

Palmer VMS Project Preliminary Aquatic Investigation

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PRESENTED TO

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EXECUTIVE SUMMARY

Constantine North Inc. (Constantine) is considering development of a mineral exploration access road to its claims near Glacier Creek, approximately 37 miles from Haines, Alaska. There is access to lower Glacier Creek from a dirt road off of State Highway 7 (Haines Highway) but there is no road access to the exploration sites. Currently, access to the exploration sites is by helicopter.

Tetra Tech conducted a desktop analysis and field survey at the request of Constantine to initiate documentation of baseline aquatic conditions for the Palmer Project. The desktop analysis of available aquatic resource information for the Bear Creek, Glacier Creek, Sarah Creek, Little Jarvis Creek, and Glacier Creek was conducted. Information sources included the Alaska Department of Fish and Game (ADF&G) Anadromous Waters Catalog (AWC) and Alaska Freshwater Fish Inventory Database (AFFI) and department records. The results from the desktop analysis were used to develop a field study plan and obtain authorization from ADF&G for field surveys. The objective of this study is to identify streams and fish habitat within a proposed mineral exploration road corridor. The results of this study will support road siting, design, and permitting.

Field surveys were limited to Glacier Creek and its tributaries, focusing on the eastern side of Glacier Creek, to support design and permitting of potential road access for exploration activities in the Glacier Creek drainage. Surveys were conducted by traversing the proposed Glacier Creek road alignment to identify and characterize unmapped streams. Fish species and the fork length of each fish captured were recorded before returning the fish to the stream.

Field surveys were conducted by two Tetra Tech staff scientists over the period of four days in July 2013. Fifteen tributaries to Glacier Creek were mapped from the proposed Glacier Creek alignment. Six tributary streams that exhibited suitable fish habitat and access, or appeared suitable for sampling, but fish presence had not been previously documented were sampled using baited minnow traps. Ten Dolly Varden were captured in one tributary approximately 50 feet above the confluence with Glacier Creek; however, fish passage barriers were noted farther up the tributary downstream of the proposed Glacier Creek road alignment. No fish were recovered from any of the tributaries on the bench where the road is being considered. Two boreal toads were observed in one tributary channel.

Visual surveys of tributaries coming down into Glacier Creek from the west side of the drainage were conducted. Due to time and access constraints to the west side of the Glacier Creek drainage, observations were made from the east side of Glacier Creek. The three west bank tributaries observed each descended steep slopes and are unlikely to provide fish habitat other than in the immediate proximity to Glacier Creek. Location, slope gradients, photos and stream widths were estimated from the east bank of Glacier Creek.

Seventeen additional minnow traps were set in Glacier Creek between the washed-out bridge and Christmas Creek to confirm presence and species of fish documented by ADF&G Anadromous Waters Catalog and AFFI. Ten Dolly Varden (33-millimeter to 165-millimeter fork length) were recorded in Glacier Creek by minnow, net, or bucket trap or visual observations. No other species were documented.

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ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
ADF&G	Alaska Department of Fish and Game
AWC	Anadromous Waters Catalog
AFFI	Alaska Freshwater Fish Inventory
AS	Alaska Statutes
Constantine	Constantine North Inc.
GPS	global positioning system
mm	millimeter
NHD	National Hydrography Dataset

DEFINITIONS

Word/Term	Definition
Anadromous Fish	A fish or fish species that spends portions of its life cycle in both fresh and salt waters, entering fresh water from the sea to spawn and includes the anadromous forms of Pacific trout and salmon of the genus <i>Oncorhynchus</i> (rainbow and cutthroat trout and Chinook, coho, sockeye, chum and pink salmon), Arctic char, Dolly Varden, sheefish, smelts, lamprey, whitefish, and sturgeon.
Fish	Any species of aquatic finfish, invertebrate, or amphibian, in any stage of its life cycle, found in or introduced into the state, and includes any part of such aquatic finfish, invertebrate, or amphibian.
River	A stream of fairly large size flowing in a definite course or channel, or a series of diverging and converging channels.
Specified Water Body	A river, stream, or lake, in its liquid or frozen state, its braided channels, distributaries, sloughs, backwaters, and estuaries, including the portion of the bed(s) and banks up to the ordinary high water mark, from its mouth to its specified upper limit as depicted in “An Atlas to the Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes” or listed in the “Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes.”
Stream	A natural or artificial watercourse containing flowing water at least part of the year including a river, creek, or tributary.

1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION AND LOCATION

Constantine North Inc. (Constantine) is considering development of a mineral exploration access road to its claims near Glacier Creek, approximately 37 miles from Haines, Alaska. There is access to lower Glacier Creek from a dirt road off of State Highway 7 (Haines Highway) but there is no road access to the exploration sites. Currently, access to the exploration sites is by helicopter.

The Palmer Project targets a volcanogenic massive sulfide with polymetallic (multi-metal) mining potential and is currently in its exploration phase (Constantine Metal Resources Ltd, 2013). Constantine requested the documentation of baseline aquatic conditions for the Palmer Project, specifically the characterization of aquatic conditions along a proposed Glacier Creek road alignment to support future exploration activities in the Glacier Creek drainage.

1.2 STUDY PURPOSE AND METHODOLOGY

The objective of this preliminary aquatic study is to identify streams and fish habitat within the proposed mineral exploration road corridor near Glacier Creek. The results of this study will support road siting, design, and permitting.

