			+1			
Per const / 600 cm	in to X	UE	small (2-16mm)	30		L R		IC N/A			
A DOWN SON		LE	large (16-64mm)	10	Confinement						
Stable %	15	CE	sm.cobble (64-128n		Valley: Channel Ratio		M H				
COVER: Total %		4E	ige. cobble (128-25)	<sup>mm)</sup> <b>20</b> 5	Descent Control of the Control of th	Dry L Brai	$\rightarrow$	N			
	oulder In Veg Over Ve	Cutbank	boulder (>256mm)	5	Flood Signs Ht(m)						
Comp. Dp Pool L.O.D. B sum 100% 20 5	5/60	10	Bedlook IRI		Bars (%) 35%	pH -	O <sub>2</sub> ippr Cond.(25*				
Crown Closure %	5 Aspect	E	D <sub>90</sub> (cm) Comp.	action OM H		Turb.(cm)		<u></u>			
	DISC	HARGE			REA	CH SYMBO	L				
	Value Method		Specific Data		ļ	1					
Wetted Width (m)	·										
Mean Depth(m)					-						
Mean Velocity (m/s)					(Width, Valley: Channel, Slope	,	(Be	d Material)			
Discharge (m <sup>3</sup> /s)					teriotit, e alle y. Chamiles, Stope		D DEC. 87	SS187			
QP #18241					•		-				

STREAM/VALLEY CROSS-SECTION (Looking Downstream) PLANIMETRIC VIEW	R
COMMENTS	
/	
Channel Stability . Debris . Management Concerns . Obstructions . Riparian Zone . Valley Wall Processes	Etc.
This rates section follows cutdook on Kigh	hand
Note lastre 15 Centiled on left is about 15	on away
	Tan and a
Climbran sea wedge detres from the	Pitt
This sellin is aggregated with fines interspers	- juis
sections of boulder + cobble	
Stump seen right to right banks	
Rip: 54, Bl. Hw. Birch, develo elul, Red Ossier, Con stanzing nettle, Thimble herry, Twinbarry, Lady	is foin, Al.
no- Slifa reen	<i>V</i>
	Edited by:
	Date Y M D:
the state of the s	

Nortec Consulting

### D) SISS Cards for Owen Creek

		-					CTE		O/MOE Survey	FORM							
		_			<del></del>					1011111		<del></del>	,	Acces	58 FG	-7C	Method
Sim	miling	(gaz	1 Ocu	en C	reek		(1	ocal) Oz	ugn	1	· ·	Received:	3 /	Length		8	
"ar	mari en	rica L	146	21419	010 011 E		<del></del>		7 8877743	001 12		FIT IF			10 /2.		
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in	7	12/	1 p 2	44		100	es8 (9)	KUW/		Photos		Air Filot	0.61		<b>2005</b>	न्धारक	ଶ୍ୟର
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	Vernitte'			323 (2.3)	3.5	LE	1								M283	+	+
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	Ave.Max.				Im	LE					1000001				20.77		
	fatetha.		· ·		3,6	56		BED M	ATERIAL	%			BANKS				
والمخدود	47/0/72		0/10	"5" O (	61177	GE.	imi	clay,sil	l,sand (<2mm		15	Height(m)	3 %Unst		200		1—1
300					ó□uá□ <sub>E</sub>	at	le i e i	small (2	2-16mm)		B 1	Texture	00	L R	es red		
100		2				CE	THE CAN	large (1	6-64mm)	2	0		linement	EN CO		00 U	
		able		- C		GE		sm.cob	ble (64-128m	n)	0	Valley: Ch	annel Ratio	0-2	<u>(3)</u> }-	_	
***	CONTRACTOR			1 2	10	GE		es ige.cob	ble (128-256)	nm) 45	00		m	Dry	1	<u>и</u> н	Flood
dia.	COVE				Veg Over Veg				(>256mm)	200	X	Flood Sig	ns Ht(m)	15	Braided	$\odot$	N
	Comp. D	p Pool					The state of the s	20 20 D		- SE	- 1	Bars (%)	20	pН		Oglppm	0 ,
	100% 7	لک	20	10	20	25			Compa	ction L M	Н	Water Temp	.(°C)	Turb.(cm)	600 a	ond.(25°C	C1
被機	Crown Cl	osure	<b>*</b>   8	<u>w</u>	Aspect			4)	Ball Compa		100000		REA	CH SYM			
20.00						HARG		Specific Da	ıta .					(Fish)			
	Par	amete	Br ·	Value	Method			specific De	ila		$\dashv$						ļ
	Wetted \	Nidth	(m)			ļ							··				
	Mean De	pth (r	n)			<u> </u>					$\dashv$						ŀ
	Mean Ve										wie	sth.Valley:Cl	annel,Slope	, 1		(Bed	(Material)
,	Discharg	je (m	3/5)		<u> </u>										VISED DE	C. 87	SS1.87
	#18241																
Qr.	#10241														-		
Qr.	#10241		消	ejeven)	TYNEY.					STRE	EAM/VA	LLEY CF	OSS-SE	CTION	N.		
5		No		S(E) S(I))		Use	unitestin			STRE	EAM/VA (Look	LLEY CF	OSS-SEnstream)	CTION	X		∂o4
5	Enjoin)	1	Size Ra	ange (mm	) बार्चिता			L				LLEY CF king Down	OSS-SE	CTION			<b>2</b> -
	DV	2	Size Ri	angelmm — 130	Jov	P	UFE		**********************************				NOSS-SE	CTION		(	
	DV DV	1	Size Fit 170 132 -	ange (mr - 130 - 150	30V	P P	UT E	l.	8 <b>3</b> 60				ROSS-SE istream)	CTION			
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The state of the s	DV DV DV DV DV CO	2	120 130- 130- 165 13	ange (mm - 130 - 150	30V 80V 80V 80V 800 30V	2 2 2 2 8	WEE GT GT GT						ROSS-SE nstream)	CTION			
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	DV DV DV DV CO.	2 1 1 / /	120 130- 165 13 14 76	ange (mm - 13 <i>0</i> - 15 <i>0</i>	30V 50V 50V 50V 50V 30V 30V	P P P P P P P P P P P P P P P P P P P	CONCERNS  COT  COT  COT  COT  COT  COT  COT  CO	Obsiliance vod	fractions []  for a  fo	PLAN  TS  Ripayian  Den 16  Syntage Harris	Zone Zone Zone Zone Zone Zone Zone Zone	], Valley	Wall Proce	esses [] (Lichard March 1) (Li	as as	15. 5-20	Om
	Channel Grace Hugh Lace House Poss	1 Sta	Size Ri 120 130- 165 13 34 76 billity [ range of size	J. Debri	30V 50V 50V 50V 50V 30V 30V	P P P P P P P P P P P P P P P P P P P	CONCERNS  COT  COT  COT  COT  COT  COT  COT  CO	Obsiliance vod	fractions []  for a  fo	PLAN  TS Riparian  Sur la  Sur la   Zone [	], Valley	Wall Proce	esses [] (Lichard March 1) (Li	as as	15. 100 100	Om.	
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#### SISS Cards for Owen Creek

DFO/MOE

				_	STREAM SURVE	T FURIN				
Phys	multimi (gaz.) Ouk	m G	اممد		(local)			Access	8.8	Method
	Torreson 146	21410	01/10/01/10			<u> </u>	The A	Length(km		180
33.7				to c	confluence Min	931.094	/ 10006. 3		629	5)64
	The second second	Cree			U.T.M		CASE STATE Y			
11 II 1		4		(Mary	CBB PM BM/	Photos Ø	Air Photos		हाराजना <b>ग</b> र	Taxes
	PARAMETER	V		метн.		SPECIFIC DA	ΓA		35-	e Loc'n
	an American To		5	40					17-	+10011
Follow St. 45	vormagnitus.			HC						+-1
	Ave.Max.Riffle Depth (		30	MS_				\$250 1970		+ $+$ $+$
	Ave.Max.Pool Depth (c		90	MS		· .				+
200	ea elan 👉		2	Sc	CH BED MATERIAL	% 2	BANKS	table 175		+
(A)	Samp our ad	0 00	105	GE.	clay, silt, sand (<2m			table 75		+-+
444	STATE OF THE STATE	30 MARCH	r⊠x(i□.	GE	small (2-16mm)	24		EN CO	C OC (	UC N/A
200	277737 2000		CONTRACTOR OF THE PARTY OF	66	large (16-64mm)	35	Confinement			
	Stable %	100	40	GE	sm.cobble (64-128	(mm)	Valley: Channel Ratio	Dry L	(M) H	
	COVER: Total %	1	35	46	100 lge.cobble (128-25	66mm) 35 /16	am	18	aided Y	
		Boulder In	Veg Over Veg	Cutbank	boulder (>256mm)	變5	Flood Signs Ht(m)	o4 Bra	Odpp	<del>'                                    </del>
	sum 100% 25 200	5	135	15	Bedrock (R)		Bars (%) 15		-M Cond.125	
-	Crown Closure %	0	Aspect	NE	D <sub>90</sub> (cm) 25 Com	paction L(M)H	Water Temp.(*C)	1	- 1	
1998	Crown disease 1 7	<u>v                                     </u>	DISC	HARGE			HEA	ACH SYMB( (Fish)	JL	
	Parameter	Value	Method		Specific Data					
	Wetted Width (m)	4.13	HC	4.4.	3.24.3					_
	Mean Depth(m)	125	ms	16.	2, 27, 32, 2					
634	Mean Velocity (m/s)	. /	FC	1.0	1.12, 1.6		Width, Valley: Channel, Slop	•,	(8)	ed Material)
		:741	Fom		<i></i>		WILDWAY BROTTON		ED DEC. 87	SS187
QP	#18241									
			.,,							

			্যায় প্রা		ilsa	university.	STREAM/VALLEY CROSS-SECTION (Looking Downstream)	R
-13,4	क्षा । इस्त्रीया	No.	Size Hangeum	III SALESSAN, I			PLANIMETRIC VIEW	
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		├—		<del></del>	-			
		-			╁		- Salar	
Section 1		<del>  .                                     </del>		1	1			
is busin		1	<u> </u>				COMMENTS	
	Channe	1 Sta	ability . Debr	is 🔲 Manag	eme	nt Concerns	ns 🔝 Obstructions 📑 Riparian Zone 🔙 Valley Wall Processes 🔲 Etc.	
ij,	mt.		cocca. A	0				
	Can	De	the year	ed but	یهد	en mo	trajent Lond bus c	
		,		1 / #	110	- h		
	-19	<u>OL</u>	of cores,	very little	_0	erstreen	on over, fields right to edge of stream	
	-ON	yar	ca bearle	entosiena	$\sigma$	ozent,	I, more so than excheen	
and the second								
1	_B^	de	ed upla	dz-M-S	500	m (po	cossidy attempted striking by meme)	
鳌			4.6 Cod	Eusens	عمت	Jen, r	will one, alder, Dev clob, and replacemy	
	<u> </u>	<u>:</u>		rd Osla			Edited by:	
	- Im	Mo	ie are lov	SUL S	0	12 ANAIR	Date YMD:	
1	Lh	M	=15pcs					

