Assessment of
Lower Klappan River and Tributary Crossings

Prepared for

Klabona Keepers Society

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Cover photo shows view downstream from Klappan Bridge to Slide 1 at 24.5 km

Summary

The purpose of this report is to present background information and survey results for river erosion assessments conducted at selected lower Klappan stream crossings and road encroachments. In September 2007, Suskwa Research was retained by the Klabona Keepers Society to assess various sites in the lower Klappan drainage that have been impacted by either BC Rail construction or recent snowmelt flooding. This assessment is part of a larger sub-regional effort to provide baseline information to support the Klabona Land Stewardship Plan process.

The primary objective of this project is to focus on Sites 1 to 5 as delineated by Shell Canada and additional sites upstream on Klappan River. Site 1 is a historic landslide located at 24.5 km just downstream of the Klappan River crossing. Site 2 is the northern approach to Klappan River Bridge crossing. Site 3 is an unnamed creek crossing the BC Rail grade at 26.5 km. Site 4 is a unnamed creek crossing the BC Rail grade at approximately 27.5 km. Site 5 is a 300 m in width section of the BC Rail grade which has been eroded by Klappan River at 29 km. In aggregate, Klabona Keepers' view the cumulative works identified as Sites 1 to 5, as well as the other sites identified in the Shell materials such as the "Big Eddy" site, as a major project.

Water quality in the Klappan River has been compromised as a result of BC Rail construction activities. The rail grade is located on the northern floodplain for much of its length. Construction practices (rip-rapping) effectively reduced the lateral movement of the river in some floodplain areas, blocking off some of the floodplain and many side and back channels. Chronic erosion is due to failing hillslopes, stream banks, and a lack of erosion control measures. These impacts could be mitigated by implementing bank erosion measures such as applying revegetation, bioengineering, hydro and dry seeding, mechanical pullback and re-contouring, and installing rock blankets and rip-rap where required.

The present physical situation is a result of the connections that exist between the lower Klappan River floodplain and high value fish habitat, the position of the abandoned BC Rail grade, the poor construction practices employed building the grade, the lack of maintenance and monitoring on the grade, and the high snowpack levels in the Klappan drainage that caused overbank flooding in 2007.

Sites 1 through 5 are similar in that road maintenance and monitoring required by current B.C. legislation has not occurred. BC Government is neither taking liability for the B.C. Rail grade or its environmental management even though they enabled the construction of it and continue to permit third party interests to use it on an adhoc basis. In turn, Fortune Minerals who holds the Special Use Permit (S24493) and Shell Canada who has been granted road user status are not mitigating the ongoing environmental risks and liabilities associated with the grade.

Klabona Keepers believes it is in the best interests of local First Nations and the B.C. Government to discuss the overall Klappan development issue and move forward on establishing suitable and equitable socio-economic solutions. There is a clear and compelling need for planning that takes into account First Nation values and interests, adequate levels of environmental management, and how land and resources are to be used.

Discussions between Klabona Keepers and the B.C. Government in early 2007 in regard to the environmental problems on the grade and the restoration efforts needed to mitigate fish passage and sediment control concerns did not advance due to the government no-liability position. Klabona Keepers has documented 25 additional sites affected by the B.C. Rail grade in the Klappan drainage that need to rehabilitated.

There is an emerging consensus that environmental management in the Klappan needs to be conducted differently to avoid the conceptual conflicts that are endemic to the current approach. The current approach may serve the public interest less in the future as First Nations and regional communities demand healthy ecosystems and sustainable development values.

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1.0 Introduction

The purpose of this report is to present background information and survey results for river erosion and stream crossing assessments conducted at selected lower Klappan stream crossings and road encroachments. In September 2007, Suskwa Research was retained by the Klabona Keepers Society to assess various sites in the lower Klappan drainage that have been impacted by either BC Rail construction or recent snowmelt flooding. This assessment is part of a larger regional effort to provide baseline information to support the Klabona Land Stewardship Plan process. The primary objective of this project was to focus on Sites 1 to 5 as delineated by Shell Canada (2007a) that were impacted by the 2007 Klappan River snowmelt flood and provide remedial recommendations that conserve fisheries values and protect aquatic habitat.

1.1 Location and Access

Klappan River flows generally northwestward into the Stikine River confluence approximately 17 km east of Highway 37. The Klappan watershed is bounded on the north by tributaries to the Stikine River, to the east by the Spatsizi drainage, to the west by the headwaters of Iskut River, and to the south by headwater tributaries of the Nass and Bell-Irving rivers. The Klappan watershed drains a western portion of Stikine Plateau and the northwestern portion of the Skeena Mountains. The Klappan River is located approximately 500 km north of Smithers, B.C.

Road access to the Klappan drainage is afforded by Ealue Lake Road, which turns eastward from Highway 37 close to Tatogga and about 18 km south of Iskut. Ealue Lake Road approaches the Klappan River at approximately 24.3 km and crosses the Klappan River at 25.1 km, where the road meets the abandoned BC Rail grade. The rail grade stays on the east bank of the Klappan and Little Klappan rivers to the headwaters, traverses through the upper section of the Spatsizi drainage, then heads southeasterly down the north bank of the Skeena River eventually reaching Fort St. James. Other access to the Klappan River is by river boat and air.

1.2 Klabona Keepers

Klabona Keepers Society embodies Klabona Elders and community members focused on cultural continuity and community development. Klabona Keepers represents aboriginal members in a non-profit structure that focuses on research, sustainable cultural and economic development, and cross-cultural education related to their traditional territories.

Most Klabona Keepers reside in Iskut that is located alongside Hwy #37 in northwest British Columbia. Iskut community ancestors have resided in the area for many thousands of years. Presently, most community members have strong values, interests, and perspectives revolving around our lands, resources, and rebuilding a vibrant and healthy aboriginal culture. Klabona Keepers have increasing concerns in regard to exercising their rights to access or use their ancestral lands and resources and wish to establish reasonable and sustainable social and economic plans for future generations.

Klabona refers to the extraordinary place, the Sacred Headwaters that comprise the headwaters of three great salmon ecosystems; the Stikine, Skeena, and Nass Rivers. The Sacred Headwaters area has significant cultural, recreation, fish, wildlife, education, and economic values and interests to Iskut community. The area is rich in Klabona cultural heritage and seasonal traditional activities continue into the present.

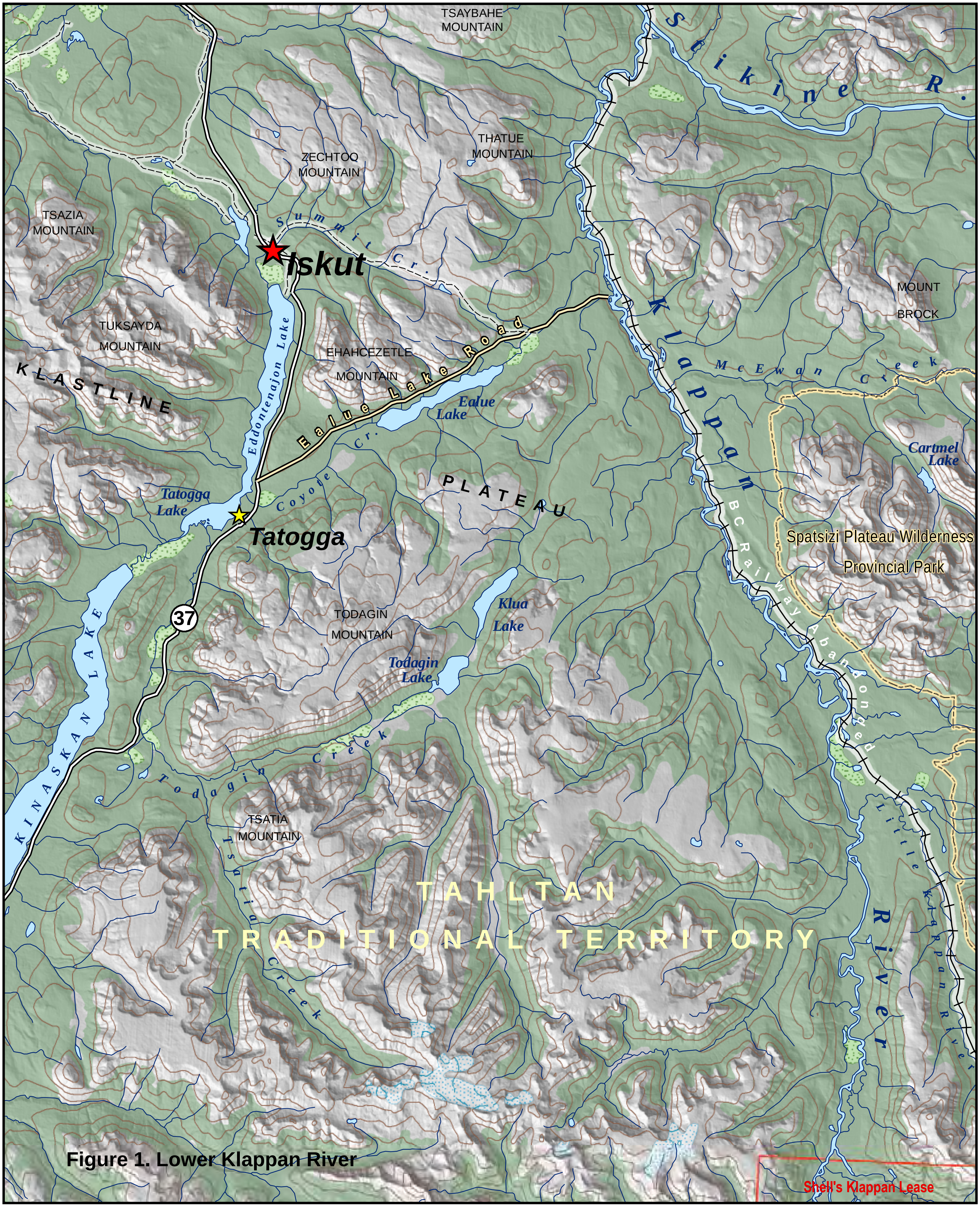


Figure 1. Lower Klappan River

2.0 Environmental Setting

The Klappan River is a large tributary of the Stikine River draining approximately 6.9% of the Stikine watershed. The Stikine drainage encompasses approximately 52,000 km2 and includes major tributaries such as the Chutine, Iskut Tahltan, Spatsizi, and Klappan rivers. The Klappan flows approximately 140 km northwest from its headwaters near Nass Lake to the confluence with the Stikine River.