A desktop analysis of available aquatic resource information for Bear Creek, Glacier Creek, Sarah Creek, Little Jarvis Creek, and Glacier Creek was conducted. Information sources included the Alaska Department of Fish and Game (ADF&G) Anadromous Waters Catalog (AWC) and Alaska Freshwater Fish Inventory (AFFI) Database and department records. The results from the desktop analysis were used to develop a field study plan and obtain authorization from ADF&G for field surveys.

Field surveys were limited to Glacier Creek and its tributaries that could be affected by the proposed road. The field survey included habitat mapping to support design and permitting of potential road access for exploration activities in the Glacier Creek drainage. Tetra Tech obtained a fish handling permit from ADF&G (Permit SF2013-252). Field surveys were conducted by traversing the proposed Glacier Creek road alignment to identify and characterize unmapped streams. Streams that exhibited suitable fish habitat and access, or appeared suitable for sampling, but where fish presence had not been previously documented, were sampled using baited minnow traps. Fish species and the fork length of each fish captured were recorded before returning the fish to the stream.

The following stream characteristics were recorded:

- Location (Garmin Oregon 1983 North American Datum and/or map)
- Channel gradient
- Fish presence/absence
- Number, species, and fork length of fish species collected
- Barrier presence and type

1.3 APPLICABLE REGULATIONS

The **Anadromous Fish Act** (Alaska Statutes [AS] 16.05.871- .901) requires prior notification and authorization from ADF&G before altering or affecting “the natural flow or bed” of a specified waterbody, or fish stream. All activities within or across a specified anadromous waterbody require approval from the ADF&G, Division of Habitat, including construction; road crossings; gravel removal; mining; water withdrawals; the use of vehicles or equipment in the waterway; stream realignment or diversion; bank stabilization; blasting; and the placement, excavation, deposition, or removal of any material.

To be protected under AS 16.05.871, water bodies must be documented as supporting some life function of an anadromous fish species (salmon, trout, char, whitefish, sturgeon, etc.). Specified anadromous water bodies are listed in the “Catalog of Waters Important for the Spawning Rearing or Migration of Anadromous Fishes,” (Johnson, 2013) which is updated annually.

The **Fishway Act** (AS 16.05.841) requires that an individual or government agency notify and obtain authorization from the ADF&G, Division of Habitat, for activities within or across a stream used by fish if it is determined that such uses or activities could represent an impediment to the efficient passage of resident or anadromous fish.

2.0 DESKTOP STUDY

This section summarizes available aquatic information for Bear Creek, Glacier Creek, Sarah Creek, Little Jarvis Creek, and other unnamed creeks in the area (Figure 1) acquired during the desktop study. Information sources included the ADF&G AWC, AFFI, and department records. All streams within the desktop analysis area are part of the Klehini River system (Hydrologic Unit Code 1901030310). The Klehini River originates in British Columbia and flows east until it joins the Chilkat River. Review of the AWC and AFFI indicate that the Klehini River hosts Chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), chum (*O. keta*), and sockeye salmon (*O. nerka*); cutthroat trout (*O. clarki*); and Dolly Varden char (*Salvelinus malma*).

Bear Creek

Bear Creek is a Tributary to the Klehini River. It is a specified water body (AWC# 115-32-10250-2077-3113) for Chinook salmon (present) and coho salmon (spawning and rearing). The AFFI indicates the presence of coho salmon, Dolly Varden, and cutthroat trout.

In 2003, ADF&G radio tagged 123 adult Chilkat River coho salmon. One of these tags was recovered in Bear Creek. ADF&G indicates that each radio-tagged fish represented approximately 950 adult coho salmon (Ericksen R. , 2004). ADF&G records also indicate that 84 adult coho salmon were sampled in November 2003 (Ericksen & Chapell, 2005). Additionally, juvenile coho and Dolly Varden were recorded during minnow trap surveys conducted by the Takshanuk Watershed Council in August 2007 (Shields & Chapell, AWC Nomination Form 07-879, 2007).

Glacier Creek

Glacier Creek is the focus of this investigation. Originating from the Saksai Glacier, it flows northeast approximately 4.5 miles (7.1 kilometers) before joining the Klehini River. It is a specified water body (AWC# 115-32-10250-2077-3151) for coho salmon (present), cutthroat trout (present) and Dolly Varden char (present). The AFFI provides no data on Glacier Creek.

The proposed road would cross Glacier Creek upstream of the AWC specified segment of this water body; however, original documentation for listing Glacier Creek in the AWC indicates that the upper extent documents the limits of fish surveys and usually not the extent of fish habitat (Alaska Department of Fish and Game, 1983).

Unnamed Tributary to Glacier Creek

The AWC identifies an anadromous stream west of and paralleling the lower reach of Glacier Creek. It is a specified water body (AWC# 115-32-10250-2077-3151-4010) for coho salmon (rearing), cutthroat trout (rearing) and Dolly Varden char (rearing). The AFFI provides no data on this unnamed tributary to Glacier Creek.

