3787/WP-1578

Bulkley TSA Critical Stream Reach Inventory

Prepared for:

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May, 2007

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Executive Summary

Triton Environmental Consultants Ltd. (Triton) was retained by the Ministry of Forests and Range (MOFR) to conduct a critical fish-stream reach inventory within the Bulkley Timber Supply Area (TSA). The goal of the inventory was to assist licensees by providing a known resource feature intended to clarify what specific reaches require special management and provide direction to licensees when developing their future Forest Stewardship Plans.

The initial step of the project was to develop definitions of "critical" and "high" value habitat. Definitions and indicators of critical and high value habitat were developed in a workshop setting, starting with the definitions and indicators used in the Kispiox and Cranberry TSA critical stream reach project (Triton 2006). Workshop attendees included local authorities on fish and fish habitat, MOFR representatives, potential end-users of the product (*e.g*. forestry industry representatives), and Triton fisheries specialists.

Next, fish and fish habitat reports completed within the study area were reviewed to determine where critical and high value habitats were located. Data sources included:

- Provincial on-line sources,
- Skeena Fisheries Management Report Series,
- DFO Stream Information Summary maps,
- 1:20,000 Reconnaissance Fish and Fish Habitat Inventory projects, and
- Triton documents in hand in the Prince George and Terrace offices.

A list of relevant reports that had been obtained was compiled, and forwarded to Regional DFO and MOE staff and First Nations representatives for comment on the completeness of literature obtained.

Digital TRIM maps were acquired for the Bulkley TSA. Streams from all of the TRIM map tiles were merged into one layer, and then split into reaches. Using GIS software (ArcView with the FishMap extension), some relevant reach calculations were generated (*i.e*. reach length, upstream and downstream elevation, and gradient). A ranking column for each fish species of concern, an overall reach ranking column, a comment field and a reference field were added to the basic reach information table. The end result was that for each reach (including lake reaches), the relational database includes a unique reach identifier, a ranking of the relative importance of that reach for each fish species, an overall reach rank, comments as to why the reach was ranked as indicated, and a reference to the data that resulted in the ranking. Reaches were ranked from 0-4 as follows:

  - 1 = known critical habitat;
  - 2 = known high value habitat;
  - 3 = potentially critical/high value habitat (unsampled or sampled reaches);
  - 4 = likely not critical or high value habitat (based on existing data and interpretation based on gradient); and
  - 0 = unknown habitat value (no or insufficient data), or marginal or low value habitats only.

The overall rank assigned to a reach was the highest habitat value for any fish species ranked in the reach. For example, if a reach was determined to have possibly high value habitats for rainbow trout and bull trout, but known high value habitat for steelhead, the reach would be assigned an overall rank (which is depicted on the project map) of known high value habitat ("2").

Results

A total of 17,059 reaches were identified on 15,400 km of mapped stream network within the study area. A total of 108 reaches (808 km of stream network) were identified to be critical for one or more of the target fish species. Critical stream reaches had an average gradient of 1.5%, and a maximum gradient of 7.7%. A total of 167 reaches (460 km of stream network) were identified to contain high value habitat for one or more of the target fish species. High value stream reaches had an average gradient of 4.4%. A total of 196 reaches (326 km of stream network) were identified as potentially critical habitat for one or more of the target fish species. Potentially critical stream reaches had an average gradient of 6.0%. A total of 10,074 reaches (7,753 km of stream network) were classified as likely not critical for the target fish species. Reaches assessed as likely not critical had an average gradient of 25.2%.

The number of reaches identified as critical, high, or potentially critical, by fish species is presented in the following table.

Species	Identified Reaches	Species	Identified Reaches
Bull trout	50	Lamprey	10
Chinook	40	Pink	36
Coho	178	Salmon, general	7
Dolly Varden	125	Sockeye	51
Kokanee	48	Steelhead	99

Major river mainstems were flagged as either having known critical habitats due to the presence of spawning habitat, or known high value habitats associated with migratory routes. Reaches flagged as having potentially critical or high value habitats included low-moderate gradient sections of tributaries not already ranked, and reaches in systems with limited habitat data or only presence/absence data. Reaches that are not likely to provide critical or high value habitats are typically first order, headwater reaches.

Management Strategies

A 4-step procedure was developed to help establish management strategies for forestry and development activities near reaches identified as containing critical habitat. The steps proposed were:

1. Identify why the reach has been classified as critical;
2. Identify potential direct and indirect impacts of proposed activity to the critical habitat;
3. Consult with experts in varying fields to determine scope of potential impacts;

4. Use a Risk Assessment Matrix to develop management strategies based on Scale of Negative Effect and Sensitivity of Fish and Fish Habitat.

Fisheries Sensitive Watersheds

Under Schedule A of *Order – Fisheries Sensitive Watersheds – Skeena Region*, five watersheds within the Skeena Region have previously been identified as Fisheries Sensitive Watersheds. The procedure used to classify watersheds as Fisheries Sensitive was reviewed and summary information for the five watersheds previously identified as meeting the criteria was provided. Based on the results, each of the five was found to meet the requirements to varying degrees. Additional watersheds throughout the Bulkley TSA were identified for consideration for classification as Fisheries Sensitive Watersheds. However, additional detailed surveys would be required to complete a detailed analysis of each.

Acknowledgements

Triton Environmental Ltd. would like to thank the following for their contribution to the Bulkley TSA Critical Fish-Stream Reach Inventory project:

- Bob Mitchell and Cheryl MacKenzie (Ministry of Forests and Range) for providing the funding for the project and acting as the client representatives.

- Attendees of the February 15 definition and indicator workshop: Blair Ells, Cheryl MacKenzie, Bob Mitchell, Glen Buhr, Dave Amirault (MOFR); Barry Finnegan (DFO); Alan Baxter (West Fraser); Dean Peard (MOE); Glen McIntosh and Vince Ross (Canfor – Houston).

- Barry Finnegan (Department of Fisheries and Oceans) for providing detailed maps and comments regarding critical habitats from the DFO perspective that may not have been included in background reports.

- Dean Peard (Ministry of Environment), for providing detailed comments regarding critical habitats from the MOE perspective that may not have been included in background reports, and for providing relevant RFFHI databases.

- Alan Baxter (West Fraser) for providing access to relevant operational and inventory data.

Triton staff involved with the project included: Ryan Liebe, R.P.Bio. (project management and report writing), Mark LeRuez (GIS), Greg Sykes, R.P.Bio. (report writing), Rachel Manson (literature search), Shawna Hartman (data acquisition and report writing), Chaz Ware (data acquisition and report writing), and Jason Dorey, R.P.Bio. (workshop facilitation).

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List of Attachments

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1 Introduction

Triton Environmental Consultants Ltd. (Triton) was retained by the Ministry of Forests and Range (MOFR) to conduct a critical fish-stream reach inventory within the Bulkley Timber Supply Area (TSA). The goal of the inventory was to assist licensees by providing a known resource feature intended to clarify what specific reaches require special management and provide direction to licensees when developing their Forest Stewardship Plans (FSP).

As additional background, the District Managers at the MOFR must sign off on FSPs. Within the Skeena-Stikine Forest District it was determined that a tool was needed to make decisions regarding whether fisheries objectives were being met in the FSPs. This was particularly important as the Bulkley Land and Resource Management Plan (LRMP) omitted the critical fish habitat section in the final version of the document. The MOFR still desired a product to support the District Manager, therefore funding was secured for this project

The primary objectives of this office-based study were:

- To create a spatially mapped critical fish-stream/lakeshore reach inventory for the Bulkley TSA;
- To provide an inventory to licensees as a known resource feature, intended to clarify what specific reaches will require licensees to produce measurable and verifiable results and strategies in future FSPs;
- To develop recommendations for forest management in and around critical stream reaches that licensees shall consider in developing FSP results and strategies;
- To verify the Fish Sensitive Watersheds identified in the regulations, as well as to identify other possible Fish Sensitive Watershed candidates in the Bulkley TSA.

Secondary objectives of this project were:

- To create a living inventory that can be periodically updated as new information becomes available; and
- To provide a scenario-modeling and/or sensitivity analyses tool for future provincial timber supply reviews within the Skeena Stikine Forest District.

In order to achieve the above objectives, the following general steps were completed:

- Existing fisheries information was obtained (*e.g*. databases from Fish and Fish Habitat Inventories, FISS point file, scientific reports, discussions with local fisheries experts).
- A definition of "critical" fish habitat was developed that was consistent with Provincial (*i.e*. Ministry of Environment) and Federal (*i.e*. Fisheries and Oceans Canada) positions. Indicators of critical and high value habitat that account for regional species and issues were developed, and were vetted through regional representatives in the form of a workshop.

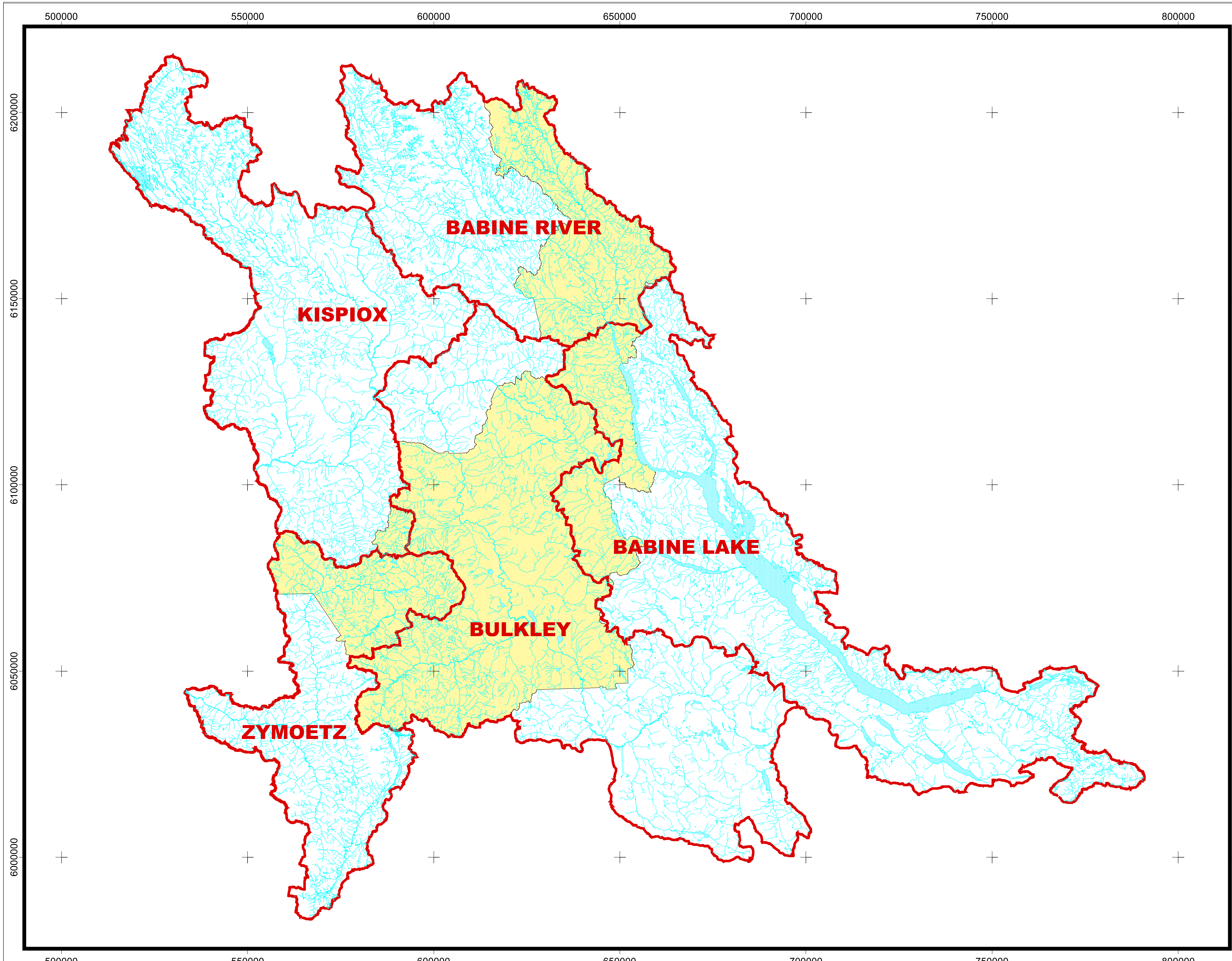
- A base map, including a district-wide stream network with reach breaks, was created. A relational table was linked to the stream layer that include columns for the presence of critical, high, potentially high or unknown fish habitat values.
- The relational database was populated with known critical and high value fish habitat reaches based on existing data.
- The results were reported including desirable forest management objectives for the protection of fish habitat in identified critical reaches.

1.1 Study Area

The Bulkley Timber Supply Area (TSA) is located in the northwest part of British Columbia within the Skeena Stikine Forest District, Northern Interior Forest Region. The Bukley TSA is located on the eastern side of the Skeena watershed, and is bounded by the Nilkitkwa River to the north, the Telkwa watershed in the south, the headwaters of the Fulton River and tributaries to Babine Lake to the east, and the headwaters of the Zymoetz River to the west.

The Bulkley TSA includes six biogeoclimatic zones: Sub-Boreal Spruce (40%), Engelmann Spruce-Subalpine Fir (34 %), Interior Cedar-Hemlock (6%), Alpine Tundra (16%), Coastal Western Hemlock (2%), and Mountain Hemlock (2%; Province of British Columbia 1998). The Bulkley TSA has several high quality fisheries, and the Babine, Zymoetz and Bulkley rivers are designated as classified waters. The Babine River is a large producer of sockeye salmon and steelhead trout. Large populations of pink salmon, Dolly Varden char and cutthroat trout are also present with the TSA, as are smaller populations of chinook and coho which are considered threatened (Province of British Columbia 1998).

The Bulkley TSA borders the west arm of Babine Lake which supports a large recreational sports fishery. There are also angling opportunities in smaller lakes within the TSA. The most important areas for fish habitat are tributaries to the major rivers within the TSA. In general, these tributaries are more important than the main streams in terms of habitat for spawning and rearing (Province of British Columbia 1998).



OVERVIEW MAP

Bulkley TSA Critical Fish-Stream Reach Inventory

Scale 1 : 1,000,000

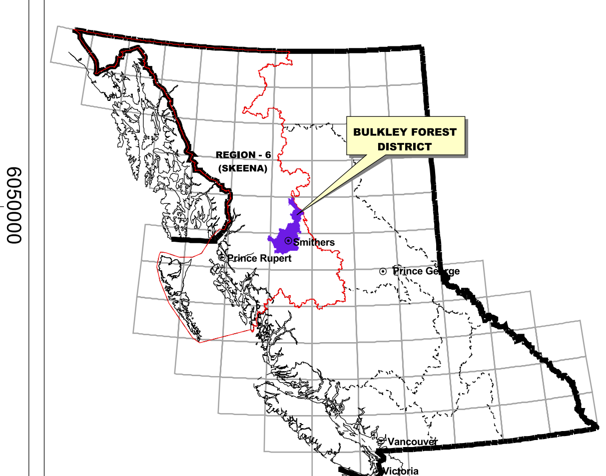
10000 0 10000 20000 30000 40000 50000 Meters

N

PROJECT CODE: 3787
DATE: March 22, 2007
COMPLETED BY: Triton Environmental Consultants Ltd.
PROJECT PROPONENT: Ministry of Forests and Range

LEGEND

- 1 : 50,000 Streams/Rivers
- 1 : 50,000 Lakes
- 1 : 50,000 Watershed Boundary
- Bulkley TSA



Position of Study Area in Province

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BASE: 1:50,000 Watershed Atlas
LOC: Bulkley TSA (Skeena Stikine Forest District)
PROJECTION: UTM Zone 9

2 Habitat requirements for target fish species

Following are brief descriptions of the life history and habitat requirements for target fish species, the knowledge of which is requisite for determining reaches that are critical or high value to specific species.

2.1 Anadromous salmon (chinook, chum, coho, pink, sockeye)

2.1.1 Chinook (*Oncorhynchus tshawytscha*)

Chinook salmon have one of the most complex and diverse life cycles of the Pacific salmon (Raleigh *et al*. 1986). There are two major life-cycle types: "stream" and "ocean" (Groot and Margolis 1991). Stream-type chinook spend one or more years as fry or parr in freshwater before migrating to the ocean. While in the ocean, they complete extensive offshore migrations and return to their natal stream in the spring or summer, several months prior to spawning. Ocean-type chinook migrate to sea during the first year of life, generally within three months of emergence from spawning gravels. They spend most of their ocean life in coastal waters and return to their natal rivers in the fall, a few days or weeks before spawning (Groot and Margolis 1991).

Chinook spend two or three years at sea prior to their spawning migration (Scott and Crossman 1973). Their primary spawning habitat in freshwater is near riffles in large rivers or tributaries, in deeper water and on larger substrates relative to other Pacific salmon (Raleigh *et al*. 1986). Timing of spawning is variable, but northern populations tend to spawn from July to September.

