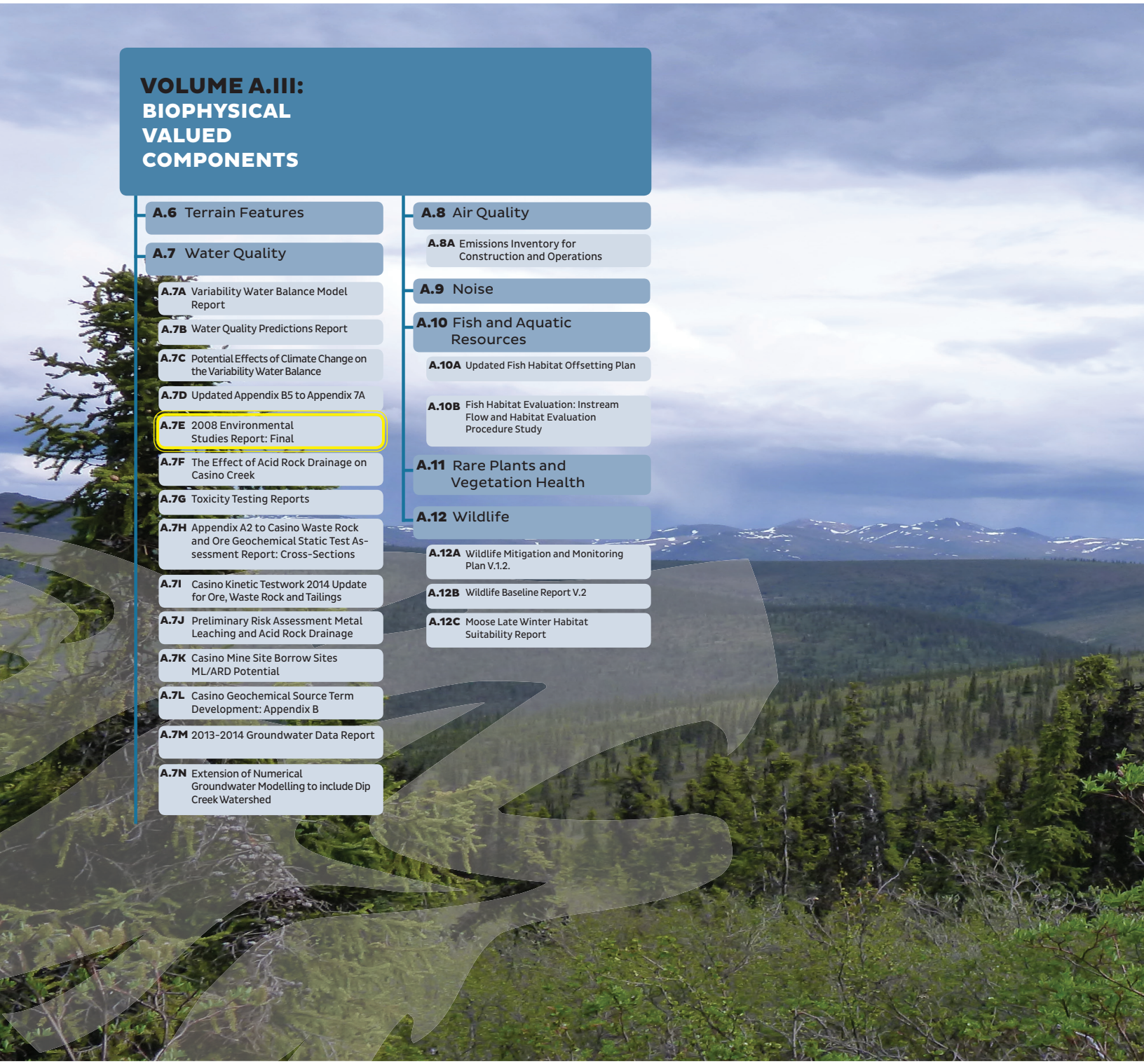
APPENDIX A.7E: 2009 Environmental Studies Report: Final



PALMER ENVIRONMENTAL CONSULTING GROUP INC.

470 Granville Street, Suite 630, Vancouver, BC V6C 1V5 t 604-629-9075

Memorandum

Date: September 3, 2014

Project: Casino Aquatics EA

To: Mary Mioska, Casino Mining Corporation

From: Rick Palmer, PECG

cc

Subject: Casino Project: 2008 Environmental Studies Report

This memo notes that while the Casino Project 2008: Environmental Studies Report submitted by AECOM Canada Ltd. in March 2009 indicates it is “draft for discussion”, the information contained within the report was considered to be final as of 2009.