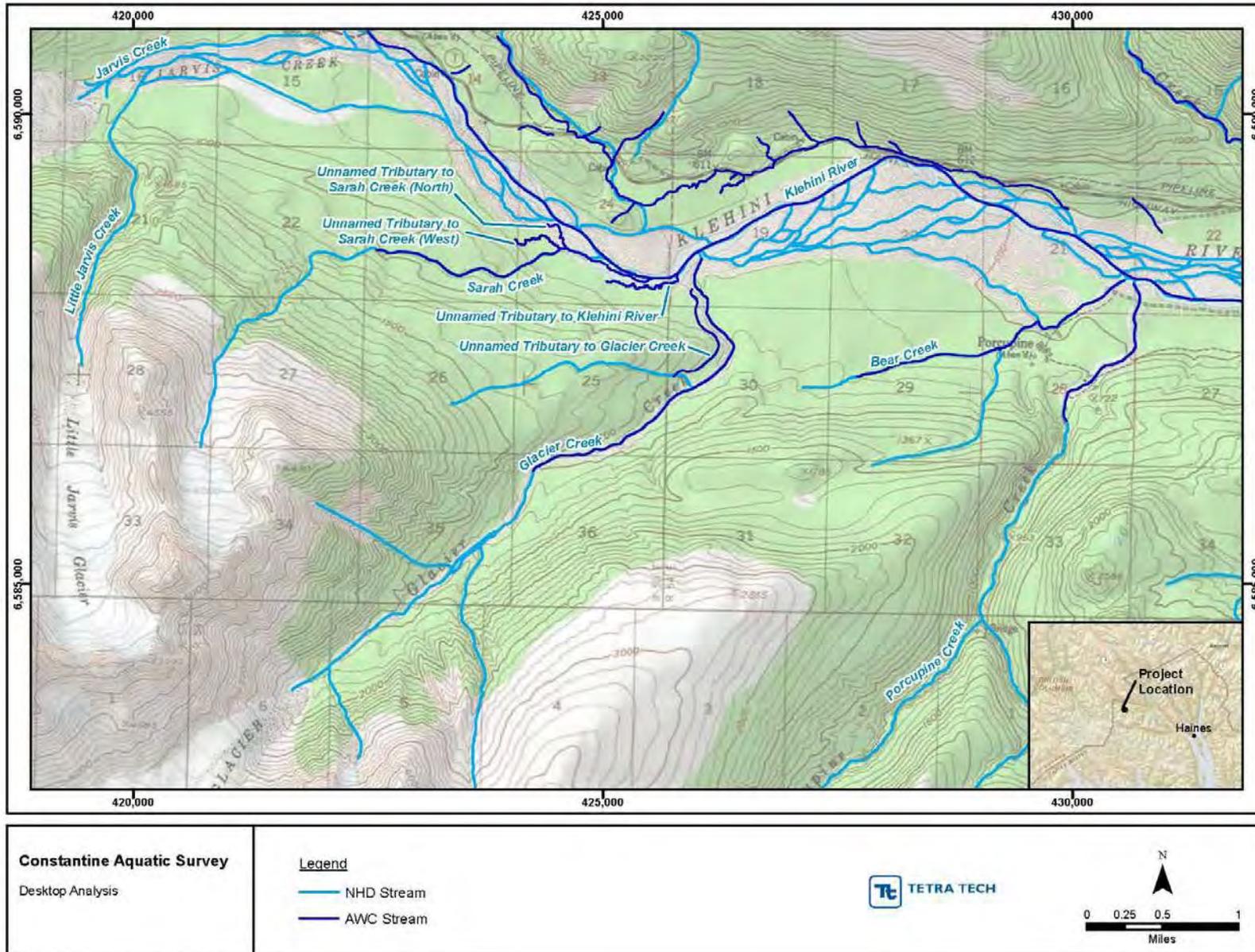


Figure 1. Streams Considered in Desktop Analysis

ADF&G conducted sampling in 1995 and observed numerous cutthroat and Dolly Varden char. The following description is taken from the ADF&G nomination form (Gaede, 1996).

“The waterway is a clear-water tributary stream on the lower west side of Glacier Creek (115-32-10250-2077-3151). The stream runs parallel to Glacier Creek for quite a distance, with the headwaters up a mildly sloped draw, and the confluence with Glacier Creek midway between the Klehini River and the Klehini River logging road. A stream survey of this waterway was conducted on 7/11 and 7/12/95 and covered a distance approximately ¼ mile upstream from the logging road crossing. In that distance, no major fish barriers were observed, with juvenile fish populations plentiful throughout.”

The report indicates that 28 Dolly Varden and 3 cutthroat were captured in minnow traps. Nomination to the AWC was based on previous studies in the Chilkat River drainage that indicate cutthroat trout and Dolly Varden char are anadromous and move from one tributary of the Chilkat River to another (Gaede, 1996).

Unnamed Tributary to Klehini River (aka North Creek)

The AWC identifies an anadromous stream south of and paralleling the Klehini River. It is a specified water body (AWC# 115-32-10250-2077-3155) for coho salmon (rearing). The AFFI indicates that coho salmon and Dolly Varden char have been documented in this stream.

Juvenile coho salmon and Dolly Varden char were sampled during minnow trap surveys conducted by the Takshanuk Watershed Council in 2007 (Shields & Chapell, AWC Nomination Form 07-823, 2007). Maps prepared by the Takshanuk Watershed Council in support of AWC nomination refer to this stream as North Creek (Shields & Chapell, AWC Nomination Form 07-823, 2007).

Sarah Creek

Sarah Creek is a tributary to the Klehini River. It is a specified water body (AWC# 115-32-10250-2077-3159) for Chinook salmon (present) and coho salmon (rearing). The AFFI indicates that coho salmon and Dolly Varden char have been documented in this stream. Juvenile coho and Dolly Varden were recorded during minnow trap surveys conducted by the Takshanuk Watershed Council in April 2007 (Shields & Chapell, AWC Nomination Form 07-840, 2007).

As currently mapped in the AWC, Sarah Creek joins the Klehini River near the mouth of Glacier Creek. Above the confluence, Sarah Creek parallels the Klehini River for approximately 1 mile before it diverges southwest towards the valley wall. It is worth noting that the Takshanuk Watershed Council appears to have questioned this route in a map prepared for submission to modify the location of the mouth of Sarah Creek (Shields & Chapell, AWC Nomination Form 07-840, 2007).