The eggs hatch in the spring, and ocean-type fry migrate almost immediately to the sea, while stream-type fry remain at least one year in freshwater (Groot and Margolis 1991). Juvenile stream-type chinook will take up residency and rear in their natal river near the spawning grounds. Later in the spring these fish will redistribute within the river system, presumably to more suitable summer rearing areas (Groot and Margolis 1991). In the fall there is a third redistribution of the stream-type chinook to suitable overwintering habitat, usually from the tributaries to the river mainstem. In the spring, the stream-type chinook will smolt and begin their migration to the ocean (Raleigh *et al*. 1986). Ocean-type chinook on the other hand will migrate downstream immediately after emerging and rear in the river estuary (Groot and Margolis 1991).

Chinook salmon are widely distributed throughout the study area and are found in the majority of large rivers and tributaries. They are found in, but not limited to, the Zymoetz (Copper; FISS 2007), Telkwa, Bulkley, and Babine river watersheds. Some of the smaller tributary streams where chinook are present include Goathorn, Driftwood, Harold Price and Toboggan Creek (Fish Habitat Inventory and Information Program 1991).

2.1.2 Chum (*O. keta*)

Chum salmon have the widest natural geographic distribution of all Pacific salmon species, but are the least abundant of the Pacific salmon species in the Skeena watershed (Gottesfeld *et al*. 2002). Chum typically mature at three to five years of age, and their return to natal streams varies with location (Hale *et al*. 1985).

In northern British Columbia they arrive on the spawning grounds as early as July (Scott and Crossman 1973). Their preferred spawning habitat is immediately above turbulent areas or where there is an upwelling. The current at the boundary between pools and riffles is also favorable for spawning (Groot and Margolis 1991). Their migration coincides with the much larger runs of pink salmon, and they usually spawn in places that also have spawning pink salmon (Gottesfeld *et al*. 2002). Female chum will select the nest site depending on hydrological and geophysical features, such as water odor, depth (~40 cm) and velocity (~50 cm/s), gravel composition (13% larger than 15 cm, 81% was 15 cm or less and 6% was silt and sand), and the presence of cover (Groot and Margolis 1991).

Depending on temperature, hatching occurs from late December to late February (Scott and Crossman 1973). The incubation time of eggs is prolonged by lower water temperatures (Groot and Margolis 1991). Chum fry migrate to the ocean under the cover of night shortly after emerging from the gravel, if the spawning ground are close to the ocean, but will spend weeks in fresh water if it is a long migration (Groot and Margolis 1991). They often rear in estuaries for several months before dispersing into the sea (Scott and Crossman 1973).

Fry spend very little time in freshwater and their basic food consists of larvae and chrysalis of chironomids, mayfly larvae and other insects (Hale *et al*. 1985). Adult chum feed on amphipod, euphausiid, pteropod, and copepod, as well as fish and squid larvae (Groot and Margolis 1991).

Chum salmon have a limited distributed throughout the study area. Chum are rare in the Bulkley River and in the Skeena River above the Kispiox River confluence, although they have been documented in the Babine River but not as a local population. Records for returning chum indicate a small population persists in the Zymoetz River (Gottesfeld *et al*. 2002).

2.1.3 Coho (*O. kisutch*)

Most coho salmon spawn at age 3 or 4, but in the north this increases to 4 to 5 year old fish (Scott and Crossman 1973). Some jacks (early maturing males that are coincidentally small) return to their natal stream to spawn only after a short period of time in the ocean. According to Gottesfeld *et al*. (2002), jacks are only present in the coastal sections of the Skeena from Kitwanga downstream. Coho spawn in swift water with shallow gravelly areas of small headwater streams that have low gradients, usually from October to November (Scott and Crossman 1973). The eggs remain in the gravel over the winter and after hatching in the spring, the alevins may remain in the gravel for an additional 2-3 weeks until their yolk sac is absorbed (Scott and Crossman 1973).

Emergent fry will spend between 1 and 2 years in natal streams and once smolting begins they will migrate downstream to the ocean where they reside for a subsequent 1 to 3 years (McMahon 1983). Coho typically rear in streams, beaver ponds, back channels and seasonally flooded areas (Groot and Margolis 1991). In ponds and lakes juveniles inhibit the near-shore littoral zone and in streams they seem to prefer habitat with structural complexity (Gottesfeld *et al*. 2002).

The diet for young coho salmon in freshwater generally consists of insects (aquatic and terrestrial), invertebrates, sockeye fry and other small fish. In the ocean they prey on chum and pink fry, herring, sand lance and other fishes (Scott and Crossman 1973). Adult coho salmon feed on wide variety of fishes and invertebrates during the ocean phase of their life cycle.

Coho salmon are widely dispersed throughout the study area, and are found in the majority of large rivers and tributaries. Some major watersheds in which coho occur include the Zymoetz (FISS 2007), Telkwa, Bulkley, and Babine River watersheds. Coho are abundant throughout the accessible tributaries of the Bulkley, especially throughout the Morice system. Historically, coho are documented to the Bulkley and Maxan lakes, but coho have not been observed above the Bulkley falls since the 1970's (Fish Habitat Inventory and Information Program 1991).

2.1.4 Pink (*O. gorbuscha*)

Pink salmon generally live two years, although individuals reaching three years of age have been reported (Groot and Margolis 1991). Adults return to the spawning streams in predictable and highly segregated even-numbered and odd-number year runs (Scott and Crossman 1973). Spawning takes place from mid-July to late October in rivers and tributary streams, typically on the lower reaches of coastal streams (Raleigh and Nelson 1985). Pink salmon typically spawn on fairly uniform spawning beds in small and large streams (Scott and Crossman 1973). Redds are constructed on spawning beds that are situated on riffles with clean gravels (Raleigh and Nelson 1985). Pink salmon avoid spawning in areas with deep pools, in areas with a slow current, or heavily silted or mud-covered streambeds (Groot and Margolis 1991).

Depending on temperature, hatching occurs from late December to late February (Raleigh and Nelson 1985). The alevins remain in the gravel until the yolk is absorbed in April or early May (Scott and Crossman 1973). Almost immediately after emerging, the fry migrate downstream to the ocean. Emergent pink salmon remain in freshwater for such a short period of time that many do not feed at all, but those fish with long migrations will feed on some nymphal and larval insects (Scott and Crossman 1973). The diet of juvenile pinks consists of copepods, euphausiids, amphipods, ostracods, larvae of decapods, cirripeds, tunicates and dipterous insects. The diet at sea consists of euphausiids, amphipods, and a variety of fishes, squid, copepods, and pteropods. On the Pacific Coast, adults do not normally feed after they begin their ascent of the spawning rivers (Scott and Crossman 1973).

Pink salmon have a fairly wide distribution within the study area. Major rivers pink occur in include, but are not limited to, the Zymoetz (FISS 2007), Babine, and Telkwa river watersheds and the Bulkley River to the confluence of the Morice system. Some of the major tributary streams pink salmon are found include Toboggan, Howson, Goathorn, Atrill, and Harold Price creeks (Fish Habitat Inventory and Information Program 1991).

2.1.5 Sockeye (*O. nerka*)

Sockeye salmon mature from ages two to six years (FOC 2006). In most systems, one age group (usually four year old fish) dominates (phenomenon called "cyclic dominance"), which means most of the offspring produced in any one "brood-year" return to spawn four years later (FOC 2006). The sockeye within the Skeena River watershed return as four and five year old fish, although three year old males (jacks) are common in some areas (Gottesfeld *et al*. 2002).

Spawning takes place in late summer and autumn in areas adjacent to lake rearing areas (Groot and Margolis 1991). Sockeye utilize headwater rivers, tributary streams, rivers between lakes, outlet rivers, spring (groundwater) areas, and submerged areas of lake beaches for spawning and rearing to varying degrees (Groot and Margolis 1991). The adaptation to utilize lake environments has resulted in reduced chances to interact with other Pacific salmon species during spawning, incubation, and juvenile life in freshwater (Groot and Margolis 1991). Suitable spawning substrates range from course granitic sands in an area with strong upwelling, to areas with large angular rubble where eggs settle in the crevices between rocks (Groot and Margolis 1991). Juvenile sockeye will rear in lakes for one to three years after emergence from the gravels; however there are some populations that utilize stream areas for rearing and may migrate soon after emergence (Scott and Crossman 1973).

Planktivore juvenile sockeye typically take advantage of the available zooplankton resource found in lakes (Groot and Margolis 1991). In the ocean, sockeye are pelagic and feed on zooplankton, squid, and infrequently on small fishes (Scott and Crossman 1973).

Sockeye salmon have a limited distribution within the study area. Major rivers sockeye occur in include, but are not limited to, the Zymoetz (FISS 2007), Babine, and the Bulkley River watersheds. Historically, sockeye have been documented to the Bulkley and Maxan lakes.

2.2 Bull trout (*S. confluentus*)

Bull trout are known to occupy a wide spectrum of habitat types, often occupying unproductive habitats where rainbow and cutthroat trout do not thrive. Resident bull trout are often found above physical barriers and within step-pool or cascade habitat.

Bull trout within the study area may have three different life histories:

- Resident: The stream resident that spends its entire life within small headwater streams, often above physical barriers.
- Fluvial: The large river type, which spends its adult life within large rivers and spawns in smaller tributaries. The large river offspring rear in these smaller tributaries until they grow large enough to compete within the large river habitat; and,
- Adfluvial: The lake type, which spends its adult life in a lake habitat and uses the tributary streams for rearing and spawning.

Sexual maturity for bull trout is reached in 5-7 years (Post and Johnston 2002) and they spawn in streams with cobble/gravel substrates and moderate flows. Spawning takes place in the fall from September to November (Scott and Crossman 1973). Bull trout populations spawn in flowing water and apparently avoid spawning in large rivers, instead preferring sites in smaller streams (Baxter and McPhail 1996). Bull trout tend to occupy headwater reaches of mountainous watersheds where they are typically the only species present. The fry hatch in the spring and reside (1-4 years) in their natal stream until reaching a large enough size to move downstream into larger bodies of water (lakes or rivers; Ford *et al*. 1995). The diet for juveniles generally consists of insects, snails, leeches, salmon eggs and once mature, bull trout prey on juvenile salmon (Scott and Crossman 1973).

A detailed distribution of bull trout populations is not well documented within the study area; however, bull trout are known to occur throughout the Skeena River watershed. The typically low densities of bull trout, low reproductive capacity, and susceptibility to angling pressure and sensitivity to changes in water quality support the provincial listing bull trout as a vulnerable (blue-listed) species.

2.3 Dolly Varden (*S. malma*)

Historically, Dolly Varden and bull trout were considered one species due to their similar appearance, similar life histories, and tendency to occupy similar habitats. More recently, it has been determined that Dolly Varden are primarily a coastal species being anadromous over much of their range (moving from salt to freshwater to spawn) and bull trout are primarily an interior species (anadromy is uncertain; McPhail and Baxter 1996, Ford *et al*. 1995).

Dolly Varden are known to occupy a wide spectrum of habitat types, often occupying unproductive habitats where rainbow and cutthroat do not thrive. Resident Dolly Varden are often found above physical barriers and within step-pool and cascade habitat.

Dolly Varden may have four different life histories:

- Resident: The stream resident that spends its entire life within small headwater streams, often above physical barriers.
- Fluvial: The large river type, which spends its adult life within large rivers and spawns in smaller tributaries. The large river offspring rear in these smaller tributaries until they grow large enough to compete within the large river habitat.
- Adfluvial: The lake type, which spends its adult life in a lake habitat and uses the tributary streams for rearing and spawning; and,
- Anadromous: Move from fresh water to salt water (spend 2 to 3 years in the ocean) then migrate back to their natal freshwater stream to spawn.

Dolly Varden reach sexual maturity in 3-6 years and spawn in streams with cobble/gravel substrates and moderate flows. Spawning takes place in the fall from September to November (Scott and Crossman 1973). The fry hatch in the spring and reside (3-4 years) in their natal stream until reaching a large enough size to move downstream into larger bodies of water. Anadromous Dolly Varden may only rear in freshwater for 2 years before they migrate to the ocean. Migration occurs during May to June and Dolly Varden may spend 2 to 3 years at sea.

Dolly Varden have a wide distribution throughout the study area. Resident, fluvial and adfluvial populations are found throughout the Zymoetz (FISS 2007), Babine, and Telkwa River watersheds, as well as, the Bulkley throughout tributaries and lakes. Some of the major tributary streams they occur in include Toboggan, Howson, Tenas, Atrill, and Harold Price creeks (Fish Habitat Inventory and Information Program 1991). The upper limits of anadromous Dolly Varden migration within the Skeena River Watershed has not been documented (P.Giroux, pers. comm.).

2.4 Kokanee (*O. nerka*)

Kokanee salmon are a resident form of sockeye salmon that spend their entire life within freshwater. Kokanee generally mature in 2-4 years and tend to spawn in streams (inlets or outlets of lakes) or along gravely shallow areas of lakes during September to October (Scott and Crossman 1973). Fry emerge in the spring and migrate up or downstream to lake habitat where they rear until mature.

Kokanee are mainly pelagic, plankton feeders but may derive a significant portion of their food from benthic organisms. They are not reported to feed on other fish species (Scott and Crossman 1973). Kokanee distribution is limited within the study area. Examples of lakes with kokanee presence include Toboggan, Babine, Nilkitkwa and McDonnel lakes.

2.5 Lake trout (*S. namaycush*)

Lake trout occur in relatively deep lakes, but in the north they are also found in relatively shallow lakes and rivers (Scott and Crossman 1973). They reach sexual maturity at age six or seven. Spawning occurs mainly in October, but sometimes as early as September in the north (Scott and Crossman 1973). Spawning often occurs over a large boulder or rubble bottom in inland lakes at depths less than 15 m and sometimes as shallow as 0.5 m. In rare instances, spawning takes place in rivers. The eggs remain incubating for four to five months and hatching usually occurs in March or April (Scott and Crossman 1973).

Lake trout are predaceous and feed upon a broad range of organisms which include fresh water sponges, crustaceans, aquatic and terrestrial insects, many species of fish and even small mammals. Their diet varies with the season (Scott and Crossman 1973). Lake trout distribution is limited within the study area. Example lakes where lake trout have been documented include Chapman, Nilkitkwa, Babine and Natazul Meadows lakes.

2.6 Pacific lamprey (*Lampetra tridentata*)

The biology and distribution of lamprey species is not fully understood in the Skeena system, largely due to the difficulty associated with field identification of juveniles (ammocoetes). As such, historical records of lamprey within the study area typically note their general presence, with no attempt to differentiate species. Although three species of lamprey are found within the Skeena system (Pacific, river and western brook), Pacific lamprey are the species most likely found within the study area, as river and western brook lamprey have a more coastal distribution.

Adult Pacific lamprey are external parasites, attaching themselves to aquatic prey by means of a suctorial disc and disc teeth. Typically described by an anadromous life history, adults migrate from the ocean to spawn in freshwater. The initial migration is in late summer or early fall, with adults spending winter months sexually maturing in freshwater. Nest building and spawning takes place the following spring on sandy gravel substrates, often hundreds of kilometers upstream from the ocean (Scott and Crossman 1973). Ammocoetes (juvenile lamprey which have an oral hood instead of a suctorial disk), burrow into mud and can spend 5 or 6 years in fresh water before transforming into adults and migrating to the ocean in late summer. Landlocked populations are common, spending their life in freshwater, preying on freshwater fishes.

Lamprey (mostly ammocoetes) are commonly found in larger systems (*e.g*. the Bulkley River) within the study area, and are likely under-represented in historical records, as they are not typically the focus of fisheries field programs.

2.7 Pygmy whitefish *(P. coulteri)*

Pygmy whitefish are typically found in the deep parts of deep, cold lakes and sometimes in some fast, cold streams. In lakes they are usually found at depths greater than 6 meters (Mackay 2000). Most pygmy whitefish are caught in benthic habitat regardless of depth (Rankin 1999). Their distribution and preference for cold water suggests that pygmy whitefish are likely a glacial relict species (Mackay 2000).

Pygmy whitefish are fall spawners and spawning has been reported in November or December, but depends on geographical location. Males mature at an early age (1 to 2 years) and at a small size (60-80 mm). Females, however mature at age 1 to 3 and from

70 to 228 mm in size (Mackay 2000). The most abundant age group is usually 2 years old (Rankin 1999).

Scott & Crossman (1973) found that the diet of pygmy whitefish varies, but generally consists of crustaceans, aquatic insect larvae, planktonic crustaceans, and eggs of other salmonids. They usually have sand and detritus in their stomachs which indicates they feed at or near the bottom. The varied diet of the pygmy whitefish shows this small fish to be an opportunistic feeder (Rankin 1999).

Pygmy whitefish have a very limited distribution throughout the study area. Their distribution is limited to a number of lakes and rivers within the study area. Lakes that support a population of pygmy whitefish include Tyhee Lake and Touhy Lake. They have also been reported in the Babine River (FISS 2007).

“Giant” pygmy whitefish (currently red-listed) are found only in two lakes in British Columbia which are Tyhee Lake (within the project area) and McLeese Lake (outside of the project area). It is not certain whether or not the pygmy and Giant pygmy whitefish are genetically different or whether the difference in size is due to environmental conditions.

2.8 Steelhead (*O. mykiss*)

The anadromous steelhead have summer and winter running tendencies (Hart 1973). Winter run fish enter rivers from November to May, while summer run fish enter between April and October (FOC 2004). Spawning occurs from January to May for both summer and winter runs (FOC 2004). Spawning habitat occurs in rivers and tributaries that have clean gravels (Hart 1973). After spawning, steelhead return to the sea for recuperation, and can return to freshwater to spawn numerous times (FOC 2006).

