

**A RECONNAISSANCE SURVEY OF
HOLY CROSS LAKE
(Watershed Code 180-5453-138 01)**

Prepared for:

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EDI Project No. 203-01

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EXECUTIVE SUMMARY

EDI Environmental Dynamics Inc. (Environmental Dynamics) was retained by the Fisheries Branch of the Ministry of Environment, Lands and Parks to conduct a Reconnaissance Lake Survey of Holy Cross Lake, within the Nechako River watershed. This lake is located approximately 70 km southwest of Vanderhoof, B.C., has no road access to it, and has not previously been surveyed. The lake was surveyed on September 15, 16, and 17, 1995.

This lake has no development along its shoreline area, however, there is some logging activity in close proximity. A hunting/trapping cabin was found on the peninsula on the west side of Holy Cross Lake. This lake was 29 m deep, and contained 3 inlets and 1 outlet. The outlet seemed to be the main spawning and rearing for fish. Seven species of fish, including whitefish, rainbow trout, northern squawfish, longnose sucker, prickly sculpin, large scale sucker and reidsided shiner were found in this lake. Fish populations seemed to be in good health, and biodiversity relatively high. Although anticipated because of its size and depth, no lake trout were captured in this lake. This may be due to the low oxygen levels at depths greater than 12 m. At the deep water sample (28 m), there was higher than acceptable levels (suggested for freshwater aquatic life by the Canadian Water Quality Guidelines) of iron. The area around this lake had a variety of bird and terrestrial wildlife.

The high biodiversity of fish and terrestrial animals found at Holy Cross Lake are not common for every lake in this area, and special efforts should be made to preserve it. Thus an appropriate reserve zone around the lake and the outlet from the lake should be established. Developing road access to the lake is highly discouraged, as the sensitive balance of biodiversity may be negatively affected by human activity.

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1.0 INTRODUCTION

EDI Environmental Dynamics Inc. (Environmental Dynamics) was retained by the Fisheries Branch of the Ministry of Environment, Lands and Parks to conduct a Reconnaissance Lake Survey of Holy Cross Lake, within the Nechako River watershed. This lake is located approximately 70 km southwest of Vanderhoof, B.C. and has not previously been surveyed. The purpose of this survey was to obtain baseline information on the lake including bathymetry, water chemistry, presence and condition of fish and other aquatic organisms, stream assessments, access conditions and other biological and geographical observations. The lake survey was conducted according to the Resource Inventory Committee's Lake and Stream Inventory Guidelines. Stream information was entered into the Department of Fisheries and Oceans / Ministry of Environment Stream Survey Database provided by the Department of Fisheries and Oceans, Habitat Management Division, Vancouver. The original copy of the lake report contains photographic negatives and original stream cards in a sleeve at back of the report.

The reconnaissance lake survey was conducted on September 15, 16 and 17, 1995, by Eric Luiker M.Sc. (Field Crew Leader, Fisheries Biologist, Environmental Dynamics), and Robert Van Schubert (Field assistant, Fisheries Technician, Environmental Dynamics).

2.0 DATA DIRECTORY

Location	<u>x</u>	Dissolved O₂/Temp. Profiles	<u>x</u>
Lake Morphometric Data	—	Winter Diss. O₂/Temp. Profiles	—
Bench Mark	<u>x</u>	Netting Record	<u>x</u>
Terrain Features	<u>x</u>	Lake Catch Summary	<u>x</u>
Access	<u>x</u>	Individual Fish Data	<u>x</u>
Resorts and Campsites	<u>x</u>	Fish Preserved	—
Other Developments	<u>x</u>	Stomach Analysis	<u>x</u>
Obstructions and Pollutions	<u>x</u>	Scale Reading	<u>x</u>
Special Restrictions	<u>x</u>	Location of Inventory Sites	<u>x</u>
Aquatic Plants	<u>x</u>	Photograph Directory	<u>x</u>
Wildlife Observations	<u>x</u>	APPENDICES:	
Miscellaneous Comments	<u>x</u>	A: Water Chemistry Analysis	<u>x</u>
Lake Drainage	<u>x</u>	B: Tributary Stream Data	<u>x</u>
Fisheries Management Comments	<u>x</u>	Bathymetric Map Reduction	—
History of Previous Surveys	—	Bathymetric Map	—
Water Chemistry Summary	<u>x</u>		