2.1 HYDROLOGY

The Klappan is a seventh order stream with a catchment area of 3,548 km^2. Elevation ranges from approximately 716 m at the mouth to 2090 m on mountains in the headwaters. Klappan River peak discharges occur typically in June and July due to spring snowmelt, and then decrease through late-July and August. In September, fall rains and runoff from early snow melt increase stream flows once again through to October. Stream flow decreases through November and December when precipitation falls as snow, with low discharges recorded January through March.

The Hydrometric Station 08CC001, located 6 km upstream from the Klappan-Stikine confluence, recorded a mean annual discharge of 72.3 m^3/s with mean discharges of 240 m^3/s for June and July over a 34 year observation period (1962–1996). Summer low flows are typically four to eight times greater than winter stream flows and are principally sustained by high elevation snowmelt draining from the Skeena Mountains, while winter low flows are derived from groundwater, lakes, and unfrozen wetlands.

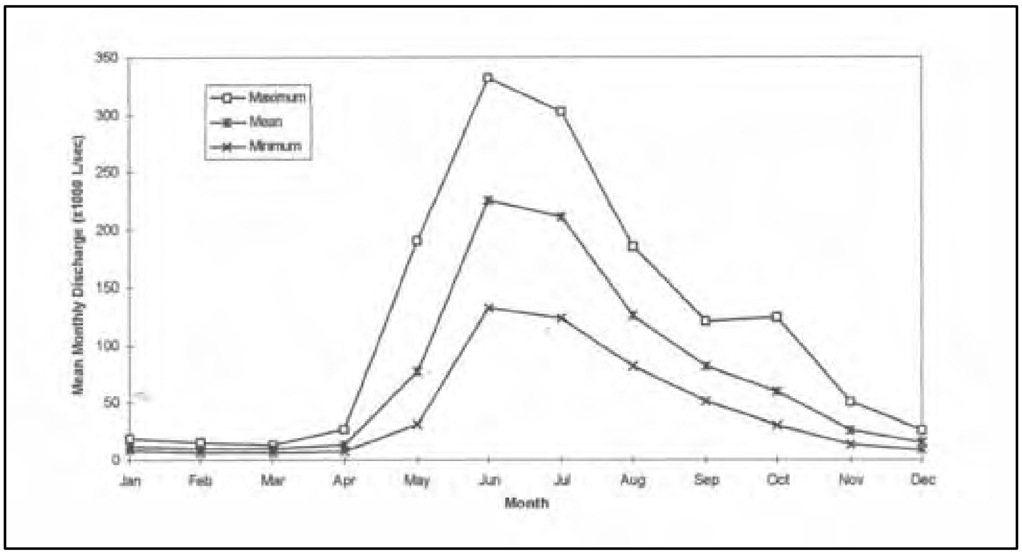


Figure 2. Klappan River hydrograph from Hydrometric Station 08CC001.

The climate of the Klappan drainage is controlled by topography and by the large-scale mid-latitude weather frontal pattern; the watershed lies in the rain shadow of the Coast Mountains and as a consequence, precipitation is relatively low. Climatic information from various short-term weather stations located in the upper Klappan shows mean annual precipitation of 650 mm with roughly half of this falling as rain in the summer season. The snowpack generally ranges from 1.5 to 2.3 m in depth.

The watershed as a whole has a moderately high response from water input due to the relative steepness of the mainstem and tributaries. In general, all tributary streams drain mountainous country and for the most part, transport relatively large amounts of bedload and suspended sediment originating from natural sources. The wide variations in the Klappan mainstem flows are primarily attributed to these tributaries. Through the summer season, the mainstem as well as many tributaries generally have glacially turbid, unstable flows.

Significant tributaries from the northeast draining the Eaglenest Range and flowing into Klappan River include McEwan, Eaglenest, Tsetia, and Conglomerate creeks and Little Klappan River. Major tributaries draining the Klappan Range include Sweeney, Tumeka, and Maitland creeks. Four lakes over 40 ha in size provide minor amounts of water storage for the drainage. A relatively moderate number of subalpine wetlands and bogs provide relatively stable flows, temperatures, and water quality characteristics.

2.1.1 Water Quality

Klappan River is normally very turbid and contributes a heavy silt load to upper Stikine River. Water quality has been sampled in portions of the watershed several times since the late 1970s. The Mount Klappan Anthracite Project environmental assessment investigated water quality between 1984 and 1986, with results indicating an oligotrophic system. Total phosphorus averaged from 0.003 mg/l to 0.025 mg/l while nitrate was generally lower than 0.05mg/l. Nitrogen to phosphorus ratios varied from less than 5:1 to greater than 10:1, indicating that either or both nutrients could be limiting primary productivity at various times of the year (Gulf Canada Corp.–Coal Division 1987). These data concurs with water quality results documented by Jones and Tsui (1979). Periphytic algae samples taken from the substrate showed chlorophyll a concentrations in a range of 0.8-3.7 mg/cm^2.

Schell (2001) conducted a 1:50,000 scale overview inventory that reported on water quality parameters assessed including temperature, pH, conductivity, and turbidity. His results indicated that:

1. Stream temperatures varied through the watershed but were relatively cold; the mean was 7.4 ^{o}C with a range from 4 to 14 ^{o}C.
2. pH values were generally basic with 21 out of 41 sites having values greater than or equal to 8.0 with a range from 6.0 to 8.7.
3. Conductivity varied from 63 to 516, with the mid and lower Klappan tributaries characterized by the higher values, the lowest values occurring in the Little Klappan and Klappan headwaters, and mid to low values attributed to the mainstems.
4. Overall tends in turbidity showed the tributaries as clearer and the mainstem more turbid with a moderate sediment load. Clear, slack water is a limiting factor to juvenile fish production in the Klappan system.
5. Water quality in the Klappan is generally high with the exception of turbididty and suspended sediment levels.

2.1.1.1 Erosion

Accelerated erosion and sedimentation can occur as a result of the removal of forest cover, breakdown of soil structure, increase gradient of cutslopes, road compaction and reduced infiltration, concentration of water on or by the road, and decreased shear or increased shear stress or both on slopes (Toews and Brownlee 1981). Mass wasting through land sliding is the main erosion problem associated with the BC Rail that passes on the north bank of and adjacent to the Klappan and Little Klappan Rivers; however, surface erosion continues to be a chronic problem as well.

Figure 3. View shows BC Rail grade at bottom foreground and eroding hillslope located at 40 km.

The key to reducing mass wasting is by planning and maintaining adequate erosion controls and drainage systems; neither of these solutions has been applied to any extent on the BC Rail grade. In regard to fish resources, sedimentation causes sufficient deposition to markedly reduce salmonid egg survival, reduces bottom gravel interstices, and reduces invertebrate production that is foundational food for fish, as well as affecting general water quality. Table 1 lists various sites where significant erosion has occurred since the mid-1970s and continues to contribute unreasonable amounts of sediment to the Klappan system. These site locations are shown in Figure 10 of this report.

BC Rail Grade in Klappan Drainage-Erosion Issues			
Site	Easting	Northing	Comment
6007	465526	6397663	Spoil from slide and bank actively eroded by the river. 38.0 km
6008	465584	6397614	Slide crosses road delivering sediment into river. 40 km
6009	465639	6397583	Middle of slide-125 m to headscarp. 38.5 km
6010	466015	6397171	Slide crosses road delivering sediment into river. 40 km
6011	466040	6397115	Extensive erosion and gullying on cutslope.
6012	466203	6395895	Spoil endhauled from 40 km slide being eroded into river
6014	472218	6389998	Cutslope slumping at 50.7 km
6015	472761	6387863	River has eroded largely sand fill on the grade that encroaches into the river. 53.05 km.
6016	477576	6380334	Cutslope slumping across road. 62.3 km.
6017	478023	6379608	3000 mm culvert collapsed. Large-scale erosion on outlet side. 63.2 km.
6018	478851	6376731	Cutslope slumping across road. 62.3 km.
6019	478738	6375760	Tsetia Creek. Erosion on eastern bridge abutment.
6020	479252	6374210	Cutslope slumping across the road. 70.1 km.
6021	491817	6360319	Cutslope slumping across the road.
6022	494121	6358476	Cutslope slumping across the road. Fillslope undercut and culvert at risk of failure.
6024	501209	6355111	Cutslope slumps into ditch and road. Ponding on the road.
6025	502054	6353886	Cutslope failing into borrow pit.
6026	502922	6353266	Cutslope failing into borrow pit.

Table 1. Sites on the BC Rail Grade with erosion issues.

2.2 GEOGRAPHY

Klappan River flows in a northwest trending valley that bisects the Eaglenest Range to the north from the Klappan Range located to the south. Three physiographic units are present in the Klappan Watershed: the Klastline Plateau, the Spatsizi Plateau, and the Northern Skeena Mountains. The valley bottoms of the Klappan River and its principal tributaries, the Little Klappan River and Eaglenest Creek, are occupied by boreal forest. Frequent fire history has created a mosaic of white spruce-, lodgepole pine-, and aspen-dominated forests in a variety of seral age classes, and extensive deciduous shrublands.