Steelhead live up to nine years and spend from one to three full years in freshwater before traveling to the sea as smolts (FOC 2004). Two or more summers are spent in the Pacific Ocean before the steelhead return to seek their natal streams at the age of four or five. Young steelhead prefer fast flowing water in the mainstream of rivers where there is cool and well oxygenated water. Older juveniles prefer deeper pool habitats with good flow (FOC 2006). These habitat preferences make steelhead particularly susceptible to types of habitat disturbance that introduce sediment which will fill in pools and would remove streamside vegetation that shades the water, keeping it cool (FOC 2006).

Steelhead have a wide distribution within the study area. Summer and winter run steelhead are found throughout the Zymoetz (FISS 2007). Only summer run occur throughout the Bulkley, Telkwa and Babine River watersheds. Tributary streams that support steelhead populations include, but not limited to, Toboggan, Goathorn, Tenas and Howsen creeks (Fish Habitat Inventory and Information Program 1991).

3 Critical Habitat

A key step of the project was to provide definitions and indicators of "critical" and "high" value habitat that are applicable to the study area. Such definitions are somewhat subjective, and as Rosenfeld and Hatfield (2006) outline there are several important considerations when identifying critical habitats including:

- The scale being considered (*e.g*. individual, population or meta-population). For this project, the evaluation of "critical" and "high" value habitat focused primarily on the population scale in the context of the study area (*i.e*. the Bulkley TSA).
- The distribution of a species within the study area (*e.g*. ubiquitous versus rare). This is particularly important for migratory species such as those within the Bulkley TSA for which seasonal habitat usage must be considered.
- The life history requirements of individual fish species and the types of habitat that are potentially limiting to that fish species at each life history stage. For example, identifying adult spawning habitat as critical and developing management strategies accordingly may not have an effect if juvenile rearing habitat is also limited.
- The assumption of a positive relationship between habitat use and habitat value may not always be appropriate. It is recognized that specific situations can exist where species abundance does not translate into habitat being high value (as outlined in Rosenfeld and Hatfield, 2006).

In order to identify critical stream reaches within the Bulkley TSA, Triton followed a procedure that is in line with the recommendations of Rosenfeld and Hatfield (2006). The primary activities are divided into two phases outlined below:

1. *Information on the basic organism life history*. A review of the relevant literature was conducted in order to develop a detailed picture of the habitat requirements of each species at each life history stage. In addition, discussions with researchers and management personnel familiar with the population specific requirements of target species within the Bulkley TSA was conducted in a workshop setting (see section 4.1).
2. *Information on the quantity and quality of different habitats available to a species*. Once information on the habitat requirements of each species at each life stage have been developed, existing data for the Bulkley TSA will be reviewed to identify those habitat types that may be limited within the TSA.

Rosenfeld and Hatfield (2006) include a third requirement based on the establishment of specific recovery targets. Unfortunately, due to limitations of the existing data the establishment of quantitative goals (*e.g*. area of habitat or numbers of individuals required) were beyond the scope of this project. Instead, the project should be viewed as a first step in identifying those critical habitats within the Bulkley TSA based on the information available, and to provide direction for future research and management activities which in turn may be able to develop specific recovery goals where needed.

4 Methodology

4.1 Definitions and indicators workshop

The initial step of the project was to develop definitions of "critical" and "high" value habitat. Definitions and indicators of critical and high value habitat were developed in a workshop setting, starting with the definitions and indicators used in the Kispiox and Cranberry TSA critical stream reach project (Triton 2006). Workshop attendees included local authorities on fish and fish habitat, MOFR representatives, potential end-users of the product (*e.g*. forestry industry representatives), and Triton fisheries specialists. A list of workshop attendees is provided in Table 1, and key workshop notes are provided in Appendix 3.

Table 1. List of attendees of the February 15 definitions and indicators workshop.

Name	Association	Name	Association
Blair Ells	MOFR, Skeena Stikine	Barry Finnegan	DFO, Smithers
Cheryl MacKenzie	MOFR, Skeena Stikine	Alan Baxter	West Fraser, Smithers
Bob Mitchell	MOFR, Skeena Stikine	Dean Peard	MOE, Smithers
Glen Buhr	MOFR, Skeena Stikine	Glenn McIntosh	Canfor – Houston
Dave Amirault	MOFR, Skeena Stikine	Vince Ross	Canfor – Houston
Ryan Liebe	Triton	Mark LeRuez	Triton
Jason Dorey	Triton		

For this project, the evaluation of "critical" and "high" value habitat was determined in the context of the study area (*e.g*. the Bulkley TSA), while being mindful of the importance that many of the fish stocks that utilize habitats in the Bulkley TSA have at the regional (*i.e*. Skeena) and provincial level. Definitions and indicators were developed to focus on scientifically defensible habitat values, rather than social values (*e.g*. wilderness lakes). Similarly, it was decided that the developed indicators of critical habitat, and critical habitats identified as part of this project would serve as a decision making tool based on science that Higher Level Plans (HLPs; *e.g*. fisheries sensitive watersheds) can draw on, rather than have the project support or carry forward fisheries habitats or values that may not have been identified in a strictly scientific manner.

Target fish species were discussed, and it was agreed that although all fish species in the TSA are target species to protect, indicator species were selected as the focus for the project. The selected list of indicator species included anadromous salmon, steelhead, bulltrout, lake trout, pygmy whitefish, and kokanee. It was also recommended that lamprey be considered as a target fish species due to the unique life history requirements of the fish. Selected indicator species are not ubiquitous in the study area, and have specific habitat requirements for one or more life stages that can be limiting.

4.1.1 "Critical" habitat

The starting point for the definition of "critical" habitat was:

> "Habitat that is critical in sustaining a subsistence, commercial or recreational fishery, or species at risk (red- and blue-listed and COSEWIC list) because of its relative rareness, productivity and sensitivity (BC Ministry of Forests 2002)."

This definition comes from the "Fish-stream crossing guidebook" and was developed with participation from Fisheries and Oceans Canada as well as the Ministry of Water, Land and Air Protection (now MOE). General indicators of critical habitat provided in the guidebook include the presence of high value spawning or rearing habitat (BC Ministry of Forests 2002).

The interpretation of "critical" habitat used in this project, was habitat that if lost or degraded, could result in a noticeable decrease in the productive capacity for a target fish species within the study area. This angle to the definition of "critical" focuses on habitat for species with a limited distribution and/or with habitat requirements for specific life history stages that are limited within the study area. Correspondingly, habitat for species that are ubiquitous and species that can meet their life history requirements in a wide variety of readily available habitats were typically not treated as critical.

The chosen interpretation of "critical" allowed for the focus of the project to be on reaches that are defensibly critical at the study area (and likely regional) level, rather than tagging every reach assessed as having the presence of spawning or rearing habitat for any species of fish as "critical."

Within the study area, indicators of critical habitat that were refined and developed in a workshop setting included:

- Reaches identified in defensible scientific reports as "critical" for meeting any of the life history requirements (*i.e*. rearing, spawning, migration, overwintering) for any of the target species.

- Reaches where staging or spawning by target fish species (anadromous salmon, kokanee, steelhead, bull trout, lamprey, species at risk) has been observed. Such species typically have a limited distribution of spawning habitat, where the loss or degradation of individual reaches could affect the productive capacity for that species.

- Lakes with confirmed populations of lake trout. The distribution of lake trout within the study area is limited to a few lakes (*e.g*. Chapman and Nilkitkwa lakes). The species slow to mature, has low reproductive potential, and is particularly sensitive to overfishing resulting from increased access.

- Lakes with confirmed populations of "giant" pygmy whitefish (*i.e*. Tyee Lake). Giant pygmy whitefish have only been identified within two lakes in British Columbia.

- Lakes confirmed to be used by sockeye for spawning or rearing. Individual lake populations of sockeye are treated by the DFO as conservation units as they are reproductively isolated and unique from a wild salmon policy perspective (B. Finnegan, pers. comm.).

4.1.2 "High" value habitat

"High" value fish habitat coarsely corresponds to the "important" category as outlined in the "Fish-stream crossing guidebook" (BC Ministry of Forests 2002). The starting point for the definition of "high" was:

> "Habitat that is used by fish for feeding, growth, and migration, but is not deemed to be critical."

Indicators of important (high) habitat include important migration corridors, the presence of suitable spawning habitat (not already deemed to be critical) and habitat with moderate rearing potential for the fish species present (BC Ministry of Forests 2002). The definition provided in the "Stream Crossing Guidebook" for important habitat was deemed to be too broad for the purposes of this study, and would have resulted in the majority of reaches with fish presence being flagged as high value habitat. The definition of high value habitat used for this study was therefore refined to:

> "Preferred or ideal habitat for a fish species that is used for rearing, overwintering or spawning, but is not deemed to be critical. High value habitats can also include less than ideal or non-preferred habitats (*e.g*. when compared to accepted suitable habitats outlined in literature) with confirmed use by indicator species. "

The inclusion of confirmed use of less than ideal habitats by indicator species as high value habitats accommodates the potential for unique local conditions. For example, Glacier Gulch Creek provides important (*e.g*. high value) habitat for rearing coho (B. Finnegan, pers. comm.) that is clearly outside of literature reported preferred water velocities for the species.

Within the study area, indicators of high value habitat that were refined and developed in a workshop setting included:

- Reaches identified in defensible scientific reports as "high value" for meeting any of the life history requirements (*i.e*. rearing, spawning, migration, overwintering) for any of the target species. "High value" habitats identified in the reviewed data without supporting fish sampling information were confirmed or refuted by comparison to known habitat requirements of the individual fish species being considered. Furthermore, it was ensured that the assessment of “high value” habitats were relevant in the context of study area.

- Reaches used for rearing by anadromous salmon, kokanee, steelhead or bull trout, or the identified presence of lamprey. Such species typically have at least one life stage where habitat is or can be a limiting factor. Additionally, such species are regionally and provincially important, and as such their confirmed presence in a stream at any life stage should result in that reach being considered high value.

- Reaches used for migration by a species to get to identified critical habitats.

4.1.3 Lake-specific criteria

Lake-specific criteria were investigated at the workshop. Triton originally proposed to include lake-specific criteria that would support the Bulkley HLP (*i.e.* maintaining lakes in a full spectrum of settings including semi-primitive and primitive), but as previously discussed, the workshop group felt that the critical stream reach project should provide the scientific support to make decisions in HLP’s, rather than have the project support or carry forward fisheries habitats or values that may not have been identified in a strictly scientific manner.

An action item from the workshop was to take a closer look at criteria that could be used to identify high value or critical lake habitats. Indicators such as fish density, and species diversity were discussed, however it was determined that the importance of lake habitat is typically assessed at a system level (*e.g.* to provide overwintering habitat), and the use of sweeping or broad ranging criteria (*e.g.* lakes with greater than 5 species of fish should be considered high value) are not appropriate. The assessment of the habitat value of a lake needs to be on a case by case basis, as reflected in a scientific report or as brought forward by local fisheries authorities, rather than applying some arbitrary criteria based on simple fish presence or population dynamics.

In the end, criteria related to lakes include those developed for specific species that reside in lakes (*i.e.* lake trout, giant pygmy whitefish), sockeye lakes, or lakes that are considered important by MOE or DFO fisheries staff (*e.g.* Onerka Lake) or have been identified as such in defensible scientific reports.

Lake-specific criteria previously described include the presence of lake trout or “giant” pygmy whitefish and sockeye lakes.

4.1.4 Possibly critical/high value stream reaches.

In addition to identifying reaches with known critical and high value habitats, an objective of the project was to identify reaches that could potentially have high value or critical habitats. Many stream systems in the study area have not been sampled, or only have basic presence/absence information, with no indication of habitat value. If habitat value has been assessed, it is usually in the context of the specific stream as opposed to the watershed or region. The identification of potentially critical or high value reaches could be used for landscape level planning, or to help identify areas that would benefit from targeted field sampling.

For the Kispiox and Cranberry TSA Critical Stream Reach project (Triton 2006), this task was completed by the Fish Habitat Assessment Tool (FHAT) modeling of a representative watershed. The results from the modeling exercise were most applicable for landscape level planning, and the identification of areas where targeted sampling to identify important habitats would be beneficial. The main difficulty with the FHAT model was applying the results from the modeled watershed to different watersheds within the study area. The results of the model had to be conservative to account for differences in fish species and geography of the watersheds within the study area.

For the Bulkley project, criteria to identify “possibly high” value stream reaches were developed as part of the criteria and indicator workshop. The suggested means of identifying such reaches was limited to background literature (or the professional opinion of local fisheries experts), that indicates that specific reaches may be high value.

- Report may actually state that the observed habitat is “possibly” high value.
- Survey timing resulted in inconclusive results so confirmation of high value habitat would require further sampling.
- No sampling completed, but physical parameters (*e.g.* channel width, substrate and gradient) suggest high value habitat may be present.

The identification of physical parameters measurable by GIS (*e.g.* order, gradient) that would suggest high value habitat may be present was investigated, however the group at the workshop indicated that due to the extent of fish sampling throughout the TSA this would be of limited value. As a conservative approach, looking at larger systems (*e.g.* 5th order) without any information was recommended, and such reaches were identified as possibly critical at the final stages of the project.

After the definition and indicator workshop, regional MOE staff provided additional input which identified specific habitats of concern, but also indicated the importance of headwater Dolly Varden populations from their perspective. Therefore, reaches with apparent headwater Dolly Varden populations (based on presence above an identified barrier) were flagged as potentially critical to support the MOE position. In such systems, fish accessible reaches (based on gradient) above a barrier were classified as potentially critical. The field confirmation of critical or high value habitats (*e.g.* spawning habitat) within these systems would be required to upgrade specific reach classifications from potentially critical to critical or high.

4.1.5 Likely not critical/high value stream reaches.

A final task of the project regarding the identification of habitats was to identify reaches that likely do not contain critical or high value habitats. The identification of such reaches could be used for landscape level planning.

For the Bulkley project, the following criteria to identify reaches that likely do not contain critical or high value habitats were developed at the workshop:

1) Existing data that indicates that specific reaches do not contain critical or high value habitats:
    - Interpretive maps from 1:20,000 RFFHI projects that indicate a reach is non-fish bearing (typically solid blue line coding on interpretive maps) or inferred non-fish bearing (typically dashed blue line-coding on interpretive maps).

2) The identification of physical parameters measurable by GIS that suggest a lack of high value or critical habitats, based on known habitat preferences of fish species in general. The outcome of the workshop regarding this criterion was a conservative approach to use the maximum gradient where fish were captured as the break point for likely not critical/high value habitat. Fish capture data was analyzed after the workshop and there were cases where fish were captured where reach gradient was over 20%. However, it was not always clear whether such fish were captured at the downstream end of a reach (*e.g.* before gradient increased), migrating downstream though a steep reach, or were actually using 20%+ gradient habitats. In the end, it was felt that flagging reaches with a gradient over 20% as "likely not critical/high" was still a conservative approach, as under most flow conditions and with most fish species a 20% gradient is an acceptable limit of distribution.

4.2 Gathering existing information

Fish and fish habitat reports completed within the study area were reviewed to determine where critical and high value habitats were located. Data sources included provincial on-line sources (*e.g.* EcoCat, FISS), the Skeena Fisheries Management Report Series, DFO Stream Information Summary maps, 1:20,000 Reconnaissance Fish and Fish Habitat Inventory (RFFHI) projects, and reports that Triton had in hand in the Prince George and Terrace offices.

Field Data Information System (FDIS) databases from relevant RFFHI projects were obtained. A review of all fish cards sampled within the area were conducted to determine which reaches contained fish habitat and what characteristics could be used to classify a reach as "critical" or "high."

The Ministry of Aboriginal Relations and Reconciliations website was used to determine which First Nations should be consulted for information regarding this project. The website provides a map that divides the province into six regions and lists all of the First Nations within each region. Regions four and five overlap with the study area. It was determined that the Gitxsan and Wetsuweten First Nations should be contacted. The Hereditary Chiefs offices for the First Nations groups were contacted to find out who was responsible for fisheries information. The fisheries manager, biologists or ranger in charge was then contacted to request fisheries information.

A list of relevant reports that had been obtained was compiled (see Appendix 2), and forwarded to Regional DFO and MOE staff for comment on the completeness of literature obtained. A communication spreadsheet was compiled to track contacts and correspondence for potential information sources (Appendix 1).

4.3 Mapping and Relational Database

Based on the objectives of the project, there were two reasonable map bases to consider: the 1:50,000 network or the 1:20,000 Terrain Resource Information Mapping (TRIM) network. The 1:50,000 stream network used for the Kispiox and Cranberry TSA Critical Stream Reach project (Triton 2006) had both advantages and disadvantages. The most important shortfall of the 1:50,000 network is that many smaller streams are not mapped. Without doubt, there are streams in the Kispiox and Cranberry TSAs that are not mapped at the 1:50,000 scale, yet defensibly could be considered as providing critical or high value habitat. Failure to include smaller tributaries in the analysis was of particular concern in the Bulkley TSA where smaller systems are considered more important than the main streams in terms of habitat for spawning and rearing (Province of British Columbia 1998).