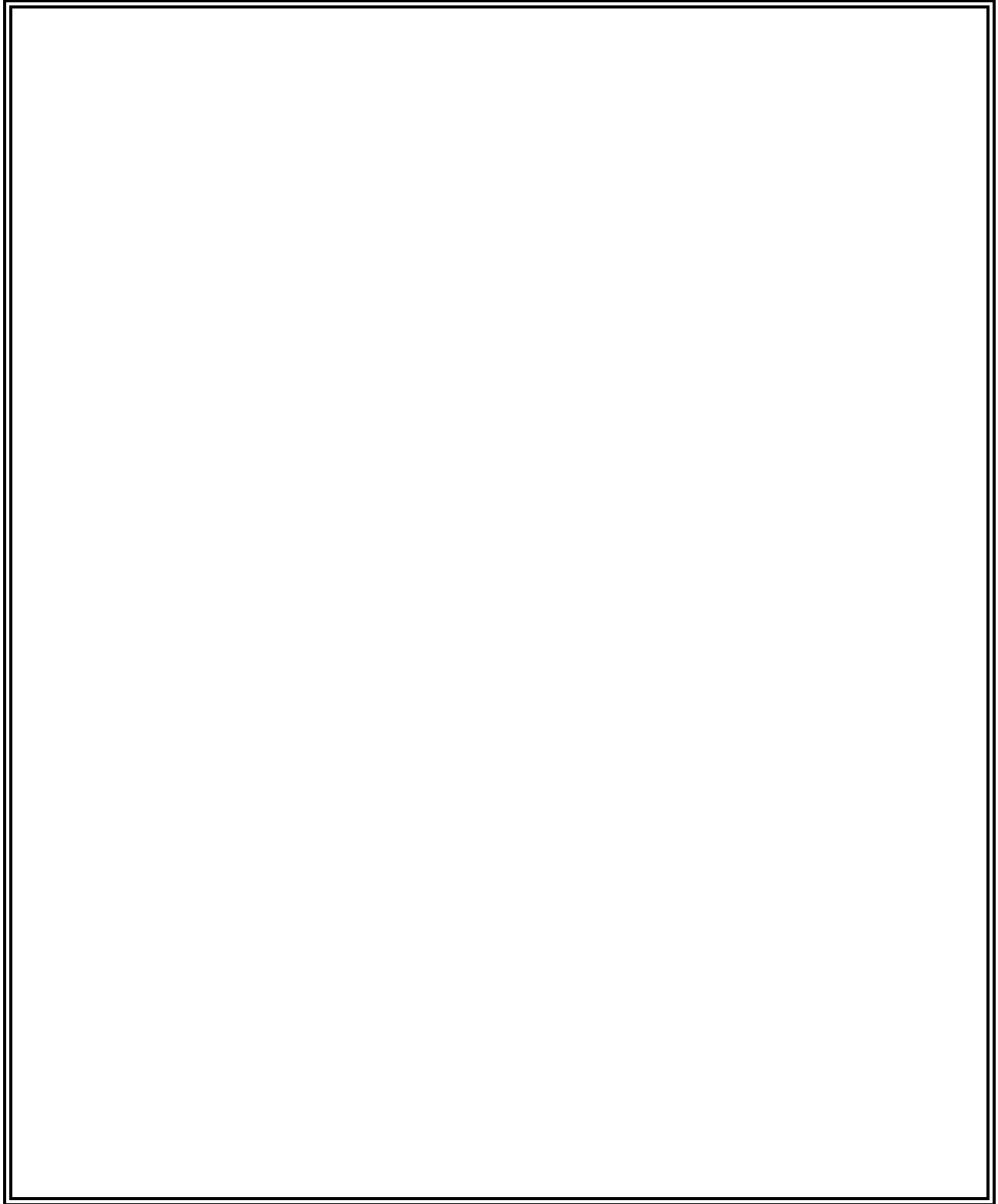


Figure 1. Location map for Holy Cross Lake (Scale 1:750,000)

3.0 LAKE GEOGRAPHICAL AND MORPHOLOGICAL INFORMATION

3.1 Location

Watershed Name:	Nechako River
Watershed Code :	180-5453-138 01
Location:	Holy Cross Lake is located 70 km south-west of Vanderhoof
Elevation:	869 m (Source: Topographic N.T.S. Map 93F/11)
Latitude/Longitude:	Lat. 53° 42' 39", Long. 125° 02' 19"
U.T.M.:	10.365467 .5953065
N.T.S. Map No.:	93F/11
Management Unit:	6-4
Biogeoclimatic Zone:	Sub boreal spruce
Forest Region:	Prince George Forest Region
Forest District:	Vanderhoof Forest District
Native Land Claim Area:	
Drainage:	Holy Cross Lake > Unnamed Outlet > Cheslatta Lake > Murray Lake > Nechako River > Fraser River

3.2 Lake Morphometric Data

Bathymetric information was collected during survey. Final data analysis and bathymetric map preparation to be completed separately.

3.3 Benchmark

Iron spike, (centre of red circle) is located 3 m above the water line at the time of survey in a 0.55 m diameter spruce tree along the north shoreline.

