Lakelse Lake Sockeye Rehabilitation Program:

Hatchery Creek Spawning Habitat Improvement Project

Prepared for:

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March 2006

Executive Summary

Hatchery Creek is one of several tributaries to Lakelse Lake that supports a declining run of sockeye salmon. A lack of suitable spawning and incubation habitat is believed to be the main factor limiting sockeye production in Hatchery Creek and in the Lakelse Watershed in general. Hatchery Creek was formerly part of the Granite Creek floodplain. It was isolated from Granite Creek by a dike to protect residential properties in the 1970's. The dike has promoted stable groundwater flows in Hatchery Creek, but has prevented gravel recruitment and flushing flows for the maintenance of salmon spawning habitat.

In the spring of 2005, the Lakelse Watershed Society, in partnership with Fisheries and Oceans Canada, BC Parks and the Ministry of Environment received funding from the Pacific Salmon Commission to improve spawning and rearing habitat for sockeye and other salmonids in Hatchery Creek. This was to be accomplished through debris jam removals, large woody debris (LWD) and gravel placements and through the provision of increased groundwater flows to downstream habitat.

In the summer of 2005, habitat and topographic surveys were conducted in the creek to finalise plans for habitat improvements. These surveys identified areas of silt accumulation and small woody debris jams to be removed. It was also determined that sufficient large woody debris existed in the creek, so the plan to add more LWD to the creek was discontinued. The topographic survey included upper portions of Hatchery Creek, upstream from the large beaver pond and portions of adjacent Granite Creek to assess the feasibility of providing flushing flows for lower Hatchery using water from Granite Creek.

Several debris jams and old beaver dams were removed from a two hundred meter reach of Hatchery Creek from 1st Avenue to the large beaver dam/pond at its headwaters. Substantial amounts of silt that had accumulated upstream of these dams was flushed naturally by creek flows and removed using an excavator to reveal a gravel-cobble substrate below. Gravel suitable for sockeye spawning was fabricated and delivered to the site, but placement in the creek was delayed for a year to allow for additional fall/spring flushing events to mobilize additional silt.

In early March, 2006 test pits were excavated during a low water period to determine the depth of the groundwater table and the feasibility of increasing groundwater flows to the creek downstream. Two of the test pits were dominated by river gravels and produced large amounts of good quality groundwater that was within 2 meters of the ground surface. These test pits were then connected through the excavation of a channel to an inlet stream that flows into the large beaver pond/headwaters of Hatchery Creek. The inlet stream was deepened to create a channel that extended further into the water table and accessed more groundwater for downstream flows.

Gravel placement, interpretive signage and ongoing monitoring to assess spawning and incubation success in the gravel additions are planned for 2006/07.

Acknowledgements

This project was conducted under the umbrella and direction of the Department of Fisheries & Oceans Canada who provided personnel, labour, travel, equipment and technical expertise as 'in-kind' contributions to this Pacific Salmon Commission funded project.

DFO personnel directly involved included:

Don Hjorth - Restoration Engineer, Resource Restoration Unit
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Steve Cox-Rogers - Biologist, Stock Assessment.

Additional government assistance was given by:

Mr Ben Sabal, Area Supervisor, BC Parks
Mr. Chris Broster, Ministry of Environment.
Mr. Ted Pellegrino, Kitimat-Stikine Regional District

Other personnel involved included:

Ongoing support and efforts were also rendered by members of the Lakelse Lake Watershed Society (Ian and Wilma Maxwell, Alan Lanctot, Kelly Kline) based out of the Lakelse Lake area.

Mr. Ken Simons, ' Ken's Trucking', for his interest and enthusiasm for the project.

Mr. Ross Stenquist from 'Nechako Northcoast Construction" and Mr. Terry Montague from 'T. Montague Contracting' for exceptional excavation work in sediment removal, gravel placement and channel excavation.

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1.0 Introduction

Sockeye salmon stocks in the Lakelse Lake have been declining at an alarming rate due to physical changes and habitat impacts caused by logging, linear development and beaver activity. Stock escapements to Lakelse Lake have been depressed relative to historic levels. Department of Fisheries & Oceans Canada (DFO) – Stock Assessment Branch - concluded in 2003 that lake densities of juvenile sockeye in Lakelse Lake were less than 5% of the rearing capacity, representing the offspring from just 750 spawners. Work done in 2004 and 2005 indicate that this trend continues and escapements have declined by 92% over the last 3 cycles, or 12 years. (Lakelse Lake Sockeye Recovery Plan, 2005)

Hatchery Creek was reported as once being a side channel of the adjacent Granite Creek which became isolated from that flow and gravel source in the late 1970's when a flood control dike was constructed. (Kitimat-Stikine Regional Planning Department, Ted Pellegrino, 1994) Incidents of channel avulsion and flooding are documented in the "Hatchery Creek Impact Study" (Skeena Cellulose, 1987).
A major flood in the fall of 1969 promoted the construction of an initial dike with more major work including channelization, diking and rip rapping being done in 1977. The dike was built to protect nearby a residential development comprised of full time and recreational properties along First Avenue – Lakelse Lake. Flooding occurred again in 1978 so in 1979, dikes were constructed on either side of the creek between Highway #37 South and First Avenue. This was done under "the Flood Relief Act" by MOT and MOE. (Kitimat-Stikine Regional Planning Department, Ted Pellegrino, 1994)

Since its isolation from Granite Creek, the lack of flushing flows and gravel recruitment have degraded previously suitable fish habitat in Hatchery Creek. Upper reaches of the creek were dominated by small woody debris dams, beaver dams and large amounts of silt accumulated above these dams. This occurred downstream of a large, well established beaver dam and pond that acts the headwater for this small system.

Development in the area has greatly contributed to the reduction in quality and the elimination of suitable spawning habitat in the creek. Gravel is no longer recruited from Granite Creek to replenish the site and the natural flushing and cleaning due, in part, to the lack of returning spawners, is not occurring.