The inclusion of smaller tributaries was largely addressed by using of the 1:20,000 TRIM network which has much greater detail compared to the 1:50,000 watershed atlas stream network. While it is recognized that even at the 1:20,000 scale many streams are still not mapped, based on Triton's extensive experience working at that scale, it is felt that the majority of those streams that may be missed would be drainages with low potential to provide high value or critical habitat.

The use of the TRIM2 layer was also investigated, however, it was decided that the TRIM1 stream layer would be used for the project. There were several reasons why the TRIM1 stream layer was determined to be appropriate for the identification of critical stream reaches in the Bulkley TSA:

- The most recent stream inventory standards (April 2006) list TRIM1 as the standard stream layer.

- The TRIM1 layer is still the typical layer used for general stream work. For example, recent data entry projects completed by Triton for the Ministry of Environment specify that only TRIM1 data should be used.

- All existing inventory reach breaking has been completed on the TRIM1 stream network. Similarly, all the existing 1:20,000 Fish and Fish Habitat Inventory data (which is the majority of existing fisheries information for the district) has been completed on the TRIM1 stream network.

- The TRIM2 layer has approximately 40% more stream network. The additional stream network is typically comprised of short first order streams that do no show up on the TRIM1, or extensions of first order TRIM1 streams further upslope. Even when using TRIM1, a percentage of streams end up being drainages when ground truthed. The majority of additional stream lines identified on the TRIM2 network end up being drainages as well. It is unlikely that "critical" stream reaches would occur on the TRIM2 line network.

The major disadvantage of the 1:20,000 stream network (TRIM1 or TRIM2) was that there is no systematic reach layer, such as is available with the 1:50,000 network. However, at the proposal stage it was determined that a large proportion of the study area (approximately 75%) had been inventoried and it was assumed that inventoried watersheds would have a useable reach break layer. This did not turn out to be the case as the majority of inventories were completed pre-standards (*e.g*. 1997). Several watersheds had been updated (*e.g*. the Telkwa, Harold Price), and useable reach break information was obtained for approximately 30% of the TSA.

Digital TRIM maps were acquired for the entire Bulkley TSA. Streams from all of the TRIM map tiles were merged into one layer, and then split into reaches. For watersheds where a Reconnaissance (1:20,000) Fish and Fish Habitat Inventory had been completed (~30% of the TSA) the existing reach breaks that were generated during that project (*e.g*. from the corresponding FDIS database) were utilized. For watersheds where no Reconnaissance (1:20,000) Fish and Fish Habitat Inventory had been completed, reach breaking was completed following criteria outlined in the Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures (April 2001 version). Using GIS software (ArcView with the FishMap extension), some relevant reach calculations were generated (*i.e*. reach length, upstream and downstream elevation, and gradient).

A ranking column for each fish species of concern, an overall reach ranking column, a comment field and a reference field were added to the basic reach information table. The end result was that for each reach (including lake reaches), the relational database includes a unique reach identifier, a ranking of the relative importance of that reach for each fish species, an overall reach rank, comments as to why the reach was ranked as indicated, and a reference to the data that resulted in the ranking. Reaches were ranked from 0-4 as follows:

- 1 = known critical habitat;
- 2 = known high value habitat;
- 3 = potentially critical/high value habitat (unsampled or sampled reaches);
- 4 = likely not critical or high value habitat (based on existing data and interpretation based on gradient); and

- 0 = unknown habitat value (no or insufficient data), or marginal or low value habitats only.

The overall rank assigned to a reach was the highest habitat value for any fish species ranked in the reach. For example, if a reach was determined to have possibly high value habitats for rainbow trout and bull trout, but known high value habitat for steelhead, the reach would be assigned an overall rank (which is depicted on the project map) of known high value habitat (“2”).

Table 2. Example of fields added to the relational table associated with the 1:20,000 reach break layer.

TRIM Map	Watershed Code	Reach	BT	CH	CO	DV	KO	L	LT	PK	PW	SA	SK	ST	RANK	RANKING Comment	REFERENCES
093L.054		1	2	0	0	0	0	0	0	0	0	0	0	2	2	BT, ST rearing	FISS 2007; David Bustard & Associates 1998
093L.054		7	1	0	0	0	0	0	0	0	0	0	0	0	1	BT spawning	David Bustard & Associates 1998
093L.043	460-422700-35700	9	0	0	0	0	0	0	0	0	0	0	0	0	4	Confirmed or Inferred Non Fish Bearing	Triton stream inventory for PIR (1996 to 2001)
093L.064	460-422700-28300	1	0	0	0	0	0	0	0	0	0	0	0	2	2	ST presence	FISS 2007
093L.064		2	0	0	0	0	0	0	0	0	0	0	0	0	0		
093L.064		1	0	0	0	0	0	0	0	0	0	0	0	0	0		
093L.074		2	0	0	0	0	0	0	0	0	0	0	0	0	0		
093L.044	460-422700-35700-54900	12	0	0	0	0	0	0	0	0	0	0	0	0	4	Confirmed or Inferred Non Fish Bearing	Triton stream inventory for PIR (1996 to 2001)
093L.055	460-422700-09600-48500	5	0	0	0	0	0	0	0	0	0	0	0	0	0		
093L.055		3	0	0	0	0	0	0	0	0	0	0	0	0	4	Confirmed or Inferred Non Fish Bearing	Triton stream inventory for PIR (1996 to 2001)
093L.053	460-422700-35700-59900	4	0	0	0	0	0	0	0	0	0	0	0	0	4	Confirmed or Inferred Non Fish Bearing	Triton stream inventory for PIR (1996 to 2001)
093L.063	460-422700-51100	5	0	0	0	0	0	0	0	0	0	0	0	0	0		
093L.053	460-422700-59600	2	0	0	1	0	0	0	0	0	0	0	0	0	1	CO spawning	Finnegan 2007 (pers. comm.)
093L.053		4	0	0	0	0	0	0	0	0	0	0	0	0	4	Confirmed or Inferred Non Fish Bearing; reach gradient >20%	Triton stream inventory for PIR (1996 to 2001)
093L.063		1	0	0	0	0	0	0	0	0	0	0	0	0	0		
093L.042	460-422700	9	0	0	0	0	0	0	0	0	0	0	0	0	0		
093L.053		1	0	0	0	0	0	0	0	0	0	0	0	0	4	Confirmed or Inferred Non Fish Bearing; reach gradient >20%	Triton stream inventory for PIR (1996 to 2001)
093L.053		2	0	0	0	0	0	0	0	0	0	0	0	0	4	Confirmed or Inferred Non Fish Bearing	Triton stream inventory for PIR (1996 to 2001)

5 Results

5.1 Identification of critical and high value reaches

A total of 17,059 reaches were identified on 15,400 km of mapped stream network within the study area, and there were 368 lakes greater than 1 hectare in size. A total of 108 reaches (808 km of stream network) were identified to be critical for one or more of the target fish species. Critical stream reaches had an average gradient of 1.5%, and a maximum gradient of 7.7%. A total of 167 reaches (460 km of stream network) were identified to contain high value habitat for one or more of the target fish species. High value stream reaches had an average gradient of 4.4%. A total of 196 reaches (326 km of stream network) were identified as potentially critical habitat for one or more of the target fish species. Potentially critical stream reaches had an average gradient of 6.0%. A total of 10,074 reaches (7,753 km of stream network) were classified as likely not critical for the target fish species. Reaches assessed as likely not critical had an average gradient of 25.2%.

The number of reaches identified as critical, high, or potentially critical, by fish species is presented in the following table.

Table 3. Identified critical, high or potentially critical reaches, by fish species.

Species	Identified Reaches	Species	Identified Reaches
Bull trout	50	Lamprey	10
Chinook	40	Pink	36
Coho	178	Salmon, general	7
Dolly Varden	125	Sockeye	51
Kokanee	48	Steelhead	99

The detailed results of the study area provided in the mapping shape files are available in the associated relational database (Attachment 1). Figure 2 depicts the overall ranking of reaches within the study area. Major river mainstems were flagged as either having known critical habitats due to the presence of spawning habitat, or known high value habitats associated with migratory routes.

Reaches flagged as having potentially critical or high value habitats included low-moderate gradient sections of 5th order or greater tributaries not already ranked, reaches that potentially support isolated populations of Dolly Varden, and reaches in systems with limited habitat data or only presence/absence data. Reaches that are not likely to provide critical or high value habitats are typically first order, headwater reaches.

Bulkley TSA Critical Fish-Stream Reach Inventory
Ranking Overview Map
Projection: UMT Zone 9
Datum: NAD83
Basemap: Digital 1:20,000 TRIM1 layer
Date: May 22, 2007
Map # 3787/Presentaion/Bulk-1
By: ML
N
W
E
S
Scale 1:150,000
5
0
5
10 Kilometers
Prepared for:
British Columbia
Ministry of Forests and Range
Produced by:
TRITON
ENVIRONMENTAL CONSULTANTS LTD.
Legend
Reach Ranking
= unknown (no or insufficient data)
= known critical
= known high
= possibly critical/high (unsampled or sampled reaches)
= likely not critical or high (based on gradient, barriers)
Lake Ranking
= unknown (no or insufficient data)
= known critical
= known high
= possibly critical/high (unsampled or sampled reaches)
= likely not critical or high (based on gradient, barriers)
Map Features
1:20,000 Marshes
1:20,000 Swamps
REGION - 6 (SKEENA)
BULKLEY FOREST DISTRICT
Smithers
Prince Rupert
Prince George
Vancouver
Victoria
Location of Bulkley TSA within Province.
560000
580000
600000
620000
640000
660000
Disclaimer
Users are cautioned that interpreted information on this product is subject to review by a statutory decision maker for the purposes of determining whether or not to approve an operational plan. The identification of critical and high value habitats is a continuing process, and identified reaches (particularly possibly critical/high reaches) should not be viewed as the definitive extent of important habitats. The limitations of the product are discussed in the associated report entitled:
Bulkley TSA Critical Stream Reach Inventory. 2007. Prepared for the Ministry of Forest and Range, Smithers BC. Prepared by Triton Environmental Consultants Ltd.

5.2 Lakes

The identification of critical lake habitats was focused on the presence of specific species (*e.g*. lake trout), or use of lake habitats by a life stage of a species (*e.g*. coho spawning in Onerka Lake, or sockeye rearing in McDonnel Lake). Specifically identified lakes of concern are provided in Table 4.

Table 4. Critical or high-value lakes identified within the study area.

Lake Name	System	Comment
Chapman Lake	Fulton River	Lake trout lake.
Onerka Lake	Nilkitkwa River	Sockeye rearing and spawning, coho spawning.
Touhy Lake	Blunt Creek	Important coho lake, and potential use by sockeye.
McDonnel Lake	Zymoetz River	Sockeye rearing and spawning. Kokanee.
Dennis Lake	Zymoetz River	Sockeye rearing.
Aldrich Lake	Zymoetz River	Sockeye rearing.
Natazul Meadows Lake	Harold-Price	Lake trout lake.
Nilkitkwa Lake	Babine River	Lake trout lake.
Secret Lake	Babine River	Steelhead spawning at outlet.
Tyee Lake	Bulkley	"Giant" pygmy whitefish.

6 Discussion

The main objective of the project was to identify critical and high value habitats. The difficulty with this task is that the assessment as to what constitutes critical or high value habitat is somewhat subjective, and dependant on the scale being considered, the distribution of a species within the study area, the life history requirements of individual fish species, and the types of habitat that are limiting to that fish species at the scale being considered. For this project, the evaluation of critical and high value habitat was determined in the context of the Bulkley TSA.

6.1 Limitations of study

The most notable limitation regarding the study is that it was an office-based exercise based on existing information and the knowledge of regional fisheries experts. There was no ground-truthing component to the work, and existing data was generally taken to be accurate (the exception being obvious data entry errors).

The identification of critical habitats for most populations of fish is a difficult task generally requiring multiple sampling events over several years. For migratory species such as most salmonids, more complex studies often involving radio telemetry are required to accurately identify migration routes and patterns. Unfortunately, such studies can be difficult to implement due to limited funding, and are not commonly completed to the extent that all critical or high value habitats for the fish species in question are definitively identified within the chosen study area. When data from these types of studies are available, they tend to focus on a few key species (*e.g*. steelhead), leaving the extent of data available for most fish species (*e.g*. whitefish) to basic presence/absence.

Biological systems can be very complex and also highly variable, which further increases the difficulty in confirming critical habitats. For example, sockeye use of spawning habitats can be highly variable from year to year, with significant periods of time between use. Even though not all spawning habitats are used on a yearly basis, the occasional use of a habitat for spawning confirms the critical nature of the habitat. Variability in use of habitats means that even when sufficient effort is spent designing and implementing studies to identify critical habitats, there are no guarantees of success.

The majority of available data comes either through inventory programs (*e.g*. 1:20,000 Reconnaissance Fish and Fish Habitat Inventory), or operational work that typically provides only a snap-shot of fish use of stream habitats, and are not designed to identify critical habitats. In addition, since many of these programs focus on smaller scale stream networks (*e.g*. 1:20,000 or 1:10,000 level), a considerable amount of the data is for small, streams that provide marginal habitat values at the TSA level. FDIS databases produced for inventory projects can also be difficult to make use of since they tend to be full of comments identifying reaches as having "high" or "moderate-high" habitat values with no reference as to what species the classification refers to. In addition, classifications are often relative to other reaches assessed within the scope of that particular project and therefore may not be comparable to reaches assigned the same classification in another watershed by a different individual. Therefore, while inventory type projects commonly identify "high value" habitats, it is often inappropriate to carry the bulk of these classifications forward to the TSA level.

6.2 Addressing data gaps and improvements in data collection

Users of the land base (*e.g*. forestry licensees, linear developments such as rail) are generally not required to obtain stream and species information necessary to designate critical stream reaches as part of on-going permitting or operational activities. For example in the forestry industry, the stream inventory focus in the past has been on cutblock specific sampling for fish presence/absence to obtain Riparian Management Area stream classifications (S1-S6). In the future it would be beneficial to adapt stream sampling procedures to capture the information necessary to designate critical stream reaches. Adapted stream sampling procedures would include:

- sub basin habitat characterization *versus* cutblock specific sampling;
- fish sampling *versus* default fish-bearing classifications (<20% gradient);
- sample for species diversity *versus* fish presence/absence; and
- standardized habitat quality assessments.

Where critical habitats are identified, it is also imperative to understand why the habitats are critical (*e.g*. groundwater influence, clean substrates, appropriate depth and water velocity for overwintering). Management direction for protection of critical habitats is provided in Section 7.

6.3 State of change and constant need for update/improve

The identification of important habitats is a continuing process, and reaches identified by the project should not be viewed as the definitive extent of critical and high value habitats. Users of the final product need to be aware of the limitations of the product. The use of the project map depicting critical habitats by individuals without a fisheries background, and in isolation of the report which outlines the limitations should be avoided. The simple avoidance of highlighted streams is not sufficient to ensure critical and high value fish habitats are not impacted. For example, protecting tributaries upstream of critical habitat may be required to afford suitable protection (even if the tributaries are not likely critical or confirmed non-fish bearing) rather than simply increasing buffers adjacent to the specific critical reach. There needs to be an appreciation that other high and critical habitats have yet to be identified. A solid understanding of what makes a habitat critical or high value, and how proposed activities could possibly affect such habitats is requisite to demonstrate due diligence. Finally, the inclusion of relevant agencies and local fisheries experts in such determinations and assessment of risk is recommended (see Section 7).

It is a difficult task to accurately identify and categorize all critical and high value fish habitats within the Bulkley TSA. The point data typically used to classify critical habitats, gives an indication of use, but it is a snapshot in time and in most cases does not indicate critical and high value habitat that is required for all stages of the target species life history. However, it is the opinion of the authors that some starting point is required to identify known critical habitats, and the product will need to be refined and updated as new information is collected. The end product is an available tool that identifies known critical habitats that require specific plans to avoid impacts, and focuses users on areas where additional site investigations should be conducted to ensure critical or high value habitat is not impacted.

7 Management strategies to protect critical habitat

The designation of a critical stream reach is intended to identify areas that contain physical and biological features that are essential for the conservation and protection of target fish species. As forest development activities (access, harvesting, silviculture *etc.*) have the potential to adversely impact critical stream reaches, the identification of these areas allows forest managers and licensees to address the potential for impacts during the development planning stage. Forest management strategies can then be established to mitigate potential impacts to conserve and protect critical stream reaches and target fish species.

However, the strategy used to manage identified critical reaches will change depending on the species, life-stage and habitat requirements that are involved in defining a reach as critical, as well as the potential *direct* and *indirect* impacts of the proposed forest development activity. In some instances the scale of the developed management plan may need to be increased from the reach level to the watershed level (such as when management of ground water is important) and professionals from a wide range of backgrounds (*e.g*. hydrologists, fluvial geomorphologists, biologists, and engineers) may need to be consulted. The following steps are proposed as a means of ensuring that the proper management strategies are developed to protect identified critical stream reaches.