The high water mark is 0.45 m above water level at the time of survey.

3.4 Terrain Features

3.4.1 Immediate Shoreline

Holy Cross Lake is treed up to the water's edge around the majority of the shoreline. The trees around the shoreline consist primarily of spruce and pine. Grasses are found along shoreline edge around most of lake. There were lots of windfall and deadheads surrounding lake, a potential for hazardous boat conditions. An extensive littoral zone was found around lake, with substrate of lakeshore consisting primarily of gravel and cobble. In bay areas of lake, the substrate is primarily silt.

3.4.2 Surrounding Terrain

The terrain around Holy Cross Lake is dominated by forests, consisting mostly of spruce and pine. The south and east areas are quite flat with few steep slopes, the north side of the lake has steeper slopes with a few peaks visible from the lake. There are some logged cutblocks on the west and north sides, which are visible from the lake.

3.5 Lake Drainage

General

Holy Cross Lake has three inlets and one outlet. Two inlets are main inlet streams, the other one drains from a pond or small lake from the north-east corner of the lake. The outlet from Holy Cross Lake flows into Cheslatta Lake.

Major Systems

None

Minor Systems

Note: Streams were surveyed using the DFO/MOE stream survey methodology and data were collected on stream survey cards. In situations where the area was either a seepage area, runoff, or beaver pond, information did not conform to the survey card requirements and therefore, field notes were taken instead.

Minor Systems (continued)

Stream #1 - (watershed code 180-5453-138-457). This stream is a secondary inlet which drains from a small lake, located on the south-east corner of Holy Cross Lake. The average channel width was 1.4 m, with an average wetted width of 0.60 m. There was no flow in the stream which had a gradient of 1%. Stream bed substrate was composed of 100% organics and fines that made for a very soft bottom. The channel Meandered. This stream had no fisheries values.

Stream # 2 - (watershed code 180-5453-138-500). This stream is a secondary inlet, which drains from a small lake and is located on the northeast corner of Holy Cross Lake. The channel is very braided, with a gradient of less than 1%. The average water depth was 0.8 m, which was primarily standing water covered with duckweed. Lots of beaver activity on this stream, with a series of dams along channel. Dams at mouth of stream were 1.5m in height.

Stream # 3 - (watershed code 180-5453-138). This is the main inlet draining from a lake, and is located on the north side of Holy Cross Lake. This stream within 200m of the lake would be better described as a beaver pond. Approximately 150 m upstream from the lake the beaver dam is roughly 30 m in length, and approximately 1.5 m in height, some water escaping over the dam. The pond extends behind dam for at least 100 m.

Stream # 4 - (watershed code 180-5453-138). This is the outlet from Holy Cross Lake, and is located on the southside. This stream drains into Cheslatta Lake. For details on the stream survey, refer to the stream survey card information presented in Appendix B.

4.0 ACCESS TO LAKE AND DEVELOPMENT IN AREA

4.1 Access and Directions

There is no road access to Holy Cross Lake. Access to the lake was obtained by fixed wing Cessna 185 aircraft from Nechako Lodge (1.5 km east of Kenney dam), with a travel time of 15 minutes north-west to Holy Cross Lake. The directions to Nechako Lodge are:

From Vanderhoof drive south from Highway #16 onto Kenney Dam Road.
Take Kenney Dam Road to the dam (92.5 km).
Turn left onto Kluskus- Nataalkuz Forest Road.
Travel 1.1 km to Nechako Lodge sign, turn right and follow signs.

4.2 Road Type and Conditions

There is no road access to Holy Cross Lake. For access to Nechako Lodge the Kenney Dam road is a gravel logging road, that is fairly wide and well maintained. Access can be made with a two-wheel drive vehicle.

4.3 Restrictions

None Known.

4.4 Resorts and Campsites

None known.

4.5 Other Developments

There is a log cabin on the westside of the lake on the peninsula. Ownership unknown. Historical signs of trapping and hunting were evident around cabin.

4.6 Obstructions and Pollutions

There were several small beaver dams on the outlet that are not impeding fish passage.

4.7 Special Restrictions

None known.

5.0 FLORA AND FAUNA

5.1 Aquatic Plants

Aquatic plant growth was relatively sparse through main body of Holy Cross Lake, however, dense growth was found in bay areas. During the lake survey aquatic plants that were identified included Yellow water lilly (*Nuphar lutea*), *Potamageton* sp., and *Elodea canadensis* (very heavy mats in some bay areas). Grasses and sedges were also found around perimeter of lake.

5.2 Wildlife Observations

Wildlife observations during the lake survey included: bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), several grebes (*Podiceps* sp.), belted kingfisher (*Megaceryle alcyon*), Canada geese (*Branta canadensis*), unidentified ducks, and loons. Although not directly observed, tracks and markings around lake were spotted for beaver, squirrels, and moose.