In the summer of 2004, the Skeena Sockeye Workshop was held to discuss the status of the sockeye salmon in the Skeena drainage. The studies presented at this gathering included solid data confirming an alarming decline in sockeye populations in the Lakelse system. As a result, the Lakelse Lake Sockeye Salmon Recovery Plan Committee was struck to develop and implement a plan for Lakelse Sockeye population recovery. This Recovery Plan Committee consists of stakeholder representatives from various branches of DFO, B.C.'s Ministry of Environment, BC Timber Sales, Kitselas First Nations, Terrace Salmonid Enhancement Society and the volunteer community-based Lakelse Lake Watershed Society. A Recovery Plan document was formulated and stakeholders were involved in reviewing the status of stocks and habitat, identifying the limiting factors, developing potential projects and placing these projects in a logical sequence of priority. These projects were ranked on the basis of feasibility, cost effectiveness, cost-benefit analysis, potential for immediate help to the sockeye salmon and the project's ability to address the limiting factors affecting the sockeye in this system. Projects were identified in three different categories: improved information, habitat restoration and stock enhancement. *The Hatchery Creek Spawning Habitat Improvement* project was ranked first of five habitat rehabilitation projects by this group in the developing framework of the Lakelse Lake

Sockeye Salmon Recovery Plan. It was selected as a high priority project because it would immediately address what is believed to be the main limiting factor for sockeye in the Lakelse System – a lack of quality spawning habitat. It was also a relatively small project that was deemed feasible in 2005/2006, whereas other systems (Williams Creek and Scully Creek) required additional feasibility studies before projects could be proposed.

This report summarizes the project which was funded by the Pacific Salmon Commission and is intended to be a record of the project to provide a better understanding of the limiting factors affecting sockeye in this system, how they were addressed and the ongoing monitoring and assessment. It is hopeful that this work will also further reinforce strong educational and stewardship opportunities within the surrounding community regarding this run of sockeye salmon.

2.0 Study Area

Hatchery Creek is located near Lakelse Lake approximately 20 kilometres south of the city of Terrace in north western British Columbia. It drains a westward facing basin and flows into Lakelse Lake which, in turn, flows into the 18 km-long Lakelse River. Lakelse River is a Skeena River tributary that enters the Skeena approximately 150 kilometers from its mouth. Hatchery Creek is a groundwater fed system that percolates out of the ground between Highway #37 South and Lakelse Lake and flows into a large, well established beaver pond and then downstream through a mostly forested gravel/cobble alluvial fan formed by adjacent Granite Creek. The entire system is less than 1.5 km in length.

The specific project location is: Latitude: 54 23” 16” N Longitude: 128 32” 25” W
Lot 3984, Lakelse Lake Park

The initial phase of this project was conducted in a 200m reach of Hatchery Creek that extends from the First Avenue culvert upstream to the large beaver dam. The second phase of this project was conducted upstream from the large beaver pond from approximately 200 to 600 meters upstream from First Avenue.

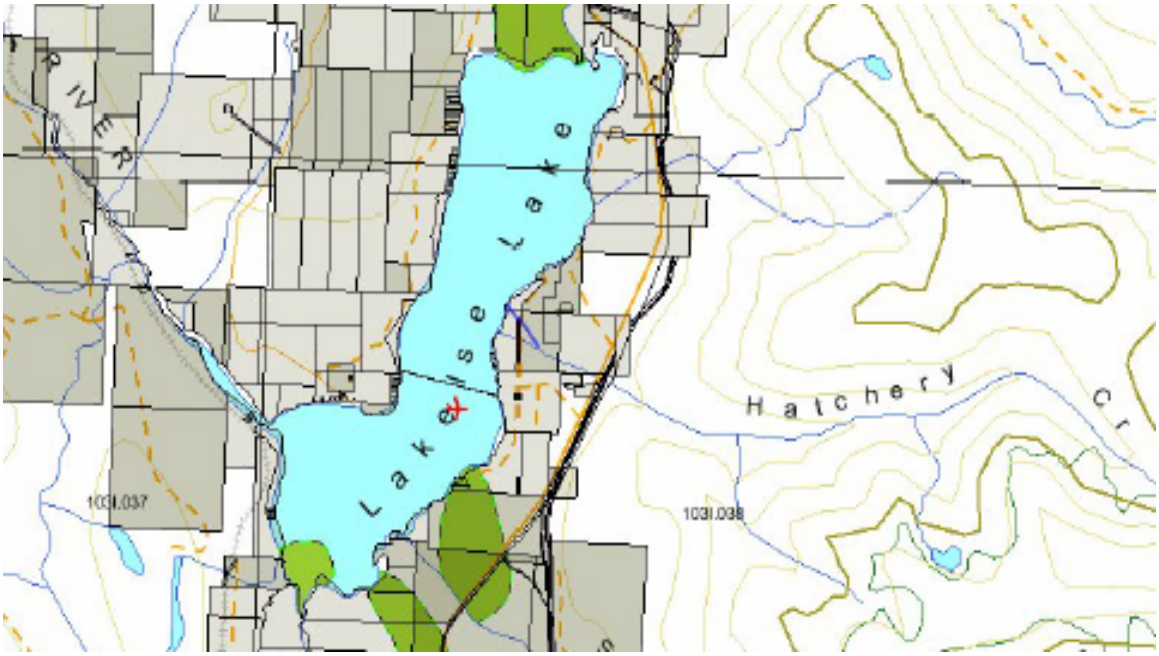

Figure 1. Map of Lakelse Lake Area – Showing Hatchery Creek

3.0 Methods

3.1 Pre-assessment

Pre-assessment of incubation survival through hydraulic sampling in the lower reaches of Hatchery Creek was planned for the fall 2004 to establish base-line incubation survival. Data collected from the 'restored' reaches could be compared post-construction to the base-line information. Hydraulic sampling involves the use of a probe to pump water into a redd and disturb the incubating eggs. The eggs are then collected in a net and live versus dead are counted to determine % survival. No sockeye were observed spawning in Hatchery Creek in 2004, so this portion of the project was not conducted. Plans were made to attempt this assessment in 'natural' and 'restored' reaches in the fall/winter of 2005, however a lack of sockeye spawners prevented this from taking place. "Tidbit" temperature loggers were installed in the creek approximately 50m upstream from First Avenue, Lakelse Lake to monitor accumulated temperature units (ATU's) for future sampling efforts. Loggers were placed in a small plastic PVC cup that was perforated with holes. The cup was cabled to the stream bank and then weighed down with a 5 lb lead weight and situated in the middle of the stream. The logger was set to record temperatures every hour and the unit was downloaded every 6 months.