7.1 Step #1: Identify why the reach has been identified as critical habitat

A reach can be identified as critical based on a range of life-history requirements (*i.e*. rearing, spawning, overwintering, migration) for a range of target species. However, due to the often unique requirements of each species at each life-history stage, the degree to which a specific activity impacts a critical reach can vary. For example a given forestry activity will have different potential impacts on a reach that has been identified as being critical due to the presence of chinook salmon spawning habitat than one with critical overwintering habitat. Similarly, the habitat requirements for rainbow trout spawning differ from that of bull trout. Therefore, determining the specific species and life-history stage(s) that results in the reach being classified as critical will help managers determine how a proposed activity might impact the identified reach. Consultation with the regional MOE Fisheries Specialist at this stage would help determine what species, life-stages and habitat types are considered critical within a given reach.

7.2 Step #2: Identify the potential impacts

Given the interconnectivity of streams and critical stream reaches within drainage basins, management strategies must consider both *direct* impacts, as well as *indirect* impacts of proposed forestry activities.

Direct impacts generally occur at the reach level, an area easily observable and quantifiable. Some examples include:

- Any harmful alteration, disruption or destruction (HADD) of critical fish habitat;
- Fish passage issues;
- Target fish species mortality;
- Removal of riparian vegetation; and
- Introduction of sediment or bedload to the channel.

Alternatively, indirect impacts are generally not as readily apparent as direct impacts. They are also not limited to the reach level and as a result may need to be addressed at a watershed level. Indirect impacts can be generally characterized as;

- Changes in water quality (temperature, suspended sediment/bedload, turbidity, pH, *etc*.);
- Changes in forest hydrology;
- Changes in riparian ecosystem function; and
- Improved public access to critical stream reaches.

Management strategies, tools and techniques for the mitigation of direct forest development impacts can be applied at a landscape level across the Study Area as federal and provincial legislation, guidelines and regulations exist for the protection of fish and fish habitat regardless of their designation. However, management of indirect impacts often needs to be determined on a case-by-case basis.

7.2.1 Management Strategies for Direct Impacts

Existing federal and provincial legislation, guidelines and regulations currently provide the framework to effectively manage for direct impacts to fish and fish habitat. Guiding federal legislation includes the following Acts, policies, and guidelines:

- *Fisheries Act*
- *Canadian Environmental Assessment Act*
- Policy for the Management of Fish Habitat
- Habitat Conservation and Protection Guidelines
- Decision Framework for the Determination and Authorization of Harmful Alteration, Disruption or Destruction of Fish Habitat

Guiding provincial legislation includes the following Acts along with associated guidelines and regulations:

- *BC Environmental Assessment Act*
- *Environment and Land Use Act*
- *Environmental Management Act*
- *Fish Protection Act*
- *Forest and Range Practices Act*
- *Forest Land Reserve Act*
- *Forest and Range Practices Act*
- *Municipal Act*
- *Waste Management Act*
- *Water Act*
- *Wildlife Act*

Applicable guidelines and best management practices include:

- Fish-stream crossing guidebook.
- A users' guide to working in and around water.
- MOE Skeena region: reduced risk in-stream work windows and measures.
- DFO land development guidelines for the protection of aquatic habitat.
- DFO Pacific Region operational statements including:
  - Aquatic vegetation removal.
  - Bridge maintenance.
  - Clear span bridges.
  - Culvert maintenance.
  - Ice and snow fill bridges.
  - Maintenance of riparian vegetation in existing right-of-ways.

Consultation with regulatory agencies, utilization of accepted guidelines and procedures, and following best management practices can mitigate direct impacts to critical reaches.

7.2.2 Management Strategies for Indirect Impacts

Managing for potential indirect impacts to critical stream reaches generally involves planning at the watershed level as opposed to the reach level. This is because even though a particular forestry activity such as harvesting a block or putting in a road may not occur directly adjacent to a critical stream reach, changes in water quality, increases in sedimentation, or decreases in organic input that may result can still affect downstream critical reaches. At a broader level, impacts to ground water and surface water runoff may impact reaches throughout a watershed. The following sections outline some of the major indirect impacts that should be considered when developing management strategies for critical stream reaches.

7.2.2.1 Water Quality

Water quality is an important biological parameter for target fish species as well as their preferred habitat. Factors known to cause poor water quality (if degraded) for aquatic life include temperature, sedimentation, runoff, erosion, dissolved oxygen, pH, decayed organic materials, pesticides, and an array of other toxic and hazardous substances. Negative changes in water quality parameters can affect target species migration, spawning, overwintering and rearing habitat. Individual water quality parameters (temperature, suspended solids, *etc*.) can have varying impacts on the target species and their critical habitats. For example, an increase in water temperature may impact the ability for Dolly Varden to compete with rainbow trout, as Dolly Varden tend to be more competitive in the cooler streams where their growth physiology gives them a competitive advantage (Oliver and Fidler 2001). Increased levels of suspended sediments are also of concern as they may affect salmonids by altering their physiology, behaviour and habitat, which may lead to stress and reduced survival rates (Bash *et al*. 2001).

Management strategies should include provisions to maintain water quality within critical stream reaches. The *British Columbia Approved Water Quality Guidelines* (*Criteria*) *1998 Edition* has been prepared pursuant to *Section 2(e)* of the *Environmental Management Act* and provides water quality criteria for the protection of aquatic life. The guidelines provide the benchmarks for the assessment of water quality and setting water quality objectives. Maintaining water quality criteria to these guidelines would be considered as a best management objective for minimizing indirect impacts to water quality and habitat within critical stream reaches.

It is difficult to pin-point one aspect of the forestry industry which has the greatest impact on water quality. Cumulative effects of forest activities typically have a short term impact on water quality and can be described as:

- Input of sediment from roads or skid trails;
- Increases in peak flows during storms;
- Increases in base flows;
- Increases in nutrient concentrations (primarily nitrogen and phosphorous);

- Increases in herbicides/fertilizers and derivative products; and
- Thermal pollution (increased stream temperature).

Leeching of disturbed or exposed soils may elevate levels of organics and nutrients and the application of fertilizers may alter stream chemistry depending on the type of fertilizer used and how it is applied. The preservation and restoration of forest cover around aquatic habitat is crucial to maintain water quality.

Management strategies for future development (*e.g*. logging, road construction, silviculture) within the Bulkley TSA should be conducted in a manner that maintains fish access and avoids and/or minimizes impacts to critical reaches. Development on land adjacent to spawning and rearing streams has the potential to introduce sediment and debris, damage riparian habitat and scour substrate that could adversely affect the survival of eggs and young fish as well as reduce habitat quality (Ford *et al*. 1995). Increased loads of fine sediment can lead to infilling of interstitial spaces (cementing) in gravel habitat and can limit the amount of habitat available for bull trout young (alevins and fry).

7.2.2.2 Riparian Vegetation

Riparian vegetation is an important parameter as it protects water quality, stabilizes stream banks, regulates stream temperatures and provides a continual source of woody debris to the stream channel. It also is a continuous source of food organisms and nutrients for fish. Changes to forest hydrology and riparian ecosystem function due to forest development activities may indirectly impact critical stream reaches through changes in stream discharge, timing, and productivity.

An important management strategy is to retain sufficient vegetation along streams to provide shade, to reduce bank microclimate changes, and to maintain natural channel and bank stability (Forest Practices Code 1995). Increased water temperatures can detrimentally affect the timing of fish development, result in mortality of aquatic organisms (including fish) and decrease the quality of water for domestic consumption. It is important to maintain bank and channel stability to protect downstream values.

7.2.2.3 Public Access

Improved public access to specific critical reaches that are sensitive to angling pressure could have a negative impact on the target species utilizing those particular reaches. For example, the vulnerability of bull trout to increased angling pressure should be considered by resource managers prior to implementing access management plans. Increased angling pressure on staging areas could potentially fish out a spawning population of bull trout in a single season (Schell 2003).

Management strategies should take into account how improved public access will impact those critical reaches (overwintering habitat, staging or spawning areas) that are sensitive to angling pressure. Catch restrictions, gear regulations and closures can be implemented by managers for the protection of specific fish populations within critical reaches and limiting angler access to identified critical reaches may be critical for the protection of sensitive fish stocks.

7.3 Step 3: Consultation

The degree to which the potential direct and indirect impacts will affect the identified critical habitat may be difficult to determine. It is important, therefore, that consultation with experts from different fields be included in the process. Some of the areas which may require outside consultation include:

- Hydrology;
- Geology;
- Fluvial Geomorphology;
- Engineering; and
- Limnology.

7.4 Step 4: Risk Assessment

Once the potential direct and indirect impacts have been identified, an assessment of the relative risk of each should be completed. The developed risk rankings could be used to trigger minimum planning requirements for each forestry activity. Forest managers, licensees, and regulatory agencies could then consistently apply management practices to protect critical stream reaches and ultimately fish and fish habitat. For example higher level planning may be required for high risk development activities (instream works) adjacent to critical stream reaches. Higher level plans may include the development of site specific mitigation measures and/or detailed impact assessments outlining the potential impacts to critical stream reaches.

In order to complete the assessment, a Risk Assessment Matrix similar to the one proposed in the *Practitioners Guide to the Risk Management Framework for DFO Habitat Management Staff (Version 1.0)*, could be used. The intent of that document is to provide guidance to Fisheries and Oceans Canada Habitat Management Program (HMP) staff, and to assist them in making transparent and consistent decisions during the regulatory review of works that affect fish and fish habitat. The Risk Assessment Matrix assesses proposed activities based on two criteria: Sensitivity of Fish and Fish Habitat and Scale of Negative Effect.

7.4.1 Sensitivity of Fish and Fish Habitat

The first criterion included in the Risk Assessment Matrix is the degree to which the specific habitat that resulted in the critical reach classification is sensitive to the potential impacts of the forestry activity proposed. Some of the considerations include:

1. Dependence on Habitat – relative importance of the habitat to a particular species or life-stage. Likely to be identified as "high" given that the reach has been classified as critical.

2. Rarity of Habitat – prevalence of the habitat type throughout the watershed.

3. Habitat Resiliency – ability of aquatic ecosystem to recover from changed in environment conditions.

Given that the habitat being assessed has previously been identified as critical, it is likely that the target species and/or life-stage are heavily dependent on it. However, the relative abundance of that habitat type throughout the watershed as well as the resiliency of the habitat type to resist or recover from change may effect management decisions.

7.4.2 Scale of Negative Effect

The second criterion included in the Risk Assessment Matrix deals with the expected degree of the direct and indirect impacts. The attributes that need to be considered when determining the scale of the negative effect are:

1. Extent – refers to the "footprint" of the development proposal both directly (*i.e*. reach level) and indirectly (*i.e*. watershed level).

2. Duration – the amount of time the impact will persist (days vs. weeks/months vs. years).

3. Intensity – the expected amount of change from baseline conditions. Timing of work may have a major effect on intensity (ex. sediment release during a spawning event *versus* during a non-spawning period).

7.4.3 Risk Assessment Matrix

An example of the Risk Assessment Matrix proposed in *Practitioners Guide to the Risk Management Framework for DFO Habitat Management Staff (Version 1.0)*, is provided in Figure 3. The results of the matrix analysis can be used to trigger specific regulatory processes and help identify projects where the potential risk to critical stream reaches is considered too high. However, it is important that the various sources of uncertainty that may be associated with predicting both the sensitivity of fish and fish habitat and the scale of negative effect be acknowledged. Even with expert consultation and thorough data collection and analysis, the uncertainty as to how the critical habitat will be affected can be high. Therefore, users of such a Risk Assessment Matrix should provide a discussion of the uncertainty of the various components of the matrix.

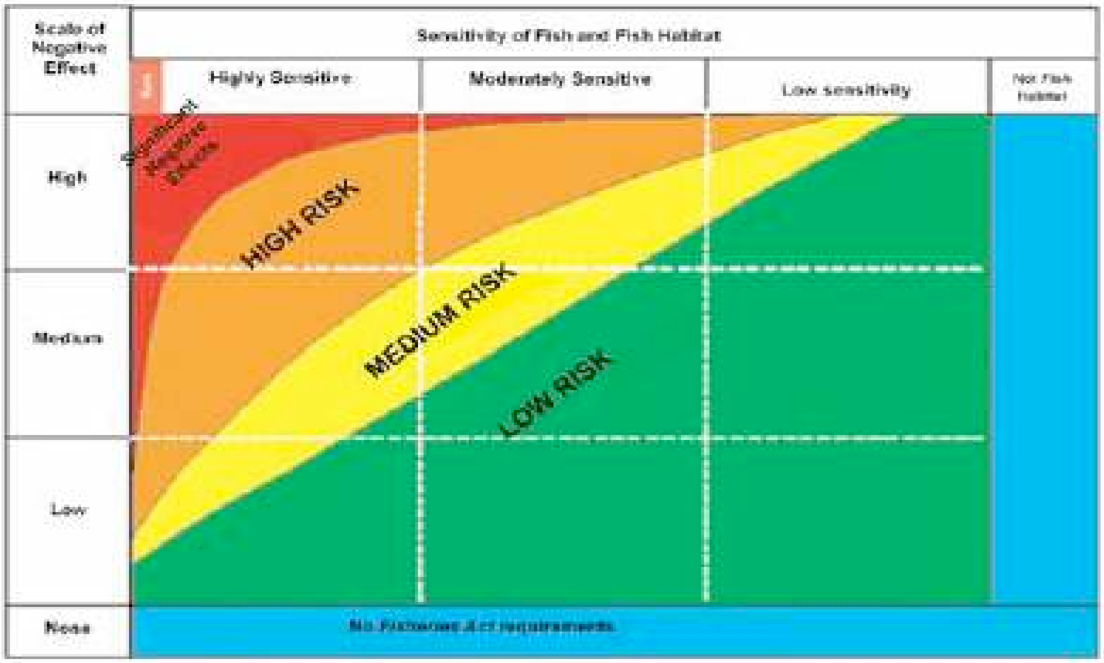

Figure 3. Example Risk Assessment Matrix that could be used to assess forest management strategies in relation to identified critical stream reaches (from *Practitioners Guide to the Risk Management Framework for DFO Habitat Management Staff (Version 1.0)*).

7.4.4 Effectiveness Evaluation and Adaptive Management

Forest managers, licensees, and regulatory agencies should consider implementing effectiveness evaluations and adaptive management as mechanisms to evaluate current management practices and modify those practices where necessary to maintain the function of stream reaches with critical habitat. Effectiveness evaluations and adaptive management would allow for:

- ensuring management objectives are defined and achieved;
- continuous improvement of management practices;
- consistent implementation of management practices;
- identification of key information gaps;
- improving knowledge of management practices;
- ensuring management decisions are made on reliable, objective information; and
- demonstration of due diligence.

8 Fisheries Sensitive Watersheds

Under the *Proposed Designation of Fisheries Sensitive Watersheds and establishment of an objective for these Watersheds: Skeena Region,* in order for a watershed to be designated a "Fisheries Sensitive Watershed" it must have both significant fisheries resources and significant watershed sensitivity. The criteria used to assess each of those categories are as follows:

1. Significant Fisheries Values:

    - *Biodiversity* – watersheds with a greater diversity are considered more valuable. Higher scores are given for presence of salmonid species and for threatened or endangered species.
    - *Regionally significant stocks* – presence of species such as steelhead that are considered to be regionally significant.
    - *Temperature sensitivity* – as identified under the Forest and Range Protection Act. At present only applies to the Nadina and Nicola watersheds.
    - *Sensitive stream* – as identified by the Fisheries Protection Act. A total of 15 streams within the province have this designation, none within the Skeena Region.
    - *Economic Value* – combined assessment of species escapement fore each watershed plus predicted angler effort for all lakes.

2. Significant Watershed Sensitivity:

    - *Terrain and soil sensitivity* – percentage of the watershed with slope greater than 50%.
    - *Stream channel hydrology* – stream density as measured by total channel length for reaches less than 8% gradient.
    - *Riparian disturbance* – percentage of stream reaches less than 8% gradient with riparian disturbances.
    - *Road density* – the higher the density of roads the higher the sensitivity.
    - *Previous disturbance* – percentage of watershed in a disturbed state (clearcut, selectively logged, fire, *etc*.).

Under Schedule A of *Order – Fisheries Sensitive Watersheds – Skeena Region*, five watersheds within the Skeena Region have previously been identified as Fisheries Sensitive Watersheds. The available summary information for each of these streams relative to the criteria listed for classification as a Fisheries Sensitive Watershed is provided in Table 5.

It should be noted that additional field surveys and a more exhaustive review of existing data would be required to thoroughly assess each the five watersheds. In particular, detailed data on terrain and soil sensitivity and stream channel hydrology was unavailable for this analysis. Existing overview information for some of the watersheds was available from a "Bulkley Watershed Ranking" completed in 2004 using the procedure outlined in Wilford and Lalonde, 2004. Based on that information as well as information available online (FISS, DFO Mapster, *etc*.), in available reports, and through orthophoto interpretation, each of the five identified watersheds meets the criteria for classification as a Fisheries Sensitive Watershed to varying extents:

1. Toboggan Creek appears to be the best suited for the designation of a Fisheries Sensitive Watershed based on highest biodiversity, presence of regionally significant species, economic value, and level of existing disturbance. Major road

crossings are visible on the TRIM orthophoto mosaic and the watershed is largely accessible throughout. The majority of Toboggan Creek was identified as containing critical habitat due to the presence of coho, pink and steelhead spawning habitat as well as high-value rearing habitat for steelhead and Dolly Varden. Toboggan Creek is also a salmon migration corridor. The watershed was identified as having sediment issues in the Bulkley Watershed Ranking.