## SISS Cards for Owen Creek

DFO/MOE

	- /		_	_	SINEAM SURVET	CONW			$\sim$		<del></del>		
eter	nin (him) (gaz.) O	(FA)	CREEK		(local)					Acce		<u> </u>	Method
	mmeterin 146		0001	0 1		ىلىد		imes "	2	Length		3.85	
	- 11	ssed			Jugan 21 - upper Miss	934.0	94	THE TEA		Fishi			HC '
	2 12 6	7	- 3		um brodge 510 m U.T.M.			One end	Y	(b)		nr X	art.
	30 115 1 18 9	17		& ency		Photos 3		Air Photo	8			,	
6	PARAMETER		7-177-4-0	METH.		PECIFIC D	ATA				to all the second	इस्त्राप्रहा	
in medical	रुक्त अवस्ति होता है।		5	GE								Туре	Loc'n
	vina henre		41	CE									1
	Ave.Max.Riffle Depth	(cm)	32	MS									
	Ave.Max.Pool Depth (		80	ms									
	errolea -	10	6	51	BED MATERIAL	%	ic.		BANKS				1
添	1 a a a 1 5 a		001020	GE.	final clay, silt, sand (<2mm)	10/10		leight(m)	6 %Unst	able Ho			11
	Sec. Chron Land		(6)X (70□	Cak	small (2-16mm)	10	T	exture	F) G	(C) R			$\perp$
71078	MT 25 1 10		n x x	1.6	large (16-64mm)	22 25	Emple Vil	Confi	nement	EN (CO	).FC	oc u	
72.00	Stable %	27-108	8Ø	CIE	sm.cobble (64-128mm	15	V	alley: Chà	nnel Ratio	Q-2	2-5 5	-10 10 .	N/A
	COVER: Total %		50	CE	Larges Ige.cobble (128-256m	" 25 20		m		Dry	r (	M) H	Flood
			n Veg Over Veg		boulder (>256mm)	20	F	lood Sign	s Ht(m)		Braided	1 (4)	N
	sum	00	140	10	Bedrock (R)	W 780 /		Bars (%)	10	рН		Oglppm	,
		5	Car Aspect	ENE	Den(cm) Qd Compact	ion L (M) H	機構 v	Vater Temp.(	o 3	Turb.(cm)	4	Cand.(25°C	»
\$40.00 \$70.00	Grown ensemble 1 /s		DISC	HARGE					REA	CH SYM	BOL		
	Parameter	Value	Method		Specific Data					(FISH)		•	
	Wetted Width (m)						]						
	Mean Depth(m)		<b>1</b>				]						
							_						
	Discharge (m <sup>3</sup> /s)						Widt	h,Valley:Cha	nnel,Slope)				Material)
QP	#18241					``				RE	VISED D	EU. 07	SS187

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· j.·nj.	incret)	No		isis sidili Range (mm)		Use	innesitin.	STREAM/VALLEY CROSS-SECTION (Looking Downstream)
	\$ . ·							PLANIMETRIC VIEW
- cu (1)								
								FINA & MARKET ELECTION OF THE E
								- somme
						<u> </u>		
			<u> </u>		<u> </u>	<u> </u>	l	COMMENTS
i i di				[] p	[] Manag		u Concerns	Obstructions : Riparian Zone : Valley Wall Processes : Etc.
	* Sec	tun	ck	paracter	sed as	كنت	code	
ياند دو دونون								pued by lan cascade/rille sections of cabble/boulder
62				J <sub>A</sub> -	pelon /	241d	Jr Brin	dient 2-6%
2				recorde		,	4 / /	of-demal and indemal - new 'active
Se194	+ Loras	طم						on Start out
	* Nad	m		·		<u> </u>	th moss	. However, there was large grantity of blowdown
14.42				4			, ,	
	00	يصد			block -		channel	I law handerly continued
کامیات در در	4 K160	CIO	<u>~ -</u>	None	block wa	wol.	mut sw	but labours adder willow, them lock, collowiel Edited by:
1	/		-1	Diron ku	"Suis bim	<u>, , , , , , , , , , , , , , , , , , , </u>	wh was	hocklebony, alder, Hiller, Himblebony, don't sedited by: (100, 40 - osier, Humberny Date YMD:
100	1500	Ξ	<u>@</u> 33	pes				

#### SISS Cards for Owen Creek

	DF	0/	MOE	
STRE	AM	SU	IRVEY	<b>FORM</b>

i in	in inin (gaz.)	Owe	en Co	$\nu$	. (100	al)						A	cess	FI		Method
نسد ، إ	and the sales and the sales are a sales and the sales are a sales				1 , 1100	;a.ı,		<del></del>		I izana	<i>-</i> 3					netitou
			100 1011		<u> </u>	<u> </u>	2550 40	<u></u> _			_		gth(km)	8.8		
क्रमान					TREAM	Within		934.	094				11120111		ر ج	M
ío.		Collo		PPPINC	0.998.003		U.T.M.			r'nr e		(N)	rede d	Gerral I	<b>V</b>	171
and in the	917 /10				CSB COM	RM/SM		hotos	_3_	Air Pho	otos			Variation,	CARROLING CO.	NOT 80
S acrestale	PARAMETER		VALUE	METH.			<u>s</u>	PECIFIC	DATA				TA PERSON			A
	Megaloment co			ļ			*	<del></del>						পাক্ত		Loc'n
	Assittation in	1 200												3	BD	754,
	Ave.Max.Riffle Depth	(cm)					<u></u>									
	Ave.Max.Pool Depth (			<u> </u>		51										
1	entime is some	starile.			ON WALE			%	10		BANKS	·	7			
		800	Olk	l		clay, silt, sand	I (<2mm)			Height(m)	%Uns	able	1000			
	September 1			0	Contract of the second	small (2-16)	nm)		-	Texture	FG	L R				
	and the second				GIAN.	laige (16-64	mm)		E. Wal	Cor	nfinement	EN (	CO FC	ОС	UC	N/A
	Stable %		DOR			sm.cobble (6	4-128mm)		经验	Valley: Ch	nannel Ratio	0-2	2-5	5-10	10 •	N/A
温	COVER: Total %				Latora	ige.cobble (1	28-256mm	, ,			nir:	Dry	L	М	н	Flood
		Boulder I	n Veg Over Veg	Cutbank		boulder (>25	6mm)			Flood Sig	gns Ht(m)		Braide	ed	Υ .	N
	sum 100%			1	Bedroc	C(R)	The state of	5 70		Bars (%)		ρН		0,	(ppm)	
	Crown Closure %		Car Aspect	ENE	D <sub>90</sub> (cm)	C.	Compaction		Н	Water Temp	o.(°C)	Turb,icm	)	Cond.	(2'5°C)	
				HARGE			·			<del></del>	REA	CH SY		•		
	Parameter	Value	Method		Spec	ific Data			1			(Fish)	)			
ACCURAGE A	Wetted Width (m)			1 .												
	Mean Depth (m)			<b>1</b>	-											
	Mean Velocity (m/s)															- 1
	Discharge (m <sup>3</sup> /s)								tWid	Ith,Valley:Ch	eqol2,lennar	1			(Bed M	aterial)
	<b>#18241</b>		L									F	EVISED (	DEC. 87		\$5187

STREAM/VALLEY CROSS-SECTION (Looking Downstream)  PLANIMETRIC VIEW	R
PLANIMETRIC VIEW	
<u>.</u>	]
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COMMENTS	
Channel Stability ; Debris ; Management Concerns ; Obstructions ; Riparian Zone ; Valley Wall Processes ; Etc.	
This site is very similiar to site #1. The forest has switched to	
mostly decideos trees in the lower end of the site	
Obstruction is 3m ligh beaver dam - complex of some	elen
Jame He redisent creek through forest for 400ml dwn	stre
(Alle to heald notes)	
Nowe ent of beaun influence has geo textile to protect bonks indicating exis	stongput
The lower pettern has more med changest bas and	
moding binks banks are made up of fines of Clay.	
R.D. 5X BI ACT Aspen Birch, also, Willows, devil club and osse	
I I I I I I I I I I I I I I I I I I I	

Nortec Consulting

#### SISS Cards for Owen Creek

DFO/MOE STREAM SURVEY FORM

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Survey States (ga	z.) C	wen	Cres	a K			(lo	cal) C	ne	2n (	mo.	, lc	T	210				ccess	Fa	36	Method
Madadia eec	1 14	62,4	100	1017	101	īĪ	1 1	1 .	<u> </u>	1 1			1 1	Erres!	N/3	-	Lei	gth(km)	4.4		
sording /					€ e	~~	( 1			TYTY!	931	.0	84	1000	_	1	2.13	ing(m	899	7	
wall					DVOC					U.T.M.			•	rin	_	Y	(N)	C.	garyan.	4	11/ t . }
DATE FOR 417				430	A04052			16	/RVY	1/	Photo	s '	3	Air Pho	tos						
	METER	_	VAL		METH.		I I WAREN	10007			SPEC	IFIC	DATA	_L				.6	BSTR	Ta eff	
VVa रचेत्र छन्त्रीय			2,	3.	HC	,			,									Prince 3	2 and 2 a		Loc'n
Programme and			2,	5	1+6	<del>                                     </del>						***									
Ave.Max.Riffi		-	35		Cr.	1															1
Ave.Max.Pool	Depth	(cm)	80	)	ar										-			133			<b>†</b>
a formation		3	8		5(	C	(Alla) E	ED MA	ATERI	AL	XX.	%	₹C-		BAN	<b>IKS</b>		202			<u> </u>
150	070	2 7	500	60	6.E	100	TANKS OF STREET	clay, silt			1,117	026		Height(m)	1	%Unst	able 3	0			
Scracions	27.44	0.0000	1000	BASKAR (	ムビ			small (2	2-16mn	n)	7	25	25 CK - 50	Texture	(F)	(G)		R W			
ATANS .	3000		() a 🗀	No 🖂	45	3274	SIAVA	large (1	6 ·64m	m)	14	15		. · Conl	linem	ent	EN	co/fc	ОС	UC	N/A
Stable	%	3	30		45		200	sm.cobt	ble (64	-128mm	, <u>&amp;</u>	<b>独20</b>		Valley: Ch	annel	Ratio	0-2	2=3	5-10	10+	N/A
COVER: T	otal %		75		LE		1000	ige.cobi	ble (12	8-256m	ım)	2 -	1	Desired	m.		Dry	L	(M)	Н	Flood
Comp. Dp Pool	L.O.D.	Boulder	In Veg	Over Veg			4	boulder	(>256n	nm)		1/2	1	Flood Sig	-			Braid	ed (	Ŷ	N
sum 100% 25	75	10		30	10	13 2 2 2 2 3	THE PERSON NAMED IN	k)(B)	S	V. P. V. C. C. C.	X S		1.44	Bars (%)	1	ς	pH	1	. 04	ppm)	
Crown Closure	* C	1/2		Aspect	NNE	A CALCON	D <sub>go</sub> (cm	1.00 to 10.00 to	To the second	compact	tion L	M)H	A	Water Temp.	(°C)	र्रुश	Turb,(cr	ni Max	Cond.(		<b>†</b>
2072031		<u> </u>	11932234	DISC	HARGE	Second P	30	1101	T-SECTION STATE		<del></del>		1		مل ب	REA	CH S	MBOL			I
Paramet	er	Value	Me	ethod			Spe	cific Dat	a				1 .				(Fist				
Wetted Width	(m)	<b>†</b>	<b>†</b> •				-		······				1								
Mean Depth (	m)	1											1				Ŧ				
Mean Velocit	y (m/s)	<u> </u>	1										1								
Discharge (m		<b>†</b>	1										Widt	h,Valley:Cha	nnel,	Slope)	i		(	Bed M	(aterial)
QP #18241					1					· ·								REVISED	DEC. 87		-SS187
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		MINIMA					•	•		S	TREA	M/VA	LLEY	CROSS wnstream	-SE	CTIO	N 🔽	r /[]			
Secreti No. Size	Range	(mm) FE	יהליי	Use	<b>Ernar</b>	71:79%	L							-	1117		<b>1</b> /-		<b>)</b> .	R	1
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						}		MY	W.	14		`	X	$C_{i}$		B				•	$\dashv$
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					1			COM	MEN	TS											
Channel Stability	☐. De	bris .	Man	agemer	nt Conce	erns	]. Obs	truction	ns [];	Ripar	rian Z	one [	], Val	ley Wall f	Proce	3585	ı	tc.			
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-show ago	in Co	Cod	5/	300	<u>-210</u>	<u>~                                    </u>	<u>22.</u> ن	29	-19						.,	7				^	
SKP-PC		Jew	10	CM	piec	<del>*</del>		^		<del></del>	<u> </u>	.1:	. 1	I.P.	1	101	1		1/	1	1.0
MP. H	<u>u</u> ,	HC	! +-	DH	$\sim \lambda$	( P	۲, -	וניטו	Lou	2,1	100	115	CIU	<del>v ,</del>	<b>0</b> 1	لاس	عمد	a-, W	Less, W	my	T)
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107 001	naso	<del>1                                    </del>	ne	ght	-ply	inlj		-	-0	1	+1		rai	· 7.	60		1	of al	for	00	داء