Sincerely,

R. Palmer

Rick Palmer, M.Sc., R.P.Bio.
Casino Project Aquatics Discipline Lead

AECOM

Report

Western Copper Corporation

Casino Project: 2008 Environmental Studies Report

draft for discussion

AECOM

Western Copper Corporation

Casino Project: 2008 Environmental Studies Report

draft for discussion

Prepared by:

AECOM Canada Ltd.
275 – 3001 Wayburne Drive, Burnaby, BC, Canada V5G 4W3
T 604.438.5311 F 604.438.5587 www.aecom.com

Project Number:

80049 107402

Date:

March 2009

Statement of Qualifications and Limitations

© 2009 AECOM CANADA LTD. OR CLIENT (IF COPYRIGHT ASSIGNED TO CLIENT). ALL RIGHTS RESERVED. THIS DOCUMENT IS PROTECTED BY COPYRIGHT AND TRADE SECRET LAW AND MAY NOT BE REPRODUCED IN ANY MANNER, EXCEPT BY CLIENT FOR ITS OWN USE, OR WITH THE WRITTEN PERMISSION OF AECOM CANADA LTD. OR CLIENT (IF COPYRIGHT ASSIGNED TO CLIENT).

The attached Report (the "Report") has been prepared by AECOM Canada Ltd. ("Consultant") for the benefit of the client ("Client") in accordance with the agreement between Consultant and Client, including the scope of work detailed therein (the "Agreement").

The information, data, recommendations and conclusions contained in the Report:

- **are subject to the budgetary, time, scope, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the "Limitations");**
- **represent Consultants' professional judgement in light of the Limitations and industry standards for the preparation of similar reports;**
- **may be based on information provided to Consultant which has not been independently verified;**
- **have not been updated since the date of issuance of the Report and their accuracy is limited to the time period and circumstances in which they were collected, processed, made or issued;**
- **must be read as a whole and sections thereof should not be read out of such context;**
- **were prepared for the specific purposes described in the Report and the Agreement;**
- **in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time.**

Unless expressly stated to the contrary in the Report or the Agreement, Consultant:

- **shall not be responsible for any events or circumstances that may have occurred since the date on which the Report was prepared or for any inaccuracies contained in information that was provided to Consultant;**
- **makes no representations whatsoever with respect to the Report or any part thereof, other than that the Report represents Consultant's professional judgement as described above, and is intended only for the specific purpose described in the Report and the Agreement;**
- **in the case of subsurface, environmental or geotechnical conditions, is not responsible for variability in such conditions geographically or over time.**

Except as required by law or otherwise agreed by Consultant and Client, the Report:

- **is to be treated as confidential;**
- **may not be used or relied upon by third parties.**

Any use of this Report is subject to this Statement of Qualifications and Limitations. Any damages arising from improper use of the Report or parts thereof shall be borne by the party making such use.

This Statement of Qualifications and Limitations is attached to and forms part of the Report.

AECOM
275 – 3001 Wayburne Drive, Burnaby, BC, Canada V5G 4W3
T 604.438.5311 F 604.438.5587 www.aecom.com

March 25, 2009 Project Number: 80049 107402

Paul West-Sells
Executive Vice President, Corporate Development
Western Copper Corporation
2050-1111 West Georgia Street
Vancouver, BC V6E 4M3

draft for discussion

Dear Dr. West-Sells:

Re: Casino Project: 2008 Environmental Studies Report

AECOM is pleased to submit the attached report describing the studies conducted in 2008 on the atmospheric, aquatic and terrestrial environments of the Casino Project area. If there are any questions or comments on this report, then please contact the undersigned. Thank you for the opportunity to work with you on this project.

Sincerely,
AECOM Canada Ltd.

Rick Palmer, B.Sc., R.P.Bio.
Senior Aquatic Biologist
Rick.Palmer@aecom.com

RP:gc

Distribution List

# of Copies	Association / Company Name	PDF	Hard Copy
	Western Copper Corporation		
	AECOM		

Revision Log

Revision #	Revised By	Date	Issue / Revision Description

Executive Summary

This report describes the studies conducted in 2008 on the atmospheric, aquatic and terrestrial environments of the Casino Project area. The Casino Project is a proposed porphyry copper-gold-molybdenum mine located at latitude 62° 44'N and longitude 138° 50'W in west-central Yukon, 300 km northwest of the territorial capital of Whitehorse.