2. Five Mile Creek also has good salmonid biodiversity and regionally significant species with economic value, however, the level of existing disturbance within the watershed appears to be less than in the other four watersheds. One major road crossing of Five Mile Creek was visible on the TRIM orthophoto mosaic. Critical habitat was identified at the downstream end of the Five Mile Creek due to the presence of sockeye and kokanee spawning habitat and coho rearing habitat.
3. Gramophone Creek had the lowest biodiversity (2 species) but does contain one regionally significant species (steelhead). The level of existing disturbance is fairly high but limited to the downstream half of the watershed. Two major road crossings were observed on the orthophoto. Sections of critical habitat were identified along Gramophone Creek due to the presence of steelhead spawning and due to the creek being a salmon migration corridor.
4. Cumming Creek contains regionally significant species but they likely have little economic value. The level of existing disturbance is fairly high but limited to the downstream half of the watershed. One 700 m long section of riparian disturbance was visible near the confluence of Cumming Creek. No major road crossings were observed but it is likely that several secondary roads are present. No critical habitat was identified within the Cumming Creek watershed.
5. Jonas Creek also had records of only two species with one being regionally significant (Dolly Varden). There is likely little to no economic value however it was the only watershed of the five with resource sensitivity records in FISS due to the presence of steep side slopes. The report from which that record was generated was reviewed but there was no information as to whether the steep slopes persist throughout the watershed or are limited to one particular site. Channel stability issues were also identified during the Bulkley Watershed ranking in 2004. Orthophoto coverage shows substantial historic harvesting within the watershed with one major road crossing of Jonas Creek. No critical habitat was identified within the Jonas Creek watershed.

8.1 Candidate watersheds for consideration

Based on the criteria listed for classification as a Fisheries Sensitive Watershed and the information gathered from the critical stream reach analysis, several other watersheds within the study area could be investigated further in consideration for classification. Further investigation (especially in regards to watershed sensitivity), and discussions with local experts would be required to confirm the suitability of each. Watersheds that may warrant further investigation include:

Goathorn Creek (tributary to Telkwa River):

- Records of CH, DV, PK, RB, and ST;
- Significant road, agricultural and forestry development;
- Identified as having temperature sensitivities in the Bulkley Watershed Ranking;
- Identified as containing critical habitat due to the presence of CH, BT, ST and DV rearing habitat with BT, PK, ST and DV spawning habitat. The creek has also been identified as a salmon migration corridor.

Tenas Creek (tributary to Goathorn Creek):

- Records of DV, MW, RB, and ST;
- Significant road, agricultural and forestry development;
- Identified as containing critical habitat due to the presence of BT, ST and PK spawning habitat.

Silvern Creek (tributary to Zymoetz River):

- Records of CO, DV, SK and ST;
- Significant road and forestry development;
- Identified as having temperature sensitivities in the Bulkley Watershed Ranking;
- Identified as containing critical habitat due to the presence of CO and SK spawning habitat with ground water influences.

Hankin Creek (tributary to Zymoetz River):

- Records of CO, CT, DV, RB, and ST;
- Significant road and forestry development;
- Identified as having sediment source issues in the Bulkley Watershed Ranking;
- Identified as containing critical habitat due to the presence of CO rearing and ST spawning habitat.

Kathlyn Creek (tributary to Bulkley River):

- Records of CO, CT, L, MW, PK, RB, and ST;
- Significant road, residential and agricultural development;
- DFO escapement records (CO - 600; PK – 2,500);
- Identified as containing critical habitat due to the presence of CO and ST spawning habitat and being a salmon migration corridor.

Trout Creek (tributary to Bulkley River):

- Records of CO, CT, PK, RB and ST;
- Significant road, residential and agricultural development;
- DFO escapement records (CO - 300; PK – 3,000);
- Identified as containing critical habitat due to the presence of CO and ST spawning habitat.

Table 5. Summary information for the five streams classified as Fisheries Sensitive Watersheds in the Bulkley TSA.

	Significant Fisheries Values					Significant Watershed Sensitivity								
	Biodiversity[1]	Regionally Significant Species	Temperature Sensitivity	Sensitive Stream (FPA)	Econonic Value	Terrain and Soil Sensitivity[2]	Stream Channel Hydrology	Riparian Disturbance	Road Density	Previous Disturbance	Identified as Critical Habitat?	Preliminary Human Impact[3]	Aquatic Resource Sensitivity[3]	Overall Watershed Ranking[3]
Cumming Creek	DV, RB, ST	Yes	No	No	low to none: No DFO escapement data, limited recreational value	None Identified	unknown	Historic logging visible on orthophoto; potential riparian disturbance of 700m upstream of confluence (based on	Few roads visible on ortho but historic logging suggests secondary roads present.	Historic logging visible in d/s portion of watershed on orthophoto.	No	Low	Moderate	6
Jonas Creek	DV, RB	Yes	No	No	low to none: No DFO escapement data, limited recreational value	Areas of steep side slopes referenced in FISS. High preliminary human impacts[3].	unknown	Historic logging visible on orthophoto; buffer on Jonas Creek appears continuous (based on ortho interpretation).	Major road crossing on Jonas Creek, several secondary logging roads also present.	Historic logging visible in d/s portion of watershed on orthophoto.	No	High	Moderate	2
Toboggan Creek	CH, CO, CT, DV, L, MW, PK, RB, SK, ST	Yes	No	No	DFO escapement: CO (55 year max of 9000); PK (55 year max of 20,000)	Low preliminary human impact[3].	unknown	Extensive agricultural and residential areas visible on ortho.	Major road crossings visible on ortho.	Extensive agricultural and residential areas visible on ortho.	Yes	Low	High	5
Gramophone Creek	RB, ST	Yes	No	No	low to none: No DFO escapement data, limited recreational value	None Identified	unknown	Potential ranching/agricultural development at d/s end; buffer on Gramophone Creek appears continuous (based on ortho interpretation).	Two road crossings visible on ortho. Other secondary roads likely present.	Agricultural development at d/s end with some historic logging visible at u/s end.	Yes	Low	Moderate	6
Five Mile Creek	CAS, CO, DV, EB, KO, LNC, RB, SK	Yes	No	No	DFO escapement: SK (55 year max of 4000); limited recreational value.	None Identified	unknown	None observed on orthophoto.	One major road crossing with no secondary roads observed on ortho.	Historic logging limted to u/s portion of watershed.	Yes (d/s only)	Low	Moderate	6

[1] Species listed in FISS (CAS - prickly sculpin; CH - chinook; CO - coho; CT - cutthroat; DV - Dolly Varden; EB - brook trout; KO - kokanee; L - lamprey; LNC - longnose dace; MW - mountain whitefish; PK - pink salmon; RB - rainbow trout; SK - sockeye; ST - steelhead)

[2] Bulkley Watershed Ranking, 2004

[3] Based on "A framework for effective watershed monitoring" Wilford and Lalonde, 2004.

9 References

Bash, J, C. Berman & S. Bolton, 2001. Effects of Turbidity and Suspended Solids on Salmonids. Center for Streamside Studies, University of Washington.

Baxter J.S., and J.D. McPhail 1996. A review of bull trout (*Salvelinus confluentus*) life-history and habitat use in relation to compensation and improvement opportunities. Fisheries Management Report No. 104. Department of Zoology, UBC, Vancouver, BC.

BC Ministry of Forests. 2002. Fish-stream crossing guidebook. For. Prac. Br., Min. For., Victoria, B.C. Forest Practices Code of British Columbia.

British Columbia Approved Water Quality Guidelines (Criteria) 1998 Edition. Prepared pursuant to Section 2(e) of the *Environment Management Act*, 1981, Original signed by Don Fast, Assistant Deputy Minister Environment and Lands HQ Division September 11, 1998. Updated: August 24, 2001.

Fish Habitat Inventory and Information Program. 1991. Stream Summary Catalogue. Subdistrict 4C and 4D Hazelton. Department of Fisheries and Oceans, Vancouver, B.C.

Fisheries and Oceans Canada, 2006. Fish Stocks of the Pacific Coast: Online Book. http://www-comm.pac.dfo-mpo.gc.ca/publications/speciesbook/Salmon.html

Fisheries and Oceans Canada, 2004. Fish and Aquatic Life. Underwater World: Pacific Salmon. http://www.dfo-mpo.gc.ca/zone/underwater_sous-marin/salmon/salmon-saumon_e.htm

Fisheries and Oceans Canada. *Practitioners Guide to the Risk Management Framework for DFO Habitat Management Staff (Version 1.0),* Internal Document. Habitat Management Program.

Ford, B.S., P.S. Higgins, A.F. Lewis, K.L. Cooper, T.A. Watson, C.M. Gee, G.L. Ennis, and R.L. Sweeting. 1995. Literature reviews of the life history, habitat requirements and mitigation/compensation strategies for thirteen sport fish species in the Peace, Liard and Columbia River drainages of British Columbia. Canadian Manuscript Report of Fisheries and Aquatic Sciences No. 2321.

Gottesfeld, A.S., Rabnett, K.A., Hall, P.E. 2002. Conserving Skeena Fish Populations and Their Habitat. Prepared for the Skeena Fisheries Commission.

Groot, C. and L. Margolis (eds). 1991. Pacific Salmon Life Histories. UBC Press, Vancouver . pp 564.

Hale, S.S., T.E. McMahon and P.C. Nelson. 1985. Habitat Suitability Index Models and Instream Flow Suitability Curves: Chum Salmon. U.S. Fish and Wildl. Serv. Biol. Rep. 82(10.108). 48pp.

Hart J.L., 1973. Pacific Fishes of Canada. Fisheries Research Board of Canada. Bulletin 180. St. Andrews, N.B. pp 106-136.

Mackay, W. C. 2000. Status of the Pygmy Whitefish (Prosopium coulteri) in Alberta. Alberta Environment, Fisheries and Wildlife Management Division, and Alberta Conservation Association, Wildlife Status Report No. 27, Edmonton, AB. 16 pp.

McMahon, T.E. 1983. Habitat Suitability Index Models and Instream Flow Suitability Curves: Coho Salmon.. U.S. Fish Wildl. Serv. FWS/OBS-82/10.49. 29pp.

Oliver, G.G. and Fidler, L.E., 2001. Towards a Water Quality Guideline for Temperature in the Province of British Columbia. Prepared for Ministry of Environment, Lands and Parks, Water Quality Section, Victoria

Post, J. R. and F. D. Johnston. 2002. Status of the Bull Trout (Salvelinus confluentus) in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, and Alberta Conservation Association, Wildlife Status Report No. 39, Edmonton, AB. 40 pp.

Province of British Columbia. 2001. *Reconnaissance (1:20,000) Fish and fish habitat inventory: standards and procedures*. Prepared by BC Fisheries, Information services branch. Prepared for the Resources Inventory Committee. Version 2.0.

Province of British Columbia. 2005. Freshwater fishing synopsis 2005-2006.

Province of British Columbia. 1998. Approved Bulkley Land and Resource Management Plan. Available on-line at: http://ilmbwww.gov.bc.ca/ilmb/lup/lrmp/northern/bulkley/approved_plan/toc.htm

Raleigh.R.F., and P.C. Nelson. 1985. Habitat Suitability Index Models and Instream Flow Suitability Curves: Pink Salmon. U.S. Fish Wildl. Serv. Biol. Rep. 82(10.109). 36pp.

Rankin, L., Phylogenetic and Ecological Relationship Between “Giant” Pygmy whitefish (Prosopium spp.) and Pygmy Whitefish (Prosopium coulteri) in North-Central British Columbia. The University of Northern British Columbia

Rosenfeld, S. and T. Hatfield. 2006. Information needs for assessing critical habitat of freshwater fish. Can. J. Fish. Aquat. Sci. 63: 683-698.

Scott, W.B. & E.J. Crossman. 1973. Freshwater fishes of Canada. Bryant Press Ltd. Ottawa, Canada.

Triton Environmental Consultants Ltd. 2006. Kispiox and Cranberry TSA Critical Stream Reach Inventory. Prepared for the Ministry of Forests and Range, Smithers, BC.

Wilford, D and R. Lalonde, 2004. A Framework for Effective Watershed Monitoring. Streamline Watershed Management Bulletin, Vol.28/No. 1, Fall 2004.

9.1 Personal Communication

Giroux, P., 2006. Personal Communication. Fish Biologist - Ministry of Environment. February 28, 2006.

Finnegan, B., 2007. Personal Communication. Fisheries and Oceans Canada, Northern Salmon Stock Assessment. Smithers. March 21, 2007.

APPENDIX 1 – INFORMATION SOURCES.

Appendix 1. Information sources.

Name	Organization	Date Contacted	Information Received	Comment
EcoCat Report Server	MOE	Jan 3, 2007	71 reports downloaded	Advanced search. Specifics selected included Bulkley and Babine watershed groups and fish and aquatic habitat reports.
DFO Waves Library	Department of Fisheries and Oceans	Jan 4, 2007	33 reports documented and requested from Triton Librarian.	Searches in Catalogue included: Bulkley River, Bulkley Forest District, Telkwa, Babine River, Upper Babine Lake, Nilkitkwa, Chapman Lake, Harold Price Creek, Nichyeskwa, Toboggan Creek, Fulton River, Upper Fulton River, Blunt Creek, West Nilkitkwa Lake.
Fisheries Project Registry	Department of Fisheries and Oceans Canada.	Jan 4, 2007		Active and completed projects for the Bulkley Forest District were searched and any relevant projects were documented in a Microsoft word Document.
Habitat Conservation Trust Fund Online Library		Jan 4, 2007		Enhancement projects for region 6 were searched. One project regarding giant pygmy white fish in Tyhee Lake was found.
Maria Emerson	Habitat Conservation Trust Fund	Jan 4, 2007		Maria was contacted by phone regarding obtaining a report for the giant pygmy white fish project, she suggested we e-mail her the information we are after and she will see if she can find anything in her project files. An e-mail was sent.
FISS Report Server	Ministry of Environment	Jan 4, 2007		Searched report database for Bulkley River. 20 reports found. Telkwa River. 7 reports found.
Paul Giroux	Ministry of Environment	Jan 8, 2007		Email was sent notifying him that we would like to come to the Smithers office to photocopy some hardcopy reports from the library. Paul informed me that he would not be available and indicated Dean Peard may be able to provide some assistance.
Paul Giroux	Ministry of Environment	Jan 17, 2007	39 hardcopy reports and 8 memos	Paul supervised while we were in the MoE library photocopying hardcopy reports.
Tom Pendray	Department of Fisheries and Oceans Canada.	Jan 19, 2007		Tom was contacted to review the list of reports that Triton was able to acquire for the Bulkley TSA. An E-mail was sent with the report list attached.
Paul Giroux	Ministry of Environment	Jan 19, 2007		Paul was contacted to review the list of reports that Triton was able to acquire for the Bulkley TSA. An E-mail was sent with the report list attached.
Kenny Rabnett	Gitxsan Watershed Authority	Jan 19, 2007		Kenny was contacted via. E-mail and asked to review the list of reports that Triton was able to acquire for the Bulkley TSA. He was also asked to provide names of any stakeholders he felt should be contacted regarding the project.

Name	Organization	Date Contacted	Information Received	Comment
Allen Gottesfeld	Gitxsan Watershed Authority	Jan 19, 2007		Allen was contacted via. E-mail and asked to review the list of reports that Triton was able to acquire for the Bulkley TSA. He was also asked to provide names of any stakeholders he felt should be contacted regarding the project.
Walter Joseph	Wetsuweten Fisheries Department	Jan 19, 2007		Walter was contacted by phone and asked to review the list of reports that Triton was able to acquire for the Bulkley TSA. He was also asked to provide names of any stakeholders he felt should be contacted regarding the project. Walter replied that Nadina Community Futures should be contacted. An E-mail was sent with the report list attached.
Reception	Nadina Community Futures Development Corporation	Jan 19, 2007		Spoke with reception and was referred to the Department of Fisheries and Oceans Canada.
Bill Spenst	Lake Babine Nation	Jan 19, 2007		Bill was contacted by phone, and was asked to review the list of reports that Triton was able to acquire for the Bulkley TSA. He was also asked to provide names of any stakeholders he felt should be contacted regarding the project. An E-mail was sent with the report list attached.
Tom Pendray	Department of Fisheries and Oceans Canada	Jan 22, 2007	Contact information.	Tom replied to message sent on January 19, 2007. He said the report list looks very comprehensive and said that he will send an e-mail if he thinks of any other potential contacts or reports. Tom said he would contact Barry Finnegan from the DFO Stock Assessment Branch for escapement information regarding specific areas (*e.g*. Upper Telkwa River for coho) where there may be additional geographic detail regarding normal distribution of spawners.
Berry Finnegan	Department of Fisheries and Oceans Canada	Jan 24, 2007	Will e-mail response at a later date.	A phone message was left for Berry in regards to unpublished escapement summaries and regular spawners surveys for drainages within the Bulkley TSA. Tom Pendray forwarded our discussion to Berry and Chaz followed up with a phone message.
Kenny Rabnett	Gitxsan Watershed Authority	Jan 24, 2007	Has not replied.	An E-mail was sent to follow up on the previous message sent on January 19, 2007.
Allen Gottesfeld	Gitxsan Watershed Authority	Jan 24, 2007	Has not replied.	An E-mail was sent to follow up on the previous message sent on January 19, 2007.