Extensive wetland habitats, in the form of fens, marshes, swamps and bogs are common along the valley bottoms. Subalpine fir and scrub birch habitat prevails at upper elevations. Above the boreal forest and in higher elevation valleys from about 1,000 to 1,650 m elevation, extensive areas of open white spruce forest, scrub birch, and willows are most common. In areas of cold air ponding in the upper Klappan, the scrub/woodland is replaced by open meadows of grass and forbs and thickets of low deciduous shrubs. Four biogeoclimatic zones are located in the watershed. The Klappan River valley floor contains mostly boreal white and black spruce (BWBS) with some Engelmann spruce - subalpine fir (ESSF) at the southern end including Tumeka and Sweeny valley floors. All other valleys and the valley walls of the Klappan River valley support spruce-willow-birch (SWB). Alpine tundra (AT) dominates at higher elevations.

Folded and faulted Bowser Basin marine sediments characterize the underlying bedrock in the Klappan Watershed. The ice that covered and flowed down the Klappan Valley during the last glacial period strongly glaciated the mountain slopes and the basin, leaving thick blankets of glacial till covering the main valley and mountain valleys and extending partially up the valley sidewalls.

The lower Klappan River floodplain and alluvial terraces are composed mostly of gravel and sand, which dominate the surficial materials. This is primarily due to the river downcutting into outwash materials from the end of the Pleistocene glaciation. On the very lowest elevations within the current floodplain, recent alluvial deposits range from sand to silty materials and gravels.

2.2.1 Reach 2 Stream Channel

The Klappan River cuts through a rugged landscape composed of a diverse assemblage of glaciated mountains. The moderately steep-sided valley has been filled with hundreds of meters of sediment carried by the river since deglaciation, 10,300 to 11,000 years ago. The sediment deposition has formed a wide low-lying valley flat containing many islands and gravel bars, sizeable logjams, and extensive back channels and wetland areas.

Of interest to this study is Reach 2 that starts 1.6 km downstream of the Klappan River Bridge and extends upstream 5.8 km, almost to McEwan Creek. Reach 2 is characterized as a wandering gravel bed river with a straight and sinuous channel pattern. This reach possesses an average gradient of 0.09% and average widths of 150 m. Average velocity during moderate flows is up to or are 1 m/s. Schell (2001) noted that the Klappan River mainstem is generally a cold, moderately turbid system. Large secondary channels 20-50 m in width are plentiful. Numerous divided channels, backwaters, and swampy areas resulting from shifting islands and gravel bars characterize the Reach 2 floodplain, which averages 680 m in width. In this section, islands range in size up to 4 ha and continuously undergo substantial changes, resulting in this being a dynamic section of the river.

Streamflow conditions in the Klappan River are highly variable over short time periods, and consequently, habitat attributes such as water velocity and depth have the potential to change rapidly. Most of the river channels have complex histories of abandonment, filling, re-excavation, and reuse. Sloughs are common and the majority of sloughs on the north bank have been created because of the rail grade blocking flood channels. A small number of these sloughs are borrow pits associated with the railroad construction. Observations indicate that Reach 2 has high natural levels of overbank flooding, lateral channel migration, and in general can be expected to display a great degree of instability.

Figure 4. View southward of Reach 2 just upstream of Klappan River Bridge crossing shows the productive multi-channel habitat.

Schell (2001) noted that primary and secondary channels contained good to excellent rearing and overwintering habitat for large adult fish. Overhanging vegetation and large woody debris are the dominant cover with moderate amounts of boulders, deep pools, and undercut banks. Spawning habitat was rated fair to good in secondary channels and apparently was limited by the high amount of substrate fines.

Figure 5. View westward from Site 5 across Klappan River to bars, logjams, and islands.

Unique and conspicuous features of this river section are the relatively large logjams, which range from a few tree lengths to logs piled continuously for up 150 meters. These log piles are important structural features that promote sediment deposition when located on or adjacent to a mid-channel bar; if positioned at the mouth of a back channel, they stabilize and train the river channel. Unlike logjams elsewhere in the Klappan system, these large logjams provide juvenile habitat at most discharge stages. Side channels regulated by logjams do not get scoured and provide important habitat for juvenile fish. The logjams provide the predominant all-season cover for fish in Reach 2.

2.2.2 Klappan River Floodplain

Numerous divided channels, backwaters, and swampy areas resulting from shifting islands and gravel bars characterize the Reach 2 floodplain, which averages 680 m in width with a range from 0.340 to 1.48 km. The active floodplain is defined as "that part of the contemporary floodplain subject to occupation by standing or flowing water more frequently than once in five years, on average" (Church and Eaton 2001). The main concept underlying the Klappan River active floodplain is that it is snow melt dominated. This is characterized by the large amount of high elevation ground within the watershed and by the hydrograph that predictably has a single peak in discharge during June and July. This snow melt peak usually has slight annual variations in magnitude based on snow accumulation and rate of melt.

Brown (2002) examined the relationships between B.C. floodplains, flooding, and salmonid habitats. He noted that from an ecological perspective, flooding is a natural event and an integral part of salmonid life cycles. When a river is separated from its floodplain and held to a permanent course by dykes such as the BC Rail grade in the lower Klappan, considerable loss of salmonid habitat will result. As well, the BC Rail grade channel alterations have had and continue to have damaging hydraulic effects.

In many instances, the channel alteration blocks off side channels and offchannel habitats. The cross-sectional area available for transport of water and debris during floods can often be dramatically reduced, flow velocities can be increased, with consequential interruption of natural flows. This flood dynamic occurs in the lower Klappan to a certain extent and is indicated by bank erosion, especially on outside meander bends.

On the active Klappan River floodplain, there is a need to maintain natural flooding patterns as well as restore historic floodplain fish habitats that were disconnected or restricted by the BC Rail grade construction practices. It is important that the natural hydrograph that supports wetlands be maintained, that floodplain flooding occur, that natural avulsion and lateral channel migration be allowed. These factors are important in supporting the health of the river, riparian zone, and floodplain (Brown 2002).

The 2007 spring snowmelt flood on Klappan River produced significant flooding in Reach 2; however, the flood height was undetermined. The Hydrometric Station 08CC001 located on the lower Klappan River has been inactive since 1996. Figure 6 shows the snow water equivalent for Tumeka Creek snow pillow data (Station 4D10P) for 2006-2007. The flood overtopped the river banks and substantial silt and sediment deposits are evident on the floodplain above the abandoned BC Rail grade. This is especially noticeable at Site 5, where the river was channelized; here high velocity flows eroded close to 300 m of light to moderate weight riprap and the road prism delivering the sediment downstream.

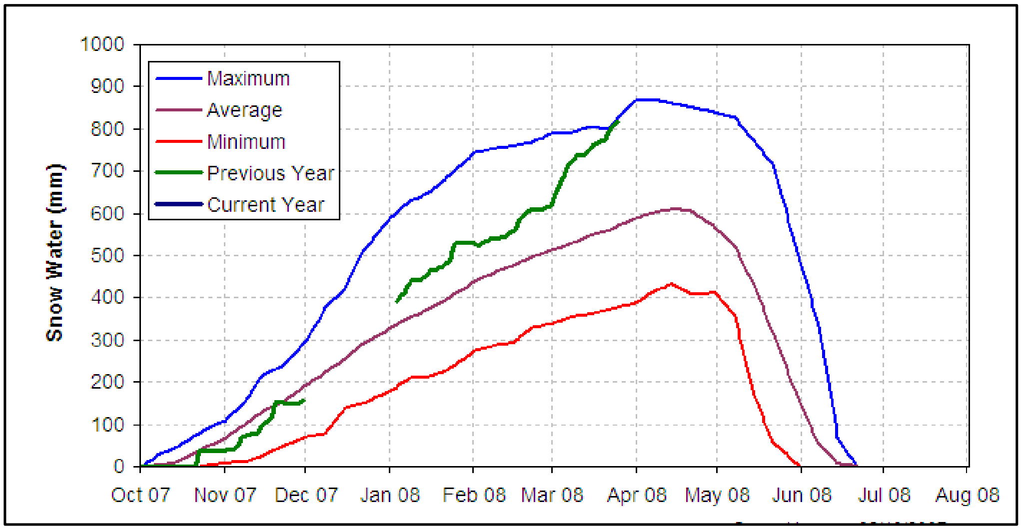


Figure 6. Upper Klappan snow water equivalent plot, 2007. Adapted from Ministry of Environment 2007. Note: years should read 06 and 07.

A notable feature of the Klappan River, Reach 2 floodplain is the relatively large quantity of beaver activity that support juvenile salmonids, particularly rainbow trout, mountain whitefish, and bull trout. The benefits of beaver activity include creating large amounts of high quality juvenile rearing habitat, which is of considerable value in the Klappan system. This is due to the lack of clear and slack water with protective cover and abundant food supplies. Rainbow trout, mountain whitefish, and bull trout young of the year prefer slack water. Age two and three juveniles will move out into secondary and main channels; however, their preference then is to seek cover, particularly in and around boulders. Negative effects are primarily due to dam failures, which potentially can create dramatic outburst flows causing channel changes, bank erosion, and scour.

Figure 7. Typical off-channel habitat created by beaver activity adjacent to Site 5.

Reduced hydrological connectivity in these floodplain habitats relative to other off-channel stream habitats may leave juvenile fish disproportionately susceptible to interannual variations in summer streamflows. In Reach 2, this principle applies to the lack of accessibility and fish passage to and from the high value and productive floodplain habitats to the main river channel that is separated by the BC Rail grade. Conditions during a drier summer have and will negatively impact juvenile fish populations by causing stranding of out-migrating juveniles, increasing vulnerability to predation and physiological stress, and restricting access to, and the ability to disperse among, floodplain habitats (Rabnett 2005).

2.2.3 Fish Passage

The connectivity of diverse fish habitats for various fish life stages is fundamental to supporting fish abundance in the Klappan watershed's freshwater habitats. Tributary streams, lakes, off-channels, back channels, ponds, and sloughs all provide critical habitat. Ensuring that these components remain connected for the free migration of spawning adults and rearing juvenile fish is a critical component in maintaining healthy fish populations.