Edited by: Date YMD:

## E) SISS Cards for Feeny Brook

					STR	EAM SUF	RVEY F	ORM							
खिए	The Unit (gaz.) For	ENG	1 BRES	OK	(lo	cal)						Acc	ess	DWA	Method
777	name or 190		10001			Ĺij	1 1			Rome	10.	Leng	h(km)	3	HC
b.y.	Confluer	aa	V 7660	ma	- 44 81	ream	Mape 9	134.	080	/ Purson		SINT	relief	3000	14
Z	moust Ka	ufe	w Mo	sort			U.T.M.			Cur. or	77. Y	(N)	(e)	Trick L	10
Qal	17/05	人力同	3:00	Ageno	N7 Crim	SH/GW	// Pho	otos	ÉS	Air Pho	tos				
· C	PARAMETER		VALUE	METH.			SP	ECIFIC	DAT	Ą				शित्राह	
	Language Manifestor	. Officer	10	HC	4-	-30 H	1 ru	nce	2/6	shann	dia		76	Yillii Tyr	Loc'n
	kyrkýriky/rijskoj.	2.15	2	HC				0						62 E	
4	Ave.Max.Riffle Depth	(cm)	15	M5									F. 100		
2	Ave.Max.Pool Depth	(cm)	60	45	ran	se l'	To -	4.	2.	To an	52		77755 0-141		
	entra:	20.4162	2	cc	(C) (A) (B)	ED MATER	IAL	%	C	211	BANKS				
	15 ME 70	個八	5 900	62	Finese	clay,sill,sand	(<2mm)	15 1	53	Height(m)	.5 %Unst	able 60	200		
*	Section 1 00 D	NO DO		62	Gravela	small (2-16m)	m)	12	公園	Texlure	$\mathcal{C}^{\bullet}$	L R	璺		
***	Cebrie Mass 500□	30 EV	(1e □ ¥1e □ ??			large (16-64m	ım)	73	OM	Con	finement	EN CO	(FC	) oc i	IC N/A
1000	Stable %		50			şm.cobble (64			5	Valley: Ch	annel Ratio	0-2	2-5	5-10 10	N/A
10	COVER: Total %		35	42	12100	ige.cobble (12	8-256mm)	3/1	3		Tro	Dry	L	(M) H	Flood
4	Comp. Dp Pool L.O.D.	Boulder	n Veg Over Veg	Cutbank		boulder (>256)	mm)	2	2	Flood Sig	ns Ht(m)	.25	Braide	d (V)	· N
	100% 30 10	5	5 30	20	androe	k (R)LAGA	Autom			Bars (%)	40	рН		Oyppn	7)
	Crown Closure %	0	Aspect	NS	D <sub>90</sub> (cm)		Compaction	L)M	н	Water Temp.	.(°C) 4	Turb,(cm)	.75	Cond.(25°	0)
			DISCH	IARGE			777		T		REAC	CH SYN	IBQL		
	Parameter	Value	Method		Spec	cific Data			7			(Fish)	•		
1,207	Wetted Width (m)								7						
	Mean Depth(m)								7					^	·
₹v°	Mean Velocity (m/s)														
	Discharge (m³/s)		. 1						(W)	dth,Valley:Ch	annel,Slopel	1		(Bed	Material)
QP	#18241					*:						RE	VISED C	EC. 87	SS1 87

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	oneir -	No.		(SUM) e (mm)	grie. Mediane	Use M	ria vali	STREAM/VALLEY CROSS-SECTION (Looking Downstream)  PLANIMETRIC VIEW
	Ju	ve	iles	06	sec	4	100 M 1 M 1 M 1 M 1 M 1 M 1 M 1 M 1 M 1	
	Syp	101	0 23	01	1 abo	re		
	•	4	JP_		. See			
		-	a second	-				
	<u> </u>	4					t :	-
4.2		ا نا						COMMENTS
	Chapne	l Sta	bility[]. (	) ebris	]. Manage	ment (	Concerns	Destructions, Riparian Zone, Valley Wall Processes, Etc.
Z	tee	ny,	brook	U	Chan	nela	red	Duer 80% of this weich from his nece
	WO	U	s, C	NŖ	, mi	rato	prop	reity. Much of the selated to 6108
	10	772	the U	2 4	W 20	y <sup>2</sup> 5	Roll	looking a loging related gully failure.
14	Cass	Łg	8/10	se,	mese	uCL	VYL	US In Channelized Seefing
	641	re	o an	<u>e '</u>	yan i	Ya	de g	other than dauger property LCNR
Z	Con	lu	eme	4	in a	Pau	450	Class seem adequat Continued
	be	14	4 86	ule	wed.	et	sur	I in thusmans. CNA confinesor
	Cof	in	Wes	512	pen	10		250 M. 87. CV Co Hydrolline X
1	DO.	ve	n Rcl	CI	/ fil	Rea	ew	Sedenart CNRCU nay be Edited by:
1 (	ı				•			madequiato Date YMD:

DFO/MOE

		$\overline{}$				SINEAM SURVET	FUNIVI			$\overline{}$		<u></u>			
Hi	fina (	(gaz.)	Ell	01		(local) 5/1.06	ck				Acc	:055	Foo	<b>پر</b>	Method
(20	titile	Words Ly	6/214	2000	ر الا	<u> </u>	للبلل		me	Y. 1	Leng	th(km)			•
1.70	nin.	W/81	mu	n of	rvell	n on Red. Week	93L.0	84	Train	1	all y n	icini,	780	>	F
L		[20M	(	V	U	U.T.M.			n er		N	(***	Pir		îrîs 🔃
-0	· (1)	917110	15	<b>iii</b> //30	Abmey	con cou/ch/	Photos 3	5	Air Pho	tos					
		PARAMETER	٦	VALUE	метн.		SPECIFIC D	ATA		•		್ರಾ	1973	1001	THE .
incia deri		and daily di	n 16 2 4 4 5 2 1 1	10	146					•		G	$\{ H_{it}\}_{i}$	Туре	Loc'n
Alexa	tr	Armedica:	10000	_:3	140		-								
点量	Ave.	Max.Riffle Dept	th (cm)	25	GE							EL ev			
4	Ave.	Max.Pool Depth	ı (cm)	65	45										
	bette and and	m.	أتحسينات		45	BED MATERIAL	%	(0)		BANKS					
199		公口製造グ	0國/	0 9154	LE	clay,sill,sand (<2mm)	2020	He	ight(m)	3 %Unsta	able 50				
	SPP		le co		45	small (2-16mm)	30	Te	xture	<u>(D(G)</u>	L R				
	-	WW/50			LE	large (16-64mm)	30	2. 3.3	Conf	linement	EN C	) FC	600	) UC	N/A
3		Stable %	$\Omega$	,	LE	sm.cobble (64-128mm	10 10	. Va	illey: Chi	annel Ratio	0-2	2-5 (	<b>3-10</b>	10+	N/A
1200	Ğ	VER: Total %		<b>3</b> 5	40	100 ige. cabble (128-256m)	m1 12 10		111	Ħ	Dry	L	EM	Н	Flood
	Comp	Dp Pool L.O.D.	. Boulder	In Veg Over Veg	Cutbank	boulder (>256mm)		Flo	ood Sig	ns Ht(m)	-3	Braide	ed (	Ÿ)	N
-	100	40		30	30	immovin.		Ва	rs (%)	50	рН		02	(ppm)	12
	Crow	n Closure %	60	Aspect	$\mathcal{E}$	D <sub>90</sub> (cm) 30 Compact	ion L(M)H	Wa	iter Temp.	100 5	Turb.(cm)	4	Cond.	25°C)	
ice see	1			DISCI	HARGE					REAC	CH SYN	1BOL			
		Parameter	Value	Method		Specific Data					(Fish)				
	Wette	d Width (m)	3m		3					,					
*	Mean	Depth (m)	0,23		0. 7.	2,0,7,0.8,0.7			***************************************						
		Velocity (m/s	1/13		12	1,21,6									
	Disch	arge (m³/s)	2.3				•	(Width, V	/alley:Cha	innel Slope)	. 1			Bed M	aterial)
QP	#1824	1									RE	VISED	DEC. 87		SS187

			ার:	, dela	Mil.					Ø.	<del>万</del> .		STRE	AM/VAL	LEY C	ROSS	-SEC1	rion	IO/		
	नित्रभा	No.	Size Rang		MINIST	1713	Use	thung!		161	14.				ng Dov	/	am)	νV	7/	,	R
El Joseph	Co	2	30-6	o ch	400	19	50	085	$\neg$	$ \mathscr{C}$			PLAN	METRIC	VIEV	ر ۱۲	13	/;			_
B					2 Y	4/6	W	tags		- 1	W	()						٦	1		
	DV	4	15-2	004	pou	UT:	50	<u> 285</u>	_	-	1/2	2					$\Pi$				
Same										-	1	-	P						Ų -		
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	Stable %		00%	at		sm.cobble	(64-128mm)	15	X	Valley: Cha	nnel Ratio	0-2	(2-5)	5-10	10+	N/A
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	other	<u>-</u>	(as	cacle	*Fa115				
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DFO/MOE STREAM SURVEY FORM

·		STREAM SURVET	1 Ortho				
MITTO NATION (gaz.) Elliot Cree	eK	(local) Elliot me	KK.		Access	Foot	Method
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V. Manifell Co. 2, 5	5 40						
Ave.Max.Riffle Depth (cm) 40	UE						
Ave.Max.Pool Depth (cm) 1.5	40	,			La Company		
inchar:	90 SC	BED MATERIAL	≫ % <sup>†</sup> C	BANKS	(3)		
(2 x 60 2 5 m) / Sub + 00	66 UE	clay,sill,sand (<2mm)	05 05	Height(m) / %Unsta	ble 25		
25 TO	YOU GE	small (2-16mm)	7 C 3	Texturé (F) (G)	L R		
10 10 10 10 10 10 10 10 10 10 10 10 10 1	With Le	(3/1) large (16-64mm)	10	Confinement	EN CO	> ∞ uc	N/A
Stable % US		sm.cobble (64-128mm	1300	Valley: Channel Ratio	0-2 2-5	5-10 10+	N/A
COVER: Total % (O)	7.5	1000 lge.cobble (128-256m	m) 30 30	COLUMN .	Dry L	(M) H	Flood
Comp. pp Pool L.O.D. Boulder in Veg C	Over Veg Cutbank	boulder (>256mm)	\$ 40	Flood Signs Ht(m)	Braid	ed Y	N
ISCARS SUM	90 05	Transparation and the same of		Bars (%) 10	рН	Oglppm	
C TARRE	Aspect ENE	D <sub>90</sub> (cm) 80 S Compact	ion L (M) H	Water Temp.(°C) 30 1	urb.(cm) Mad	Cond.(25°C	)
	DISCHARGE			REAC	H SYMBOL		
7.75	ethod	Specific Data		1	(Fish)		
Wetted Width (m)							
Mean Depth(m)		•					
Mean Velocity (m/s)			,				
Discharge (m <sup>3</sup> /s)			. wi	idth,Valley:Channel,Slope)	•		Material)
QP #18241					REVISED	DEC. 87	SS1 87

STREAM/VALLEY CROSS-SEC (Looking Downstream)  PLANIMETRIC VIEW	TION R
COMMENTS	,
Channel Stability : Debris : Management Concerns . Obstructions : Riparian Zone : Valley Wall Proces	Etc.
cascach = other	
teulis	
- obstructions are los reman/ scaline weekers	
Steep modiest stream with caseades over be	oulders. Musico
fall over sed wedges	
Lacks sisting	
Rip sames as Keach & except more dee	rils elub +
ptu.	
Numerous obstructions.	Edited by:
Resply entirched	Date Y M D:
Rot of blow down	Jours 1 m o.