Name	Organization	Date Contacted	Information Received	Comment
Walter Joseph	Wetsuweten Fisheries Department	Jan 24, 2007	Has not replied.	An E-mail was sent to follow up on the previous message sent on January 19, 2007.
Bill Spenst	Lake Babine Nation	Jan 24, 2007	Has not replied.	An E-mail was sent to follow up on the previous message sent on January 19, 2007.
Cameron Stevens	Gitxsan Watershed Authority	Jan 24, 2007	Has not replied.	Cameron was contacted via. E-mail and asked to review the list of reports that Triton was able to acquire for the Bulkley TSA. He was also asked to provide names of any stakeholders he felt should be contacted regarding the project.
Kenny Rabnett	Gitxsan Watershed Authority	Jan 26, 2007	None to date	Kenny replied to the follow up E-mail and said he would forward any data or contact information if any comes to mind in the future.
Paul Giroux	Ministry of Environment	Jan 30, 2007	Summary of Bigelow Lake and Call Lake files from MoE Library in Smithers.	Paul sent an E-mail summarizing the file for Bigelow Lake and Call Lake.
Barry Finnegan	Department of Fisheries and Oceans Canada	Feb 12, 2007	Brief summary of Upper Nilkitkwa River and Onerka Lake, Nichyeskwa Creek, Blunt Creek, Touhy Creek and upper Harold Price Creek, McDonnell Lake and upper Zymoetz (Copper) River.	Barry provided a word document with maps and summaries of specific drainages that he feels were either missed or not properly described upon review of the report list generated from Tritons literature review.

APPENDIX 2 – OBTAINED LITERATURE

Report Name	Report Author	Year	Relevant Information? (y/n)	Within Study Area? (y/n)	Comments
Gravel incubation and fry-to-smolt rearing of chinook salmon (*Oncorhynchus tshawytscha*) at Fulton River	Banford, C.	1978	No	No	Hatchery method techniques.
Heath tray incubation and rearing of steelhead trout (*Salmo gairdneir*) at Fulton River	Banford, C.	1978	No	No	Hatchery method techniques.
An evaluation of the use of a rotary screw fish trap for assessment steelhead smolt emigrations in the Little Bulkley River 1993	Beere, M.C.	1993	Yes	No	
Radio Telemetry Investigations of Steelhead Tagged in the Lower Bulkley River 1989.	Beere, M.C.	1991	No	Yes	Migration speed information.
Reconnaissance lake inventory of unnamed lake (Alias B32)	BioLith	1998	No	No	
Reconnaissance Lake Inventory of unnamed Lake (Alias B33)	BiolLith	1998	No	Yes	CT captured.
Historical data review on the Upper Bulkley Watershed.	Brocklehurst, S.J.	1998	Yes	No	Upper Bulkley watershed.
1982 investigations of adult coho salmon in the Telkwa River.	Bustard, D.R. (Read Environmental and Planning Associates Ltd.)	1983	Yes	Yes	Lots of information regarding coho use of the Telkwa River and major tributaries.
Environmental overview of the Telkwa project area prepared for Crows Nest Resources Ltd.	Bustard, D.R. (Read Environmental and Planning Associates Ltd.)	1982	Yes	Yes	Steelhead overwintering comment. Most of data too vague to map.
Meristic characteristics of pacific salmon & steelhead trout captured at Moricetown Falls 1961-66.	Buxton, J.D.	1971	No	Yes	Unlikely to contain relevant information.
The Babine Lake salmon development program: progress report to March 31, 1968.	Canada. Dept. of Fisheries; Fisheries Research Board of Canada	1968	No	No	
Suskwa River steelhead trout: the colonization of Harold-Price Creek with hatchery-reared steelhead.	Chudyk, W.E.	1979	No	Yes	No habitat data. ST stocked in upper Harold-Price.
Suskwa River steelhead trout: the colonization of Harold-Price Creek with steelhead fry hatched and reared near Skilokis Creek.	Chudyk, W.E.	1981	No	Yes	No habitat specific data.

Report Name	Report Author	Year	Relevant Information? (y/n)	Within Study Area? (y/n)	Comments
Progress report 1980.					
Suskwa River steelhead trout. The 1977 inventory, creel survey and life history characteristics study leading to the removal of a barrier on Harold-Price Creek.	Chudyk, W.E.	1978	No	Yes	No specific habitat data.
The marking of sockeye salmon fry (*Oncorhynchus nerka*) at Fulton River and Pinkut Creek, Babine Lake, B.C. (1971-1972)	Coburn, A.S. and J. McDonald	1973	No	No	
The trapping and marking of sockeye salmon fry (*Oncorhynchus nerka*) at Fulton River, Babine Lake, B.C., 1966-1968	Coburn, A.S. and J. McDonald	1972	No	No	
A reconnaissance survey of Seymour Lake	Coombes, D. M. V.	1983	No	Yes	Some fish sampling results (no relevant fish to project criteria).
An Evaluation of Fish Habitat and Fish Populations in Toboggan Creek, near Smithers, Relevant to Steelhead Enhancement Opportunities	D. Tredger, Fisheries Biologist (SEP) - Fisheries Assessment and Improvement Unit	1979	Yes	Yes	Provides info on habitat value for reaches within the Tobbogan Creek watershed.
Data summaries for KM 1019 Creek on Telkwa Forest Service Road.	Dave Bustard and Associates	2001	Yes	Yes	CO capture locations. No map or UTMs.
Results of fish salvage on Kathlyn Creek at the Smithers golf course.	David Bustard	1991	Yes	Yes	ST and CO capture locations.
Assessment of coho salmon recruitment from streams tributary to Babine Lake.	David Bustard & Associates Ltd.	1990	Yes	Yes	Provides info on coho spanwing and rearing in tributaries to Babine and Nilkitwa Lakes.
Sustut and Bulkley Rivers Juvenile Steelhead Surveys. 1999.	David Bustard & Associates Ltd.	2000	Yes	Yes	ST rearing in Bulkley mainstem. No maps.
Fish distribution in Atrill Creek, tributary to Bulkley River near Hazleton.	David Bustard & Associates Ltd.	2000	Yes	Yes	ST rearing in lower reach.
Juvenile Coho population estimates in the Telkwa Ponds, May 1995.	David Bustard & Associates Ltd.	1995	Yes	Yes	Off-channel ponds of the Telkwa River provide important rearing and overwintering habitat for CO.
Juvenile Coho population estimates in the Telkwa Ponds, May 1994.	David Bustard & Associates Ltd.	1994	Yes	Yes	Off-channel ponds of the Telkwa River provide important rearing and overwintering habitat for CO.
Juvenile Coho population estimates in the Telkwa Ponds. Year 2000.	David Bustard & Associates Ltd.	2000	Yes	Yes	Off-channel ponds of the Telkwa River provide important rearing and overwintering habitat for CO.

Report Name	Report Author	Year	Relevant Information? (y/n)	Within Study Area? (y/n)	Comments
Juvenile Coho population estimates in the Telkwa Ponds. Year 2001.	David Bustard & Associates Ltd.	2001	Yes	Yes	Off-channel ponds of the Telkwa River provide important rearing and overwintering habitat for CO.
Salvage Permit #SM05-17933 - Dahlie Creek.	David Bustard & Associates Ltd.	2005	Yes	Yes	
Aquatic resource assessment of the Telkwa Coal Project. 1984 studies.	David Bustard & Associates Ltd.	1985	Yes	Yes	Summarized in 1997 baseline document.
Aquatic resource baseline studies: Telkwa Coal Project. 1997.	David Bustard & Associates Ltd.	1998	Yes	Yes	Lots of information regarding steelhead, coho and bull trout use of the Telkwa River and major tributaries.
1995 Reconnaissance survey of Bristol Lake. Watershed Code 480-6972-65 01 (00585BABL)	DeGisi, J. S. and J. Burrows	1996	No	Yes	Fish presence information.
1995 Reconnaissance survey of Torkelsen Lake. Watershed Code 460-0817-439-616 03 (00259BULK)	DeGisi, J. S. and J. Burrows	1996	No	Yes	Fish presence information.
Stream summary catalogue. Subdistrict 4D, Smithers (Volume2), Bulkley	Demarco, R.	1991	Yes	Yes	Provides stream inventory information for Smithers area. Covered by FISS points (available on-line).
Babine River fence extension	Department of Fisheries and Oceans	1997	No	Yes	Fence operations extended from September 1 to October 1.
Upper Skeena River adult coho surveys.	Department of Fisheries and Oceans	1997	No	No	No applicable information.
Coho escapement counts on Bulkley watershed streams.	Department of fisheries and Oceans	2001	Yes	Yes	CO spawning identified in Kathyln, and Byman Creek.
Moricetown coho conservation and tagging program.	Department of Fisheries and Oceans	2002	No	Yes	CO tags recovered at Toboggan Creek fence. Project summary only.
Babine Lake Development Project No. 9, Fulton River spawning channel, Contract No. 3 : Completion Stage One	Department of Fisheries Canada.	1969	No	No	
The Babine Lake development program for sockeye salmon	Department of Fisheries Canada.	1967	No	No	Details selection of Fulton River and Pinkut Creek enhancement sites.
Fulton River fry quality and ecology program: report of 1968 studies	Dill, L.M.	1969	No	No	
The 1969 Fulton River sockeye fry quality and ecology program : summary of results	Dill, L.M.	1970	No	No	

Report Name	**Report Author**	**Year**	**Relevant Information? (y/n)**	**Within Study Area? (y/n)**	**Comments**
Babine River adult coho sampling program: 2001 program report.	Donas, B.	2001	No	Yes	Mark recapture information for Babine fence.
Upper Bulkley River and Toboggan Creek overwintering study, 2000-2001	Donas, B. and R. Saimoto	2001	Yes	Yes	Mainstem Tobboggan Creek provides important CO overwintering habitat.
Juvenile Salmonid Studies in the Sustut and Bear Rivers, B.C., 1984	Envirocon Ltd.	1985	No	No	
G.S. Eldridge & Co9. Ltd. and Standard Testing Laboratories: Chemical Analysis of Chapman Lake	G.S. Eldridge & Co. Ltd.; Fairall, R.C.	1959	No	Yes	
Fulton River upwellling gravel incubator for sockeye salmon	Ginetz, R.M.J	1976	No	No	
Sockeye egg-to-fry mortality in the Fulton River spawning channels.	Ginetz, R.M.J	1972	No	No	
Assessment of lake trout (*Salvelinus namaycush*) stocks and an evaluation of netting and analysis techniques in Chapman, Augier, Pinkut, Taltapin and Doris Lakes, BC	Giroux, P.A.	2003	Yes	Yes	Confirms LT presence in Chapman Lake.
Biophysical stream survey of fourteen sockeye streams tributary to the Babine-Nilkitkwa lakes.	Graham, C.C., R.A. McIndoe, and D.N. Meyers.	1976	Yes	Yes	Brief comments on SK spawning in 9 Mile and 5 Mile creeks. Salmon presence indicated for several streams, but not specific. Report mostly details biophysical information.
Preliminary report on proposed rehabilitation of Round and Tyee lakes.	Griffith, R.P.	1979	Yes	Yes	Confirms the presence of "giant" pygmy whitefish in Tyee Lake.
Toboggan Creek: a report on the results of field work undertaken by the Bulkley Valley Steelhead Club, August to October 1978.	Hatlevik, S. P.	1978	Yes	Yes	A map of known spawning areas for CO and PK in Tobbogan Creek is provided.
Upper Bulkley fish fence project 1989.	Houston chapter of the steelhead society of British Columbia.	1989	Yes	No	
A reconnaissance survey of Summit Lake.	Janssen, R.G. and Bustard	1970	No		CT captured.
Lake Survey Data: Broman Lake	Janssen; Bustard	1970	No	No	
Lake Survey Data: Chapman Lake	Janssen; Bustard	1970	No	Yes	Physical survey data.
1996 Reconnaissance Inventory of Coppermine Lake (Watershed Code 460-7449-858) (01097BULK)	Klohn-Crippen Consultants Ltd.	1997	No	Yes	Apparently barren of fish.

Report Name	Report Author	Year	Relevant Information? (y/n)	Within Study Area? (y/n)	Comments
A Reconnaissance Inventory of Unnamed Lake North of Farewell Lake.	Klohn-Crippen Consultants Ltd.	1997	No	Yes	RB captured.
Reconnaissance inventory of Camp Lake (alias) (watershed code unknown) (0086BULK)	Klohn-Crippen Consultants Ltd.	1997	No	Yes	CT captured.
1996 reconnaissance inventory of unnamed (Alias Netalzul) Lake (00035BULK).	Klohn-Crippen Consultants Ltd.	1997	Yes	Yes	Lake trout presence confirmed.
1996 reconnaissance inventory of Clota Lake (Watershed Code 480-4026) (00067BABL).	Klohn-Crippen Consultants Ltd.	1997	No	Yes	CT captured.
1996 reconnaissance inventory of North Lake (Watershed Code 460-7449-858) (01051 BULK).	Klohn-Crippen Consultants Ltd.	1997	No	Yes	No fish captured.
1996 reconnaissance inventory of Unnamed (alias Netalzul Meadow) Lake (00067BULK).	Klohn-Crippen Consultants Ltd.	1997	No	Yes	DV captured.
Reconnaissance Inventory of Unnamed Lake North of Farewell Lake (Watershed Code Unknown) (00857BULK)	Klohn-Crippen Consultants Ltd.	1997	No	Yes	RB captured.
A summary of the Moricetown Falls steelhead release project. A co-management initiative. August 24 - September 16, 1992.	Lough, J.R.C	1992	No	Yes	Tagging program methodology and results.
Radio Telemetry Studies of Summer Steelhead trout in the Cranberry, Kispiox, Kitwanga and Zymoetz Rivers and Toboggan Creek, 1980.	Lough, M.J.	1983	Yes	Yes	Spawning and overwintering locations for Toboggan Creek ST.
Seymour Lake: 1984 data summary and recommendation.	Maclean, D.B.	1984	No	Yes	Nutrient loading data.
Gravel incubation and fry-to-smolt rearing of chinook salmon (*Oncorhynchus tshawytscha*) at Fulton River	McDonald, J.E., and R.M.J Ginetz	1977	No	No	Hatchery method techniques.
1998 Toboggan Creek Steelhead Assessment	Mitchell, S.	1999	No	Yes	Fence data.
A Comparison of Steelhead Angler Effort and Catch Estimates on the Bulkley River in 1997 and 1998	Morten, K.L.	1999	No	Yes	Creel data only.
A Survey of Bulkley River Steelhead Anglers in 1998	Morten, K.L.	1999	No	Yes	Creel data.
A Survey of Bulkley River Steelhead Anglers During the Classified Waters Period of 1997	Morten, K.L., and C.K. Parken	1998	No	Yes	Creel data.
Value of the fisheries resources in the Bulkley River system.	Mullen, D.	1987	No	Yes	Stock value assessment. No habitat information.

Report Name	Report Author	Year	Relevant Information? (y/n)	Within Study Area? (y/n)	Comments
Age and size of rainbow trout at the outlet of Babine Lake and in Babine River 1975.	Narver, D.W. (Pacific Biological Station Nanaimo, BC)	1975	No	Yes	Age and size data.
1995 Toboggan Creek steelhead assessment.	O'Neill, M.	1995	No	Yes	Run timing, but no habitat site specific info.
Bulkley River Steelhead trout: A Report on Angler Use, Tagging, and Life History Studies Conducted in 1982 and 1983.	O'Neill, M.J. and M.R. Whately	1984	No	Yes	Provides angling and life history data, but no habitat info.
Fulton River fry quality and ecology program : report of 1970 studies	Paine, J.R.	1971	No	No	
An assessment of salmon migration & the native food fishery at Moricetown Falls in 1966.	Palmer, R.N.	1967	No	Yes	Enumeration data.
Sockeye salmon migration in Babine River and Lake as indicated by tagging at Babine fence in 1946	Pritchard, A.L.	1946	No	Yes	Migration speed information.
Phylogenetic and ecological relationship between "giant" pygmy whitefish (*Prosopium* spp.) and pygmy whitefish (*Prosopium coulteri*) in North-Central British Columbia.	Rankin, L.	1999	Yes	Yes	Identifies Tyee Lake as one of two lakes in BC supporting "giant" pygmy whitefish.
Water quality in the Toboggan Creek watershed 1996-1998: are land use activities affecting water quality and salmonid health?	Remington, D., and B. Donas	1999	Yes	Yes	Map of Toboggan Creek spawning and rearing habitats for CO, PK and ST. Toboggan Lake important for rearing salmonids.
Tyee Lake management plan.	Rysavy, S., and I. Sharpe	1995	Yes	Yes	Identifies Tyee Lake as supporting "giant" pygmy whitefish.
Literature review for stream inventory in the Bulkley Forest District.	Saimoto, R.S. (SKR Consultants Ltd.)	1996	No	Yes	General fish presence information. No maps.
Purse seine catches of sockeye salmon (*Oncorhynchus nerka*) and other species of fish at Babine Lake, British Columbia, 1966 to 1968.	Scarsbrook, J.R.and J. McDonald	1970	No	Borderline	Species presence information for Babine Lake.
Purse seine catches of sockeye salmon (*Oncorhynchus nerka*) and other species of fish at Babine Lake, British Columbia, 1971.	Scarsbrook, J.R.and J. McDonald	1972	No	Borderline	Species presence information for Babine Lake.
Suskwa River Steelhead: 1982 Colonization of the Upper Harold Price with Steelhead Fry.	Schultze, G.C.	1983	No	Yes	No habitat data. ST stocked in upper Harold-Price.
Call Lake Creel Census (1984, 1985)	Schultze, G.C.	1985	No	Yes	No habitat data. EB stocked lake.
Survival Rates of Fry Released in the Headwaters of the Suskwa and Zymoetz Rivers- A Preliminary Assessment 1987.	Schultze,C.G. and M.J. Lough	1987	No	Yes	No site-specific or habitat data.

