

December 10, 2012

Pacific Booker Minerals  
1702 – 1166 Alberni Street  
Vancouver, British Columbia  
V6E 3Z3

**Erik Tornquist**  
**Executive VP and COO**

Dear Mr. Erik Tornquist:

**Morrison Project**  
**Morrison Lake Summary**

## **1 INTRODUCTION AND SUMMARY**

This letter summarizes the studies and data that have been carried out on Morrison Lake since the early 1900's, and includes the studies that have been carried out by Pacific Booker Minerals over the period of 2003 to 2012. The summary is focused on the lake and does not include the associated studies on the aquatic and environmental aspects of the tributary streams and Nakinilerak Lake, that have also been carried out in support of the Environmental Assessment.

Morrison Lake has a surface area of 13 km<sup>2</sup>, has a mean depth of 21 m and a maximum depth of 60 m. Morrison Lake drains via the Morrison River into the Morrison Arm of Babine Lake. Fish species composition in Morrison Lake include rainbow trout, cutthroat trout, kokanee, sockeye salmon, coho salmon, chinook salmon, lake trout, lake whitefish, mountain whitefish, longnose sucker, largescale sucker, northern pikeminnow, burbot, peamouth chub, redbside shiner, and prickly sculpin.

Lake trout and lake whitefish are the predominant fish species within Morrison Lake and high-value lake trout spawning areas are prevalent within the north basin. Morrison sockeye salmon spawn in both the inlet and outlet of Morrison Lake (Tahlo Creek and the Morrison River). Sockeye spawning within Morrison Lake has only been observed in one short location around the approximately 48 km shoreline of the lake. While Morrison Lake provides good physical habitat for juvenile sockeye the lake is nutrient limited (oligotrophic) with negligible shoreline spawning habitat. The results of at least five shoreline spawning surveys indicate that in the order of less than 300 sockeye salmon spawn in Morrison Lake each year.

Rainbow trout from Morrison Lake utilize tributary streams up to impassable barriers for spawning and juvenile rearing. In addition, small populations of lake resident cutthroat trout are present within Morrison Lake and utilize lower Tahlo Creek for spawning. Burbot comprise less than 2% of the fish community while small-bodied in Morrison Lake are dominated by northern pike minnow, prickly sculpin, and redbside shiner.

121210L-Morrison Lake Summary.docx  
M09382A06.722

## 2 HISTORICAL FISH AND FISH HABITAT INFORMATION AVAILABLE

The following historical fisheries information is available for Morrison Lake and a summary of key information is included in Table 2.1:

- Sockeye spawning hatchery data from 1907 to 1938. Eggs were collected from Morrison Creek sockeye, incubated in a hatchery at the Morrison Lake outlet. Fry were released into Morrison Lake.
- The Department of Fisheries and Oceans annual salmon escapements into Morrison and Tahlo Creeks since approximately 1930. These estimates represent a combination of aerial and ground surveys.
- Detailed limnology and fish diet studies were undertaken in Morrison Lake during the summer period from 1945 to 1948.
- sockeye smolt migration information for Morrison Lake is described by Groot (1972) from early studies conducted in association with enhancement of sockeye salmon.
- Fisheries information on experimental outplantings of coho fry into Morrison Lake were undertaken between 2001 and 2003 in response to the collapse of upper Skeena coho stocks during the mid-1990's.

**Table 2.1 Summary of Fish and Fish Habitat and Lake Studies for Morrison Lake**

Date	Fisheries Study		Comment
	Author	Description	
1907 to 1938	Department of Fisheries and Oceans	Sockeye spawning hatchery data from 1907 to 1938. Eggs were collected from Morrison Creek sockeye, incubated in a hatchery at the Morrison Lake outlet. Fry were released into Morrison Lake.	
1930	Department of Fisheries and Oceans	Estimates of annual salmon escapements into Morrison and Tahlo Creeks based on a combination of aerial and ground surveys	
19445 to 1948	Fisheries Research Board	Detailed limnology, fish population netting program, and fish diet studies were undertaken in Morrison Lake during the summer period.	Kokanee represented 11% of the overall catch reported during the 1946-1947 netting program.
1972	Groot	Research study on Morrison sockeye smolt migration associated with enhancement of sockeye salmon	Morrison Lake provides high-quality rearing habitat for juvenile sockeye.
1998	Shortreed et. al	Lake trawl and hydroacoustic surveys.	Sockeye fry dominated the trawl catches in Morrison Lake
1995	Shortreed et. al	Limnology survey and nutrient capacity study.	Morrison Lake provides high-quality habitat for sockeye salmon fry although fry densities are low due to limited spawning areas.
2008	Rescan	Bathymetry Surveys of Morrison Lake.	
2004	Bustard	Morrison Lake shoreline spawning surveys, limnology survey, fish community lake survey.	Followed RISC standards for lake survey; Lake trout and mountain whitefish together comprised approximately 50% of the survey catch; Sockeye spawned along the Morrison Lake shoreline immediately south of Creek 44800 with a total Morrison River sockeye run in 2004 of 13,000 fish.
2006 to 2008	Rescan	Fish community survey in Morrison Lake species presence, length and weight measurements, condition factors, length-frequency distributions, and catch per unit effort. Shoreline habitat and spawning surveys. Detailed bathymetric surveys.	Sockeye spawn in the Morrison Lake outlet to Morrison River, immediately south of the mouth of stream #44800, and extensively throughout the Morrison River down to Lake Babine from August to mid-October. Productive high-quality lake trout spawning sites occur in the northern basin of Morrison Lake.
2010	Lake Babine Nation	Morrison Lake shoreline spawning surveys with a focus on sockeye salmon	Sockeye spawn in the Morrison Lake outlet to Morrison River, and immediately south of the mouth of stream #44800.
2011	Lake Babine Nation	Morrison Lake shoreline spawning surveys with a focus on sockeye salmon	In 2011 the sockeye populations of the Morrison Watershed experienced a relatively abundant return, however, the total number of Sockeye spawners observed in Morrison Lake totaled 224
2010 to 2011	KCB	Shoreline habitat and spawning surveys, depth profiling and in <i>situ</i> measurements of temperature profiles to confirm stratification, pH, dissolved oxygen, total dissolved solids, conductivity and oxidation reduction potential was conducted. Water sampling included sampling during freshet (Ice-Off) which confirmed that the Lake turns over	Sockeye spawn in the Morrison Lake outlet to Morrison River, and immediately south of the mouth of stream #44800.