On October 3, 2008, the Casino meteorological station was installed on Patton Hill at an elevation of 1,203 m above sea level. The station consists of a 10 m-high, free-standing tower equipped with instrumentation, datalogger, and logger enclosure. It records wind speed and direction, rainfall, air temperature, barometric pressure, relative humidity and snow depth and stores the records in a datalogger powered by a battery charged with a solar panel. The datalogger is equipped with a satellite modem for remotely accessing the data.

Surveys of the aquatic environment were made on May 9, May 20-24, July 7-11, September 9-13 and October 9-11. The objectives were to measure stream flows, to sample water quality, stream sediment quality, periphyton communities, benthic invertebrate communities and fish communities, and to describe fish habitat.

In May 2008, dataloggers were installed at six hydrometric stations to measure water surface elevation (from which stream flows were calculated) and water temperature. A seventh station was added in October. Those data were downloaded on subsequent trips in July, September and October. Stations were winterized in October. In general, manual measurements of discharge and stage were conducted at medium to high flows. Analysis showed fair to strong correlations of discharge and stage. Reconstruction of the hydrographs showed two large peaks of discharge at all stations that were assumed to be initiated by a regional precipitation event. Historic discharge data for 1993 and 1994 were compared to the 2008 flow data at three sites.

A total of 19 sites were chosen for water quality sampling. Water samples were collected from each site in May, July and September and analyzed for the full suite of physical parameters, anions, nutrients and total and dissolved metals. Exceedances of the Canadian Council of Ministers of the Environment (CCME) guidelines for protection of freshwater aquatic life were observed for nine parameters. The number of exceedances was highest for cadmium, copper and aluminum and least for cyanide. Exceedances were most numerous in May, similar between July and September and least numerous in October, indicating a seasonal trend most likely directly related to hydrological factors such as snow melt and stream flow.

Principal components analysis was used to identify the major spatial and temporal trends in water quality. The first component, WQ1, was positively correlated with 16 dissolved and total metals and negatively correlated with total and dissolved molybdenum, and was the geochemical signal of drainage from the adit of the lower camp into the upper reach of Casino Creek.

The second component, WQ2, was positively correlated with ten dissolved and total metals, sulphate, nitrite and ammonia and negatively correlated with pH, alkalinity, barium and nitrate. This “iron-pH” component

reflects the geochemical signature of the surficial geology of Proctor Gulch, the upper Casino Creek and Britannia Creek.

The third component, WQ3, was positively correlated with hardness, conductivity, Total Dissolved Solids (TDS), and 13 total and dissolved metals. These parameters typically reflect the influence of groundwater flows.

The fourth component, WQ4, was positively correlated with 12 dissolved and total metals, Total Suspended Solids (TSS) and Total Kjeldahl Nitrogen (TKN) and negatively correlated with dissolved and total silicon. The scores for this “vanadium-silicon” component were lowest for sites in Casino Creek and in upper Britannia Creek, and highest for sites in Dip Creek, Britannia Creek, Sunshine Creek and the Yukon River. Therefore, WQ4 represents a geochemical signal found at all sites except those in Casino Creek and upper Britannia Creek.

The fifth component, WQ5, was positively correlated with dissolved and total selenium and nickel and turbidity. The scores for this “selenium-nickel-turbidity” component were highest for sites in the Yukon River, hence WQ5 represents a geochemical signal associated with the Yukon River.

Sediment samples were collected from a sub-set of 12 stream sites in September and pH and total metal concentrations were measured. Exceedances of CCME sediment guidelines were identified for five total metals: arsenic, cadmium, copper, lead and zinc. All of those metals except arsenic were also observed to exceed CCME water quality guidelines at some stations on some dates. A PCA of sediment quality variables extracted three components that accounted for 87.7% of the explained variance. SQ1 was highly positively correlated with manganese, cadmium, cobalt, zinc, lead and antimony; SQ2 was highly positively correlated with vanadium, titanium, aluminum, tin, phosphorus, sodium and barium; and SQ3 was highly positively correlated with bismuth, silver and arsenic and highly negatively correlated with pH.

Five samples each of periphyton and benthic invertebrate communities were collected from seven stream sites in September. There were highly significant differences in mean periphyton density among sites with sites P8, P7 and P4 in Casino Creek having significantly higher mean density than other sites. There were no significant differences among sites in the Shannon-Weiner diversity index, but there were highly significant differences among sites in species richness because of higher richness for sites P8, P7 and P4 than for other sites.