Field confirmation of the location and extent of Sarah Creek is advised if future projects are proposed in the area.

The Takshanuk Watershed Council has identified two small tributaries in the lower portion of Sarah Creek, which are described further below.

Unnamed Tributary to Sarah Creek (north)¹

This unnamed tributary to Sarah Creek is a specified water body (AWC# 115-32-10250-2077-3159-4011¹) for coho (rearing). Juvenile coho and Dolly Varden char were recorded during minnow trap surveys conducted by the Takshanuk Watershed Council in September 2007 (Shields & Chapell, AWC Nomination Form 07-830, 2007).

¹ A discrepancy exists in the AWC related to the two unnamed tributaries to Sarah Creek. The nomination form linked to the north tributary describes the west tributary and vice versa. This report provides the correct stream description for each stream based on the mapping provided in the nomination forms. Because of this discrepancy, AWC numbers may be reversed.

Unnamed Tributary to Sarah Creek (west)¹

This unnamed tributary to Sarah Creek is a specified water body (AWC# 115-32-10250-2077-3159-4009¹) for coho rearing. Coho were observed by Takshanuk Watershed Council staff in September 2008 (Shields & Chapell, AWC Nomination Form 09-1180, 2009).

Jarvis Creek and Little Jarvis Creek

Jarvis and Little Jarvis Creeks originate from the Jarvis and Little Jarvis Glaciers, respectively, and feed into the Klehini River. Jarvis and Little Jarvis Creeks are not specified water bodies. The AFFI does not provide any information on Jarvis or Little Jarvis Creeks.

3.0 FIELD INVESTIGATION

Field surveys were conducted by Tetra Tech staff scientists David Cox and Katie Goodwin over the period of 4 days (July 7–10, 2013). Field surveys were conducted by traversing the proposed Glacier Creek road alignment to identify and characterize unmapped streams. A pre-existing trail following the proposed road alignment was used by the field surveyors to access the study area. The trail was accessed off an existing logging road accessed from Porcupine Road. A helicopter was used to access upper tributaries; however, all eastern tributaries to Glacier Creek were accessible by foot. The survey was conducted on foot; when a stream was encountered along the proposed road alignment, a global positioning system (GPS) point and notes were taken. The stream was then walked its full extent down to Glacier Creek, taking note of gradient changes, available habitat, and potential fish barriers. Where suitable habitat was observed that was accessible from Glacier Creek, meaning there were no previously known or observed fish passage barriers, baited minnow traps were placed in the stream and allowed to soak anywhere from 1 to 21 hours before being pulled and checked for captured fish.

Characteristics of each tributary and fish sampling results are presented below. Section 3.1 presents information on the 15 eastern tributaries; Section 3.2 presents information on 3 western tributaries observed from the east side of Glacier Creek; and Section 3.3 presents fish sampling results from Glacier Creek.

3.1 GLACIER CREEK TRIBUTARIES (EAST)

Fifteen tributaries on the east side of Glacier Creek were mapped along the proposed Glacier Creek road alignment (Figure 2). Because these tributaries were previously unmapped, the naming convention “Glacier Creek Tributary [# of tributary]” was used. Six of the Glacier Creek tributaries were determined in the field to have potential habitat for fish. Minnow traps were set in multiple locations along these six tributaries to sample for fish presence (Table 1, at the end of Section 3.1). Fish were only captured in Glacier Creek Tributary 3, in its lower gradient reach near Glacier Creek. No fish were captured in the remaining five tributaries that were sampled for fish presence. No fish were captured in any creek near the proposed road alignment.

Glacier Creek Tributary 1: Stream gradient over 20 percent with a stream width of less than 2 feet. There is a high gradient barrier about 100 feet below the proposed road alignment and a stream gradient greater than 18 percent above the road alignment. No sampling occurred due to lack of suitable sampling site (too shallow). Fish presence not expected.

Glacier Creek Tributary 2: Stream gradient greater than 20 percent with a stream width of 3 feet. A 15-foot barrier falls is located about 200 feet above Glacier Creek blocking fish access to the road alignment. Three baited minnow traps were set in this tributary for confirmation. One trap was set at the proposed road crossing. Two traps were set 50 and 100 feet downstream from the road alignment crossing (Photo 1). The three traps were soaked for 4 hours each for a combined time of 12 hours of sampling effort. No fish were captured. It is expected that the 15-foot barrier falls (Photo 2) below the road alignment has blocked fish from the upper portion of Tributary 2.