The maintenance of healthy fish populations requires that streams crossed by roads and non-open bottom structures such as culverts permit the free migration of spawning adult fish and rearing juveniles to upstream habitat (Parker 2000). Many kilometres of critical habitat on the lower Klappan that used to support salmonids are inaccessible due to improperly designed and installed fish passage structures along the abandoned BC Rail grade. Installation of at least twelve culverts has changed stream hydraulics, particularly by increasing flow velocities and creating outfall drops, which have caused migration barriers. Restoring access to additional upstream habitat through culvert rehabilitation is one of the most timely and cost effective activities that can benefit fish abundance and habitat productivity.

Figure 8. Wetland created as part of beaver pond complex adjacent to the BC Rail grade at 27.5 km. This pond located approximately 95 m upstream from the Klappan River is disconnected due to dysfunctional culverts.

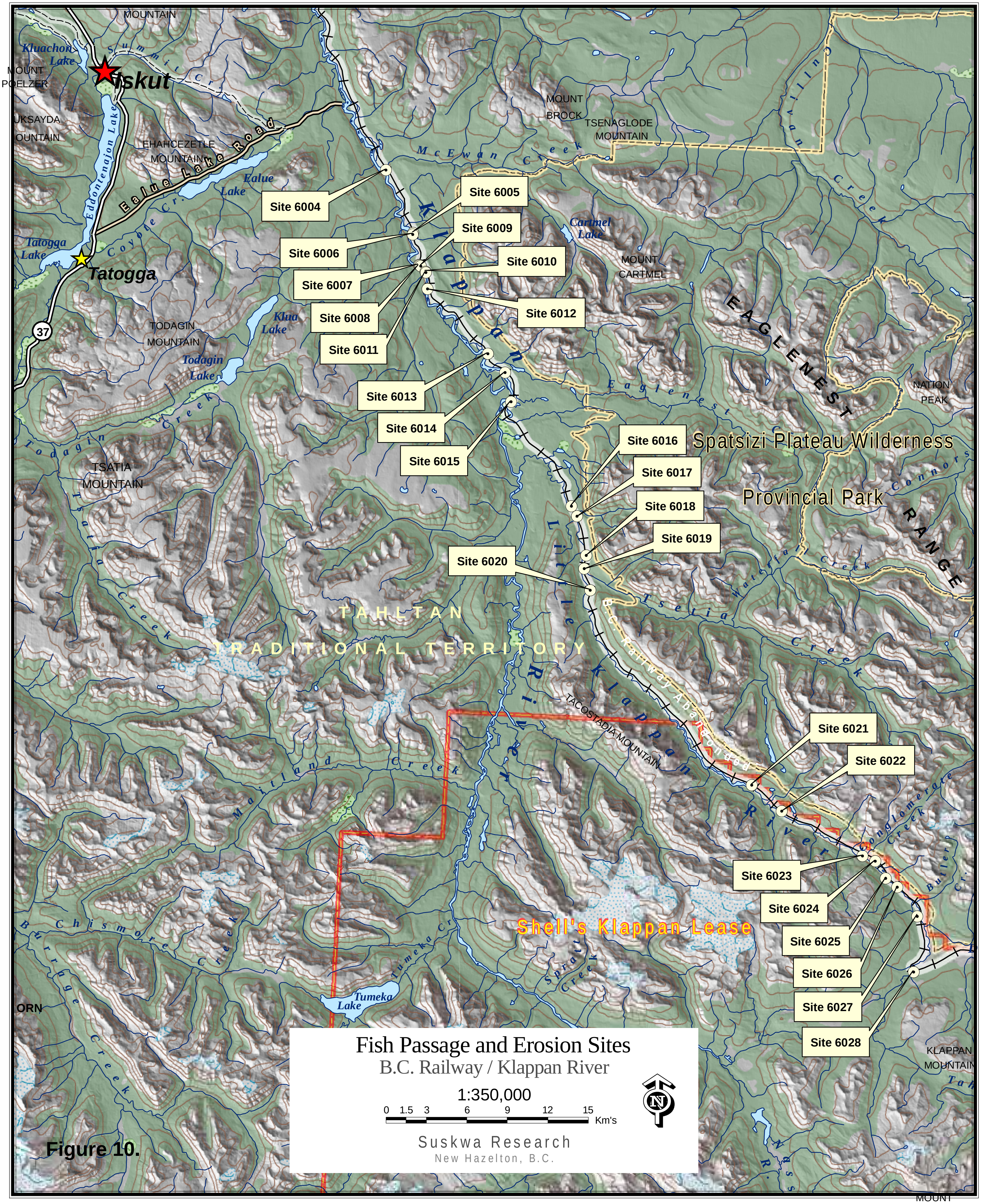
The movement of fish through culverts can be restricted by many factors including culvert length and gradient, stream levels and velocities, and inlet and outlet configurations. Improper culvert design and installation can block fish passage to spawning and rearing areas such as small streams, lakes, and wetlands. In some cases, depending on culvert location, large portions of sub-basins may be inaccessible due to full or partial obstruction at crossings. The direction and length of migration vary with the fish species and life stage; consequently, the necessary timing, frequency, and duration for unimpeded access to required habitats also vary. On a finer scale, juvenile salmonids and adult resident freshwater species need to freely disperse to find optimal rearing conditions that ensure their survival, such as habitat with reduced competition, high quality and low velocity refuge habitat, and fewer predators.

Figure 9. This culvert located at 63.2 km is a significant fish passage issue that needs to be mitigated.

Restoring fish passage increases the amount of available habitat within a stream system. If habitat abundance is the limiting factor, increased access to additional habitat will likely result in a rise in fish populations. However, the population response to habitat gain is also frequently dependent on numerous other factors, which may include the quality and quantity of new habitat, the nature and abundance of predators, and the presence of competitors.

Fish Passage Issues on BC Rail Crossings in Klappan Watershed			
Site No.	Easting	Northing	Comment
6004	462775	6404562	2-2500 mm culverts with outfall drops on McEwan Creek crossing.
6005	464959	6400015	Backchannel disconnected from river.
6006	464942	6399891	Tsanadto Creek, culvert velocity barrier.
6013	470887	6391334	3 culverts, 2-1000 and 1-1800 mm. Inlets partially blocked.
6017	478023	6379608	3000 mm culvert overhanging and then collapsed. Large-scale erosion on the outlet bank. 63.2 km.
6019	478738	6375760	Tsetia Creek. Erosion on eastern bridge abutment.
6022	494121	6358476	Fillslope undercut and culvert at risk of failure.
6023	500269	6355471	Conglomerate Creek. Culvert outfall drop and velocity barriers.
6027	504522	6351174	Little Klappan River. Twin culverts at 4% gradient present excessive velocities and a fish passage barrier.
6028	504404	6347059	Little Klappan River. Downstream culvert tilted up and dysfunctional. Both culverts are likely velocity barriers.

Table 2. Critical fish passage issues at BC Rail grade crossings in Klappan watershed.


Fish Passage and Erosion Sites
B.C. Railway / Klappan River
1:350,000
0 1.5 3 6 9 12 15
Km's
Suskwa Research
New Hazelton, B.C.
Iskut
Tatogga
Kluachon Lake
Eddontenajon Lake
Ealue Lake Road
Ealue Lake
Tatogga Lake
Klua Lake
Todagin Lake
Cartmel Lake
Tumeka Lake
MOUNT POELZER
EHAHCEZETLE MOUNTAIN
TODAGIN MOUNTAIN
TSATIA MOUNTAIN
MOUNT BROCK
TSENAGLODE MOUNTAIN
MOUNT CARTMEL
NATION PEAK
TACOSTADIA MOUNTAIN
KLAPPAN MOUNTAIN
EAGLENEST RANGE
Spatsizi Plateau Wilderness
Provincial Park
TAHLTAN
TRADITIONAL TERRITORY
Shell's Klappan Lease
B.C. Railway Abandoned Grade
Klappan River
Little Klappan River
McEwan Creek
Eaglenest Creek
Tsetia Creek
Waterfall Creek
Todagin Creek
Tsatia Creek
Maitland Creek
Chismore Creek
Burrage Creek
Tumeka Cr.
Spratt Creek
Conglomerate Creek
Coyote Cr.
Summit Cr.
Site 6004
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Site 6020
Site 6021
Site 6022
Site 6023
Site 6024
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Site 6026
Site 6027
Site 6028
37

Figure 10.

3.0 Fish Values

The Klappan River watershed is composed of approximately 140 km of mainstem and over 200 km of tributary streams that are considered high value fish habitat, provide a migration corridor, and support spawning and rearing. The Grand Canyon of the Stikine, located downstream of the Klappan River, is a barrier to anadromous fish; therefore, Pacific salmon are not present. The fish community contributes to the ecology, nutrient regime and structural diversity of the drainage. It also supports aboriginal and recreational fisheries. The fish presence is a strong part of cultural and community values and identity within the watershed. The high fishery values are rooted in the quality spawning and rearing habitat.

3.1 Fish Presence

Freshwater members of the family Salmonidae utilizing the Klappan and its tributaries include mountain whitefish, rainbow trout, bull trout char, artic grayling. As well, burbot a member of the gadiform order, and longnose sucker reside in the drainage.

3.1 Previous Studies

Four major fisheries surveys have been conducted on the Klappan system. In 1977, Shepard and Algard (1977) surveyed fish resources associated with the BC Rail grade including the mainstems of Klapppan and Little Klappan rivers and many of the eastern tributaries. This study was followed by multiple surveys in the late 1970s that were related to the proposed Stikine-Iskut hydroelectric development; these were reported by Irvine (1977) and Jones and Tsui (1979).