### 3 1995 MORRISON LAKE FISHERIES INFORMATION SUMMARY

A baseline limnology, plankton, and fish community survey was conducted by Shortreed et al. (1998) to assess sockeye fry rearing in Morrison Lake.

#### 3.1 Summary of Results

- Morrison Lake provided high-quality physical habitat for sockeye salmon fry.
- Nutrient concentrations and phytoplankton biomass place Morrison Lake in the upper range of oligotrophy.
- The zooplankton community was dominated by copepods, with the calanoid copepod (*Epischura* sp.) the most important food item for juvenile sockeye.
- Age 0 fall sockeye fry were relatively large, indicating an adequate food resource in Morrison Lake at present fish densities.
- Sockeye densities were low due to limited spawning ground capacity.
- To increase fry recruitment, the author suggests improvements to spawning grounds (i.e., removal of beaver dams) and/or supplementing native sockeye stocks with fry outplants.

### 4 2004 MORRISON LAKE FISHERIES INFORMATION SUMMARY

Fisheries background studies for Morrison Lake were conducted by Bustard in 2004. Work completed in Morrison Lake during the assessment included:

- Morrison lake shoreline spawning studies for kokanee and sockeye salmon at eight Morrison Lake locations, as well as within Tahlo Creek and Morrison River;
- Morrison Lake fish population survey including descriptive statistics (length, weight, sex, maturity for all captured species), and fish ageing analysis;
- baseline fish tissue metals analysis program;
- fish health assessment following fish health assessment procedures outlined in Environment Canada (2002); and
- shoreline survey, updated limnology study, and bathymetry analysis.

#### 4.1 Summary of Fisheries Data Results

- Morrison Lake fish species included lake whitefish, northern pikeminnow, kokanee salmon, sockeye salmon, peamouth chub, lake trout, rainbow trout, mountain whitefish, longnose and largescale sucker, burbot, cutthroat trout, coho salmon, and redbside shiner.
- Lake trout and mountain whitefish together comprised approximately 50% of the survey catch.

- Adult and juvenile rainbow trout occupied accessible portions of Morrison Lake tributary streams.
- Rainbow trout were a small component of the overall fish population in Morrison Lake.
- Juvenile coho occupied several Morrison Lake tributary streams below natural fish barriers (many temporary and permanent barriers to upstream fish migration exist in the form of beaver dams and waterfalls).
- Adult sockeye and coho spawned in lower Tahlo Creek, the Tahlo Creek beach mouth to Morrison Lake, and the Morrison Lake beach outlet. Also, depending on the year and stream flow, sockeye and coho spawned in one or more additional Morrison Lake tributary streams below natural fish barriers.
- Sockeye spawned along the Morrison Lake shoreline immediately south of Creek 44800 with a total Morrison River sockeye run in 2004 of 13,000 fish.
- Fish metal tissue analysis results showed elevated copper and zinc levels compared to uncontaminated lakes in BC.
- Mercury levels in lake trout samples from Morrison Lake showed elevated concentrations of mercury.

## 5 2006-2008 MORRISON LAKE FISHERIES INFORMATION SUMMARY

Work completed on Morrison Lake during the 2006-2008 Morrison Baseline Fisheries Assessment included:

- fish habitat and water quality assessments of Morrison Lake inlets/outlets, and tributary streams;
- fish community survey in Morrison Lake including species presence, length and weight measurements, condition factors, length-frequency distributions, and catch per unit effort;
- shoreline habitat and spawning surveys in Morrison Lake; and
- detailed bathymetry survey of Morrison Lake.