3.2 Topographic Surveys, Fish Habitat Surveys, Drafting and Design

In the planning stages of the project, Hatchery Creek and adjacent Granite Creek were surveyed in June 2005 by the DFO Resource Restoration Unit Engineering Technician and the Biology Technician using a total station instrument. The purpose of the survey was to assist with the planning of upcoming habitat improvements. This identified the relic beaver dams and other debris which would require removal in addition to determining the locations for spawning gravel placement.

In early July, 2005 a modified fish habitat survey was conducted in the 200m reach of Hatchery Creek from First Avenue to the large, upstream beaver pond. Average areas of spawning habitat (glides and riffles with suitable gravel substrate), rearing habitat (pools), large woody debris (LWD) and silt accumulations were documented. A meter stick and tape measure were used to measure habitat variables.

Figure 2. C. Broster Measures Silt at Hatchery Creek Prior to Removal

The pond inlet stream and portions of adjacent Granite Creek were surveyed and drafted by McElhanney Consultants, Terrace, B.C. in January 2006. The Hatchery Creek project lies within a BC Park and stringent standards had to be met with respect to impact and aesthetic issues in addition to normal operating standards. Test pit sites were identified and stream access sites for the excavator were determined in order to minimize impact to coniferous vegetation and still maintain personnel and equipment safety.

3.3 Construction

3.3.1 Beaver Dam and Small Woody Debris Jam Removals

On August 11, 2005, six 'volunteers' from DFO, the Lakelse Lake Watershed Society and Ministry of Environment began the work of pulling out old beaver dams, obstacles and small woody debris using hand tools. After dams were removed, stream flows cut a channel through this accumulated silt over a period of almost two weeks, exposing the natural gravel/cobble substrate below.

Figure 3. Volunteer Crew Works to Remove Small Woody Debris

Figure 4. Removal of Beaver Dams

3.3.2 Silt Mobilization by Hand

Access into some portions of the creek to remove silt with an excavator would have been too damaging to riparian vegetation and in-stream woody debris, so hand mobilization was planned for some sites. This was accomplished with a team of volunteers over a period of three days. In pool areas where silt had accumulated, volunteers used shovels and other hand tools to move fines from the channel and up onto the stream banks or just mobilize silt so that it could be flushed downstream. Some silt accumulation still remains in areas where flows were insufficient to flush much material downstream.

3.3.3 Silt Removal - Mechanical

After letting water flows mobilize some of the silt for several days after beaver dams were removed, a "John Deere" EX200 excavator from 'Nechako Northcoast Construction' was brought to the site to complete the mechanical removal silt from the creek on August 23, 2005. The machine was clean and equipped with environmentally-friendly hydraulic fluids. Equipment access to the stream was gained from two separate staging areas off the flood control dyke on the south side of Hatchery Creek, where impact to the terrain was deemed to be minimal. Some removal of riparian vegetation was necessary to access the site. The excavator worked from the left bank of the stream and side-cast silt and debris onto the stream bank.

Figure 5. Mechanical Excavation of Silt

Figure 6. Side Casting Materials

3.3.4 Gravel Production and Delivery

Several sources of gravel were sought in the Terrace area using spawning gravel specifications already determined for the DFO Fulton/Babine spawning facility.

"Raw" pit gravel from the Contractor's chosen source had to be screened to remove oversize and undersize material to yield a target spawning gravel matrix meeting the gradation limits set out in TABLE 1 below:

Grading Limits for Spawning Gravel

Sieve Size [Square Opening]	Total Passing Sieve Percent by Weight
75mm [3in]	100%
50mm [2in]	75% - 85%
38mm [1 1/2in]	50% - 75%
25mm [1in]	30% - 50%
20mm [3/4in]	10% - 30%
12mm [1/2in]	0% - 10%

NOTE: The spawning gravel gradation shall not be achieved by using crushed rock or stone.

Department of Fisheries & Oceans Canada, 2001

TABLE 1. Spawning Gravel Specifications

As per those specifications, gravel for this purpose was to be wholly individual rounded stones that were sound and durable, free of all organic and deleterious materials, and free of crushed stone. In addition, it could not be from a salt water environment and could not contain unacceptable amounts of iron oxide, sulphur or other deleterious chemicals or minerals.

A very suitable supply of gravel was located and chosen from a contractor in close proximity to the project which was similar material to that of Hatchery and Granite Creeks. This saved substantially on trucking and delivery costs as estimates in the proposal were based on gravel trucked from Terrace. The gravel was smaller in diameter than the dominant substrate in Hatchery and Granite Creeks, which is relatively large for sockeye spawning.

Gravel was delivered to the site via the south flood control dike and moved by an excavator to two stock pile locations immediately adjacent to the creek. Initially gravel was to be placed in stream at the same time as the excavator was on site to remove the silt. Weather, equipment/ operator availability and the noted presence of coho in the creek during the fall of 2005 (Ian Maxwell, October 24th stream walk), prevented the placement of gravel into the stream bed as originally planned. However, it was also decided a system flush of fall/spring high water events would probably be helpful.

3.3.5 Upstream Test Pit and Channel Excavation

On March 6, 2006 *a CAT 320C Excavator* with Terry Montague from 'T. Montague Contracting' was mobilized to the site. Four test pits were excavated upstream of the beaver pond inlet stream at cross sections H, F, E and between E and F (see drawings 820-01 in Appendix 2). Each test pit was excavated to a depth of at least 3 – 4 meters. Substrate quality, water depth and water quality was documented. Water temperature, dissolved oxygen in parts per million (ppm) and % Oxygen saturation were measured using an "Oxyguard DO Meter".
A pump test was conducted on one of the test pits to determine approximate ground water flow from that site using a 3" trash pump.