Fisheries investigations in relation to the proposed Mount Klappan Coal Project were reported on by Sekarak *et al.* (1984). This study focused on the distribution and composition of the fish community, critical habitat of the main fish species, and potential adverse impacts on fish from the proposed coal project. Fish sampling and habitat assessment was conducted on Quarry Creek, a tributary to the Klappan River for the Red Chris property. This intensive sampling was in relation to the proposed tailings impoundment in the headwaters of Quarry Creek. These studies noting rainbow trout abundance were reported on by Hallam Knight Piesold (1996), by Rescan (1998), and by McElhanney (2004) and summarized by Amec (2004).

Schell (2001) conducted a 1:50,000 scale overview inventory of the Klappan watershed with the objective of providing data regarding fish absence/presence, fish distribution, and broad interpretations of habitat sensitivity and fish production capability. This study is the most comprehensive to date in regard to fish presence and distribution and various habitat attributes.

Recent fisheries investigations include studies by Harwood, who assessed habitat and fish presence at four sites on the Ealue Lake Road (Harwood 2006a), at three sites on the BC Rail grade in the Skeena River drainage (Harwood 2006b), and at Sites 1-5 on the lower Klappan (Harwood 2007). Triton (2007) conducted an office-based fisheries background review, identifies in-stream work windows, and produced a map series displaying historical fish data. The Harwood reports and the Triton study were completed under the auspices of the proposed Shell Canada Klappan project.

3.2 Fisheries Information Status

It is important to note that other than the overview reconnaissance inventory conducted by Schell (2001), all fisheries studies have been completed as a by-product of development activities. Currently, available fisheries information pertaining to the Klappan watershed has determined what species are present in the drainage. However, it is interesting that Schell (2001) never captured artic grayling or burbot, which were historically documented as present, at any of the 43 stream and lakes site investigated. Has artic grayling or burbot declined to low or very low levels of abundance in the last three decades? Other basic stock assessment questions, that currently are lacking in answers include:

1) Are any of the fish populations or groups of populations special in some way?
2) How are the six known fish species performing in terms of abundance and health?

Overall, information is sparse on resident freshwater fishes in both fluvial (rivers) and lacustrine (lake) habitats of Klappan Watershed. Defining conservation levels requires understanding fish values and the biology of the species, including their critical habitats and population status. What and where are critical areas for fish, particularly in relation to the major life history stages? What are the capability and constraints for fish production? Are there fish populations of special interest or status that are now unknown?

There is a real need for systematic aquatic and fisheries resources baseline data in the Klappan watershed. Aquatic resources and fisheries conservation policies must rest on a solid foundation of information. Ecological and life history information that permits good conservation planning is critical. This concept is presently especially important in the Klappan given the high cost of rehabilitation and restoration efforts needed due to a lack of fish inventory and poor planning. Government and First Nation decision-makers must have sufficient information to weigh management alternatives and proposed development activities. However, even with the respectively moderate extent of information, enough is presently known to effectively manage the Klappan fisheries resource and conserve fish habitat.

3.3 Rainbow Trout

Schell (2001) reported on rainbow trout presence and distribution, length frequency, and age frequency. Rainbow trout were captured in Tumeka Creek, in the lower Klappan mainstem, in tributaries of the lower Klappan River downstream of and including Quarry and McEwan creeks, and in the middle reaches including tributaries of the Little Klappan River. In about 1977, rainbow trout were transplanted into Tumeka Lake by an unknown guide-outfitter. Balkwill *et al.* (1984) assessed the transplanted rainbows and found the fish to be large and unusually healthy. Anecdotal reports since that time indicate that the fish size and condition have significantly deteriorated.

Figure 11. Juvenile rainbow trout.

Rainbow trout females construct redds in fine gravel into which the eggs are deposited. Young emerge from the gravel in the summer and usually migrate into rearing areas of clear slack water such as backchannels, ponds, or lakes in the first year. Capture data from Klappan rainbow trout young-of the-year suggests they remain in these slower flowing waters until they reach maturity in two to four years, before moving back to natal streams for spawning. Carlander (1969) noted that generally, the growth of rainbow trout is slower in streams than in pond and lake habitat. Scott and Crossman (1973) reported that survival after spawning is usually low, and the number of repeat spawners is often less than 10% of the total spawning population.

Rainbow trout exhibit a wide range of growth rates dependent on habitat, food type and availability, and life history strategy. The fish show seasonal movement to access suitable habitat for feeding and overwintering. Critical habitat needs are reviewed in Ford *et al.* (1995). Generally, the type of food eaten reflects the size of rainbows and the season, with principal prey being zooplankton, benthic invertebrates, terrestrial insects, and fish. Juvenile rainbows may eat zooplankton, crustaceans, and small insects, while larger trout may take leeches, larger insects, molluscs, and a variety of juvenile fish.

3.2 BULL TROUT

Bull trout (*Salvelinus confluentus*) are actually a char that are provincially classified as "S3," a species of concern by the BC Conservation Data Center. They are also listed as a B.C. Identified Wildlife Species. This conservation status is due primarily to their limited global distribution and because of characteristics that make them particularly sensitive to human activities or natural events.

Sampling prior to 2000 in the Klappan River was done previous to the recognition of bull trout as a separate species from Dolly Varden. The earlier records for Dolly Varden could be referring to either of these species. Bull trout are common within the Stikine River and its tributaries, are known to exist in sympatry, and suspected to be found throughout the drainage.

Schell's (2001) overview inventory sample results indicated that no Dolly Varden were identified and that all branchiostegal counts were greater than or equal to 26, which determined the fish to be bull trout. Schell (2001) indicated that bull trout comprised 17.2% of all fish captured during his investigation. Bull trout have been captured or observed in the Klappan River mainstem and some of its tributaries, as well as in the Little Klappan mainstem and some of its tributaries upstream to the canyon in its upper reach.

Studies on bull trout in northwest B.C. are limited to the Morice Watershed (Bahr 2002) and the Shelagyote River (Giroux 2002). Even with differences in life history traits and morphometry, confusion between bull trout and Dolly Varden is common, and much of the available information on distribution is suspect (McPhail and Carveth. 1993). Both bull trout and Dolly Varden char occur in some Stikine tributaries. In these situations they appear to have divergent live history patterns, but it is possible some hybridization occurs in some streams.

Figure 12. Bull trout.

Fluvial and adfluvial populations spawn in small tributary streams and over-winter in larger rivers or lakes. Maturity is generally reached at five years of age, though precocious males may mature by age three (Shepard *et al.* 1984). Recent observations by Giroux (2002) and Bahr (2002) showed that upper Skeena bull trout typically spawn in gravel and cobble pockets in streams during late summer and early fall. Schell's (2001) observations indicated that Klappan bull trout spawning occurs in mid to late-August. Usually, eggs in the gravel hatch before the end of January, with fry emerging in late spring. After hatching, bull trout fry rear in low velocity backwaters and side channels and avoid riffles and runs (McPhail and Murray 1979). Juveniles tend to utilize a variety of stream and lake habitats and are most abundant where water temperatures are 12^0C or less. Their intra-watershed distribution patterns indicate they are sensitive to water temperatures, preferring cold natal streams.

Bull trout are a long-lived repeat spawning fish that can exceed twenty years of age and 10 kg in weight; however, in general terms, most bull trout captured by anglers range between 45 and 60 cm in length, and are 8–17 years old. Bull trout are a popular sport fish and are frequently harvested by sport anglers as by-catch during recreational fisheries targeting other salmonids. As adults, they are an aggressive piscivorous fish and vulnerable to overharvest by anglers. Limiting angler access, alongside identification and protection of critical habitat, remain the most significant issues for the protection of bull trout in northwest B.C.

3.3 MOUNTAIN WHITEFISH

Rocky Mountain whitefish is one of the six species in the genus *Prosopium*. Rocky Mountain whitefish, also commonly called mountain whitefish, are the most widely distributed and abundant fish in the Klappan Watershed (Schell 2001). That investigation showed mountain whitefish composed 68.8% of all fish captured and indicated distribution throughout the Klappan and Little Klappan mainstems and in the larger tributaries.

Mountain whitefish spawning habitat needs to be determined for local Klappan populations. Mountain whitefish use a wide range of habitats for spawning and do not construct redds (Ford *et al.* 1995). Mainstream river resident and lake dwelling populations move into tributary streams in the late fall to spawn (Northcote and Ennis 1994); however, McPhail and Lindsey (1970) report some cases of spawning occurring within lakes. Mountain whitefish are generally nocturnal spawners (McPhail and Lindsey 1970). The eggs hatch in early spring usually at the time of ice break-up. Young of the year generally leave near-shore or slack water habitat during the summer. There appears to be relatively little specific information in regards to yearling and sub-adult

Figure 13. Mountain whitefish.

Feeding and migration habitat. Godfrey (1955) noted that adults often occupy shallow portions of lakes or ponds and feed on aquatic insects and some small clams and snails. Although whitefish has attracted moderate attention from anglers, there are surprising gaps in knowledge of its life history and biology. Additionally, information gaps exist in relation to stock recognition, and impacts to water quality and to habitat change from development activities.

3.4 FISHERIES

3.4.1 First Nations Traditional Use

Klabonatin people have resided in the headwaters of the Stikine, Nass, and Skeena drainages since time immemorial. For the Klabonatin, freshwater fish resources were and are a very important cultural food source. This includes rainbow trout, bull trout, artic grayling in the mainstems and larger tributaries, and bull trout and mountain whitefish in the upper and headwater reaches. The abundant and predictable fish resource, particularly during spawning times, provided the opportunity for the Klabonatin people to harvest and preserve a high quality staple food. Allbright (1984) noted that the traditional freshwater fishery formed a key element of the subsistence economy.

The harvest of surplus to conservation needs on a species by species basis allowed for optimal utilization of the fish resource. The catching, processing, and storage of large quantities of seasonally available fish, alongside hunting and gathering plant and tree resources, enabled a resilient economy. Traditionally, camps were strategically located to take advantage of the rich Klabona fish stocks. Within Klappan drainage, fishing sites are reflected in the relatively large number of traditional use and archaeological sites located close to fish-bearing waters. To date, Klabonatin traditional lands and resources, as well as, cultural values and interests have not been well documented, mapped, and subsequently planned for. The Klabona Cultural Heritage program, which is documenting Klabonatin traditional use sites in the Klappan, is currently underway.