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in	milim (gaz.) E	liot	Creek		(loc	a) 8 / 1:0	) <del>(</del>					Acce	58	Fox		Method
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	on the 164	5	<del></del>		•	·	U.T.M.			r M. Mr.	Υ. (	(N)	• Years	TY'R	Σ	R.C.
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16	PARAMETER		VALUE	метн.			SF	PECIFIC	DATA				Si of die	181/1		JNE.
	MANAGER STREET		.3.5	H<										ייילווא	Туре	Loc'n
terano	e reamination of	المُن الله	3	1+C												
	Ave.Max.Riffle Depth	·(cm)	30	WE.												
	Ave.Max.Pool Depth	(cm)	1.2m	GE							•					
	dinim 's		12%	5<	· 3	ED MATER	IAL SEE	%	100		ANKS					
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east.	SINCOLO / 5		(0) X (0)	hE.	1	small (2-16m)	m)	1	10	Texture (	F) G ((	.) R				
	1m 200		TIN.	4E		large (16-64m	nm)		ID	Confine	ement	EN (CO	FĈ	) œ	UC	N/A
	Stable %	6	W	UE		sm,cobble (64	-128mm)		10	Valley: Chan	nel Ratio	<u>0-2</u> )	2-5	5-10	10+	N/A
	COVER: Total %	4	-5	4E	-राला	ige.cobble (12	8-256mm)		20	in a life	S. Alle	Dry	L	W)	Н	Flood
74. V	Comp. Dp Pool L.O.D.	Boulder I	n Veg Over Veg	Cutbank		boulder (>256	mm) .		30	Flood Signs	Ht(m)	~8	Braide	ed /	Y)	N
	100% 20 25	30	25		frence	(B) (#		5 mm	10	Bars (%)	40	рН		02	ppm)	
	Crown Closure %			ENE	D <sub>90</sub> (cm)	140	Compaction	L/M	)H	Water Temp.(°C	) / Tu	rb.(cm)	L	Cond.	25°C)	
40	L		DISCI	IARGE							REAC	SYM	BOL			
	Parameter	Value	Method		Speic	ific Data						(Fish)				
	Wetted Width (m)		,		**	2.12										
	Mean Depth(m)					•				• .						
	Mean Velocity (m/s)									·	•					
	Discharge (m <sup>3</sup> /s)				,				Widi	h,Valley:Chanr	rel,Slope)				(Bed M	(aterial)

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1024	जुक्कर (१) 	ize Hange (mm)	High ggsc wels De	oncerns	], Obstruct	el re pin aldu,	STREAM/VALLEY CROSS— (Looking Downstream)  PLANIMETRIC VIEW  Riparian Zone ; Valley Wall P  Plating Led wed  Linarkin fun, Thus	rocesses 🗆	EIC.	R
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7	Amas S S OF			O.	45	677		rge (16-6	4mm)		10	grave and Formation	Co	nfinen	nent	EN C	O) FC	00	UC	N/A
	Stable %		50	-	LE			m.cobble (	64-128mm	1) (6/1)	10	V	alley: C	hanne	Ratio	(0-2)	2-5	5-10	10+	N/A
4	COVER: Total %		45		GE.	PY.	1	ge. cabble (	128-256m	m)	10	222.	Lands of	mr.		Dry	L	<u>(M)</u>	Н	Flood
Parent.	Comp. Dp Pool L.O.D.		In Veg O	er Veg	Cutbank			oulder (>2	56mm)		50	F	lood Si	gns l	Ht(m)		Braid	ed (	$\mathfrak{D}_{-}$	N
E-33	l cum l	60	-	5-				(h)			05	В	ars (%)	7	-5	ρΗ٠		0,	(ppm)	
		0	Q A	pect	٨/				Compac	tion L	K)H	W.	ater Tem	p.(°C)	10	Turb.(cm)	MUI	Cond.	(25°C)	
27.2.25			77.77		HARGE	2.022		<u> </u>	***						REA	CH SY	MBOL			
200	Parameter	Value	Meth	nod		\$	Specif	ic Data	•					•		(Fish)	•			•
	Wetted Width (m)	·																		
	Mean Depth(m)		1.																	
	Mean Velocity (m/s)		1									İ								•
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Nortec Consulting

# DFO/MOE STREAM SURVEY FORM

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	Stable %		45	210	LE	ign.		sm.cobble (6	4-128mm)	4	os		Valley: C	hanne	Ratio	0-	2	2-5	5-10	<b>(0)</b>	N/A
	OVER: Total %			****	GE	8	mi	ige.cobble (1	28-256mm	1 6	05		13.54	rya:	٠.,	Dr	y	L	<u>(M)</u>	Н	Flood
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(編集) SU	0% 60 10	_	05	10	15	B	dioc	k (R)			/	1	Bars (%)			pl	н		0,	(ppm)	
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			1 November 1	DISC	HARGE		-	1 11355					,		REAC			BOL			
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Dis	charge (m³/s)		-									Widi	h,Valley:Cl	hannel	(Slope)						laterial)
QP #18	241																REV	ISED	DEC. 8	7	SS187

STREAM/VALLEY CROSS-SECTION (Looking Downstream)  No. Size Range (mm) (Use (Th)) (Use (T	
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COMMENTS	
Channel Stability, Debris, Management Concerns, Obstructions, Riparian Zone, Valley Wall Processes, Etc.	
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As we got closer to the take the channel braided art into the field -A+ this p	t there
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# DFO/MOE STREAM SURVEY FORM

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39	С	OVER: T	otal %		60	010			Ymo	ige.cob	ble (12	8-256m	m) <b>S</b> C	10		eriediil.	nr.		Dry	L	<b>Ø</b>	н	Flood
	Com	p. Dp Pool	L.O.D.	Boulde	r In Ve	Over Veg	Cutbank		100	boulder	(>256	mm)		05		Flood Si	gns l	Ht(m)		Braid	ed	Υ (	€)
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		STREAM SURVEY FORM	Access FAX Method			
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Ave.Max.Pool Depth (cm) 70	GE	\$ - cg or				
(arrapid) V 2	SC	BED MATERIAL %	BANKS 33			
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25 02	100000000000000000000000000000000000000	small (2-16mm) 35 Texture	optinement EN CO FC (OC) UC N/A			
	WALE	large (16-64mm) /5 C	Animonian			
Stable % 45	CE	September 12 III. CODDIE (04 1 = 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -				
COVER: Total % 70	LE	Larges ige.cobble (128-256mm)				
Comp. Dp Pool L.O.D. Boulder In Veg		boulder (>256mm) Flood S	Ingris Hittin   2   Section   Company			
sum 100% 50 Z5 /	10 15	Bars (%				
- Cartina	1	Males Tax				
Crown Cosure % 20			REACH SYMBOL (Fish)			
Parameter Value M		Specific Data				
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365 1101100 11101	1,2,	.33 34.2.11				
1999	7/1	- 7/8 7/25 7/15 ·	(Bed Material)			
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<u> </u>		OTDEAM MALLEY C	POSS-SECTION 17			
AVINUES: FIEL		(Looking Dow	nstream) R			
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			Wall Processes Fig.			
Channel Stability ; Debris	Management	Concerns . Obstructions . Riparian Zone . Valle	y Wall Floodssoo C. C.O.			
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25:1-0-1 27:1-1-1	DISCHARGE    Value   Method   Specific Data     13.8   3.8, 3.8, 4.     0.24   2, 33.34.2.11     15.57   7/11   7/8   7/25   7/15     15   0.39   STREAM/VALLEY CROSS-SECTION   REVISED DEC. 87   S\$187.    Comments   ADx + 5   Abs   ADx + 5   Abs   ADx + 5   Abs   A					
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	٠	STREAM SURVEY FORM  Access / Od 6 Method
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PARAMETER VALUE	метн.	SPECIFIC DATA  SPECIFIC DATA  SPECIFIC DATA
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Ave.Max.Riffle Depth (cm)	LE.	5:03 6:05
Ave.Max.Pool Depth (cm)	GF	BANKS
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300000000000000000000000000000000000000	J. L.P	small (2-16mm)
MAN AND AND AND AND AND AND AND AND AND A	JACE	large (16-64mm) N/A
Stable % /5	CE	sm. cobble (64-128mm)
COVER: Total % 20	aE	Project (V) N
Comp. Dp Pool L.O.D. Boulder In Veg Over	Veg Cutbank	K 18 18 18 18 18 18 18 18 18 18 18 18 18
sum 100% US 70 10 1. 15		Bedrock (用) 编数 编数 数数
Tasas Crown Closure / / / Tasas	eci NE	BEACH SYMBOL
D	SCHARG	E (Fish)
Parameter Value Metho	d	Specific Data
Wetted Width (m)		
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Mean Velocity (m/s)		(Width, Valley:Channel, Slope) (Bed Materia
Discharge (m <sup>3</sup> /s)		REVISED DEC. 87 SS1
QP #18241		
	ty a governorm	STREAM/VALLEY CROSS-SECTION E
ANTONE PER		STREAM/VALLEY CROSS-SECTION (Looking Downstream) R
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FITTI No. Size Range (mm)		COMMENTS
FIGURE No. Size Range (mm)		COMMENTS  Concerns Obstructions Riparian Zone Valley Wall Processes Etc.
Channel Stability : Debris : Ma	nagement	COMMENTS  Concerns , Obstructions , Riparian Zone , Valley Wall Processes , Etc.
Channel Stability , Debris , Ma	nagement	COMMENTS  Concerns Obstructions Riparian Zone Valley Wall Processes Etc.
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# DFO/MOE STREAM SURVEY FORM