Figure 7. Excavation of Test Pit

Figure 8. Measuring for Data

Figure 9. Size Reference - Materials

A sediment fence was set up at the downstream end of the inlet channel and the channel was salvaged for fish. Over the next several days, a channel was excavated to connect the two downstream test pits to the beaver pond inlet stream. The inlet stream was deepened by approximately 2 meters to access additional groundwater flows. Large woody debris was placed in the channel as the excavator worked downstream. A gravel truck was brought in to remove excavated material from the channel and place it along the dike instead of side-casting material on the stream banks.

Increased flows from the newly excavated channel were pumped from the pool just upstream from the sediment fence onto the dike using a 3" trash pump to prevent silt-laden water from entering the beaver pond.

Figure 10. Silt Fence In Place

3.4 Asbuilt Survey

An asbuilt survey to document completed works was completed on March 17^{tth}, 2006 by McElhanney Consulting Services. The survey was completed using a total station instrument to produce an electronic drawing of the site post-construction.

Figure 11. Completed Channel - Upstream

4.0 Results and Discussion

4.1 Pre-Assessment

The pre-assessment incubation survival hydraulic sampling was not done due to the lack of spawning sockeye. Two "Tidbit" temperature loggers were installed in the creek approximately 50m upstream from Lakelse Avenue in the fall of 2004 to monitor accumulated temperature units for future sampling efforts. The loggers were set to record temperature every hour and the unit was downloaded approximately every 6 months. The following graph illustrates Hatchery Creek water temperatures from July, 2005 to March, 2006.

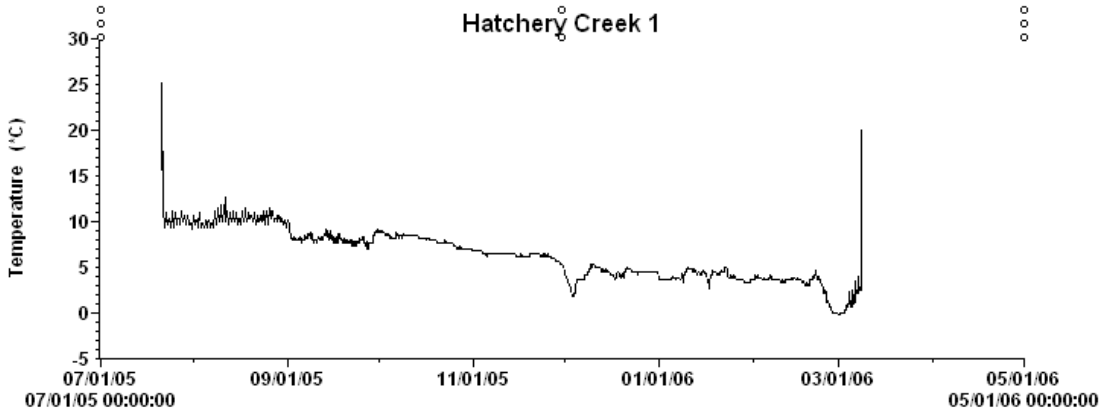

Figure 12. Hatchery Creek Water Temperatures – July, 2005 to March, 2006.

Important Note: The graph shows a few higher temperature points just prior to installing the logger in the creek and after removing from the creek (office temperatures). This graph only shows temperature data from July, 2005 to March, 2006. Several months of data (fall, 2004 to July, 2005) have been misplaced and are therefore not included in this graph.

4.2 Topographic Surveys, Fish Habitat Surveys, Drafting and Design

4.2.1 Initial Planning – Topographic Survey

In the planning stages of the project, Hatchery Creek and adjacent Granite Creek were surveyed in June 2005 by the DFO Resource Restoration Unit Engineering Technicians and the Biology Technician using a total station instrument. A copy of the survey can be found in Appendix 2. Relic beaver dams and other debris were identified and subsequently removed

4.2.2 Fish Habitat Survey

In early July, 2005 a 'Modified Fish Habitat Survey' was conducted in the 200m reach of Hatchery Creek from 1st Ave. to the large, upstream beaver pond. The results of this survey are summarised in the table below and detailed in Appendix 3.

	Total Pool Habitat	Total Riffle/Glide Habitat	Total Spawning Habitat
Before Habitat Improvements	**951.56m2**	**433.19m2**	**24m2**
After Habitat Improvements	**624.08m2**	**760.67m2**	**350m2**

Table 2. Modified Fish Habitat Survey from 1st Avenue Culvert to Base of Large Beaver Dam

Much of the pool habitat prior to the improvement work (debris jam and silt removal) was dominated by large accumulations of silt. These conditions have been improved and silt depth has been significantly decreased.

Much of the riffle habitat prior to habitat improvement works was dominated by large cobble substrate 4 to 8" in diameter. After gravel placement in summer 2006, much of the available spawning habitat will be 3" minus substrate.

It should be noted that the fish habitat survey indicated that desirable amounts of large woody debris already existed in this reach of the channel – so no additions of LWD were considered necessary and this portion of the project was dropped.

4.2.3 Upstream Water Augmentation Planning Survey

The pond inlet stream and portions of adjacent Granite Creek were surveyed and drafted by McElhanney Consultants, Terrace, B.C. in January 2006. This survey identified test pit sites and stream access sites for the excavator were determined in order to minimize impacts to coniferous vegetation and still maintain personnel and equipment safety. The inlet stream to the large beaver pond was surveyed and suggested test pit locations were identified upstream from the inlet stream at cross sections E to H. This survey (drawing number 820-01) is provided in Appendix 2.