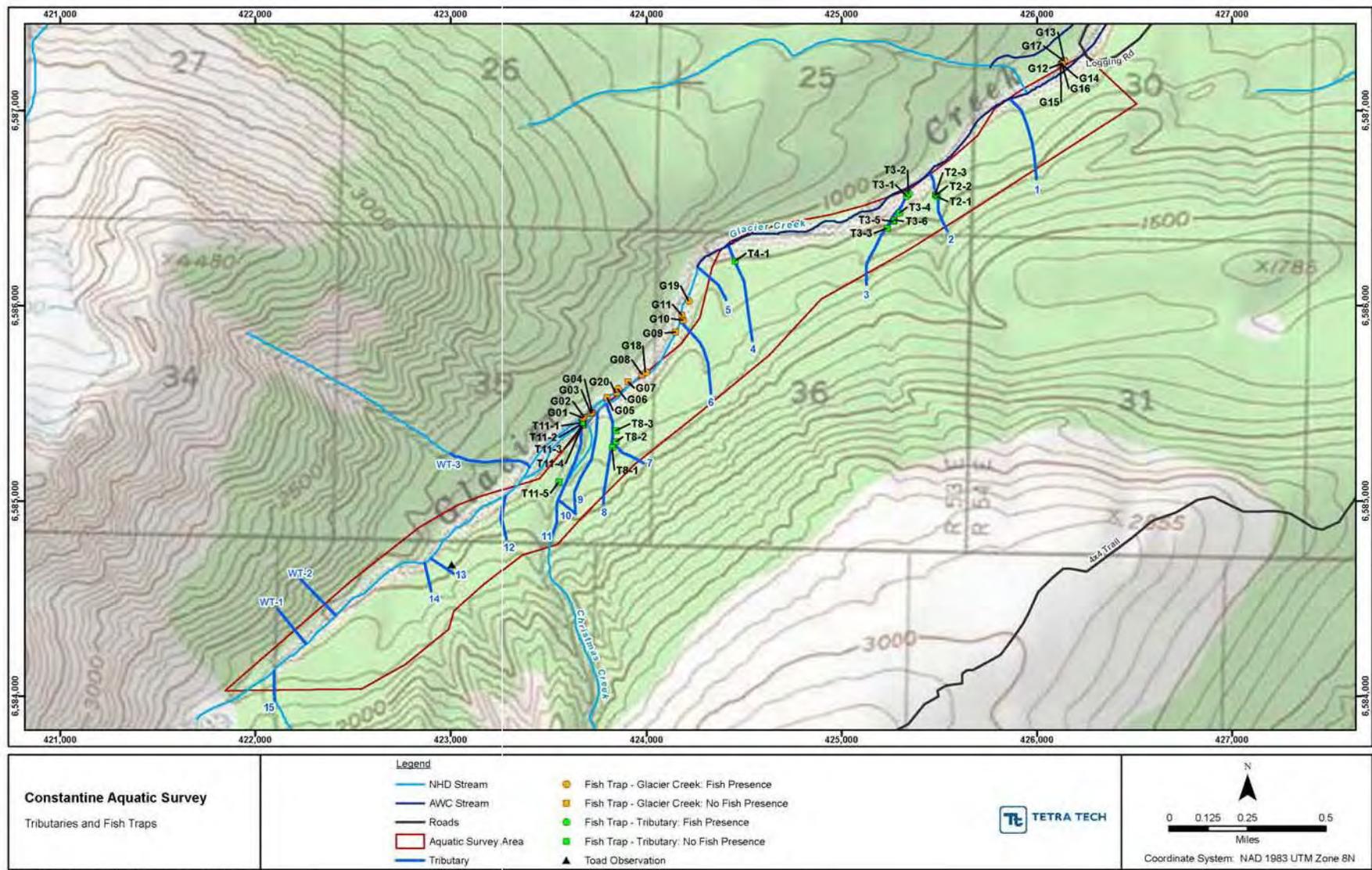


Figure 2. Glacier Creek Tributaries and Minnow Trap Sampling Location



Photo 1. Baited Minnow Trap 50 Feet Downstream from Road Alignment

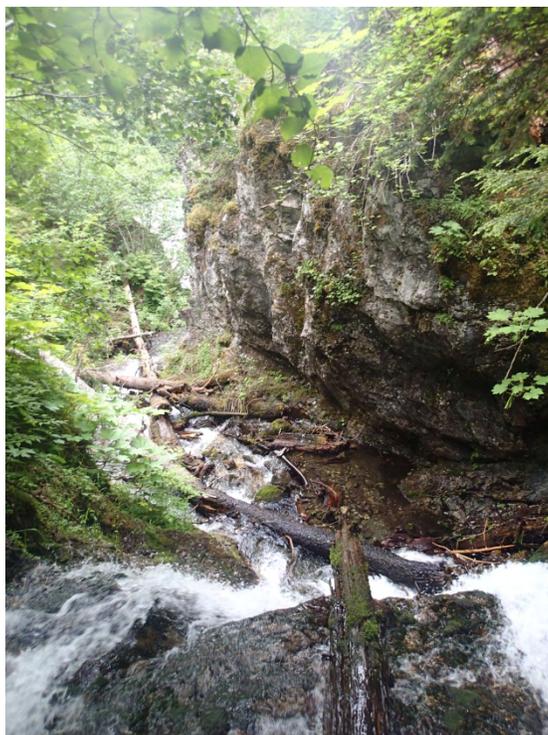


Photo 2. 15-foot Barrier Falls Below Road Alignment (view from above)

Glacier Creek Tributary 3: Stream gradient greater than 25 percent with a stream width of 3 to 5 feet. A gradient barrier of 40 percent slopes greater than 80 feet long is located about 100 feet below the road alignment. Three traps were set on July 7, 2013. Traps 1 and 2 were set 50 feet up from Glacier Creek below the gradient barrier. A third trap was set directly above the road alignment and above the gradient barrier run. These three traps were soaked overnight for 21 hours each for a total of 63 hours of sampling effort. Trap 1 captured 3 Dolly Varden with fork lengths of 120, 123, and 156 millimeters (mm). Trap 2 captured 7 Dolly Varden with fork lengths of 60, 60, 80, 93, 95, 102, and 115 mm (Photo 3). On July 8, 2013, 3 more traps were set above the gradient barrier, to confirm presence or absence of fish above the barrier. Trap 1 was set 100 feet below the road alignment; trap 2 was set 200 feet below trap 1. Trap 3 was set 215 feet below trap 2 (Photo 4). Traps were soaked for 4 hours each for a total of 12 hours of sampling effort above the gradient barrier. No fish were captured in these three upper traps.