5.3 Miscellaneous Comments

Many bay areas on Holy Cross Lake had dense growths of aquatic vegetation, providing good rearing habitat for fish and other aquatic animals, but making motorised boat travel difficult.

6.0 FISHERY INFORMATION

6.1 Netting Record

Mesh sizes of panels of gill nets used in experimental order are: 25, 76, 51, 89, 38, 64 mm.

NETTING SITE #1

Total net set hours:	13 hrs 25 min	Time set:	1950 hrs
Date set:	September 15, 1995	Time lifted:	0915 hrs
Date lifted:	September 16, 1995		
Type:	Sinking monofilament		
Net dimensions:	Length: 91.4m	Depth:	2.4 m
Shallow end mesh size:	25 mm	Depth at shallow end:	1.0 m
		Substrate at shallow end:	cobble, gravel
Deep end mesh size:	64mm	Depth at deep end:	14 m
		Substrate at deep end:	Unknown

6.2 Total Fish Catch Summary

Table 1. Total fish catch summary

Species	Net Site No. 1	Minnow Trap	Other	Total	# Sampled	# Preserved	Size Range (cm)
PS	-	2	-	2	-	-	6.0-7.5
NSC	84	-	-	84	-	-	10.5-34.0
LSU	16	-	-	16	-	-	22.0-42.0
CSU	15	-	-	15	-	-	22.0-36.0
RB	6	-	-	6	6 sc	-	18.9-32.5
LWF	6	-	-	6	6 sc	-	30.5-35.9
RSC	123	-	-	123	-	-	9.0-11.0

(RB - Rainbow trout (*Oncorhynchus mykiss*), NSC - Northern squawfish (*Ptychocheilus oregonensis*), LSU - Longnose sucker (*Catostomus catostomus*), PS - Prickly sculpin (*Cottus asper*), CSU - Large scale sucker (*Catostomus macrocheilus*), LWF - Lake whitefish (*Coregonus clupeaformis*), RSC - Redsided shiner (*Richardsonius balteatus*), sc.- scales)

6.3 Individual Fish Data From Gill Net Catches

Date captured: September 16, 1995
Method of capture: Sinking monofilament gill net
Age determination completed by: Tara White and Dwight Hickey
Sample size: 6 rainbow trout and 6 lake whitefish were biologically sampled, 5 rainbow trout were aged.

Table 2. Individual fish data from the gill net catch

Species	Fork	Weight	Sex	Gonadal	Sample	Age	Stomach Contents				Comments
	Length (cm)	(grams)		Maturity	Type		Plankton	Insects	Fish	Other	
LWF	30.5	350	M	MT	-		x				
LWF	31.0	390	F	MT	-						st. empty
LWF	34.0	390	F	MT	-						st. empty
LWF	32.6	420	F	MT	-						st. empty
LWF	35.9	560	F	MT	-						st. empty
LWF	35.8	550	F	MT	-						st. empty
RB	32.5	350	M	MT	SC	4+					st. empty
RB	30.6	310	M	MT	-	-	X				
RB	25.2	190	F	MG	SC	4+	X				
RB	27.7	230	M	MG	SC	3+	X				
RB	27.3	210	?	IMM	SC	3+		X			
RB	18.9	80	?	IMM	SC	3+		X			

DATA CODES: RB - Rainbow trout *Oncorhynchus mykiss* LWF - Lake whitefish *Coregonus clupeaformis*