The feasibility of installing a permanent intake from Granite Creek to Hatchery Creek was also explored to provide periodic flushing flows in Hatchery Creek. The survey completed by Colin Atkinson (DFO Engineer Tech.) indicated that a pipe of approximately 123 meters in length would be required to acquire sufficient grade for gravity-fed flushing flows to be piped to Hatchery Creek from Granite Creek. The potential cost for this was estimated at over $300,000.00 The possibility of pumping periodic (annual) flushing flows from Granite Creek to Hatchery Creek using a rental unit of high capacity pumps and associated pipes was then explored and the cost estimate was approximately $12,500.00 for a one-time attempt. The main cost for this work is the mobilisation of appropriate equipment from Vancouver, BC to the North Coast area.

4.3 Construction

4.3.1 Beaver Dam and Small Woody Debris Jam Removals

On August 11, 2005, personnel from DFO, the Lakelse Lake Watershed Society and Ministry of Environment began the work of pulling out old beaver dams, obstacles and small woody debris using hand tools. This work was delayed by a month due to the late emergence of cutthroat fry. After dams were removed, stream flows cut a channel through this accumulated silt over a period of several weeks, exposing the natural gravel/cobble substrate below.

Figure 13. Sediment Accumulation Before Removal

Figure 14. Channel Cutting Through Silt After Dam Removal

4.3.2 Silt Mobilization by Hand

It should be noted that in most locations along this stream, the silt was half a meter or more deep and only a small layer of water on top of the silt was visible. No available spawning habitat and relatively poor rearing/holding habitat existed due to the depth of silt.

Hand removal/mobilisation was accomplished with a team of volunteers over a period of three days. In pool areas where silt had accumulated, volunteers used shovels and other hand tools to remove fines from the channel or just mobilized the silt so that it could be flushed downstream. This portion of the project was less successful, as many of these areas were slow-moving pools and silt mobilization was difficult. Some of the pools were too deep for personnel to effectively work. Although some silt mobilization was possible, much of the silt accumulation still remains in areas where flows were insufficient to flush much material downstream.

The small woody debris and silt removal efforts resulted in an approximate 14-fold increase in potential spawning habitat in the creek (from 24m2 to 350m2). Although some of the exposed material is somewhat large in diameter for spawning habitat, the placement of smaller gravels in these areas in 2006 will improve spawning potential for sockeye, coho and other salmonids.

4.3.3 Silt Removal - Mechanical

After letting water flows mobilize some of the silt for several days after beaver dams were removed (see Figure 13 illustrating channel cutting through silt after dam removal), an excavator was mobilized to the site to complete the mechanical removal silt from the creek on August 23, 2005. Some removal of riparian vegetation was necessary to access the site. This portion of the project was deemed quite successful. The substrate was still quite large (average 4-6" minus diameter substrate), so the addition of smaller spawning gravel, more appropriate for sockeye (3" minus diameter) was scheduled.

Figure 15. Removal of Silt with Excavator

4.3.4 Gravel Production and Delivery

Initially, gravel was to be delivered and placed in-stream at the same time as the silt excavation. Although the sediment removal operation was highly successful, it was believed that gravel placement might be more effective if Hatchery Creek was allowed to be flushed by fall/spring high water events. This decision was also affected by the timing of the operation and availability of gravel supplies and equipment operators with necessary skills and machines suitable to do in-stream work.

Approximately 75 cubic meters of raw pit gravel from Ken Simon's pit was screened to remove oversized and undersized material to yield a target spawning gravel matrix. (See Table 1 on page 12) It was delivered and placed in two locations adjacent to Hatchery Creek, off the south flood control dike in December, 2005. Plans have been made to have this gravel placed in-stream as spawning platforms in the 2006 season with DFO's commitment and guidance.

4.3.5 Upstream Test Pit and Channel Excavation Improvement of Downstream Flows

On March 6, 2006 an excavator was mobilized to the site to begin test pit excavation and possible channel construction. Four test pits were excavated upstream of the beaver pond inlet stream at cross sections H, F, E and between E and F (see drawing 820-01 in Appendix 2). Each test pit was excavated to a depth of at 3-4 meters and substrate quality, water depth and water quality was documented.

Test Pit Number	Location (x-section on survey)	Water Quality (Temp. *C, Dissolved Oxygen - ppm & % saturation	Depth of Water Table	Substrate Quality / Type
1	H	No water found	N/A	Sand, fines, cobble, gravel
2	F	Not measured	4m – too deep	Good – sand, cobble, gravel
3	E	1.9*C; 13.5ppm; 97% sat'n	2.5m	Good – cobble, gravel, sand
4	Between E & F	1.7*C; 13.3ppm; 95%sat'n	1.5m	Good – cobble, gravel, sand
N/A	Pond	2.2*C; 12.1ppm; 87% sat'n	N/A	N/A

Table 3. Test Pit Results.

Figure 16. Test Pit Data Collection

Test pit results indicated that the excavated channel should not extend past the halfway point between cross-section E and F. The water table during low flow periods was too deep and the channel would likely flow subsurface if we extended further upstream. A channel was excavated to connect the two downstream test pits (#3 and 4) to the beaver pond inlet stream. The inlet stream which consisted of isolated pools was subsequnetly deepened by approximately 2 meters to access additional groundwater flows and maintain connectivity. Large woody debris was placed in the channel to provide cover for fish. A gravel truck was brought in to remove excavated material from the site to improve the aesthetics of the channel, in part, because is was located in a Park. As a result of the channel construction, the beaver pond levels had been raised by approximately one meter and downstream flows appeared to have doubled.

Figure 17. Completed Channel

4.4 Asbuilt Survey

An asbuilt survey to document completed works was completed on March 17th, 2006 by McElhanney Consulting Services and Autocad drawings are almost completed. This topographic survey will provide a record of the works completed and can also be used to monitor changes to the site over time. The asbuilt survey is provided in Appendix 2.

4.5 Post-assessment and Monitoring

Stream walks were conducted by the Lakelse Watershed Society in August through to November, 2005 to enumerate sockeye and coho salmon and to map redds. Unfortunately, no salmonids were observed using the newly exposed gravel areas but coho were observed in the creek in October. Future monitoring and assessment is planned and is outlined in the following section.