Photo 3. Dolly Varden Captured in Baited Minnow Trap 50 Feet above Glacier Creek



Photo 4. Pulling Baited Minnow Trap with Captured Dolly Varden Char

Glacier Creek Tributary 4: Stream gradient greater than 20 percent with a stream width of less than 2 feet. A gradient barrier of 35 to 40 percent slopes for greater than 70 feet exists below the road alignment. Flow was intermittent at the time of survey with flowing water disappearing into the ground and reappearing farther downstream. The gradient and size of the stream and intermittent flow presented unsuitable habitat for fish. Fish presence not expected.

Glacier Creek Tributary 5: Stream gradients ranging 10 to 25 percent with a stream width of 4 to 7 feet. One trap was set for 3 hours downstream of the road alignment (about half way between road alignment and Glacier Creek). No fish were captured in the trap, and fish presence is not expected (Photo 5).



Photo 5. Baited Minnow Trap in Tributary 5

Glacier Creek Tributary 6: Stream gradient greater than 20 percent with a stream width of less than 1 foot. A gradient barrier of 40 percent slopes for about 150 feet exists downstream of the road alignment. The gradient and size of the stream and intermittent flow presented unsuitable habitat for fish, fish presence not expected.

Glacier Creek Tributary 7: Stream gradient about 10 percent with a stream width of 1 to 2 feet. Tributary 7 joins with Tributary 8 about 200 feet downstream from the road alignment. One trap was set in a pool in Tributary 7 directly above the confluence with Tributary 8. The trap was soaked for 2 hours; no fish were captured.

Glacier Creek Tributary 8: Stream gradient greater than 35 percent with a stream width of 1 to 2 feet. Tributary 7 joins with Tributary 8 about 200 feet downstream from the road alignment. A 15-foot bedrock drop 500 feet below the road alignment is a fish barrier. Two traps were set in a pool in Tributary 8 directly below the confluence with Tributary 7. The two traps were soaked for 2 hours each for a total of 4 hours of sampling effort; no fish were captured below the confluence of Tributaries 7 and 8 (Photo 6).



Photo 6. Baited Minnow Trap Set below the Confluence of Tributaries 7 and 8

Glacier Creek Tributary 9: Stream gradient 30 to 40 percent with a stream width of 4 to 6 feet. The stream channel was dry, with a steep gradient; no fish presence due to lack of water in channel (Photo 7).

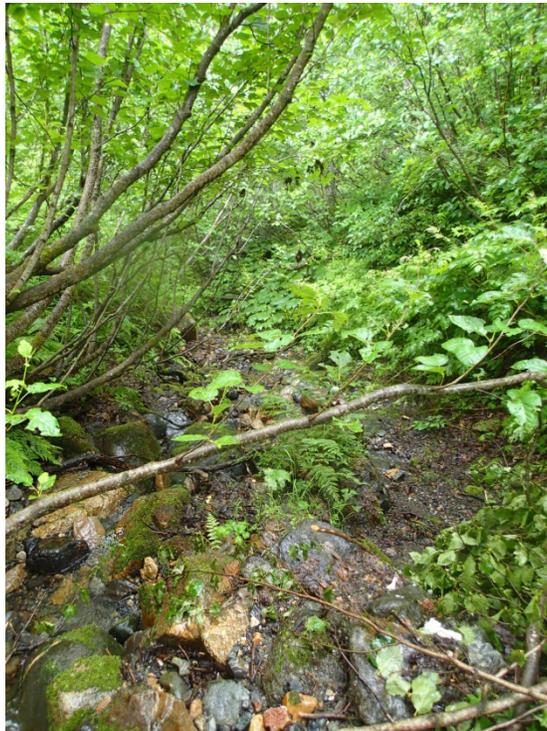


Photo 7. Glacier Creek Tributary 9 with a Dry Stream Bed

Glacier Creek Tributary 10: Stream gradient greater than 20 percent with a stream width of 1 foot. Tributary 10 is a tributary of Tributary 11 (Christmas Creek), its confluence below the road alignment. The gradient and size of the stream presented unsuitable habitat for fish; fish presence is not expected.

Glacier Creek Tributary 11 (Christmas Creek): Stream gradient 10 to 25 percent with a stream width of 3 to 10 feet wide (Photo 8). The length of stream from the road alignment down to Glacier Creek has variable gradients ranging from 10 to 25 percent, with step pools. On July 8, 2013, two traps were set at the road alignment. The traps were soaked for 18 hours each for a total of 36 hours of sampling effort. No fish were captured in these traps. On July 9, 2013, four traps were set in Christmas Creek just above its confluence with Glacier Creek. The traps were soaked for 18 hours each for a total of 72 hours of sampling effort at the confluence of Glacier Creek and Christmas Creek. No fish were captured in these traps.