<u>Sex:</u> M-Male F-Female ?-Not Obvious	<u>Maturity:</u> IMM-Immature MG-Maturing MT-Mature GV-Gravid SP-Spent	<u>Sample Type:</u> Eg-Egg Fr-Fin Ray HD-Head ML-Milt OT-Otolith	Sc-Scale ST-Stomach TG-Fish Tag WF-Wholefish
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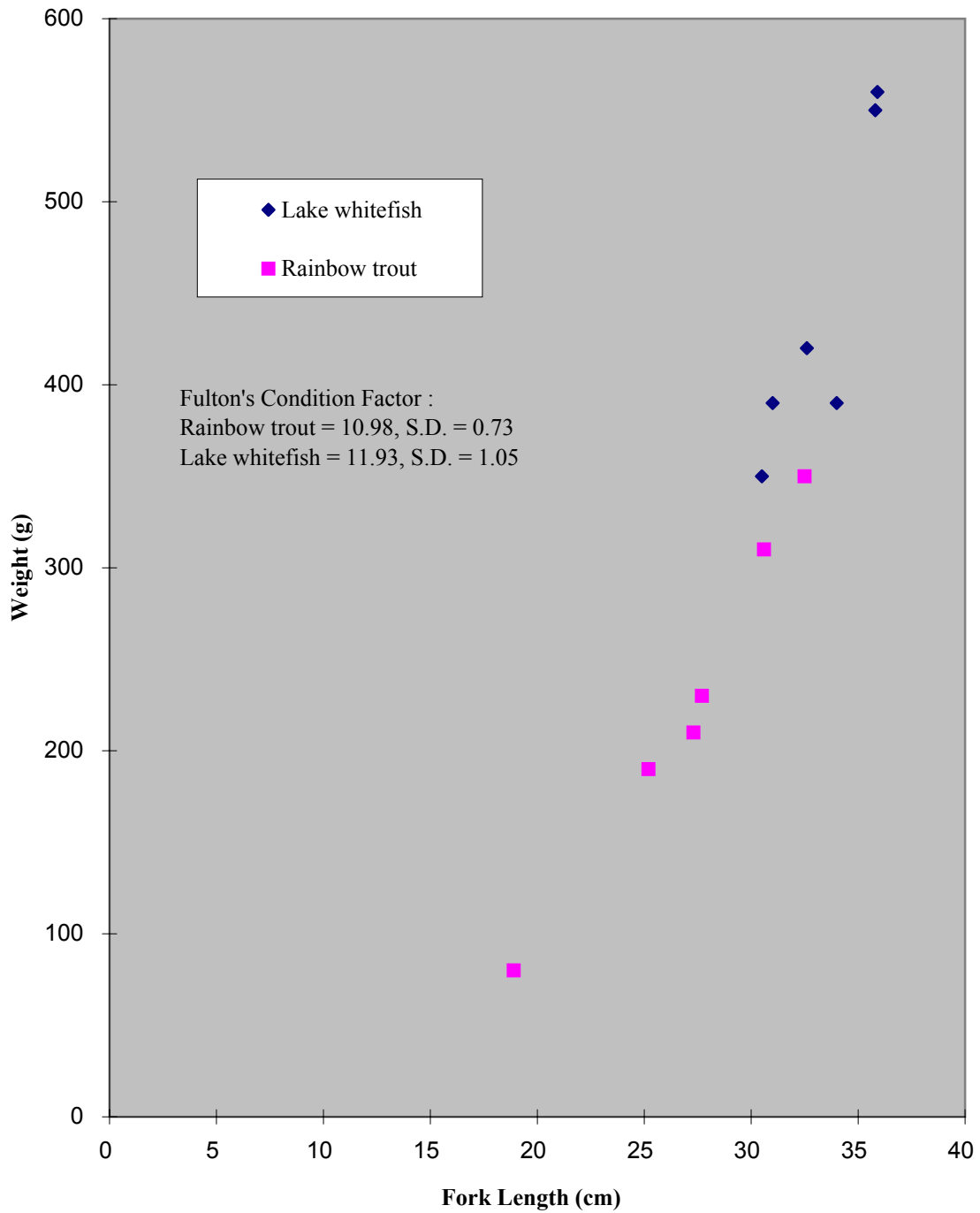


Figure 2. Rainbow trout and lake whitefish fork length vs. weight (6 rainbow trout amd 6 lakewhitefish sampled)

6.4 Minnow Trap Catch Summary

Table 3. Minnow trap catch summary

Trap #	Soak Time	Depth (m)	Substrate			Species	# of Fish Caught	Size Range (cm)
1	18'45"	1.0	silt	aq. veg.	-	-	-	-
2	23'45"	1.5	silt	aq. veg.	L.O.D.	PS	2	6.0-7.5
3	20'55"	0.5	silt	L.O.D.	-	-	-	-
4	18'05"	1.0	silt	aq. veg.	-	-	-	-

Minnow trap:

1	Set: 1315 hrs, September 16, 1995	3	Set: 1510 hrs, September 16, 1995
	Pulled: 0800 hrs, September 17, 1995		Pulled: 1205 hrs, September 17, 1995
2	Set: 1400 hrs, September 16, 1995	4	Set: 1640 hrs, September 16, 1995
	Pulled: 1315 hrs, September 17, 1995		Pulled: 1045 hrs, September 17, 1995

Sardines were used as bait for the traps. (PS - Prickly sculpin (*Cottus asper*), aq. veg. - aquatic vegetation, L.O.D. - large organic debris)

6.5 Fisheries Management Comments

Seven species of fish were caught in Holy Cross Lake, the prickly sculpin (*Cottus asper*), northern squawfish (*Ptychocheilus oregonensis*), largescale sucker (*Catostomus macrocheilus*), longnose sucker (*Catostomus catostomus*), rainbow trout (*Oncorhynchus mykiss*), lake whitefish (*Coregonus clupeaformis*), and the reidsided shiner (*Richardsonius balteatus*). Lake trout were expected to be found in Holy Cross Lake, but none were caught in the gill net set. This may be due to the low oxygen levels (<2.0 mg/L) at depths greater than 12 m. Maximum depth of the lake was 29 m. The diversity of fish species in this lake suggest that there is a good natural balance of aquatic life and enhancement of the fish populations of this lake is not required. The outlet from Holy Cross Lake is the main stream for spawning and rearing and should have an appropriate riparian reserve zone in place to protect it. The reserve zone around the lake would help protect the natural fish biodiversity in this lake.