4.0 Development Activities

The principal development activity in Klappan watershed has been the B.C. Rail grade. There have also been moderate amounts of mineral exploration and minor amounts of coalbed gas exploration.

4.1 B.C. Rail Grade

Section 4.1 is presented to give context and should be distinguished as a general comment in regard to the B.C. Rail grade as opposed to Sites 1-5.

Linear development in the Klappan watershed includes the BC Rail (BCR) grade, which was part of the Dease Lake Extension, and was abandoned by BC Rail and the BC Government in 1977 (Gates and Reid 1985). From 1970 to 1977, a rudimentary railroad grade was constructed from Fort St. James 664 km north to Dease Lake. Steel rail was only laid to a few km north of Chipmunk Creek, with the subgrade in various stages of completion for the remaining 225 km to Dease Lake.

By 1972 costs had escalated and claims were launched by various contractors against the railway. In December 1975, a change in government ushered in a different philosophical direction for the railway. A board of directors was formed to operate the British Columbia Railway and this removed direct political influence from the day-to-day operation of the railway. The railway had become so deeply entwined with the ebb and low of provincial finances that in December 1976, a royal commission was appointed to sort it out. The construction of the Dease Lake Extension was suspended in April, 1977.

The report from the Mackenzie Royal Commission in 1978 changed the structure of BC Rail (McKenzie *et al.* 1978). It encouraged a new direction of operating on a commercial mandate rather than its previous role as an instrument of public policy and provincial development. Besides the socio-economic effects on Iskut, Takla/Bear Lake, and Stuart-Trembleur First Nations, the Commission revealed that extensive environmental damage occurred, as well as large-scale effects on fish and wildlife habitats and populations.

Site investigations, by Provincial government staff and by consultants to BCR during the 1970-1977 period of construction, showed that significant environmental damage had occurred as a result of poor design related to right-of-way alignment, river encroachments, culvert installations, and unstable conditions causing mass wasting. These studies and reports include: Bustard and Chudyk (1975), B.C. Fish and Wildlife Branch (1974), Taylor (1973), Galbraith (1975), and B.C. Ministry of Recreation and Conservation (1977).

In 1984, B.C. Ministry of Environment undertook a reconnaissance level investigation of the abandoned B.C. Rail grade with the purpose of:

1) Determining the degree of natural repair to the environment that occurred along the right-of-way in the past decade;
2) Identify areas where chronic environmental impacts continue;
3) Determine if there is a need for BC Rail in conjunction with BC Ministry of Environment to develop a program to correct damages and chronic impacts.

This investigation was reported on by Gates and Reid (1985). They concluded that it is impossible to determine the actual resource losses that resulted from short and long-term impacts caused by BC Rail construction activities. Impacts were still occurring at some sites where sensitive environmental conditions were noted in 1974. Notwithstanding the above, BCMoE recommended BC Rail, in cooperation with the Ministry:

1. Undertake a program of periodic inspections of major culverts and fills along the right-of-way in order to ensure their continued safe operation;
2. Examine the cost effectiveness of providing fish passage into certain tributary streams presently obstructed by improperly functioning culverts;

3. Undertake a program to define and solve problems resulting from uncontrolled access into wilderness areas along the railway;
4. Undertake a program to reclaim abandoned construction camps and borrow pits by removing abandoned trailers, buildings, culverts, machinery, etc, and by reseeding disturbed land;
5. take no action to replace those sections of railway washed out or damaged by culvert failure if the railway is not be reopened and if such measures are likely to cause further environmental impacts to water quality and fish resources.

No action has been taken on the first three recommendations, and only partial activities have occurred in relation to recommendation 4.

The majority of the rail grade was a First Nation trail that connected the upper Klappan, Skeena, and Nass basins with the Iskut valley (Klabona Keepers 2007, McLellan 1973, B.C. Department of Lands 1929). Since the grade was abandoned in the 1977, Iskut First Nation has maintained it on a “as needed basis” to afford access to their traditional use areas. In the early 1980s, Gulf Canada upgraded the BC Rail grade between the Ealue Lake Road and their exploration camp at 120 km.

In 2005, Fortune Minerals was granted a Special Use Permit (SUP) (S24493) to use the rail grade through the Klappan watershed. Clearly, the B.C. Government owns the rail grade if they are permitting use of it. The SUP places a responsibility on Fortune Minerals to maintain the road and that responsibility for maintenance was placed on Shell Canada by Fortune Minerals when it assigned the SUP to Shell. The failure to maintain the road by both or either Fortune Minerals and Shell Canada may constitute a regulatory offence where there is an obligation to act.

It is likely that Fortune Minerals is not in compliance with B.C.’s legislative framework, especially the *Forest Act*, the *Forest Practices Code of British Columbia Act*, and the *Forest and Range Practices Act*. The latter two acts contain regulatory provisions that relate to fish passage and sediment contribution concerns. As well, Fortune Minerals is delinquent in adhering to the permit Schedule A (Section 3.09), which states:

a) A maintenance plan must be submitted before July 1 each year that this permit is in place
b) A list of all maintenance works carried out in the previous year must be provided before the start of the following years work program.

B.C. Government has told Klabona Keepers that it is not responsible for the B.C Rail grade, does not accept legal liability for any historical construction on the B.C. Rail grade, and claims it has no obligation to act in regard to rehabilitation (Integrated Land Management Bureau 2007). Klabona Keepers takes the position that B.C. Government, Fortune Minerals, and Shell Canada all have an ongoing obligation to act.

Since 1977, the B.C Rail grade has not been managed in compliance with and according to Federal and Provincial legislated land development regulations and guidelines in regard to riparian, sediment control, fish passage, and salmonid habitat. Klabona Keepers notes that DFO should fulfil its enforcement responsibilities by initiating consultations with B.C. Government, Fortune Minerals, and Shell Canada with respect to mitigating the degradation to fish resources and habitat originating with the B.C. Rail grade. Klabona Keepers believes that the DFO has a responsibility to act to prevent Shell Canada, Fortune Minerals, and the B.C. Government from harming fish and fish habitat on an ongoing basis.

Fortune Minerals has not undertaken any surveys or discussed with local First Nations and government, mitigation and/or maintenance plans in regard to the B.C. Rail grade. Discussions between Klabona Keepers and the B.C. Government in early 2007 involved the environmental problems on the grade and restoration efforts needed to mitigate fish passage and sediment control concerns. Unfortunately, these discussions did not advance due to the government no-liability position. This issue clearly needs to be resolved.

4.2 Mineral Exploration

Klappan watershed lies in the northern portion of the Bowser Basin. Sedimentary rocks of the Middle to Late Jurassic Bowser Lake Group underlie nearly all of the Klappan drainage. The Bowser Lake Group, formed approximately 157-136 ma ago in the middle to late Jurassic Period, is a series of marine and non-marine sedimentary rocks formed by massive and rapid erosion of land to the east. This deposit is made up of mudstones, sandstones, and conglomerate rock. During the course of massive deposition, the environment changed from offshore to nearshore, then to lowland fluvial sites.

These rocks were folded, with the dominant fold trend to the northwest, and thrust faulted, showing extremely complex forms. In parts of the Groundhog Range and the Skeena valley, broad open folds predominate (Holland 1976). A strong pattern of north to northwest block faulting and occasional cross faults break up the mountains and form the wide valley systems.

Since the turn of the 20th Century, mineral exploration has revolved around the Klappan Coalfield, which contains semi-anthracite coal. Early exploration efforts were reported on by Malloch (1914), Buckham and Latour (1950), and Richards and Gilchrist (1979). In 1981, Gulf Canada acquired the Mount Klappan coal licenses and annually conducted comprehensive activities until 1988, including maintenance as needed on the BC Rail grade. In 2002, Fortune Minerals acquired the Mount Klappan property and since then has conducted periodic assessment and fieldwork mostly related to environmental applications and permitting for the B.C Environmental Assessment Office.

4.3 Coalbed Methane Exploration

In 2004, BC Ministry of Energy and Mines granted a lease to Shell Canada that enables coalbed methane exploration activities in the upper Klappan, upper Spatsizi, and upper Skeena area. In 2004, Shell Canada utilized the Ealue Lake road and the BC Rail grade to access their lease, where they established four leases and drilled three exploratory wells in the upper Klappan and Spatsizi drainages adjacent to the B.C. Rail grade. Shell Canada also conducted seismic testing in the upper Skeena headwaters upstream of Beirnes Creek. In addition, they conducted a moderate amount of maintenance activities on the BC Rail grade such as gravelling, rip-rapping, replaced a culvert at McEwan Creek, cleared the mudslide at 40 km, and repaired the washout past Eaglenest Creek. However, the poor design related to the rail grade alignment, river encroachments, culvert installations, and unstable conditions causing mass wasting was not dealt with. Since 2004, no exploration activities have occurred, although a few environmental assessments have been conducted.

Shell is expecting to do further work on their lease, but there is First Nation concerns related to the potential loss of healthy air, water, and soil as well as future socio-economic and cultural values. Further to this, regional communities have concerns with the BC Government enabling development activities that will likely impinge on healthy ecosystems, particularly water quality and fish resources.

5.0 2007 River Erosion and Stream Crossing Assessment Results

A preliminary fish and fish habitat survey of Sites 1-5 was conducted in September 2007. The assessment objectives were to assess the sites and provide context and technical concerns in regard to proposed remedial measures. Sites 1-5 were also assessed for Klabona Keepers in late-August 2006 as part of a larger sub-regional effort to provide baseline and resource status information to support the Klabona Land Stewardship Plan process.