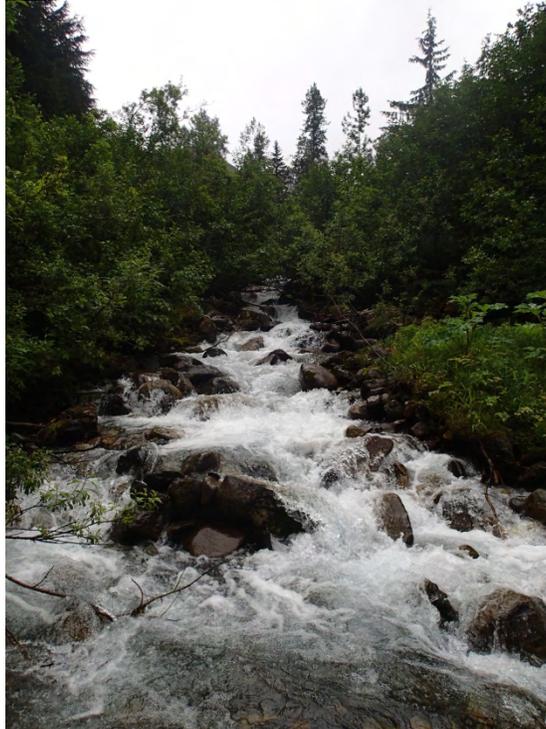


Photo 8. Glacier Creek Tributary 11 (Christmas Creek)

Glacier Creek Tributary 12: Stream gradient 25 to 30 percent with a stream width less than 3 feet. Stream gradient greater than 30 percent for over 100 feet presented unsuitable habitat for fish, fish presence is not expected.

Glacier Creek Tributary 13: Stream gradient 25 to 30 percent with a stream width of 5 to 10 feet. Stream bed was dry at the time of survey with evidence of high bedload transport and erodible banks. Unsuitable habitat for fish, fish presence is not expected. Two Boreal Toads were observed in the dry stream bed (Photo 9).

Glacier Creek Tributary 14: Stream gradient 25 to 30 percent with a stream width of 3 to 8 feet. A gradient barrier exists below the road alignment with 40 percent slopes for over 150 feet, with high bedload transport and erodible banks. Unsuitable habitat for fish, fish presence is not expected.

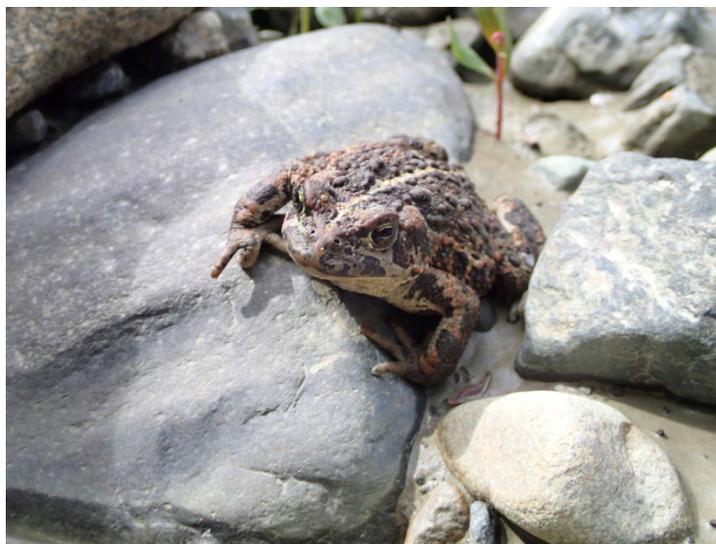


Photo 9. Boreal Toad Observed in Tributary 14

Glacier Creek Tributary 15: Stream gradient 28 to 38 percent with a channel width greater than 20 feet (Photo 10). High bedload transport, glacially fed stream. The gradient and high bedload transport presented unsuitable habitat for fish, fish presence is not expected.



Photo 10. Glacier Creek Tributary 15

Table 1 presents a summary of the eastern tributaries.

Table 1. Summary of Fish Survey, Glacier Creek Eastern Tributaries

Tributary	Gradient	Width (ft)	Minnow Trap Set (hours)	Fish Presence	Fish Species, Count, Fork Length	Barrier Presence and Type
Glacier Creek Tributary 1	>20%	<2	No	No	N/A	Yes. High Gradient 100 feet below road alignment
Glacier Creek Tributary 2	>20%	3	Yes, 3 traps set for a total of 12 hours	No	N/A	Yes. 15 foot falls 200 feet above Glacier Creek
Glacier Creek Tributary 3	>25%	3-5	Yes, 6 traps set for a total of 75 hours	Yes	10, Dolly Varden, 60-156mm. (Below barrier)	Yes. Gradient barrier 40% slope > 80 feet long, 100 feet below road alignment.
Glacier Creek Tributary 4	>20%	<2	No	No	N/A	Yes. 35-40% slopes >70 feet long, below road alignment.
Glacier Creek Tributary 5	10-25%	4-7	Yes. 1 trap set for 3 hours below road alignment.	No	N/A	No
Glacier Creek Tributary 6	>20%	1	No	No	N/A	Yes. 40% slopes >150 feet.
Glacier Creek Tributary 7	10%	1-2	Yes. 1 trap set for 2 hours.	No	N/A	Joins with Glacier Creek Tributary 10, 200 feet downstream from road alignment.
Glacier Creek Tributary 8	>35%	1-2	Yes. 2 traps set for a total of 4 hours below Tributary 9 confluence.	No	N/A	15 foot bedrock drop, 500 feet below road alignment
Glacier Creek Tributary 9	30-40%	4- 6	No	No	N/A	>30% gradient, > 100 feet Dry bed
Glacier Creek Tributary 10	20%	1	No	No	N/A	>20% slopes, tributary to Glacier Creek Tributary 6.
Glacier Creek Tributary 11 (Christmas Creek)	10-20%	3-10	Yes. 6 traps set for a total of 108 hours.	No	No	Variable gradient 10-25% with step pools.
Glacier Creek Tributary 12	25-30%	<3	No	No	N/A	Yes. >30% gradient > 100 feet.
Glacier Creek Tributary 13	25-30%	3-8	No	No	N/A	Yes. 40% slopes >150 feet. High bedload transport and erodible banks
Glacier Creek Tributary 14	25-30%	5-10	No	No	N/A	Dry bed, high bedload transport
Glacier Creek Tributary 15	28-38%	>20	No	No	N/A	High bedload transport, glacial fed stream

3.2 GLACIER CREEK TRIBUTARIES (WEST)

Visual surveys of tributaries coming down into Glacier Creek from the west side of the drainage were conducted. Due to time constraints and access to the west side of the Glacier Creek drainage, GPS points, slope gradients, photos, and stream widths were estimated from the east bank of Glacier Creek. Three streams on the west side were observed along the length of the road alignment (Figure 2, WT1-WT3). All three streams had an estimated gradient of greater than 40 percent and narrow channels. The high gradient and narrow stream channel present unsuitable habitat for fish, fish presence in the three observed west side tributaries seem unlikely (Photos 11 through 13).