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U T.M.   Photos   PARAMETER   VALUE   METH.   SPECIFIC DATA
PARAMETER VALUE METH.  SPECIFIC DATA  SPECIFIC DATA  ONLY  Type Loc'n  Ave.Max.Riffle Depth (cm)  Ave.Max.Pool Depth (cm)  Ave.Max.Pool Depth (cm)  Ave.Max.Pool Depth (cm)  Stable %  COVER: Total %  COVER: Total %  COMP. Dep Pool L.O.D. Boulder In Veg Over Veg Cutbank  Bedrock (R)  Security Data  SPECIFIC DATA  SPECIFIC
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Ave.Max.Riffle Depth (cm)  Ave.Max.Pool Depth (cm)  240  BED MATERIAL  % C. BANKS    Cay, Bill, sand (<2mm)   Cay   Height(m)   Munistable
Ave.Max.Riffle Depth (cm)  Ave.Max.Pool Depth (cm)  CITCIN  Clay, silt, sand (<2mm)  Stable %  COVER: Total %  COVER: Total %  Comp. Dop Pool  L.O.D. Boulder In Veg Over Veg Cutbank  Sed Cutbank  Bedrock (R)  Ave.Max.Riffle Depth (cm)  BED MATERIAL  % CO BANKS  Wunstable  Semall (2-16mm)  Comp. Dop Pool  L.O.D. Boulder In Veg Over Veg Cutbank  Bedrock (R)  Bank S  Comp. Dop Pool  L.O.D. Boulder In Veg Over Veg Cutbank  Bedrock (R)  Ave.Max.Riffle Depth (cm)  % Comp. Dop Pool  L.O.D. Boulder In Veg Over Veg Cutbank  Bedrock (R)  Ave.Max.Riffle Depth (cm)  % Comp. Dop Pool  L.O.D. Boulder In Veg Over Veg Cutbank  Bedrock (R)  Ave.Max.Riffle Depth (cm)  % Comp. Dop Pool  L.O.D. Boulder In Veg Over Veg Cutbank  Bedrock (R)  Ave.Max.Riffle Depth (cm)  % Comp. Dop Pool  L.O.D. Boulder In Veg Over Veg Cutbank  Bedrock (R)  Ave.Max.Riffle Depth (cm)  % Comp. Dop Pool  L.O.D. Boulder In Veg Over Veg Cutbank  Bedrock (R)  Ave.Max.Riffle Depth (cm)  % Comp. Dop Pool  L.O.D. Boulder In Veg Over Veg Cutbank  Bedrock (R)
Ave.Max.Riffle Depth (cm)  Ave.Max.Pool Depth (cm)  CITCIN  Clay, silt, sand (<2mm)  Stable %  COVER: Total %  COVER: Total %  Comp. Dop Pool  L.O.D. Boulder In Veg Over Veg Cutbank  Sed Cutbank  Bedrock (R)  Ave.Max.Riffle Depth (cm)  BED MATERIAL  % CO BANKS  Wunstable  Semall (2-16mm)  Comp. Dop Pool  L.O.D. Boulder In Veg Over Veg Cutbank  Bedrock (R)  Bank S  Comp. Dop Pool  L.O.D. Boulder In Veg Over Veg Cutbank  Bedrock (R)  Ave.Max.Riffle Depth (cm)  % Comp. Dop Pool  L.O.D. Boulder In Veg Over Veg Cutbank  Bedrock (R)  Ave.Max.Riffle Depth (cm)  % Comp. Dop Pool  L.O.D. Boulder In Veg Over Veg Cutbank  Bedrock (R)  Ave.Max.Riffle Depth (cm)  % Comp. Dop Pool  L.O.D. Boulder In Veg Over Veg Cutbank  Bedrock (R)  Ave.Max.Riffle Depth (cm)  % Comp. Dop Pool  L.O.D. Boulder In Veg Over Veg Cutbank  Bedrock (R)  Ave.Max.Riffle Depth (cm)  % Comp. Dop Pool  L.O.D. Boulder In Veg Over Veg Cutbank  Bedrock (R)  Ave.Max.Riffle Depth (cm)  % Comp. Dop Pool  L.O.D. Boulder In Veg Over Veg Cutbank  Bedrock (R)
Stable %   COVER: Total %   Comp   Dp Pool   L.O.D.   Boulder   In Veg   Over Veg   Cultbank   Cu
Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage   Coverage
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Stable %   Sm.cobble (64-128mm)   5   Valley: Channel Ratio   0-2   2-5   5-10   (0 <sup>5</sup> ) N/A
Comp. Op Pool L.O.D. Boulder In Veg Over Veg Cutbank boulder (>256mm) / Flood Signs HI(m) Braided Y N  Bars (%) PH O-ppm)
Comp. Op Pool L.O.D. Boulde in Veg Over Veg Citizania Bedrock (R) A Bars (%) PH O-ppm)
Bedrock (R) Bars (%) pH O-ppm)
Crown Closure % Aspect NE Doo(cm) Compaction (L) M H Water Temp.(*C) 4 Turb.(cm) L Cond.(25*C)
DISCHARGE REACH SYMBOL
Parameter Value Method Specific Data (Fish)
Wetted Width (m)
Mean Depth(m)
Mean Depth(m)  Mean Velocity (m/s)

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QP#19289

DFO/MOE STREAM SURVEY FORM 1002 (goz.) Clacier Gold Mocall alucier and 1 oc € Method Length(km) 8.4 931 084 U.T.M. M) 010 11 917 /10 Photos 6-Z Air Photos PARAMETER VALUE метн. SPECIFIC DATA 25m Magante min LE Type Loc'n territing their 40 4,5 Ave.Max.Riffle Depth (cm) W. Ave.Max.Pool Depth (cm) 60 cm 45 sc BANKS 3060 clay,sill,sand (<2mm) Height(m) 0 8 %Unstable J GE Texture F G R af arge (16-64mm) Confinement EN CO FC Stable % LE sm.cobble (64-128mm) Valley: Channel Ratio 0-2 2-5 5-10 10+ N/A COVER: Total % GE ige.cobble (128-256mm) യ 20 Dry Н Flood 60 Comp. Dp Pool L.O.D. sum 100% 30 40 In Veg Over Veg Cutbani Boulde ulder (>256mm) Flood Signs Ht(m) Braided 30 Bars (%) O<sub>2</sub>(ppm) ASPOCI ENE Crown Closure % OZ D<sub>90</sub>(cm) 90 Compaction (L) M H Turb.(cm) 100 Cond.(25°C) DISCHARGE REACH SYMBOL Specific Data Parameter Value Method Wetted Width (m) Mean Depth(m) Mean Velocity (m/s) Discharge (m<sup>3</sup>/s) (Width.Valley:Channel.Stooe)

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REVISED DEC. 87

DFO/MOE REAM SURVEY FORM

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域	COVER: Total %					Large.	ige cobble i	128-256mn		2		UA CLASS		Dry	Braide			N
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13.50									

REACH SYMBOL

(Width, Valley: Channel, Slope)

#### SISS Cards for Glacier Gulch Creek

DISCHARGE

Method

Crown Closure %

Parameter

Wetted Width (m) Mean Depth(m) Mean Velocity (m/s) Discharge (m<sup>3</sup>/s)

QP #18241

Value

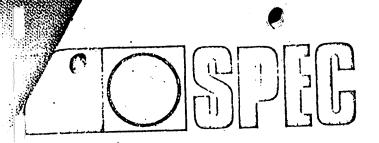
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3200	ioni ant ≥i	GE	Grave a large	(16-64mm)		20	Con	linement	EN C	O (FC)	ос	UC	N/A
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	ler in Veg Over Veg		boulde	or (>256mm)		05	Flood Sig	ns Ht(m)		Braided	TY	<u> </u>	7
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Specific Data

Signature No. Size Range (mm) With Strict Use (mn) to 150 L	TREAM/VALLEY CROSS-SECTIO (Looking Downstream)	NR
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Nortec Consulting

Appendix C:	Examples o	f Reports fr	om Feeny B	rook Files	
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May 21, 1975

# REPORT ON THE EVELYN WASHOUT, SPRING 1975

by SPEC - Smithers

On the weekend of May 11, 1975 the normally quite Finney Creek at Evelyn, nine miles north of Smithers, began to rise dramatically. Something far different from normal runoff was happening, for during the next week the character of the creek changed radically. The meandering, willow-lined brook became an unconfined rush of rock and water. Gardens and farmland disappeared under gravel deposits several feet thick and at one point a house and farm buildings were threatened. Attempts to constrain the flow with earth moving machinery proved useless as channels filled with gravel within minutes of being dug.

This was not a natural disaster. The situation had been constructed piece by piece over the past few years by government resource agencies more concerned with facilitating industry than being aware of environmental processes.

In 1970 the Lands Branch of the provincial Department of Lands, Forests, and Water Resources allowed agricultural clearing on the alluvial fan formed where Finney Creek emerges from the steep sides of the Bulkley Valley to the more level farmland below. This fan was a critical part of the creek ecology as

the brush and willow caught and filtered out much of the debris brought down the hillside by floods.

Meanwhile clearcut logging at the headwaters of Finney Creek had started in the early sixties and continued until 1974.

Four clearcuts of about 125 acres in area lie close together on the hillside above Evelyn. In recent years local residents have noticed increasingly high spring runoffs and in early 1974 Aslin Logging, contractor for Bulkley Valley Forest Industries, had to close down for several weeks as equipment became bogged down in seepage fed mud. Later that summer the Water Rights Branch issued an Order under the Water Act against the logging company following complaints of erosion due to a large extent by inadequate drainage along the logging road.

According to a letter to a local landowner from B. E. Marr, Associate Deputy Minister, Water Resources, this had supposedly been corrected by the company by November, 1974.

In the spring of this year the stage was set. The melt waters from several adjacent drainages in the clearcut area were channeled down the still poorly ditched logging road into one tributary of Finney Creek. The water hit an unstable mass of gravel in the steep bed of this normally small runoff channel and washed many millions of yards of material down the hillside.

The alluvial fan, without the filtering brush, could not stop the flow and the gravel and silt were therefore deposited on the farmland below.

The accompanying photographs, all taken on May 17, 1975 in the Finney Creek area, show clearly how the process occurred and its results.

#### CONCLUSIONS

The Evelyn Washout is a classic example of a resource industry and its supporting government agency having a greater concern for short term economics than long term environmental and social stability. In this case the land owners on Finney Creek eventually had to pay for savings made by the logging company.

The Forest Service and Lands Branch are slowly improving their understanding of soil stability and stream dynamics. However, as demand by the large sawmills and wood processing plants for trees increases these "accumulations of unfortunate factors" as the local Forest Service put it, will undoubtedly increase.

As forest land is increasingly converted into lumber and pulp, the watersheds will become more and more unstable. The tree cover has an absorbant, regulating effect. Spring show melt and heavy rains are held by the vegetation to be slowly released during dryer periods. As the cover is removed sudden floods and summer droughts become much more frequent. Soon industry, government, and residents will have to get together and acknowledge the true cost of forest industrial development.

#### RECOMMENDATIONS

In this particular case the landowners affected will be making their own representations for compensation. SPEC - Smithers does not wish to comment on this. But some more general recommendations are pertinent.

 The inter-agency 'Folio' system of determining forest use should be extended to include local public input and determination of priorities. In this way, downstream users of the watershed could be informed of logging plans and contribute their knowledge and values to the final development.

- 2. The Water Resources Service should have greater input into the layout of logging cuts under the "Folio" system. For this role the Water Rights Branch will have to acquire sufficient technical expertise to assist in designing cutting plans that are consistent with good watershed management.
- 3. In particular, the resource agencies should reject the ecologically wasteful massive square block clearcuts in favour of cutting plans that will, amongst other things, regulate water flow and preserve soils from erosion. For example, narrow clearcut strips, running in a general east-west direction will receive maximum shade from the spring sun and thus delay the snow melt. Successive cutting of strips from north to south at, say, five year intervals would allow good watershed management to be combined with good timber yield.

#### APPENDIX A

A.	Capital Works W.R.S. (Skeena) W.R.S. (Finks) W.R.S. (Devins) W.R.S. (Lychak) W.R.S. (Raufer)	November 1975 December 1975 November 1975 November 1975	\$ 605.75 42.84 950.00 420.00 78.50
		Sub Total	\$2,097.09
В.	Maintenance W.R.S. (Booth)	May 1976	360.00
c.	Cleanup/Emergency Huisman (Booth) Sargent (many) Huisman (Madigan) Huisman (Booth) Huisman (B. A. Rent) Huisman (Madigan) Huisman (Meewvisen) Huisman (Storey)	May 1976 October 1975 May 1975 May 1975 August 1975 October 1974 January 1975 May 1975	622.00 215.00 130.00 419.50 200.00 63.00 147.50 64.00
	• •	Total	\$4,318.09

Note: Above does not include \$99.00 by B.V.F.I. unreimbursed for order of the Engineer--road work.