Over 95% of the benthic organisms at each site belonged to eight taxa: the insect Orders of Diptera, Plecoptera, Ephemeroptera, Trichoptera, Prostigmata and Collembola plus the worms of Class Oligochaeta and Phylum Nematoda. There were statistically significant differences in mean density and diversity among sites.

Fish communities at 12 stream sites were sampled in July and September with minnow traps, electrofishers and angling. In addition, an aerial survey of Britannia and Canadian creeks was conducted on September 11 to search for Pacific salmon spawners (none were observed).

A total of 40 fish from two species – Arctic grayling (*Thymallus arcticus*) and slimy sculpin (*Cottus cognatus*) – were captured. Apart from one Arctic grayling caught by angling, all were captured by electrofishing. Only Arctic grayling were found in the Britannia Creek Watershed, but both Arctic grayling and slimy sculpin were found in Casino Creek and Dip Creek watersheds. Slimy sculpin made up the majority of the catch (81 to 86%) in those two watersheds, respectively.

Arctic grayling were absent from the study area in September, most likely due to late-summer outmigration in search of overwintering habitat. In contrast, the mean catch-per-unit-effort (CPUE) of slimy sculpin for Casino and Dip Creeks was not significantly different between July and September, indicating that slimy sculpin either did not outmigrate from Casino Creek until after mid-September.

Arctic grayling ranged in length from 173 to 300 mm and in age from two to siz years, indicating the presence of juvenile and adults but not young-of-the-year. Slimy sculpin ranged in length from 29 to 294 mm, indicating the presence of juveniles and adults.

Nine slimy sculpin were collected from Casino and Dip creeks in July and September and subjected to whole-body tissue metals analysis.

Reconnaissance surveys of the terrestrial environment were conducted on July 7-11 and September 8-11, 2008. The objectives were to provide sufficient preliminary information on soils and vegetation to plan a future air photograph interpretation study of vegetation communities, and to document wildlife presence and use of the various plant communities and habitats.

Aerial surveys of vegetation communities and wildlife were conducted in a helicopter that flew slowly at low altitudes. Aerial surveys were followed by ground surveys conducted on foot or with all terrain vehicles. Soil pits were dug, samples of vegetation were collected and animal sighting and signs (claw marks, paw prints, antlers, scat, etc.) were photographed and their GPS co-ordinates recorded.

The surveys showed that the study area is characterized by smooth, rolling topography with moderate to deeply incised valleys. Wildlife habitat consists of a variety of plant communities ranging from sparsely vegetated bare rock, large expanses of heath tundra, wet sedge meadows with tall riparian shrubland and treed slopes dominated by spruce, aspen, birch and willows. Open stands of black spruce and white spruce occur in valleys and lower slopes, with black spruce on wetter sites and white spruce on better drained sites. Willow, shrub birch, Labrador tea, mosses and lichens are principal understory species.

Fifteen species of mammals and ten species of birds were observed or heard during the surveys. Moose were observed along the Yukon River and along Casino and Dip creeks. The area being considered for the proposed Casino Project appears to be a preferred moose wintering area. Caribou were seen and caribou sign (e.g., pellets, shed antlers, trails, etc.) was found on ridge tops. Numerous wolf tracks and scats were observed along Dip Creek, suggesting the presence of a den site. Grizzly bears and black bears were observed and well-developed small mammal trails were observed in some spruce habitat.

Potential summer and winter range, lambing areas and escape terrain for sheep are limited within the survey area. No thinhorn sheep were observed along the Yukon River bank directly across from Britannia Creek.

Acknowledgements

The studies described in this report were carried out by the following AECOM staff:

- Project Management:
  - Rick Palmer, B.Sc., Senior Aquatic Biologist
- Hydrology:
  - Chad Davey, B.A., M.Sc., Environmental Scientist
  - Rolf Aslund, P.Eng., Senior Water Resources Engineer
- Surface Water Quality and Sediment Quality:
  - Kai Woloshyn, B.Sc., Environmental Scientist
  - May Quach, M.Env.Sci., CEPIT, Aquatic Ecologist
- Fish and Fish Habitat:
  - Jennifer Sarchuk, B.Sc., Biologist
  - Genevieve Martin, B.Sc., Environmental Biologist
  - Eric Cleveland, Fish. Wild. Tech., Environmental Technician
- Soils and Vegetation:
  - Sean Bennett, B.Sc., R.P.F., Terrestrial Ecologist
  - Kevin Lloyd, M.Sc., Senior Ecologist
- Wildlife and Wildlife Habitat:
  - Paul Fraser, B.Sc., P.Bio., Senior Wildlife Biologist
  - Laurence Turney, B.Sc., R.P.Bio., Senior Wildlife Ecologist

Climate and air quality was the responsibility of the following RWDI staff: Geoff Doerksen, M.Sc., Project Manager, and Kathy Preston.