6.6 History of Previous Surveys

None known.

7.0 FIELD CONDITIONS AND WATER CHEMISTRY

Date: September 17, 1995 **Time:** 0840 hrs
Limnology Station: #1 **Maximum Depth:** 29 m
Seam site: **Water Sampler used:** Van Dorn
Laboratory used: Zenon Environmental Laboratories

7.1 Field Conditions

Table 4. Field conditions

Parameter Measured	Result	Method Used
Wind Velocity	0-5 kph	Estimation
Wind Direction	Northeast	Observation
Air Temperature	8.0 °C	Hand glass thermometer
Cloud Cover	10%	Observation
Surface Condition	Calm	Observation
Water Colour	Green	Observation
Water Clarity	5.75 m	Secchi Disk

7.2 Water Chemistry

Water samples taken from Holy Cross Lake were sent to Zenon Laboratories, Burnaby, B.C., for water chemistry analysis. A complete listing of the results is presented in Appendix A, and a summary is presented in tables 5 and 6. Results were compared with the acceptable limits for freshwater aquatic life as established in the Canadian Water Quality Guidelines. **Water chemistry results indicated higher than acceptable levels of iron at the 28.0 m sample.**

Table 5. Water chemistry summary

Parameter Measured	Result (0.5m)	Result (28.0m)	Method Used
Dissolved Oxygen	9.4	0.1	YSI model 57 O ₂ meter
Water Temperature	16	5.5	YSI model 57 O ₂ meter
pH (field)	8.7	7.3	Hanna pH3 pH meter
pH (lab)	7.4	7.1	Automated pH meter
H ₂ S (field)	No odour	No odour	Odour Detection
Specific Conductance	137uS/cm	142uS/cm	Cond. Meter Siebold
Nonfilterable Residue	< 4mg/L	< 4mg/L	Grav. Subsamp. Buch 105C
Hardness Total	61.7 mg/L	60.9 mg/L	Calculated Result
Hardness Dissolved	60.5 mg/L	62.6 mg/L	Calculated Result
Alkalinity Phen. 8.3	< 0.5 mg/L	< 0.5 mg/L	Automated Electrometer
Alkalinity Total 4.5	64.6 mg/L	65.7 mg/L	Automated Electrometer

7.3 Water Nutrient Summary

Table 6. Summary of available phosphorus and nitrogen

Parameter Measured	Result (0.5 m)	Result (28 m)	Method
Dissolved Ortho-phosphate	0.012 mg/L	0.008 mg/L	Auto. ascorbic acid
Phosphorus (P)	0.010 mg/L	0.019 mg/L	Pres. dig. auto ascorbic A
Nitrogen Total Kjeldahl	0.35 mg/L	0.40 mg/L	HgSO ₄ dig. auto. colour
Nitrogen Total (N)	0.35 mg/L	0.50 mg/L	Calculated result
N:P Ratio	35 : 1	26.3 : 1	Average = 30.7 : 1

Note: N:P ratio is calculated: $N:P = \frac{\text{TOTAL NITROGEN}}{\text{TOTAL PHOSPHORUS}}$

A N:P ratio greater than 15:1 indicates that the lake is most likely phosphorus limiting.

7.4 Oxygen and Temperature Data

DATE: September 17, 1995

Table 7. Oxygen and temperature data (taken at 1 m intervals)

Depth (m)	Oxygen (mg/L)	Temperature (°C)
Surface	9.4	16.0
1	9.1	16.0
2	9.1	15.5
3	9.1	15.5
4	9.1	15.5
5	9.0	15.5
6	8.5	15.0
7	8.0	15.0
8	7.0	14.0
9	3.5	11.0
10	2.0	9.5
11	1.8	9.0
12	1.6	7.5
13	1.3	6.5
14	1.2	6.5
15	0.7	6.0
16	0.5	6.0
17	0.4	6.0
18	0.3	6.0
19	0.2	5.5
20	0.2	5.5
21	0.1	5.5
22	0.1	5.5
23	0.1	5.5
24	0.1	5.5
25	0.1	5.5
26	0.1	5.5
27	0.1	5.5
28	0.1	5.5
29	Lake Bottom	Lake Bottom