## APPENDIX B

## HYDRAULIC WORKS

a.	Repairs to Weirs	
	Scrub & Knockdown, <b>S</b> hape Unit Dyke Armour 90 yd. <sup>3</sup> @ \$4.50	\$ 450.00 405.00
b.	Further Weir Construction	*
	(a) Ditch rerouting 10w water 800 ft. @ \$1.00	800.00
	(b) Excavation, Shaping (or tracking) 1,670 yd. <sup>3</sup> @ \$2.00	3,340.00
	(c) Dyke Armour 450 yd. <sup>3</sup> @ \$4.50	2,025.00
	(d) Chute Lining (40 ft.) 120 ft. @ \$2.0	240.00
	Sub Total	\$ 7,260.00
	Contingencies	(25%) 1,815.00
	Sub Total	\$ 9,075.00
c.	Maintenance (1976 Capital Allocation)*	
	Year 1	\$ 1,260.00
	Year 2	840.00
	Year 3	420.00
	Year 4	360.00
	Year 5	210.00
	Sub Total	\$ 3,090.00
	Total	\$12,165.00

Ministry of Forests

# MEMORANDUM

To:

J. Lloyd-Smith Bulkley District Office From:

Research Smithers

Date:

November 12, 1986

File:

5-Feeney Brook.

SUBJECT: Silviculture Rehabilitation Project Feeney Brook

Field examination was undertaken on November 5, 1986 with R. Johnson and J. Lloyd-Smith from the Bulkley District Office.

#### Kame Terrace, Gully Erosion:

Accelerated gully erosion on the Kame terrace above Feeney Brook occurred during the October 1974 rain-on-snow event. The material introduced to the stream was transported to the fan. The aggradation of gravel at the fan contributed to stream migration (bank erosion) aggravated by landclearing and subsequent bank destabilization. Retrogression (backward) movement at the headscarp is continuing to occur, evident by small earth flows and tree toppling. Surface water interception and channelization along the upper branch road (now revegetated) is the major contributing factor accelerating the gully erosion. The upper road intercepts surface water flow from ephemeral streams and directs water down the road for approximately 1 km. The water flow from this large source area, drained by the road, crosses the main access road at culvert No. 6 which then flows directly into the headwall area of the active gully erosion. Culvert No. 5. although a lesser amount, also feeds water directly into the gully headwall. Attempts to manage the water along the main access road with cross ditching undertaken in 1975 and again in 1977?, has mitigated to some extent water flows into the active erosion headwall through redirecting water onto other sensitive slopes. interception and channelization along the upper branch road, however, has not been rectified to date.

- Intensive cross ditching along the upper road would probably eliminate most of the water problems in the vicinity of culverts 5 and 6 and the sensitive gullies (cross ditch locations flagged in blue).
- Culverts 5 and 6 are located into natural drainage channels which lead into the failed gully. These culverts could probably be left as long as the upper road is cross ditched. However, the culverts should be reassessed during Spring run-off.
- Culvert locations No. 3 and 4 should be verified with drainage from the upper cross ditch locations. This verification should be accomplished during Spring run-off and possibly an additional culvert added between culvert No 4 and 5.

- . The main access road (disturbed area and ditches) should be heavily grass seeded at a rate of  $15-30\ kg/ha$ . Ideally seeding should be undertaken immediately after disturbance on a rough soil surface.
- · Grass seeding of the failed gully at 30 kg/ha would help stabilize surface erosion and reduce much of the sediment input into Feeney Brook.
- The bridge crossing in the upper basin has debris jammed in the opening creating a small pond above the bridge. The pond will probably serve to settle out some sand and silt size sediment. However, the debris should probably be removed to permit free water flow before the bridge is washed out sometime in the future.

# Silviculture Rehabilitation Activities:

- 1. Active operation: A crawler tractor with a brush blade is being used to prepare the site for planting. The activity involves the pushing of brush and debris into windrows and a churning of organic surface soil. A minor amount of mineral soil exposure is occurring, however, soil surface disturbance and brush piling is discontinuous over the site. The tractor operator is instructed to avoid natural drainage channels on the site.
  - The back and forth across slope movement by the crawler tractor while pushing brush and debris into windrows, creates discontinuous ground surface disturbance. The discontinuous nature of the disturbance reduces the possibility of water movement along continuous channels, hence, reduces the possibility of surface erosion. Some sedimentation to Feeney Brook may occur from the operations, but the amount transported into the creek should be minimal.
  - · Tractor access trails over the site do cause more continuous disturbance. Thse areas should be cross ditched to prevent channelized erosion, on completion of the operation.
- 2. Proposed Activities (old logging): The proposed activities in the area of older logging will probably cause greater disturbance because of the steeper slopes, and greater volume of debris needed to be moved. However, frozen ground and snowfall over the past few days may actually reduce the amount of soil churning during the windrowing operation.
  - · Tractor movement should be across slope to create discontinuous disturbance and prevent channelized water.
  - · Steeper land areas should be avoided.

- $\cdot$  Tractor operations should avoid all identifiable stream channels.
- A greater amount of sediment transport should be expected.
   However, severe erosion can be prevented as long as water is not channelized.
- The erosion sensitive land area, directly above the gullies and below the main road, should not be rehabed. This area should be left in its current state to act as a sediment and erosion buffer.

# Snow Accumulation and Stream Flow (brief comments):

- The silvicultural activities in the clearcut will not change the present snow accumulation and melt conditions -- the clearcut will continue to act as a clearcut which results in greater snow pact accumulation than a dense forest cover. Areas where maximum snow accumulation occurs is under a sparse forest canopy such as a subalpine forest.
- Snow pack accumulation in the area of older logging may actually be greater than in a clearcut. Opening the area up could actually reduce snow accumulation.
- · The changes in snow accumulation and melt in these cutblocks will, however, have only minimal changes in stream flow.
- · Storm flows generated in watersheds like Feeney Brook are not increased by logging activity. These flood peaks are determined by meteorological conditions such as the rain-on-snow event in October 1974 and June 1986.

## Summary:

Silvicultural rehabilitation activities in the upper basin of Feeney Brook will not have a significant effect on stream flows. Sediment levels could be increased, however, if adequate precautions are taken with the operations, no major erosion should occur. The upper branch road should be cross ditched to restore water flow to the natural drainage channels. Grass seeding should take place along the main access road, the gully failure, and on any other sites of major disturbance.

J.W. Schwab, R.P.F. Forest Hydrologist

#### BRITISH COLUMBIA WATER RESOURCES SERVICE DEPARTMENT OF LANDS, FORESTS AND WATER RESOURCES PRINCE GEORGE, BRITISH COLUMBIA

INVESTIGATION OF

RAUFER EROSION COMPLAINT

FEENEY, BROOK, SHITHERS AREA

April 1975

File: 0183868E-H

11. E. Seymour, B.S.C.E. Regional Investigations Engineer, Skeena

# Investigation of Raufer Erosion Complaint Feeney Brook, Smithers Area

# 1. INTRODUCTION

The Water Resources Service Regional Office at Prince George received direction from B. E. Marr (Associate Deputy Minister) to prepare a report on this (drainage) problem and associated remedial measures. The directive outlined some observations made during our first evaluation of the problem detailed below. Mr. Marr's letter infers that an application for 75% cost sharing assistance may be entertained for remedial works. Because of this "offer" of consideration for Provincial Funding; special attention has been given to this project by this office.

# 2. FIRST PHASE SITE EVALUATION

On the basis of the complaint lodged with B.C. Forest Service, our Mr. B. Jamieson (Tech III) conducted a site investigation October 31, 1974. His report for that investigation recommended the attention of the writer who conducted an independent site visit

At the time of investigation (13 November, 1974) the flow in Feeney Brook was estimated at 3.0 c.f.s. The writer considers that the logging assessment road which cuts across the southwest corner of D.L. 5441A was inadequately cross drained resulting in approximately 0 c.f.s. per mile of roadway stream flow increase. Based on this

assessment an "Order of the Engineer, under Section 37 (1) of the Water Act 1968", issued November 14, 1974. This order required the excavation of cross drains on the abandoned Forestry Assessment Road northeast of Feeney Brook. Mr. Barry Graham, representing Bulkley Valley Forestry Industries Ltd. Licencee agreed to conform to the requirements of the Order of the Engineer. Between the personal actions of Mr. Helmut Raufer, and those of Northwood Pulp and Paper (Licencee) the Order of the Engineer was satisfactorily executed.

# 3. SECOND PHASE SITE EVALUATION

The B.C. Forest Service issued an order requiring the removal of hazardous decks in their (Permit 58) northeast of Feeney Brook. The licencee elected to use the Forestry Assessment Road, which had been cross drained under the Order of the Engineer by Bulkley Valley Forest Industries; establishing open road line to the decks in Permit 58. The licencee graded over (filled in) the newly installed cross drains.

# 4. LAND FEATURE OBSERVATIONS

Major creek bed erosion (non-meander) has occurred at locations between station 16+00 and the box culvert located on Forestry Assessment Road (shown as station 21+00 on our Plan A attached). Between stations 10+00 and 7+00, bed load materials have been deposited as a result of "bank hopping" meanders of the natural course of Feeney Brook. This deposition can be described as alluvial fans with thicknesses between

native vegetative soil horizon thereby diminishing the agricultural value of a portion of D.L. 5441A.

Below stations 7+00 ground east-west contours re-collect Feeney Brook waters prior to the culvert installation located at station 2+00. Between station 2+00 and the fence line of D.L. 5441A (station 0+00) considerable erosion has occurred, but this feature is beyond the slope of this evaluation.

#### 5. SOIL PROFILES

Surface material encountered are generally uncultivated hay land soil horizon extending to 8 inches, consisting primarily of loose sand, root fragments, and some stones to 2 inches. The underlying material to an approximate depth of 3 feet from the existing ground surface is a silty gravel, rounded to subrounded, moderately dense, with an angle of internal friction of approximately 40 degrees. The underlying material to the maximum depth of creek pavement scour is a gravelly and silty sand, gap graded with approximately 50% of the grain sizes lying between a number 20 and number 100 screens.

It is the judgement of the writer that recent stream flow increases related to poor cross drainage have caused a "breakthrough" into the underlying silty and gravelly sands. These materials are considerably more erosible than the upper sandy gravels, and have been and are now subjected to considerable tractive force and frictional

erosion by tangential flow. In the area of station 17+00, the pavement is approximately 2.5 ft. below the transitions of these materials.

## 6. CHANGES IN AND ABOUT A STREAM

Our site investigations reveal that the property owner had attempted bank protection by the use of selectively placed cottonwood tree trunks with diameters exceeding 2.5 ft. These trunks were placed to prevent any natural meander of Feeney Brook during high flow periods. The technical competence of these placements is seriously questioned as they have decreased the natural roughness of the channel bed and provided a "flume" or "chute" effect on the channel. The frictional erosion due to tangential flow has not been arrested by the cottonwood trees. Placements have aggravated conditions below the alteration by subjecting gravelly silts and sands to higher velocity flows. The effect of arresting meandering was ineffective because of the undefined natural course of Feeney Brook between station 7+00 and 10+00. At January 23, 1975, some of the trees placed in the area of station 7+00 were partially covered with deposition of bed load from Feeney Brook.

## 7. PHOTO RECONNAISSANCE

Three flight lines were examined in regard to the condition of Feeney Brook:

(a) B.C. 2809, and 2810 (20 chain verticals) exposed July 1960.

(b) Line B.C. 5481 (Segments 210 & 211) flown in 1972.

Land form differentiation is difficult to assess on the basis that the two chronologies of flight lines are of different scales (20 chain and 40 chain). The changed land use of the head waters of Feeney Brook cannot be established from the most recent flight lines, and this office is not equipped to establish with design accuracy either watershed size or slope change.