5.0 Conclusion and Recommendations

The *Hatchery Creek Spawning Habitat Improvement Project,* although not entirely completed, appears to have been successful to date. DFO personnel monitoring the creek noted that within a few days of the downstream debris removal, silt removal and excavation, gravel/cobble substrate was clearly visible and portions of the stream had undergone a positive transformation. Potential spawning habitat was increased 14-fold from ~24m2 to ~350m2. The spawning potential will be further improved with the addition of gravel of a more suitable size for sockeye spawners in August, 2006. This type of improved spawning habitat could support sockeye spawning densities as high as 6.6 per square meter – or over 2300 sockeye spawners (Shepherd, B. 1984).

Project Scheduling and Delays

Project delays resulted from the late emergence of cutthroat fry, changes in plans to allow for a longer period of natural flushing of silt to take place, from a lack of availability of equipment and operators and availability of DFO staff to supervise construction. Despite these obstacles, all aspects of the project went relatively smoothly.

In fact, the delays in project timing may have worked to the project's advantage since the upstream excavation work to increase downstream flows took place during the lowest water flow period of the year. In early March, the water level in the large upper beaver pond was approximately a meter lower than 'normal' levels. Water was previously noted as "percolating from the ground" on the McElhanney survey were found to have water at a depth of 4 meters below the ground surface. Had the test pits and channel been excavated during a period of higher water levels, portions of the new channel may have flowed sub-gravel at low flow times of year. Upon completion of the excavation of upper inlet channel, the pond had regained normal levels and downstream flows appeared to have doubled.

Post-assessment and Monitoring

Stream walks were conducted by the Lakelse Watershed Society in August through to November, 2005 to enumerate sockeye and coho salmon and to map redds. Lakelse Watershed Society volunteers noted that while there were no sockeye present in Hatchery Creek, they did report that coho were observed in the stream above and below the First Avenue culvert on October 24th (Ian Maxwell, Lakelse Lake Watershed Society). It should be noted that approximately 30 sockeye salmon were observed holding at the mouth of Granite Creek in August/September 2006 and this species has not been observed in Granite Creek for many years. It is possible that some or all of those fish are of Hatchery Creek origin as these two creeks were once connected and likely have the same water source. Because of similarities in water chemistry and higher flows in Granite Creek this past summer, fish that usually return to Hatchery Creek may have tried to return to Granite. Granite Creek often experiences very low flows or completely subsurface flow during drier periods in summer and winter.

Stream walks will continue through 2006 as part of the ongoing Lakelse Lake Sockeye Recovery Plan efforts.

Additional assessment is planned for 2006 including the following:

- stream walks to enumerate sockeye and coho salmon by volunteers from the Lakelse Watershed Society and DFO staff;

- an egg take and placement of Scotty-Jordan incubation boxes in gravel placement sites to monitor egg survival in the new spawning platforms;
- hydraulic sampling of redds in natural and restored spawning areas if sockeye returns are sufficient to allow for this type of sampling;
- continued temperature and water quality monitoring; and,
- flow metering to monitor stream flow fluctuations in the creek.

Outstanding Project Components

An interpretive sign describing the project, partners and ongoing rehabilitation efforts will be built and installed on or near the 1st Avenue trail head (dike road) adjacent to this project by the Lakelse Watershed Society, DFO and BC Parks. This will be financed by DFO and completed in April, 2006 under the direction of BC Parks. The Pacific Salmon Commission will be identified as a financial contributor to the project.

Seeding and planting of disturbed areas with native vegetation will be completed by DFO and LWS in the spring and summer of 2006, with direct input from BC Parks.

Final gravel placement will be paid for and supervised by DFO in August, 2006.

Possible egg takes and fry releases into Hatchery Creek to boost the local population as part of the recently funded Lakelse Sockeye Pilot Enhancement Project may take place in August/September, 2006.

It is also hoped that the upstream inlet channel will also provide an increased water flow during times when Granite Creek is in higher freshet stages. This increased flow may also be used to flush silt from Hatchery Creek. The affects of this flushing will be monitored and if necessary, the flush may be augmented by pumping water from Granite Creek as required. Pumping would be accomplished by the installation of temporary pumps and pipe works to Hatchery Creek at the reach just below the beaver dam. There are two nearby projects that may use this equipment which would greatly reduce the expense for Hatchery Creek due to the high mobilization costs to bring this equipment to the North Coast area from Vancouver, BC.

In summary, the amount and quality of sockeye spawning habitat in Hatchery Creek has been greatly improved by the removal of small woody debris and silt accumulations, the exposure of gravels/cobbles in spawning areas and an increase in downstream flows due to upstream excavation works. Further improvements will occur when the new gravel is placed in the creek in August, 2006.

Rearing and spawning habitat for other fish species has also been improved by silt removal efforts and increased flushing flows. Continued work to improve habitat in the creek and monitor project successes will ensure that this project and the investment by the Pacific Salmon Commission and project partners was a worthwhile endeavour. The Lakelse Watershed Society, DFO and MOE/BC Parks take ownership over such projects and will continue to work together to ensure that this investment is maintained for the long term benefit of Lakelse sockeye, local wildlife and local residents and visitors to this area.

6.0 REFERENCES:

Fisheries & Oceans Canada, 2001 (spawning gravel specifications)

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Skeena Cellulose, Hatchery Creek Impact Study, 1984

Shepherd, B. The Biological Design Process used in the Development of Federal Government Facilities during Phase 1 of the Salmonid Enhancement Program, Canadian Technical Report of Fisheries and Aquatic Sciences, 1975

/mk
/lm

APPENDIX 1

Proponent Information

Proponent Information

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APPENDIX 2

Survey Drawings

APPENDIX 3

Modified Fish Habitat Survey

Modified Fish Habitat Survey
Hatchery Creek from 1st Avenue Culvert to base of large beaver dam (~200m)

July 20, 21, 2005
Lana Miller – DFO; Chris Broster – MOE; Ian Maxwell - LWS

0 = culvert inlet at 1st Avenue, start of pool

0 to 35.3m = pool habitat
pool backwatered by box culvert and beaver baffler clogged with small woody debris
Length = 35.3m; average width = 10.65m ; average depth = 0.40m ; average silt depth = 0.25m; fine silt substrate
Total Area = 378.08m2