Site 1 is a historic landslide located at 24.5 km just downstream of the Klappan River crossing. Site 2 is the eroded northern and southern approach to the Klappan River Bridge crossing. Site 3 is an unnamed creek crossing the BC Rail grade at 26.5 km that was laterally displaced to the north. Site 4 is a unnamed creek crossing the BC Rail grade at approximately 27.5 km that has over-topped and eroded the road. Site 5 is a 300 m in width section of the BC Rail grade which has been eroded by Klappan River at 29 km. Due to time and logistical constraints, the “Big Eddy” site located at approximately 60 km was not assessed in 2007. In aggregate, Klabona Keepers’ view the cumulative works identified as Sites 1 to 5, as well as the other sites identified in the Shell materials such as the “Big Eddy” site, as a major project. Presently Sites 1, 2, and 5 are impassable to vehicular traffic.

There are additional sites impacted by BC Rail upstream on the Klappan and Little Klappan rivers, through the upper Spatsizi drainage, and in the Skeena headwaters that were impacted. These sites have been assessed at the reconnaissance level and require restoration activities, but the results are not fully discussed in this report.

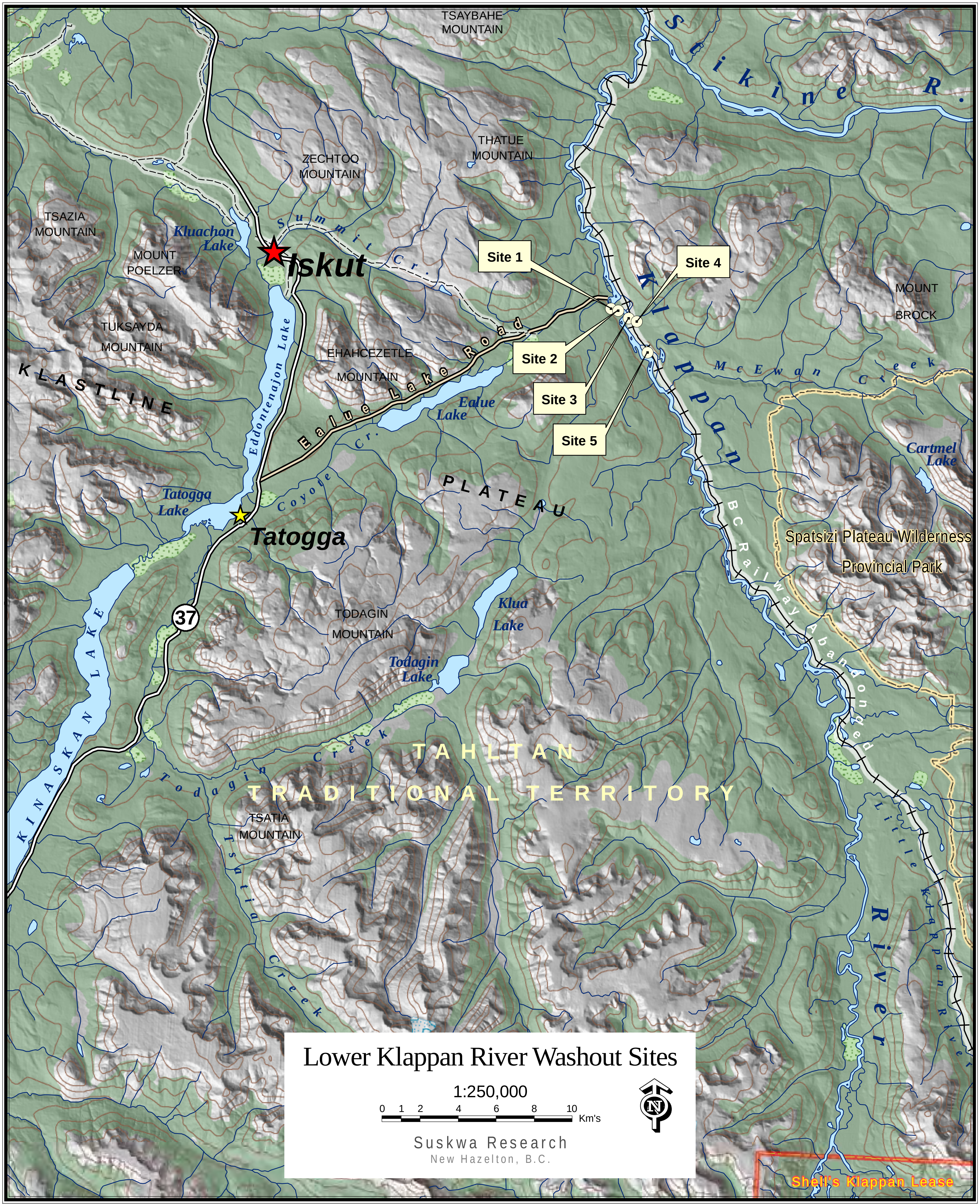
5.1 SITE 1

Site 1, also referred to as Site A, is a landslide located at 24.5 km just downstream of the Klappan River crossing. Since approximately 1975 when the Ealue Lake road connected with the BC Rail grade, Site 1 has generated failures and sediment on an annual basis. Poor road planning and construction practices followed by a lack of hillslope and bank stabilization have led to chronic surficial or shallow translational slides over decades. Past maintenance activities have primarily involved removing the spoil material off the right-of-way to facilitate continued access.

Site 1 is located on an outside bend on the left (or south) bank of the river. The river width is slightly less than 100 m and is characterized by glide habitat with an average gradient of approximately 1%. The substrate is likely boulder and gravel and sand; however due to turbidity and ravel from the hillslope, substrate determination is difficult. Fish habitat is rated as moderate to good quality and is likely used for various life history stages by numerous species.

In the spring 2007 flood, high flows eroded the river bank and in turn the road prism. The hillslope is presently unstable. The proposed remedy suggested by Allnorth (2007) (07-PC-0446 Site A 2007-Sept-181 file) will hold the slope toe from river erosion by constructing a berm utilizing gabion footings, a terrawall, and rip-rap bank protection. Presumably, the river channel bed is stable. The 3 m width of the finished berm top surface is relatively narrow. The 1 m space between the berm and the hillslope, presumably to be used as a catchment for surficial failures, will fill quickly. It is unclear how much rip-rap will be placed outside the proposed berm in terms of the length and width. Is the riprap intended to protect the berm structure or widen the berm to support a road surface more than 3 m in width?

The hillslope will continue to fail unless it is sloped back to its angle of repose, which is likely about 50%; this will require endhauling. Bioengineering techniques could be used for revegetation, but would likely fail if there is not any slope-backing completed due to the amount of seepage near the top of the slope. This seepage is currently causing surficial failures. The most likely successful bioengineering techniques would include modified brush mats and gully breaks on the face of the slope, with live pole drains used to direct the seepage into troughs or to the sides. If the seepage in the upper part of the hillslope is not managed, it will likely cause



TSAYBAHE MOUNTAIN
Stikine R.
ZECHTOO MOUNTAIN
THATUE MOUNTAIN
TSAZIA MOUNTAIN
Kluachon Lake
MOUNT POELZER
Summit Cr.
Iskut
Site 1
Site 4
Site 2
Site 3
Site 5
Klappan
MOUNT BROCK
TUKSAYDA MOUNTAIN
EHAHCEZETLE MOUNTAIN
Ealue Lake Road
Eddontenajon Lake
KLASTLINE
Ealue Lake
McEwan Creek
Cr.
Cartmel Lake
Tatogga Lake
Coyote
PLATEAU
Tatogga
BC Railway Abandoned
Spatsizi Plateau Wilderness Provincial Park
37
KINASKAN LAKE
TODAGIN MOUNTAIN
Klua Lake
Todagin Lake
Todagin Creek
TAHLTAN TRADITIONAL TERRITORY
TSATIA MOUNTAIN
Tsatia Creek
Little Klappan River
River
Lower Klappan River Washout Sites
1:250,000
0 1 2 4 6 8 10 Km's
N
Suskwa Research
New Hazelton, B.C.
Shell's Klappan Lease

persistent surficial failures such as the mud flows shown in Figure 18. This has been evidenced by other similar slides such as the Bulkley River (1.5 km) slide reported on by Rabnett (2007). As well, mechanical means such as sheet piling or bin walls could stabilize the slope. A monitoring and maintenance plan for Site 1 is needed that clearly states who will provide the service and when the activity will take place.

Figure 14. View west across Slide 1, August 2006.

Figure 15. View up Slide 1, August 2006.

Figure 16. View east on Slide 1 showing the river and toe of the slope.

Figure 17. View east on Slide 1 showing mid and upper portions of the hillslope.

Figure 18. View upslope on Slide 1 showing seepage zone and minor surficial failure.

Figure 19. View across the top of Slide 1 showing tension cracks of surface materials starting to slide.

5.2 SITE 2

Site 2 is the northern and southern approaches to the Klappan River Bridge. The crossing is actually composed of two bridges: a 9.0 m single span on the southern approach that crosses a backchannel and a 55 m in length three-span structure that crosses the Klappan River mainstem. The bridges were apparently constructed by Gulf Canada in the 1980s and are structurally sound.

In the spring 2007 flood, high flows eroded the fill adjacent to the bridge abutments. The northern and southern approaches and the upstream side the southern span were not adequately armoured with rip-rap or other erosion control measures. The southern, 9 m span crosses a sidechannel that is important high quality habitat for juvenile and adult fish. The northern approach I rated as moderate fish habitat.

Figure 20. View upstream of Site 2 sidechannel.

Mitigations efforts should consist of removal of the fill adjacent to the eroded fill and placement of free-draining fill against the abutments. Both downstream and upstream faces should be rip-rapped. The right river bank (northern) upstream of the main span should be armoured with heavy rip-rap for approximately 80 m. The upstream fill face between the spans needs to armoured with heavy rip rap due to potential channel migration. These efforts should provide erosion protection and ensure the crossing capital investment is safe-guarded. It is likely that all rip-rap placed in-stream will provide cover habitat for juvenile fish.

Other bridged stream crossings reviewed by Allnorth Consultants include Bridge #3 and Bridge #4, which were not assessed as part of this study.