Acronyms and Abbreviations

ANOVA	Analysis of variance
asl	above sea level
BC MELP	British Columbia Ministry of Environment, Lands and Parks
BC MOE	British Columbia Ministry of Environment
BC MOF	British Columbia Ministry of Forests
BC MWLAP	British Columbia Ministry of Water, Land and Air Protection
CABIN	Canadian Aquatic Biomonitoring Network
CCME	Canadian Council of Ministers of the Environment
CEAA	Canadian Environmental Assessment Agency
CO	Confined
CPUE	Catch-per-Unit-Effort
DFO	Fisheries and Oceans Canada
DOC	Dissolved Organic Carbon
EEM	Environmental Effects Monitoring
EN	Entrenched
EPT	Ephemeroptera-Plecoptera-Trichoptera
FC	Frequently confined
FES	Fraser Environmental Services Ltd.
FISS	Fisheries Information Summary System
GIF	Ground inspection plots
GPS	Global Positioning System
H’	Shannon-Weiner diversity index
HKP	Hallam Knight Piésold Ltd.
ICP	Inductively Coupled Argon Plasma Spectroscopy
ISQG	Interim Sediment Quality Guideline
K	Growth coefficient (von Bertalanffy parameter)
kPa	kilo Pascals
L_∞	Asymptotic length (von Bertalanffy parameter)
LSA	Local Study Area
LWD	Large Woody Debris
MMER	Metal Mining Effluent Regulations
µS	micro-Siemens
NA	Not applicable
NAN	Not a Number
NS	Not sampled
NTU	Nephelometric unit
NWRI	National Water Research Institute
OC	Occasionally confined
P	Probability of making a Type I error
PCA	Principal Component Analysis

Acronyms and Abbreviations (cont'd)

PEL	Probable Effects Level
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance/Quality Control
r^2	coefficient of determination
RDL	Reported Detection Limit
RPD	Relative Percent Difference
RSA	Regional Study Area
S	Taxonomic richness
SE	Standard error
t_0	age at which length is zero (von Bertalanffy parameter)
TDS	Total Dissolved Solids
TEM	Terrestrial Ecosystem Mapping
TIA	Tailings Impoundment Area
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
TSS	Total Suspended Solids
UC	Unconfined
U.S. EPA	United States Environmental Protection Agency

Table of Contents

page

Statement of Qualifications and Limitations
Letter of Transmittal
Distribution List
Executive Summary 1
Acknowledgments iv
Acronyms and Abbreviations v

1. Introduction 1

1.1 Overview 1
1.2 Project History 1
1.3 Historical Sources of Environmental Data 4
1.4 Study Areas 4
1.4.1 General 4
1.4.2 Atmospheric Environment 5
1.4.3 Aquatic Environment 5
1.4.4 Terrestrial Environment 8
1.5 Study Objectives 8

2. Methods 12

2.1 Atmospheric Environment 12
2.1.1 Location and Setup of Meteorological Station 12
2.1.2 Quality Assurance/Quality Control (QA/QC) 12
2.2 Aquatic Environment 14
2.2.1 Dates and Locations of Sampling and Surveying 14
2.2.1.1 General 14
2.2.1.2 Hydrology 15
2.2.1.3 Water Quality 17
2.2.1.4 Sediment Quality 18
2.2.1.5 Periphyton and Benthic Invertebrates 18
2.2.1.6 Fish Communities 19
2.2.1.7 Fish Habitat 21
2.2.2 Sample Collection 22
2.2.2.1 Hydrology 22
2.2.2.2 Water Quality 22
2.2.2.3 Sediment Quality 24
2.2.2.4 Periphyton 24
2.2.2.5 Benthic Invertebrates 25
2.2.2.6 Fish Community 25
2.2.2.7 Fish Tissue Metals Concentrations 26
2.2.2.8 Fish Habitat 27
2.2.3 QA/QC 28