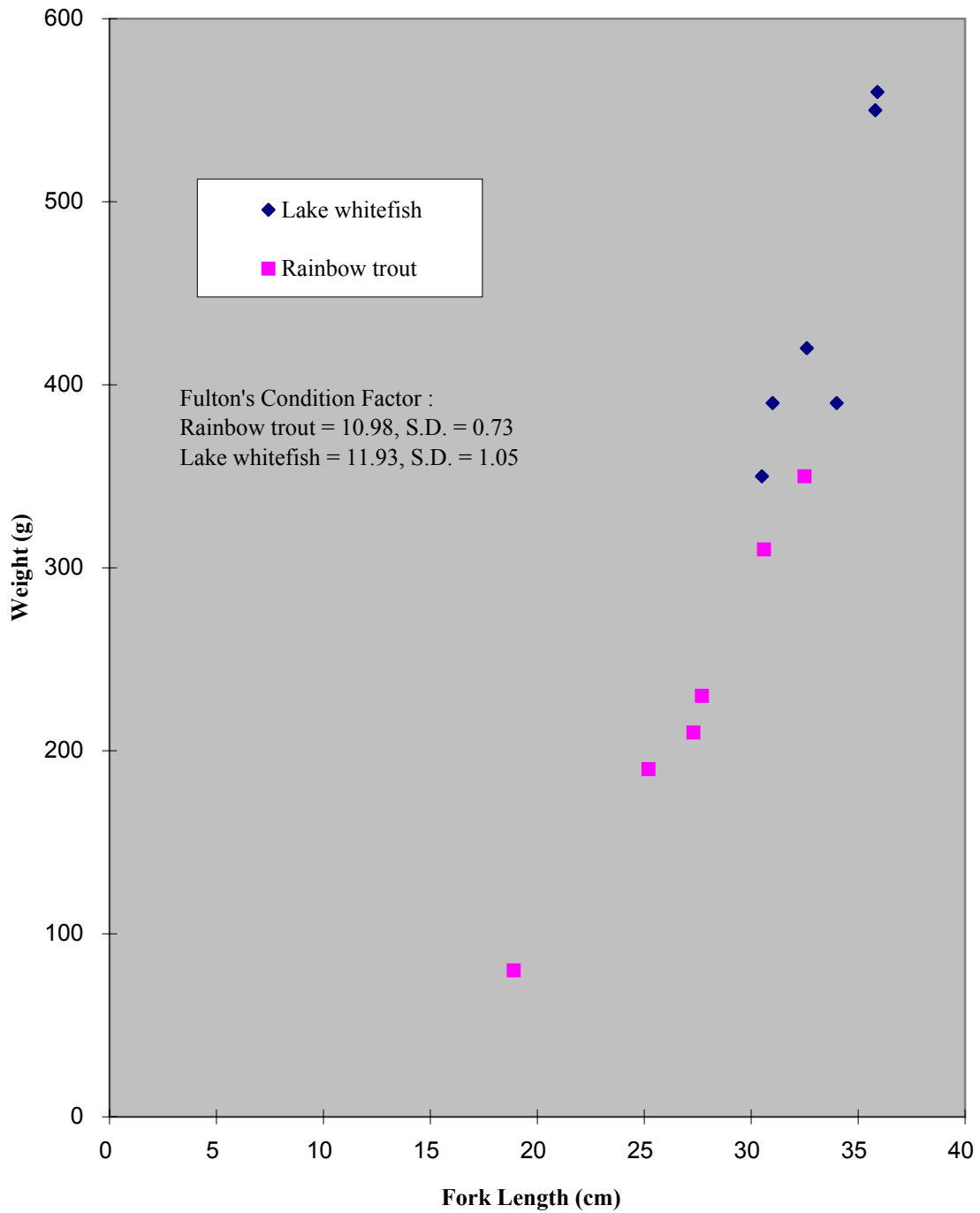


Figure 2. Rainbow trout and lake whitefish fork length vs. weight (6 rainbow trout amd 6 lakewhitefish sampled)

8.0 SUMMARY AND RECOMMENDATIONS

Holy Cross Lake is found approximately 70 km south-west of Vanderhoof , B.C. and has no road access. This lake has no development along its shoreline area, however, there is some logging activity in close proximity. A hunting/trapping cabin was found on the peninsula on the west side of Holy Cross Lake. This lake was 29 m deep, and contained 3 inlets and 1 outlet. The outlet seemed to be the main area for spawning and rearing for fish. Seven species of fish, including whitefish, rainbow trout, northern squawfish, longnose sucker, prickly sculpin, large scale sucker and reidsided shiner were found in this lake. Fish populations seemed to be in good health, and biodiversity relatively high. Although anticipated because of its size and depth, no lake trout were captured in this lake. This may be due to the low oxygen levels at depths greater than 12 m. At the deep water sample (28 m), there was higher than acceptable levels (suggested for freshwater aquatic life by the Canadian Water Quality Guidelines) of iron. The area around this lake had a variety of bird and terrestrial wildlife.