0 + 14.2m inlet stream entering into pond on right bank – 4m2 spawning gravel pad at tributary outlet

0+ 35.3m end of pool, start of riffle

35.3m to 60.3m = riffle habitat
Length = 25m; average width = 5.45m; Average depth = 0.15m; cobble-gravel substrate (3-8 inch in diameter); ~8m2 suitable spawning habitat for salmonids
Total Area = 136.25 m2

0+ 60.3m end of riffle, start of pool created by beaver dam

60.3m to 76.5m = Pool habitat
pool backwatered by debris/beaver dam ~ 0.4m high
Length = 16.2m; average width = 8.4m; average depth = 0.46m; average silt depth = 0.26m; fine silt substrate
Total Area = 136.08m2

0+76.5m end of pool, 2nd beaver dam and start of new pool

76.5m to 88.8m = Pool habitat
pool backwatered by debris/beaver dam
Average width = 11.85m; average depth = 0.72m; average silt depth = 0.47m; fine silt substrate
Total Area = 103.32m2

0+88.8m = end of pool; start of riffle

88.8m to109.8m = Riffle habitat
Length = 21m; average width = 4.95m; average depth = 0.15m; cobble-gravel substrate (average = 6 inch diameter); no suitable spawning habitat (substrate too large)
Total Area = 103.95m2

0+109.8m = end of riffle; start of pool

109.8m to 122m = Pool habitat
Small debris jam at 109.8m
Length = 12.2m; average width = 8.5m; average depth = 1.03m; average silt depth = 0.42m; fine silt substrate
Total Area = 103.7m2

0+122m = end of pool, start of riffle

122m to 142m = Riffle habitat

Length = 20m; average width = 2.0m; average depth = 0.18m; cobble-gravel substrate; approximately 10m2 salmonid spawning habitat in ~4" minus substrate
Total Area = 40m2

0+142m end of riffle, start of pool

142m to 148.2m = Pool habitat

Length = 6.2m; average width = 7.9m; average depth = 0.33m; average silt depth = 0.24m; fine silt and sand substrate
Total Area = 48.98m

0+ 148.2m= End of pool, start of riffle

148.m2 to 163.6m = Riffle habitat

Length = 15.4m, average width = 1.80m; average depth = 0.10m; compacted cobble-gravel substrate (2" to 6" minus diameter), ~2m2 spawning habitat
Total Area = 27.72m2

0+163.6m = end of riffle, start of pool at larger beaver dam ~1.5m in height

163.6m to 192.6m = Pool habitat

Length = 29m; average width = 6.6m; average silt depth = 0.31m, fine silt substrate; pool created by large old beaver dam ~1.5m in height
Total Area = 191.4m2

0+192.6m = End of pool, start of riffle

192.6m to 201.5m = Riffle habitat

Length = 8.9m; average width = 6.8m; average depth = 0.29m; cobble-gravel substrate – no suitable spawning habitat (substrate too large)
Total Area = 60.52m2

0+201.5m = end of riffle, start of braided riffle

201.5m to 223m = Braided riffle habitat

Length =21.5m; average width = 5.25m; average depth = 0.17m; cobble-gravel, some fines and sand; no suitable spawning habitat (substrate too large)
Total Area = 64.5m2

0+223m = End of reach, base of large beaver dam/pond/headwaters of Hatchery Creek

Habitat Summary Prior to Instream Habitat Improvements:

Total pool habitat prior to debris jam removal = 951.56m2
Total riffle habitat prior to debris jam removal = 433.19m2
Total spawning habitat prior to debris jam removal (riffles and glides with gravel substrate) = 24m2

Debris jams were removed at 0+ 60.3m, 76.5m, 95.1m, 109.8m and 163.6m.

Habitat Summary After Instream Habitat Improvements:

Total pool habitat after debris jam removal ~624.08m2
Total riffle/glide habitat after debris jam removal ~760.67m2
Total spawning habitat after debris jam removal ~350m2 or ~14x more spawning habitat.

APPENDIX 4

Photographs

Upstream – Before Silt and Debris Removal
View is from just above First Avenue, Lakelse Lake

Upstream – After Silt and Debris Removal

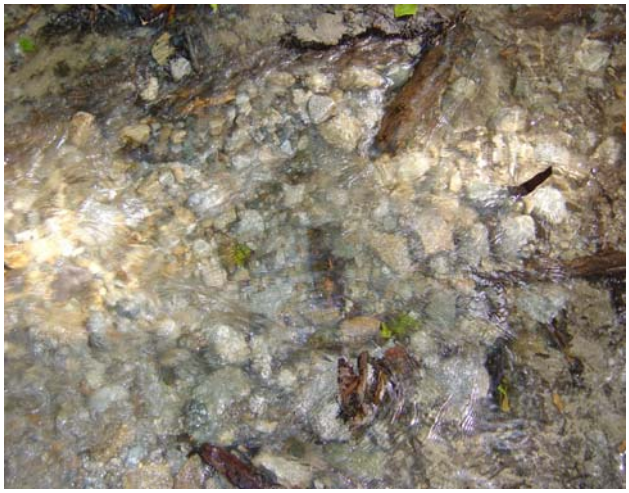
Downstream view – Before Material Removal

Upstream View – Hatchery Creek – After Work

Volunteers Work to Remove Debris and Beaver Dams Prior to Silt Removal Pictured L to R: Ben Sabal (BC Parks) Ian Maxwell and Allan Lanctot,(LWS)

Silt Removal – Ross Stenquist, Operator

Excavation - Lower Reach – R Stenquist, Operator


Gravel/Cobble revealed under silt….


Test Pit Excavation – Above Large Beaver Pond
T. Montague, Operator

Test Pit – Above Large Beaver Pond

Test Pits are now connected, large woody debris is replaced

Upper Channel - complete

View just above large beaver pond, silt fence pending….