It can be reasonably established from a review of B.C. Flight Line 2809, that the natural course of Feeney Brook has not been considerably altered by diversion. Field evidence suggests that some excavation in the old (natural channel) of Feeney Brook may have been undertaken by the owner, but the extent of such excavation cannot be assessed from the available vertical control.

#### 8. WATERSHED COMMENTARY

A portion of the headwaters of Feeney Brook have recently been logged under licence to the B.C. Forest Service. This changed land use has increased the flow quantities of Feeney Brook at the area under consideration. The one mile length of assessment road northeast of the Feeney Brook crossing was inadequately cross drained as detailed above. This is the principal constituent of increased flow being considered. The writer has suggested that the increased "pick up" of flow averaged 1 c.f.s. per mile of road length. The time of flow 'measurement' can be considered to be approximately 20% of peak flow.

Alpine freshet drainage would have likely overtopped the roadway in several locations creating their own natural cross drains, even though proper culverting was not provided by the licencee. Therefore a "worst estimate" of freshet drainage would be too inaccurate to offer herein.

#### 9. DISCUSSION

There are two problems leading to deposition of large amounts of sandy and silty gravels: (1) Tractive (frictional) erosion resulting from high velocity initiated above and below the crossing of the Forestry Assessment Road; and (2) Increased quantities in Feeney Brook due to changed land use and irresponsible road construction techniques.

It is the contention of the writer that the basic parameter to design of any remedial measures is lacking; "the quantity of flow available to Feeney Brook either with or without flow increase from natural alpine drainages re-channelled by road construction".

The most effective remedy appears to be the installation of energy dissipating devices (ostensibly between stations 13+00 and 21+00) (box culvert). As shown on Plan A attached, the natural hydraulic gradient for station 19+00 to 20+00 is 18% and that for two stations immediately below it averages 11%. Velocity estimates drawn from local flow observations suggest that 50 lb. stone "shotrock" devices on "chute systems" and quarter ton stone class on linear portions of the stream should be considered.

To re-institute natural drainage patterns the installation and maintenance of road cross drains is mandatory. The cross drains recommended in both the Orders of the Engineer were open channel systems and did not account for the hydrology of the watershed as closed drain systems would. It is the judgement of the writer from ground assessment that some culverts would require 36 inch diameter circular installations for 50 year static flow if the roadway is re-opened.

Assessment Road provides a constriction flow from the upstream alpine watershed and produces a chute effect which breaks quickly on steep hydraulic gradients. It is the judgement of the writer that the horizontal opening of this culvert, by way of constriction, amplifies the velocity problems encountered on the Raufer property, but its removal has not been affected or considered because of the unknown road requirements.

#### 10. RECOMMENDATIONS

The installation of energy dissipating devices in the area between station 13+00 and station 21+00 may be considered without a balanced hydrologic design. The Water Resources Service in Prince George dealt with a similar unbalanced installation at Moose Heights of the Quesnel Water District. On the basis of information supplied by Westcoast Transmission Co. Ltd. for that typical installation it is estimated that the cost of installation at Smithers would be approximately \$15,000. It

is stressed that such a system would not be a "sure thing" in terms of arresting erosion. Drawing upon the data outlined above, alterations in the Forestry Assessment Road, the size of the box culvert, vegetation on the property affected, removal of cottonwood trees, or translation of the water course by diversion would all have a major effect on the problem under consideration. It is therefore stressed that an undesigned energy dissipating system, while economical, may not provide results satisfactory to the property owner.

If the Surveying and Mapping Branch of the Lands Department can set a scale topographic map of the region of the Feeney Brook watershed and Forest Assessment right-of-way, this information would then supply the Water Resources Service with a crude stream bed profile above the assessment road and set a technical base for sound hydrologic review of the watershed.

#### 11. CONCLUSIONS

Before serious consideration is given to Provincial funding for any works to arrest erosion on Feeney Brook, the legal liability for the Forest Assessment Road which crosses Feeney Brook must be closely examined. It is the opinion of the writer (opinion is stressed) that approximately two-thirds of the responsibility for breaking through into more erosible soils on Raufer's property rests with the persons responsible for construction of the Forest Assessment Road. In this respect irresponsible drainage practices were employed. These practices

have only tended to accelerate the "break through" which would have naturally occurred on the stream bed. If the matter of this roadway had been brought before agencies under the folio referral system during design phase, the responsibility for damage in D.L. 5441A would likely have been Provincial. This is, however, an after the fact case, and outlining a "percentage" of responsibility for the damage is outside the writer's hindsight ability.

I'd pive it au F.

C.E. Wilson, P. Eng.

Regional Engineer

J.B. McGonigal

Prince George, B.C.

Smithers, B.C., January 9,

76

Feeney Brook

**0183868EH** 

On November 10, 1975, equipment was hired and began remedial work on the alluvial cone at Feeney Brook, under supervision of the Skeena Regional Technician.

Material for the proposed rock weirs was removed from a nearby knoll. Sizes of the rock varied from 2" to 3" in diameter. A small percentage of clay material was included with the rock during placement, which will increase future settlement within the weirs. Additional material was placed to raise the weirs to counteract this condition.

As per direction from the Prince George Regional Office, logs were removed from the existing creek channel and repositioned along the left bank to conform to the existing ground contours.

From the lower most rock weir on the creek, a shallow section was created to a large area of the creek regime for log placement and to afford a diffusing effect for freshet flows.

These logs were partially keyed and secured with fine gravel material from the site. It was suggested rock be used to anchor the logs, however the swamp type ground condition prohibited conveyance of rock to this area. The logs were placed perpendicular to the flow to create a meander effect for lower flow velocities. Thus, a bed load deposition effect from those sensitive areas upstream will be the desired result.

It was suggested debris from brush piles adjacent Feeney Brook be placed in the newly created creek location for additional filtering of wash material. However, it was considered some of the roots, limbs, trees, etc., would find their way down stream during freshet periods to block culverts and result in additional problems to property owners. Because of this potential problem, it was decided to leave this brush out of the creek.

Because soft ground conditions were creating work stoppages, it was decided to discontinue work activities till spring.

Work to be completed consists basically of:

- a. Rip rapping sections of Feeney Brook below remedial work at alluvial cone.
- b. Additional rip rap must be placed on the upper section at the beginning of the rock weirs.

c. ) rock weirs must have additional rock applied to either bank, on the upstream sides to prevent possible erosion and side cutting.

This work should be done before freshet periods.

J.B. McGonigal, Tech. 1 Water Rights Branch

JBMcG/bjs

## Appendix D: Forms 3, 4 and 6

These forms are included as they were a required component of the contract. However due to sampling methodologies and as not all component of the forms were appropriate to this watershed study, not all sections were filled out.

## Overview Assessment - Preliminary Habitat Assessment Form

607500 UTM Coordinates: 6089320 Watershed Name: Toboggan Creek

46-2400 Watershed Code: \_\_

NTS maps: 934.099+

	Restoration Opportunities								•								•
		Yes	Yes	Xes	Yes	Yes	Yes	Yes	Yes	200		•			•		
	Priority	MOD-Hay	Hig L			MOD	High.	/+:gr	High	2007							
	Major Impacts	Large Sloughing bents/Hwyll CV	3	Ingilling Beaver activity	مر	CNR+ Bower actionly	Sectimentation + Akulsions + ENR Rip Rap	sedimentates from upstope + Bank Emosion	Hayly any willed braided + 1033 of Habitet	1							
	Upslope Impact Potential	HOD	Mod	Mod	202	2007	Han			892	2			•	·	·	
80,56	Habitat Value	HOP	Han	High	Π			1	1	Τ,	3			•			
	Section	4/₩															
	Reach	7	2	7	7	2	9	7	<b>*</b>	0							

Overview Assessment - Preliminary Habitat Assessment Form

042809 0408809 UTM Coordinates: \_\_\_ Watershed Name: Hopps Brook Watershed Code: 46 - 2400 - 00 5

NTS maps: 934.084

Restoration Opportunities	Yes	705	Pass; bly													
Priority	High	MOK	Moch													,
Major Impacts	_	Loss of Promite & Book Power	1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	Cooling + Jet in Kana - 1000					•							
Upslope Impact Potential	1400 12	1002	3	4654								;	;			
Habitat Value	Heak	0.04	30	でなる。												
Section							•					•				
Reach		,	, ^	2												

Overview Assessment - Preliminary Habitat Assessment Form

UTM Coordinates: 60 9 5 5 80, 6 10 100 Watershed Name: Feeny Brook NTS maps: 934.084 Watershed Code: 46 - 2400 - 015

Restoration Opportunities	1,45	Yes	Yes			•						•		•
Priority	140 L	Woch	14:94	,		,		•						
Major Impacts	loss of Pool Sectimetate braiding	from slide solivetate to champlischen Resorten	Erroding loading Slope Pailings Channelizette								• • • • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • • •		
Upslope Impact Potentlal	Faz	14.27	nod								: :	•	<u>'</u>	
Habitat Value	Han	Tool	200						3, 3, 1,	**** ** * * *		::		
Section						•					:		1. 120 3.0 3.0	
Reach	-	2	1				·.`							

Overview Assessment - Preliminary Habitat Assessment Form

6087400, 609300 UTM Coordinates: \_\_ Watershed Name: Owens Creek

Watershed Code: 46-2400-010

NTS maps: 434.084 +434.094

	Opportunities	Yes	<i>&gt;&gt;</i>				•					•			
C	Fnoncy	Heals	Han	Mocs.					·	·	•				
	Major Impacts	loss of Riconia + Sectively, loss of Pool	sochwe ha Besser action	loss of Rigarian											
	Upslope Impact Potential	Hah	14:0.14	¥ 20 7							:		·		
	Habitat Value	141014	Mord	100							,				
	Section													:	
	Reach	-	-	24	)										

Overview Assessment - Preliminary Habitat Assessment Form

611460 6083440 UTM Coordinates: Watershed Name: [11:0t Creek

Watershed Code: 46-2400 -020

NTS maps: 934. 084

Restoration Opportunities	405														•				•
Priority	High	Low											•						
Major Impacts	chamiltoute loss of Bol Presera	Less of Diana + Low 1,300d claber 3						•											
Upslope Impact Potential	705	145.4	200	3									;				٠		
Habitat Value	14104	MOD		3						•	18. N. Y.	:		1.	:	.		:	
Section															:			: <b>\$</b> 1.5	
Reach		- 1	7	?															