The high biodiversity of fish and terrestrial animals found at Holy Cross Lake are not common for every lake in this area, and special efforts should be made to preserve it. Thus a reserve zone around the lake and the outlet from the lake should be established. Road access to the lake is highly discouraged, as the sensitive balance of biodiversity may be negatively affected by human activity.

Plate 1. Aerial photograph of Holy Cross Lake (Negative #1)

Plate 2. Stream # 1 (180-5453-138-457) looking downstream (Negative # 4)

Plate 3. Stream # 2 (180-5453-138-500) looking downstream (Negative # 5)

Plate 4. Stream # 3 (180-5453-138) looking at marsh from beaver dam (Negative # 8)

Plate 5. Stream # 3 (180-5453-138) looking at second beaver dam (Negative #9)

Plate 6. Stream # 3 (180-5453-138) looking out at stream mouth (Negative # 10)

Plate 7. Stream # 4 (180-5453-138) survey site looking upstream (Negative # 11)

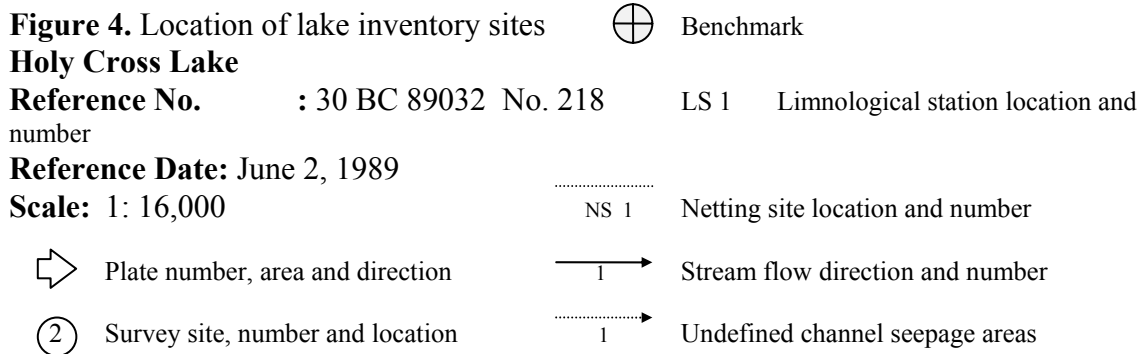
Plate 8. View from centre of lake looking north-east (Negative #14)

Plate 9. View from centre of lake looking north-west (Negative # 15)

Plate 10. View from centre of lake looking south-west (Negative # 17)

Plate 11. View from centre of lake looking south-east (Negative # 18)

Plate 12. View of benchmark from lake (Negative # 19)



APPENDIX A

WATER CHEMISTRY ANALYSIS

N.B. - * - indicates parameters that are higher than those acceptable for freshwater aquatic life as established in Canadian Water Quality Guidelines.

Canadian Council of Resource and Environment (CCREM). 1987. Canadian Water Quality Guidelines. Water Quality Objectives Division, Water Quality Branch, Inland Waters Directorate, Environment, Canada

APPENDIX B

STREAM SURVEY CARD INFORMATION

Stream survey information has been entered on DFO/MOE stream survey cards, with this information being included in the DFO/MOE stream survey database provided by DFO Habitat Management Division, Vancouver.

APPENDIX C**PHOTOGRAPH DIRECTORY**

<u>Negative #</u>	<u>Plate #</u>	<u>Description</u>
L1-1	1	Aerial Photograph of Holy Cross Lake
L1-2		Aerial Photograph
L1-3		Stream #1 looking upstream
L1-4	2	Stream #1 looking downstream
L1-5	3	Stream #2 looking downstream
L1-6		Stream #2 looking upstream at beaver dam
L1-7		Stream #3 looking at beaver dam
L1-8	4	Stream #3 looking at marsh from beaver dam
L1-9	5	Stream #3 looking at second beaver dam
L1-10	6	Stream #3 looking out at stream mouth
L1-11	7	Stream #4 survey site looking upstream
L1-12		Stream #4 looking at mouth of stream and lake
L1-13		View from centre of lake looking east
L1-14	8	View from centre of lake looking north-east
L1-15	9	View from centre of lake looking north-west
L1-16		View from centre of lake looking west
L1-17	10	View from centre of lake looking south-west
L1-18	11	View from centre of lake looking south-east
L1-19	12	View of benchmark