Above large beaver pond, looking up channel

B. Shepherd –DFO – one last look…

APPENDIX 5

Financial Report

Time frame: 01/04/05 (mm / dd / yy) to 03/31/2006 (mm / dd / yy)

Labour

Wages & Salaries

Position	# of crew	# of work days	hrs per day	rate per hour	Total (PSC + in-kind + cash)	In-Kind + Cash	PSC Amount	Actual expenditure	Variance
DFO Bio	6	8	45	2640	2,640	2,640	-		
DFO Eng	3	8	55	1320	1,320	1,320	-		
DFO Eng tech	3	8	45	1080	1,080	1,080	-		
					-		-		
Fish techs (Kitselas)	7	8	35	3920	3,920	3,920	-		
					-		-		
							-		
Person Days (# of crew x work days)		-		sub total	8,960	8,960	-		

Labour - Employer Costs (percent of wages subtotal amount)

rate	10%	sub total	900	-	900	0.00	900.00

Subcontractors & Consultants

	# of crew	# of work days	hrs per day	rate per hour					
Surveyor	2	3	8	65	3,120		3,120		
Eng/designer	1	4	8	80	2,560		2,560		
Drafter	1	4	8	60	1,920		1,920		
					-		-		
Insurance if applicable	rate	0%			-	-			
				sub total	7,600	-	7,600	7366.00	234.00

Volunteer Labour

	# of crew	# of work days	hrs per day						
Skilled	2	4	8	30	1,920	-			
Un-skilled	2	5	8	25	2,000	-			
Insurance if applicable	rate	0%			-	-	-		
				sub total	3,920	3,920	-		

		Total (PSC + in-kind + cash)		In-Kind + Cash	PSC Amount	Actual expenditure	Variance	Explanation
Site / Project costs	Detail (use additional page for details if needed)***see next worksheet							
Travel (do not include to & from work)	Travel for consultants, volunteers, partners	4,000		1,800	2,200	2186.63	13.37	*3
Small Tools & Equipment	Shovels, wrenches, etc.	200		100	100			
Site Supplies & Materials	Spawning gravel, LWD, cables, clamps, log staples	8,250			8,250	1772.01	6477.99	*4
Equipment Rental	Excavator, pumps, generators, chainsaws	7,250			7,250	15775.06	8525.06	*5
Work & Safety Gear	Hard hats, work gloves	200		100	100	0.00	100.00	In-kind
Safety Training & Supplies	First aid gear	200		100	100	0.00	100.00	In-kind
Repairs & Maintenace	n/a							
Permits	n/a				-			
Technical Monitoring	2 temperature data loggers	300		300	-			
Other site costs	Miscellaneous items	500			500			
	Total Site / Project Costs	20,900		2,300	18,600	19734.00	1134.00	*3,*4,*5
Training	Detail (use additional page for details if needed)							
N/A					-			
	Total Training	-		-	-			
Overhead	Detail (use additional page for details if needed)							
Office space; including utilities, etc.		1,200		600	600			
Insurance		200			200			
Office supplies		400		200	200			
Telephone & long Distance		300		150	150			
Photocopies & printing		500		200	300			
Other overhead costs		200			200			
	Total Overhead	2,800		1,150	1,650	1650.00	0.00	*6
Capital Costs / Assets								
N/A					-			
	Total Capital Costs	-		-				
	Project Total	45,080		16,330	28,750	28750.00	0.00	

Budget Summary (all funding sources)

Labour	21,380
Project / Site Costs	20,900

Explanation of variances between projected expenses and actual expenses:

***1** Employer labour costs were provided in-kind by project partners

***2** $4066 - initial planning site survey by McElhanney Consultants; $3300 - final asbuilt survey by McElhanney Consultants

***3** DFO travel costs for project supervision = $1272.73; Lakelse Watershed Society travel to and from the site and Terrace for planning meetings, equipment arrangements, stream walks, etc. = $913.90

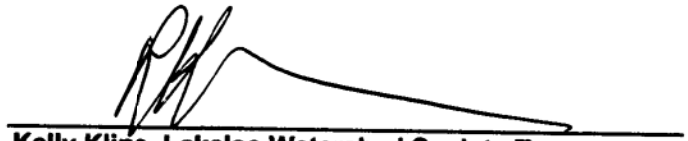
***4** Spawning gravel ($1212.30 from Ken Simons pit); filter cloth ($171.00 from Billabong Road & Bridge Maintenance Inc.), T-bar, safety fencing & supplies ($389.01 - Independent Industrial Supply). Costs are considerably less due to the final surveys/assessments which determined that there was sufficient large woody debris (LWD) in the creek - so additional LWD placement was not done. We also required less gravel for the spawning platforms which are smaller than anticipated due in part to access to the creek. Gravel cost was also considerably less than anticipated because we were able to access a local Lakelse source which saved on trucking costs, etc.

***5** Excavator rental for sediment removal, gravel placement ($804.43 from Nechako North Coast), excavator and truck for channel excavation ($14,583.03 from Terry Montague); Pump and hose rental ($387.60 from West Point Rentals). These costs were more than anticipated due to several factors. The test pit excavation was successful and we decided to excavate a channel (actually deepen an existing channel and extend it somewhat) and then connect it to the upper beaver pond. In order to retain the esthetic value of the channel, we decided to truck excavated material out of the site rather than side-cast or spoil on-site. We were able to spoil material adjacent to the dike a few hundred meters upstream from the channel - but the added cost of trucking still elevated equipment rental costs. Esthetic value of the site was of particular importance because the project is within BC Parks.

***6** $1650.00 - Lakelse Watershed Society expenses for office supplies, printing services, phone and internet services, building overhead, etc.

NOTE: We expected some variance in costs, since the project proposal was to develop the project plan and complete the project in one funding cycle. Therefore, the anticipated plan and expenditures had to be flexible in order for the final project to reflect information gathered in the initial surveys and assessments.

Signature of Lakelse Watershed Society Treasurer:



Kelly Kline, Lakelse Watershed Society Treasurer