Report Name	Report Author	Year	Relevant Information? (y/n)	Within Study Area? (y/n)	Comments
Lake surveys of the Bulkley Valley and Burns Lake area with emphasis on the age and growth of stocked rainbow trout.	Shepard, C., and J. Algard.	1977	No	Yes	Reports captures of RB in round lake.
Upper Skeena chinook stocks. Evaluation of the Bear-Sustut, Morice, and Lower Babine stocks.	Shepherd, B.	1975	Yes	Yes	Chinook spawning for 7 miles below fence.
Preparatory stream reconnaissance, smolt trapping and habitat utilization surveys for a coho salmon research program in northern British Columbia	Simpson, K.S.	1991	Yes	Yes	Provides some general comments on Tobboggan Creek being important for coho.
Telkwa watershed assessment: detailed habitat assessment of Howson Creek sub-unit road crossings.	SKR Consultants Ltd.	1998	No	Yes	DV capture locations.
Toboggan Creek coho smolt enumeration, 1995	SKR Consultants Ltd.	1995	Yes	Yes	CH, CO, ST, MW, DV, and lamprey captured.
Toboggan Creek coho smolt enumeration, 1996	SKR Consultants Ltd.	1996	Yes	Yes	CO, ST, MW, DV, and lamprey captured.
Toboggan Creek coho smolt enumeration, 1997	SKR Consultants Ltd.	1997	Yes	Yes	CH, CO, ST, MW, DV, and lamprey captured.
Analysis of coded wire tag recovery information from northern B.C. commercial fisheries for the years 1988 to 1992 of coho tagged within the Skeena River watershed.	Spilsted, B.P.	1994	No	No	No mention of habitat information.
A summary of coded wire tag recovery information from northern B.C. and Alakan commercial fisheries for the years 1987 to 1992 for coho tagged within the Skeena river watershed.	Spilsted, B.P., G. Hudson.	1994	No	No	No mention of habitat information.
Bulkley River pipeline crossing - fish habitat assessment.	Stanley Consulting Group Limited.	1997	No	No	
1999 upper Skeena River creel survey.	Struthers, D.	2000	No	Yes	Toboggan Creek creel survey information.
The Moricetown Falls fishery (1967 and 1968)	Taylor, G.D.	1968	No	Yes	
Steelhead Fry Stocking Requirements for the Upper Harold Price Creek System-1982 Revisions.	Tredger, C.D.	1982	No	Yes	No identification of spawning or rearing habitat.
Lake survey data: Bulkley Lake.	Tredger, C.D.	1974	No	Yes	Water chemistry data in separate file. RB and non-game fish captured.
Bulkley/Morice steelhead stock monitoring 1986.	Tredger, C.D.	1987	No	Yes	Identified Bulkley mainstem, and Trout and Canyon creeks as being used by ST for rearing. No maps.

Report Name	Report Author	Year	Relevant Information? (y/n)	Within Study Area? (y/n)	Comments
Bulkley/Morice steelhead stock monitoring.	Tredger, C.D.	1986	No	Yes	Identified Bulkley mainstem, and Trout and Canyon creeks as being used by ST for rearing. No maps.
Upper Bulkley River reconnaissance with reference to juvenile steelhead carrying capacity.	Tredger, C.D.	1982	Yes	No	Lower McQuarrie Creek nearest site.
Reconnaissance report (Fish Habitat Improvement) Harold-Price Creek (1983).	Tredger, C.D.	1984	No	Yes	Capture data.
Suskwa River Steelhead Fry Population Monitoring.	Tredger, D. (Fisheries Improvement Unit)	1986	No	Yes	
Bulkley/Morice steelhead stock monitoring (1984/1985)	Tredger, D. (Fisheries Improvement Unit)	1986	Yes	Yes	ST fry capture locations for several Bulkley River tributaries.
Bulkley/Morice steelhead fry assessment. 1984 and 1985.	Tredger, D. (Fisheries Improvement Unit)	1986	Yes	Yes	ST fry capture locations for several Bulkley River tributaries.
Upper Bulkley River Steelhead Population Monitoring. 1983.	Tredger, D. (Fisheries Improvement Unit)	1984	Yes	No	
Upper Bulkley River Steelhead Population Monitoring. 1982.	Tredger, D. (Fisheries Improvement Unit)	1983	Yes	No	
A reconnaissance survey of Sunset Lake.	Whately, M.R. and G.W. Nielson	1968	No	No	Bathymetric map in separate file
Lake survey data: Chapman Lake.	Whately, M.R. and G.W. Nielson	1968	No	Yes	
2000 Operational Stream Inventory for FL A-16823: A Compilation of Data from Operational Fish Stream Identification and Follow-up Sampling for Various Streams in the Babine Lake (BABL), Bulkley River (BULK), Upper Trembleur Lake (UTRE) and Francois Lake (FRAN) High-Level Watershed Groups	FINS Consulting Ltd.	2001			GIS point data for sampling results.

Report Name	Report Author	Year	Relevant Information? (y/n)	Within Study Area? (y/n)	Comments
1:5,000 Fish and Fish Habitat Inventory of Tributaries to Nilkitkwa Lake and Nichyeskwa Creek	Pacific Inland Resources Ltd.	1999			GIS point data for sampling results.
1:5,000 Fish and Fish Habitat Inventory of Unnamed Tributaries to the Babine River between Nilkitkwa River and Shahnagh Creek Working Unit 2 (Babine) Cutting Permits 633 and 639	Pacific Inland Resources Ltd.	1999			GIS point data for sampling results.
1:5000 Fish and Fish Habitat Inventroy of Unnamed Tributaries to the Bulkey River in the Gramophone Creek Area.	Pacific Inland Resources Ltd.	1999			GIS point data for sampling results.
1;5000 Fish and Fish Habitat Inventory of Unnamed Tributaries to Mero Creek and the Nilkitkwa and West Nilkitkwa Rivers	Pacific Inland Resources Ltd.	1999			GIS point data for sampling results.
1;5000 Fish and Fish Habitat Inventory of Unnamed Tributaries to the Telkwa River and Howson Creek.	Pacific Inland Resources Ltd.	1999			GIS point data for sampling results.
Fish and Fish Habitat Inventory for Forest Licences A16823 and A16825 Endako Area	RJA Forestry Ltd.	1997			GIS point data for sampling results.
1:5,000 Fish and Fish Habitat Inventory of Unnamed Tributaries in the Fulton River Watershed Working Unit 9 Access to Cutting Permits 900 and 904	Triton Environmental Consultants Ltd.	2000			GIS point data for sampling results.
1:5,000 Fish and Fish Habitat Inventory of Unnamed Tributaries to Toboggan and Trout Creeks	Triton Environmental Consultants Ltd.	1999			GIS point data for sampling results.
1:5,000 Fish and Fish Habitat Inventory of Unnamed Tributaries to Toboggan and Trout Creeks Working Unit 14 (Toboggan) Cutting Permit 361	Triton Environmental Consultants Ltd.	2000			GIS point data for sampling results.
1:5000 Stream ID for Selected Areas in the Bulkey Forest District: (Fulton and Harold Price Watersheds)	Triton Environmental Consultants Ltd.	1999			GIS point data for sampling results.

Report Name	Report Author	Year	Relevant Information? (y/n)	Within Study Area? (y/n)	Comments
1996 1997 Reconnaissance Level Fish and Fish Habitat Inventory in Working Unit 10 (Selected Tribs in Bulkley River Watershed)	Triton Environmental Consultants Ltd.	1998			GIS point data for sampling results.
1996 1997 Reconnaissance Level Fish and Fish Habitat Inventory in Working Unit 12 (Selected Tribs in Bulkley River Watershed)	Triton Environmental Consultants Ltd.	1998			GIS point data for sampling results.
1996 1997 Reconnaissance Level Fish and Fish Habitat Inventory in Working Unit 14-Toboggan (Selected Tribs in Bulkley River Watershed)	Triton Environmental Consultants Ltd.	1998			GIS point data for sampling results.
1996 1997 Reconnaissance Report for Bulkley Tribs Downstream of Telkwa	Triton Environmental Consultants Ltd.	1998			GIS point data for sampling results.
1996 Reconnaissance Level Fish and Fish Habitat Inventory in Working Unit 1 (Nilkitkwa River Watershed)	Triton Environmental Consultants Ltd.	1997			GIS point data for sampling results.
1996 Reconnaissance Level Fish and Fish Habitat Inventory in Working Unit 13 (Telkwa River Watershed)	Triton Environmental Consultants Ltd.	1997			GIS point data for sampling results.
1996 Reconnaissance Level Fish and Fish Habitat Inventory in Working Unit 9 (Selected Sections of the Upper Fulton Watershed)	Triton Environmental Consultants Ltd.	1997			GIS point data for sampling results.
1996, 1997 Reconnaissance Level Fish and Fish Habitat Inventory in Working Unit 2 (Selected Tribs in Upper Babine River Watershed)	Triton Environmental Consultants Ltd.	1997			GIS point data for sampling results.
1996, 1997 Reconnaissance Level Fish and Fish Habitat Inventory in Working Unit 3 (Nichyeskwa River Watershed)	Triton Environmental Consultants Ltd.	1998			GIS point data for sampling results.
1996, 1997 Reconnaissance Level Fish and Fish Habitat Inventory in Working Unit 5 (Tsezakwa and Selected Tribs in Babine Lake Watershed)	Triton Environmental Consultants Ltd.	1998			GIS point data for sampling results.
1996, 1997 Reconnaissance Level Fish and Fish Habitat Inventory in Working Unit 6 (Harold Price and Selected Tribs in Bulkley River	Triton Environmental Consultants Ltd.	1998			GIS point data for sampling results.

Report Name	Report Author	Year	Relevant Information? (y/n)	Within Study Area? (y/n)	Comments
Watershed)					
1996, 1997 Reconnaissance Level Fish and Fish Habitat Inventory in Working Unit 7 (Selected Tribs in Bulkley River Watershed)	Triton Environmental Consultants Ltd.	1998			GIS point data for sampling results.
1996-1997 Reconnaissance Level Fish and Fish Habitat Inventory in the Boucher Creek Watershed and Tributaries to Nilkitkwa Lake (Unit 4)	Triton Environmental Consultants Ltd.	1998			GIS point data for sampling results.
Reconnaissance 1:20,000 Fish and Fish Habitat Inventory in the Harold Price Watershed (WSC 460-081700-43900 - WSC 460-081700-43900-50400-5740)	Triton Environmental Consultants Ltd.	2002			GIS point data for sampling results.

APPENDIX 3 – WORKSHOP AND PRESENTATION COMMENTS.

Appendix 3a. February 15 workshop notes.

Background and objectives of the project

- Bob Mitchell (Ministry of Forests and Range; MOFR)
  - District Manager (DM) at MOFR must sign off on Forest Stewardship Plans (FSPs).
  - A tool is needed to make decisions regarding whether fisheries objectives are being met in the FSPs.
  - Bulkley LRMP omitted critical fish habitat section in final document.
  - MOFR still desired a product to support their DM, therefore funding was secured for this project.
  - Concerned about keeping the database current (hoping the MOE might be the stewards of the data).
  - Does not see this project as a tool to support other HLPs (*e.g*. fisheries sensitive watersheds), but rather a decision making tool based on science that HLPs can draw on.

Review and modification of target fish species

- All fish species in the TSA are target species to protect.
- Indicator fish species to be used in the project should include anadromous salmon, steelhead (ST), bull trout (BT), and KO.
- Consider adding lamprey as an indicator species due to unique life history requirements.
- **ACTION ITEM**: Dean Peard (MOE) wanted to discuss the potential for other regionally significant species with his MOE colleagues (*e.g*. whether any coarse fish species might be a concern);

  Note: Dean Peard followed up with an email identifying site-specific concerns, but also indicating that MOE is concerned about headwater DV populations.
- Group felt that adding a presence/absence column for species in each reach was unnecessary, since it would duplicate the role of on-line tools such as FishWizard.

Critical habitat – Background

- Discussed focus of management area (*i.e*. Bulkley TSA *vs*. Skeena Region)
  - Decided on limiting focus to just the Bulkley TSA (summary of discussion below).
  - Barry Finnegan (DFO)
    - Indicated that wild salmon policy lays out management requirements for salmon stocks.
      - 3 main stocks of CO to protect.
      - All SK lakes to be protected.
      -

- Glenn (MOF)
  - Is objective of protecting target species for intrinsic purposes or for commercial/sport/First Nations purposes?
  - Group seemed to feel the objective should be more for intrinsic based.
- Jason Dorey (Triton)
  - Definitions of critical and high are likely the same between TSAs, so it is appropriate to limit focus of management objective to just the Bulkley TSA.

- Barry was concerned about capturing non-fish drainages where groundwater and/or springs supports d/s populations (*e.g*. Silvern Creek).
  - Resolved that Triton would add an additional column to the data table for anecdotal information to capture issues such as important groundwater sources (*e.g*. Silvern Creek, and some tributaries to Toboggan Creek) or temperature sensitive areas (*e.g*. portions of the Babines).
- Indicator discussion
  - Alan Baxter (PIR) expressed concern regarding dated (*e.g*. 40 – 50 year old) reports alluding to critical habitat since conditions may have changed, making the reference no longer applicable.
    - Also concerned about temporal nature of existing critical habitat in some instances (*e.g*. beaver influenced area created critical rearing habitat for CO but beavers are no longer present and habitat is no longer critical).
  - No objections to including reaches where staging or spawning by anadromous salmon, KO, ST, or species as risk have been observed.
  - May wish to add lamprey spawning areas.
  - RB and non-anadromous CT can be omitted as indicator species unless information is identified that indicates critical areas exist.
  - Dean was concerned that overwintering habitat be included as an indicator
    - Since an information gap commonly exists for this parameter it may be necessary to use anecdotal information.
  - No objections to including staging or spawning areas for bull trout or Dolly Varden if supporting data exists.
  - No objections to including lakes with confirmed lake trout but there was a feeling that a size limit should apply to protect a whole lake
    - Bigger lakes (*e.g*. Babine or Chapman) should just have sensitive shoal areas delineated for protection if possible.
  - No objection to protecting “giant” pygmy whitefish lakes.
  - No support from the group for using fish-bearing reaches of Fisheries Sensitive Watersheds
    - Not ‘science-based’ designations (‘grandfathered’ into legislation)
    - Consensus to ignore this proposed indicator.

High value habitat

- Definition discussion
    - Amend suggested definition to read "Preferred ideal habitat for a fish species *(or other confirmed use)* that is…
    - Barry wanted this addition since some species may successfully use habitats that are not typically considered ideal (*e.g*. CO may be found thriving in steeper gradients with bonier substrate than normally anticipated).
    - See comments about historical reports in the 'critical habitat' section above.
    - Using classified waters not already identified as critical was only acceptable to the group if science based.
    - Stocked lakes not necessarily 'high value' habitat since they are likely deficient of some habitat component (thus the reason for stocking).
    - **ACTION ITEM:** Triton to follow up with a 'lakes expert' regarding what type of values should define a lake as 'high value' habitat.
        - **Note:** Joe DeGisi was contacted. See discussion in report.
    - Group is not in favour of trying to support HLPs with this project (vice versa)
        - Don't want social values driving this project (should be science based)
    - Reaches used by anadromous salmon, ST, anad. CT, and KO for rearing may be included for the first deliverable draft but may be removed depending on the extent of the results (*i.e*. if too many reaches get flagged this indicator may get dropped).
    - No objections to including reaches for migration to critical habitat for anadromous species and other indicator species with telemetry or other supporting data (*e.g*. BT or DV).

Potentially critical reaches

- General feeling that this would be a seldom used category due to the extent of fish sampling throughout the TSA.
- Group anticipated that a GIS exercise to define other potentially critical or high reaches would likely be of limited value
    - 5^{th} order drainages could be considered.

Likely not critical/high value stream reaches

- Reaches identified as non-fish bearing or inferred non-fish bearing from inventory projects could be included.
- >20% gradient reaches can be included. May find data to support a lower gradient if and sufficient rationale can be defined (likely watershed based)
    - Break study area into 2 main groups (*e.g*. Babine and Bulkley)
    - 15% may be reasonable. Conservatively suggested to use the maximum gradient from where fish have been captured.