### 5.1 Summary of Fisheries Data Results

- At different times of year, fish species composition in Morrison Lake included rainbow trout, cutthroat trout, kokanee, sockeye salmon, coho salmon, Chinook salmon, lake trout, lake whitefish, mountain whitefish, longnose sucker, largescale sucker, northern pikeminnow, burbot, peamouth chub, reaside shiner, and prickly sculpin.
- Lake trout and mountain whitefish together comprised approximately 87% of the catch during the Morrison Lake fish community survey.

- Lake trout were the most widely distributed and abundant large-bodied species in Morrison Lake with comparable lengths, weights, and condition factors at all sampling locations in Morrison Lake and within reference Tochcha Lake.
- Northern pikeminnow, prickly sculpin, and redbreast shiner were most abundant small-bodied fish within the Morrison Lake shoreline.
- Rainbow trout followed by coho salmon, had the widest species distribution in Morrison Lake tributary streams.
- Five Morrison Lake tributary streams were confirmed as fish bearing. No fish were present in streams #29000 and #50000-48010.
- Coho salmon and rainbow trout were captured in five Morrison Lake tributaries.
- Tahlo Creek and Morrison River contained coho salmon, rainbow trout, longnose sucker, northern pikeminnow, redbreast shiner, and prickly sculpin.
- The small-bodied fish community in Morrison Lake was dominated by northern pike minnow, prickly sculpin, and redbreast shiner.
- Morrison River and Tahlo Creek contained the highest fish abundance of all Morrison Lake tributaries.
- Coho salmon in stream #61100 were underweight compared to those in larger tributaries (i.e., Morrison River and Tahlo Creek).
- Productive high-quality lake trout spawning sites occur in the northern basin of Morrison Lake.
- Sockeye spawn in the Morrison Lake outlet to Morrison River, immediately south of the mouth of stream #44800, and extensively throughout the Morrison River down to Lake Babine from August to mid-October.
- Coho salmon spawn in smaller numbers immediately south of the mouth of stream #44800.

## 6 2010 MORRISON LAKE FISHERIES INFORMATION SUMMARY

Work completed in Morrison Lake during the 2010-2011 Morrison Baseline Fisheries Assessment included:

- shoreline spawning surveys within the south basin of Morrison Lake;
- stream habitat assessment for all Morrison Lake tributary streams; and
- quarterly water quality sampling program and in-situ water quality depth profile survey of Morrison Lake (Table 6.1).

### 6.1 Summary of Fisheries Data Results

- Productive high-quality lake trout spawning sites occur in the northern basin of Morrison Lake.

- Sockeye spawn in the Morrison Lake outlet to Morrison River, immediately south of the mouth of stream #44800, and extensively throughout the Morrison River down to Lake Babine from August to mid-October.
- Juvenile rainbow trout and coho are present within accessible portions of the lower reaches of several Morrison Lake tributary streams.

**Table 6.1 Morrison Lake Physical Data Summary**

Statistic	Morrison Lake
Surface Area (km <sup>2</sup> )	13.3
Lake Volume (m <sup>3</sup> )	286,000,000
Lake Turnover (m <sup>3</sup> /year)	145,000,000
Average Depth (m)	21.6
Maximum Depth (m)	62.9
Average Width (m)	879
Maximum Length (m)	15,150
Mean Transparency (Secchi Depth (m))	1.78
Surface Temperature (°C)	10.5
Temperature at depth (°C)	4.32
pH	7.6
Specific Conductivity (µs/cm)	0.0615
Total Dissolved Solids (g/L)	0.0399
Salinity (ppm)	0.028

This letter is an instrument of service of Klohn Crippen Berger Ltd. The letter has been prepared for the exclusive use of Pacific Broker Minerals Inc. (Client) for the specific application to the Morrison Project. The report's contents may not be relied upon by any other party without the express written permission of Klohn Crippen Berger. In this report, Klohn Crippen Berger has endeavoured to comply with generally-accepted professional practice common to the local area. Klohn Crippen Berger makes no warranty, express or implied.

Yours truly,

**KLOHN CRIPPEN BERGER LTD.**



Harvey McLeod, P.Eng., P.Ge.  
Principal

HM:cd

## REFERENCES

- Bustard, D 2004. Fisheries background studies Morrison Watershed 2004. Man. Report prepared for Pacific Booker Minerals Ltd.
- KCB June 2010. 2010-2011 Spring Field Report. Report prepared for Pacific Booker Minerals Ltd.
- Shortreed, K.S., K.F. Morton, K. Malange and J.M.B. Hume. 2001. Factors limiting sockeye production in selected B.C. Nursery Lakes. Canadian Stock Assessment Secretariat Research Document 2001/098.
- Rescan. 2009. Morrison Copper/Gold Project Fisheries Baseline Report. Report prepared for Pacific Booker Minerals Inc. by Rescan Environmental Services Ltd. December 2008.
- Rescan. 2009. Morrison Copper/Gold Project Bathymetry Report. Report prepared for Pacific Booker Minerals Inc. by Rescan Environmental Services Ltd. February 2009.