Figure 21. View downstream of northern approach showing erosion at abutment.

Figure 22. View shows erosion of fill on southern approach upstream abutment.

Figure 23. View shows northern river bank upstream of the bridge.

5.3 SITE 3

Site 3 is a relatively small unnamed tributary to the Klappan River draining an approximate 13.23 km^2 area and crossing the BC Rail grade at 26.5 km. The creek has documented rainbow trout presence and is thought to provide good quality rearing and spawning habitat (Schell 2001). The 2007 springmelt led to significant peak flows causing a channel diversion upstream from the B.C. rail grade. This creek has a history of avulsions on the shallow active fan and has alternatively crossed the B.C. Rail grade approximately 145 m to the south. At this location, an 1100 mm culvert crosses beneath the grade.

Two 1100 mm culverts have become filled with mostly buried bedload aggradation. Due to time and logistical constraints, the cause of aggradation is unknown, but may be due to any number of factors. This site needs further assessment of the channel upstream of the site to determine the cause. It is possible that a sediment wedge moving down the creek with high flows got choked at the culverts or it is also possible that the aggradation is due to large-scale sediment movement related to a landslide in the creek headwaters and is slowly moving down channel.

Depending on the cause and nature of sediment movement, mitigation of the current situation requires further assessment before an open bottom structure or bridge is installed.

Figure 24. Site 3 view southward where stream has cut through the rail grade.

Figure 25. Site 3 view north across creek avulsion.

Figure 26. View shows culvert where stream has flowed in the recent past.

5.4 SITE 4

Site 4 is a stream crossing the BC Rail grade at approximately 27.5 km. The stream drainage area is unknown as it captures an upslope basin that then drains a complex of wetlands and beaver ponds on the Klappan River floodplain. During the spring 2007 high water floods, the two 1100 mm culverts draining the wetland beaver pond complex could not handle the flow. The water flowed over the top of the road and eroded the road surface and the fill surrounding the culvert outlets. A large amount of the eroded material was deposited approximately 18 m downstream of the outlets.

Presently, the northern culvert inlet is totally plugged with beaver debris, and the southern culvert delivers the flow. The culvert inlets may have been plugged this spring, causing the road to be over-topped, or the beaver activity could have been more recent. There is a lack of maintenance issue with Site 4.

The wetland beaver complex has known fish present. The fish habitat is rated as very high quality.

It is recommended that the channel downstream of the culvert be excavated to re-establish the stream. Rehabilitation of Site 4 depends on what fish passage and flow designs are finalized at Site 5. It is likely that an open bottom structure is required at Site 4 that can pass flood flows. The elevation of the Site 4 open bottom structure will establish the stabilizing height of the wetland beaver pond complex and should be established in conjunction with the fish passage and flow structures installed at Site 5. The installed structure should have beaver guards installed. The road prism needs to be repaired with suitable fill. Before any remedial work is performed on Sites 4, it will be necessary to isolate the culvert inlet and downstream wetted areas and remove any fish.

Figure 27. Site 4, view shows culvert inlets. Note the foreground beaver debris that has sealed off the northern culvert inlet.

Figure 28. Site 4, view across the grade showing erosion.

Figure 29. Site 4, view downstream of culvert outlets and berm caused by sediment deposition.

5.5 SITE 5

Site 5 is also referred to as Site B. Site 5 is a section of the BC Rail grade which has been eroded by the Klappan River at 29 km. Site 5 is located on an outside meander of the Klappan River and is located on the active floodplain. Approximately 302 m of road were eroded downstream in the spring 2007 flood. Prior to the flood, the rail grade at Site 5 encroached on the Klappan River and erosion control measures included minor amounts of rip-rap armouring the bank. In 2004, machine operators working under the auspice of Shell Canada placed approximately 96,000 tons of rock to prevent bank erosion and channel scouring. In 2006, the Klabona Keepers assessed the area and noted the majority of this rip-rap had been displaced and there was inadequate armouring of the bank.

The area to the east of the eroded bank is active floodplain. The area has abundant wildlife sign dominated by moose and grizzly bear. A beaver channel complex connected to the wetland and beaver pond complex at Site 4 meanders to the east of Site 5. An overflow channel from the mainstem connects to the beaver channel. At the northern end of Site 5, the beaver channel is approximately 15.2 m distance. At the mid-point of Site 5, the channel is located approximately 65.3 m distance. Unidentified fry were observed in the beaver channel. The Klappan River at Site 5 is rated as good fish habitat. The adjacent beaver channel, which provides movement and refuge habitat, is rated as very high quality.

Currently, Shell Canada prefers to relocate the grade to the east of the eroded section of road. This would involve destruction of riparian habitat and potentially encroach on the high quality beaver channel habitat. It is recommended that the grade be rebuilt in its original location, with sufficient open bottom flow structures installed to allow high flows to enter the disconnected floodplain and recharge spring floods on an annual basis. These structures would also allow juvenile and adult fish to utilize the estimated 2.7 km of high quality habitat that is particularly suitable for young of the year and juvenile fish. Pursuant to s. 37 of the Fisheries Act, DFO should consider requesting Shell Canada provide an analysis of how the proposed work at Site 5 will affect fish habitat.

Re-instalment of the grade should include large size rip-rap carefully positioned for erosion control and to create fish refuge habitat. Care should be taken to avoid floodplain disturbance. The subgrade and fish passage structures design will be have to be reviewed to ensure elevations are suitable for maintaining stable flows. The culvert structures at Site 4 which drain and regulate out flows at the wetland beaver pond complex will have to be taken into consideration. It is important that the natural hydrograph that supports the wetland complex be maintained to support the health of the river, riparian zone, and the floodplain. Site 5 is a large scale restoration project and there is a need to ensure no net loss of productive habitat.

Figure 30. Site 5, August 2006. Note the inadequate bank protection and relative road height in relation to the low flow condition.

Figure 31. Site 5, view south of the eroded B.C. Rail grade.

Figure 32. Site 5, view north of the eroded B.C. Rail grade.

Figure 33. View upstream on overflow channel.

Figure 34. Beaver channel east of Site 5.

Figure 35. Sediment from spring 2007 flood on floodplain adjacent to Site 5.

Figure 36. View across beaver pond southeastward to beaver channel outlet .

5.6 Sites 1-5 Discussion

Shell Canada's proposed remedial works have marginal assessments of fish presence and fish habitat. Further assessments are required: at Site 1 to determine a hillslope stabilization plan, at Site 3 to determine the cause of the aggrading channel, at Site 4 to determine the flow structure elevation in order to maintain stable water levels, and at Site 5 to provide inflow specifications that will ensure connectivity to the wetland beaver pond complex.

Klabona Keeper's observations indicate that the lack of maintenance that led to the Sites 1-5 failures is typical with resource development companies making only minimal temporary efforts at maintenance in order to conduct exploration activities.

Klabona Keepers' view the cumulative works identified as Sites 1 to 5, as well as the other sites identified in the Shell materials such as the "Big Eddy" site, as a major project. Klabona Keepers believe that all sites they have identified in regard to fish passage, sediment generating, and deranged drainage should be rehabilitated.

The future maintenance and monitoring of Site 1-5 is an issue. Klabona Keepers has not seen a proposed maintenance schedule. Shell's proposals do not speak to mitigation of obvious short, mid, or long-term concerns with sedimentation. The proposals only address sedimentation issues that may occur during the construction phase.

The remedial proposals for Sites 1 to 5 are consistent with the historical short-term outlook that leads to mid-term and long-term disastrous effects. To be conservative, impacts over the last three decades may possibly be the largest, long-standing fish and fish habitat issue in British Columbia. Shell Canada and DFO should consider not only the effects of construction, but also the effects on fish habitat of long-term fish passage, erosion, and sedimentation problems in the Klappan drainage.

For all sites, consideration needs to be given to DFO's and BC Ministry of Environment's instream reduced risk work windows so rehabilitation efforts do not result in the harmful alteration, disruption or destruction of fish habitat. Before any remedial work is performed on Sites 1-5, it will be necessary to isolate all wetted areas and remove any fish.

To date, there is no known assessment of cumulative habitat losses in the Klappan system resulting from the pervasive short-term approach to road maintenance. It is known that chronic physical disturbances to fish habitat have resulted from this short-term approach. A monitoring and maintenance plan needs to be established that takes into account the B.C. Rail grade, aquatic resources, and streams crossed accessed by and within Shell's Klappan lease area.

6.0 Concluding Observations

Sites 1 through 5 are similar in that road maintenance and monitoring required by current B.C. legislation have not occurred. BC Government is not taking liability for the B.C. Rail grade and any environmental management, even though they enabled the construction of it and continue to permit third-party interests to use it on an ad hoc basis. In turn, Fortune Minerals which holds the Special Use Permit (S24493), and Shell Canada, which has been granted road user status, are not mitigating the ongoing environmental risks and liabilities of the B.C. Rail grade. Klabona Keepers has documented 32 additional sites affected by the B.C. Rail grade in the Klappan drainage.

There is a need establish a different approach to land use in the Klappan watershed. Klabona Keepers believes it is in the best interests of local First Nations and the B.C. Government to discuss the overall Klappan access issue and move forward on establishing solutions. DFO is important to have at the planning table and communicate best management practices and their concerns and responsibilities that revolve around fish and fish habitat. There is a clear and compelling need for planning that takes into account First Nation values and interests, adequate levels of environmental management, and how land and resources are to be used.

Discussions between Klabona Keepers and the B.C. Government in early 2007, in regard to the environmental problems on the grade and required restoration efforts needed to mitigate fish passage and sediment control concerns did not advance due to the government no-liability position. This issue needs to be clearly resolved before any remedial efforts at Site 1 to 5 are undertaken. There is an emerging consensus that environmental management in the Klappan needs to be conducted differently to avoid the conceptual conflicts that are endemic to the current approach. The current approach may serve the public interest less in the future as First Nations and regional communities demand healthy ecosystems and sustainable development values.

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