Overview Assessment - Preliminary Habitat Assessment Form

611880 6082500, UTM Coordinates: \_\_ Watershed Name: Clacier Golch Creek

Watershed Code: 46 - 2400 - 030

NTS maps: 934.089

	High Yes	Yes	Yes	Yes	Yes		•								•			
Priority	MOID-High	High	Hod	High	Moch								:					
Major Impacts	Beaver actionly + siltertion	n. les		Logaring Subscriber Plan 5. Hallan's sectional letter	Slide Bark Emosian													
Upslope Impact Potential	MOD	おると		子る子									,		•			
Habitat Value	HIGH	Han	Righ	#igh	MOD					-	35 N	:	*****		:		:	
Section							·.							;	;	•	: •2 •3	
Reach	,	7	~	7	5			·	;			,					***	

Overview Assessment - Preliminary Habitat Assessment Form

6081760 \$ 617560		NTS maps: 734.084
UTM Coordinates: 6081760		
Glass Creek	` ;	46-2400-025
Watershed Name:	•	Watershed Code:

Restoration Opportunities	Possibly				•				•		1			
Priority	MOD													
Major Impacts	Lack of Riboria want chamilization	}					•							
Upslope Impact Potential	(707)	220:									:		·	
Habitat Value	MOD							,	W. W.		ŀ		:	
Section									.			1.		
Reach				:		·								

## Level 1 field assessment - habitat survey data form

NTS map sheet: 934.094 x 934.084 1997 Forest District Bulkley Valley Survey Date: 08 10,14,13/ 10 p )

Watershed: Toboggan Creck Survey Crew: L.C, R.M, S.M, C.W. Weather.\_

Sub-Basin: Toboggan main stom (RIPIGICIO) Discharge (m<sup>3</sup>·s<sup>-1</sup>): \_ Subsampling Fractions: \_\_

Bed Material Type

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Level 1 field assessment - habitat survey data form

Forest District: (3011c1ey Valley

NTS map sheet: 43L.094 /93L.084

Survey Date: 15 24 | 10 | 177

Watershed: Toboggan Creck. Sub-Basin: \_\_\_\_\_\_\_ Discharge (r Weather. \_\_\_\_\_\_\_ Survey Crew: SM, RM, C心, L.C. Subsampling Fractions: \_\_\_\_\_\_

Sub-Basin: Owen Creek Discharge (m³·s<sup>-1</sup>): O.74/ m³/s

Pools Only Bed Material Type
Crest | Besidual | Pool | Dom. | Sub- | Spawnin (RIPIGIC10) Mean Width Mean Depth ^ > ^ ۳ ס

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Watershed: Tokog gan Cheels Weather: \_ Forest District: Bulkley Valley NTS map sheet: 934. 084 Survey Date: \_

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(R/P/G/C/0) Discharge (m³-s⁻¹): Subsampling Fractions: \_ Survey Crew: SM /Lu

Sub-Basin: Feeny Brook

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Watershed: Toboggan Creek Weather.\_\_\_ Forest District. Bulkley Valley NTS map sheet 736. 084

Sub-Basin: Elliot Creek Discharge (m<sup>3</sup>·s<sup>-1</sup>): 2.2 Subsampling Fractions: Sirvey Crew: CW/LC/RM

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Level 1 field assessment - habitat survey data form

Forest Dist NTS map s Survey Da

	(RIPIGICIO)	Bed Material Type	Sub- Spawnin Sub- Spawnin
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	P/ G	Bec	Dom.
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hed: Tobogogan Cherk	SM, RB	Mean Width	Medil Midai
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Level 1 - Habitat Diagnosis Summary Form (from Anonymous 1993)

Calculate mean values of habitat conditions over each reach and use the values from Table 5 to rate habitat conditions within reaches as poor, fair or good.

Watershed Name: Tobog gan Creck

46-2400 Watershed Code: \_\_

UTM Code: 6089320, 607500

Forest District: Bolkley Valley

Reach Number	% B	% Pools	Prequ	Pool Frequency	LWD Pieces per Channel	LWD Pieces per Channel	% Wood Cover	ood /er	Dominant Substrates	Dominant Substrates	Off-Channel Habitat	nannel litat	Gravel Quantity	ivel ntity	Holding Pools	ing
	Value	Rating	Value	Rating	Value	Rating	Value	Bating	Value	Bating	Value	Bation	Volue	Bating	Value	Rating
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5-	57	roor						Pror		Good		2000		Poor		Poor
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Level 1 - Habitat Diagnosis Summary Form (from Anonymous 1993)

Calculate mean values of habitat conditions over each reach and use the values from Table 5 to rate habitat conditions within reaches as poor, fair or good.

Watershed Name: Hopps Brook

Watershed Code: 46 - 2400 - 005

UTM Code: 6088040, 608 740

Forest District: 801k1cu

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	Holding Pools	Rating	9	3 0	60	7												_	_	
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	vel ntity	Rating	S. C.	200	Bor	Rir														
	Gravel Quantity	Value	200																	•
	itat	Ration	2	١٩١٠	40	Poor														
	Off-Channel Habitat	Value																		
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	ood	Rating	0	3	Š	Fatr														
	% Wood Cover	Value																		
	ieces annel	Rating	'n																	
	LWD Pieces per Channel Width	Value																		
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Q %	%	Value	20	9/																
Reach	Number			2	2										,					

Level 1 - Habitat Diagnosis Summary Form (from Anonymous 1993)

Calculate mean values of habitat conditions over each reach and use the values from Table 5 to rate habitat conditions within reaches as poor, fair or good.

Watershed Name: Feeny Brook

Watershed Code: 46 - 2400 -015

UTM Code: 608 5580 610100

Forest District: Bolkley Valley

Γ			T_		ī	,	1	Γ	T		Т		 Γ	T		Γ	T	1			T	T			Γ	
	Holding	Pools	Rating	9	8	9	Post									_		-		_				_		
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	gre	Qua	Value	Value																						_
	annel	itat	Ration	Sum ?	book	Poor	Park																			
	Off-Channel	Hab	Value	$\neg \Gamma$																			-			
	nant	rates	Rating	<u></u>	7	8	3																			
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Dosch	Nimber			-	2		3																			

Level 1 - Habitat Diagnosis Summary Form (from Anonymous 1993)

Calculate mean values of habitat conditions over each reach and use the values from Table 5 to rate habitat conditions within reaches as poor, fair or good.

Watershed Name: Owens Creek

Forest District: Bulkley Valley

609300

UTM Code: 6087400,

	Holding Pools		Haumg	Pos	Bor	Fair											
	HOL Po		Value														
	Gravel Quantity	,	Rating	Hod	Poor	Par											
	an Gua		Value														
	Off-Channel Habitat	,	Hating	Tair	Poor	T. C.C.											
	Off-C Hal	17.5	Value														
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	≨ ິ 	Value	Value		·												
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% Pools		Rating	Poor	4	3												
4% P		Value	20														
Reach	Number			2	3												

Level 1 - Habitat Diagnosis Summary Form (from Anonymous 1993)

Calculate mean values of habitat conditions over each reach and use the values from Table 5 to rate habitat conditions within reaches as poor, fair or good.

6083440 UTM Code: Watershed Name: Cliot Creek

46-2400 -020

Watershed Code:

Forest District: Bulkley Valley

6 11 460

ng S	Rating	0	٥	Ris	وم											
Holding Pools	Value	┱					1									
vel	Ration	-0-	Rair	प्रदेश	Fals								?			
Gravel	Value	7														 ·
Off-Channel Habitat	Ration	Ĉ.	<b>1</b>	يك	Poor											
Off-CP Hat	Value															
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% Wood Cover	Rating	֝ ֖֖֖֖֓	la'	Bor	Poor											
× ပိ	Value					·										
leces lannel	Rating															
LWD Pieces per Channel Width	Value															
Pool Frequency	Rating									1						
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Reach Number			2		2											

Level 1 - Habitat Diagnosis Summary Form (from Anonymous 1993)

Calculate mean values of habitat conditions over each reach and use the values from Table 5 to rate habitat conditions within reaches as poor, fair or good.

Watershed Name: Clacier Gulch Creek

UTM Code: 608 2200 611880

Watershed Code: 46-2400 - 030

Forest District: Bulkley Valley

	Gravel Holding Quantity Pools	Rating Value Rating	1													
	Off-Channel G Habitat Qu	Value Rating Value	9	X 27	6000	Programme	Pear									
	Dominant Substrates	Value   Rating	2		2000	Pare	Fair					•				
	% Wood Cover	Value   Rating	, , , ,	3 13	Prof	200	Post									
	LWD Pieces per Channel Width	Value Rating			0.27 Poor	+										
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Dooch	Number		1	2	3	4	5									

Level 1 - Habitat Diagnosis Summary Form (from Anonymous 1993)

Calculate mean values of habitat conditions over each reach and use the values from Table 5 to rate habitat conditions within reaches as poor, fair or good.

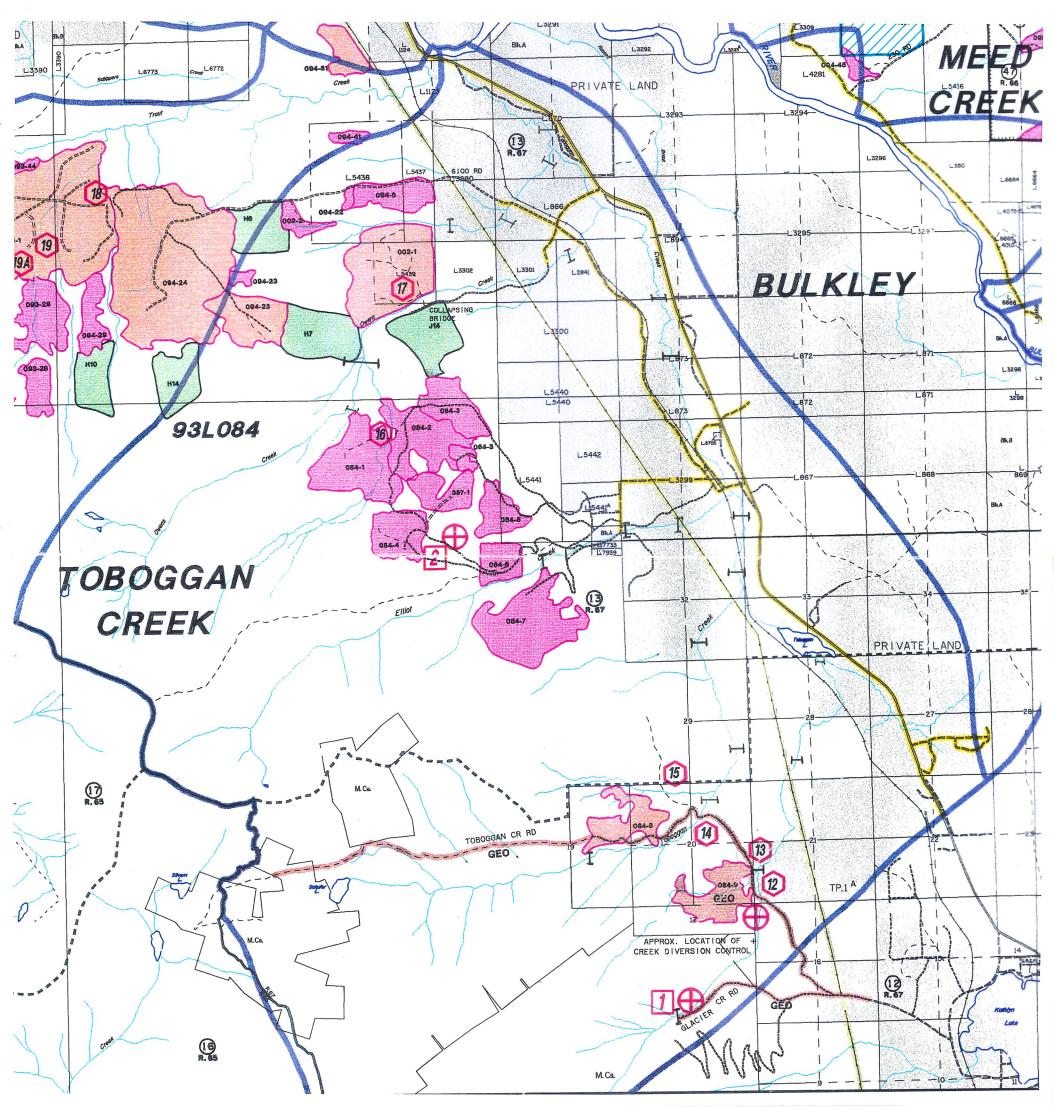
UTM Code: 6081760, Glass Creek 46-2400-025 Watershed Name: Watershed Code:

612560

Forest District: Bulkley Valley

ing sls	Rating	Poor										
Holding Pools	Value	1										
vel	Rating	-0										
Gravel Quantity	Value											
ff-Channel Habitat	Ratino	Pom										
Off-Channel Habitat	Value											
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ieces annel	Rating	,										
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## Toboggan Creek Project Area



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