Photo 11. West Glacier Creek Tributary 1

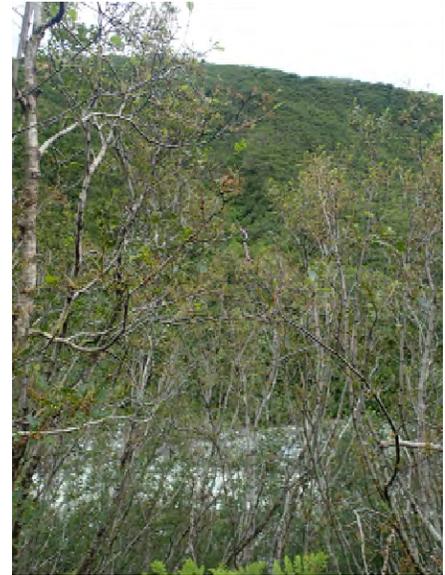


Photo 12. West Glacier Creek Tributary 2



Photo 13. West Glacier Creek Tributary 3

3.3 GLACIER CREEK SAMPLING

Seventeen additional minnow traps were set in Glacier Creek along the length of the proposed road alignment (between the washed-out bridge and Christmas Creek) to confirm presence and species of fish documented by the ADF&G AWC Database. In total, two Dolly Varden char were captured in the minnow traps G14 and G17 located just upstream of the washed out bridge (Figure 2). At locations G18 and G19, an additional five Dolly Varden char were captured using a small minnow net or bucket. Three Dolly Varden char were visually identified in side pools of Glacier Creek at G06 and G20. No species of salmon were captured during sampling efforts on Glacier Creek. The results are presented in Table 2. Photo 14 shows a Dolly Varden that was trapped in Glacier Creek. Photo 15 shows a Glacier Creek side channel in which a trap was placed.



Photo 14. Dolly Varden Captured in Glacier Creek



Photo 15. Baited Minnow Trap Set in Glacier Creek

Table 2. Fish Sampling Results in Glacier Creek

Sample Location	Method	Duration (hours)	Results
G01	Trap	2	No fish
G02	Trap	2	No fish
G03	Trap	2	No fish
G04	Trap	2	No fish
G05	Trap	2	No fish
G06	Trap/Visual	2	No fish. One juvenile Dolly Varden seen darting in pool.
G07	Trap	2	No fish
G08	Trap	2	No fish
G09	Trap	2	No fish
G10	Trap	2	No fish
G11	Trap	2	No fish
G12	Trap	1	No fish
G13	Trap	1	No fish
G14	Trap	1	1 Dolly Varden, 80 mm
G15	Trap	1	No fish
G16	Trap	1	No fish
G17	Trap	1	1 Dolly Varden, 115 mm
G18	Net	N/A	3 Dolly Varden, 33 mm each
G19	Bucket	N/A	2 Dolly Varden, 165 mm each
G20	Visual	N/A	2 Dolly Varden fry

4.0 SUMMARY

A desktop study was conducted covering streams near the Palmer Project area, from Bear Creek to the east and Jarvis Creek to the west. The results from the desktop analysis were used to develop a field study plan and obtain authorization from ADF&G for field surveys.

Field survey of Glacier Creek and its tributaries above the washed out bridge occurred in July 2013. The field survey included habitat mapping to support design and permitting of potential road access for exploration activities in the Glacier Creek drainage. Fifteen eastern tributaries to Glacier Creek were mapped from the proposed Glacier Creek alignment. Six of the Glacier Creek tributaries were sampled for fish. Minnow traps were set in multiple locations along these six tributaries. No fish were recovered from five of these tributaries. Ten Dolly Varden were captured 50 feet above the confluence of Glacier Creek Glacier Creek Tributary 3; however, fish passage barriers were noted farther upstream. No fish presence was noted along the extent of the proposed Glacier Creek road alignment. A high gradient bench exists for most of the road alignment that likely precludes fish presence where the road would be located.

Visual surveys of tributaries coming down into Glacier Creek from the west side of the drainage were conducted from the east side of Glacier Creek due to time and access constraints. Three streams on the west side were observed along the length of the road alignment. No fish are expected in these three west-side Glacier Creek tributaries observed from the east side of Glacier Creek based on channel gradient. There is a lower western tributary near the washed out bridge that was not sampled during the field study; however, previous sampling conducted by the ADF&G (Gaede, 1996) documents the presence of cutthroat trout and Dolly Varden char.

Seventeen additional minnow traps were set in Glacier Creek along the length of the proposed road alignment to confirm presence and species of fish documented by ADF&G AWC. Two Dolly Varden were captured in the minnow traps and an additional eight Dolly Varden were recorded by visual observation or bucket or minnow net capture.

No species of salmon were recorded during sampling efforts on Glacier Creek or any of the 15 Glacier Creek tributaries mapped.

5.0 WORKS CITED

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