2.2.3.1 Water Quality 28
2.2.3.2 Sediment Quality 30
2.2.3.3 Periphyton and Benthos 30
2.2.3.4 Fish and Fish Habitat 31
2.2.4 Data Analysis 31
2.2.4.1 Hydrology 31
2.2.4.2 Water Quality 32
2.2.4.3 Sediment Quality 32
2.2.4.4 Periphyton and Benthos 33
2.2.4.5 Fish and Fish Habitat 33
2.3 Terrestrial Environment 34
3. Results and Discussion 35
3.1 Atmospheric Environment 35
3.2 Aquatic Environment 35
3.2.1 Hydrology 35
3.2.1.1 Stage-Discharge Rating Curves 35
3.2.1.2 Hydrographs 40
3.2.1.3 Historic Flow Data 47
3.2.2 Water Quality 47
3.2.2.1 Statistical Summary 47
3.2.2.2 Exceedances of Water Quality Guidelines 53
3.2.2.3 Principal Component Analysis 54
3.2.3 Sediment Quality 66
3.2.3.1 Exceedances of Sediment Quality Guidelines 66
3.2.3.2 Principal Component Analysis 66
3.2.4 Periphyton 69
3.2.5 Benthic Invertebrates 72
3.2.6 Fish Community 75
3.2.6.1 Catch, Effort and CPUE 75
3.2.6.2 Size, Age and Growth 79
3.2.6.3 Tissue Metals Concentrations 84
3.2.6.4 Salmon Spawning Survey 86
3.2.7 Fish Habitat 86
3.2.7.1 General 86
3.2.7.2 Britannia Creek Watershed 86
3.2.7.3 Casino Creek Watershed 91
3.2.7.4 Dip Creek 95
3.3 Terrestrial Environment 97
3.3.1 Soils and Vegetation 97
3.3.2 Wildlife Observations 100
3.3.2.1 General 100
3.3.2.2 July 7 to 11 Survey 101
3.3.2.3 September 8 to 11 Survey 101
4. References 102

List of Figures

Figure 1. Aquatic Regional Study Area in Relation to the Yukon River 2
Figure 2. Proposed Casino Mine Site Layout..... 3
Figure 3. Atmospheric Local Study Area..... 6
Figure 4. Aquatic Regional Study Area with Sampling Sites..... 7
Figure 5. Terrestrial LSA with Wildlife Observations and Vegetation Plots..... 9
Figure 6a. Terrestrial LSA, Access Road and Areas of Interest for Thinhorn Sheep and Raptors 10
Figure 7. Stage-Discharge Rating Curve for Site W1, Britannia Creek, Casino Project, 2008 36
Figure 8. Stage-Discharge Rating Curve for Site W3, Canadian Creek, Casino Project, 2008 37
Figure 9. Stage-Discharge Rating Curve for Site W4, Casino Creek, Casino Project, 2008 38
Figure 10. Stage-Discharge Rating Curve for Site W9, Dip Creek, Casino Project, 2008 38
Figure 11. Stage-Discharge Rating Curve for Site W11, Casino Creek, Casino Project, 2008 39
Figure 12. Stage-Discharge Rating Curve for Site W14, Britannia Creek, Casino Project, 2008 40
Figure 13. Hydrograph for Station W1, Britannia Creek, Casino Project, 2008 41
Figure 14. Hydrograph for Station W3, Canadian Creek, Casino Project, 2008 42
Figure 15. Hydrograph for Station W4, Casino Creek, Casino Project, 2008 43
Figure 16. Hydrograph for Station W9, Dip Creek, Casino Project, 2008 44
Figure 17. Hydrograph for Station W11, Casino Creek, Casino Project, 2008 45
Figure 18. Hydrograph for Station W14, Britannia Creek, Casino Project, 2008 46
Figure 19. Hydrograph for Station W1, Britannia Creek, Casino Project, 1993-1994 48
Figure 20. Hydrograph for Station W3, Canadian Creek, Casino Project, 1993-1994..... 49
Figure 21. Hydrograph for Station W4, Casino Creek, Casino Project, 1993-1994 50
Figure 22. Water Quality Exceedances of CCME Guidelines, Casino Project, 2008..... 54
Figure 23. Plot of Mean WQ1 Scores on Sampling Site, Casino Project, 2008..... 57
Figure 24. Plot of WQ1 Scores on Sampling Date, Yukon River and Sunshine Creek, Casino Project, 2008..... 58
Figure 25. Plot of WQ1 Scores on Sampling Date, Britannia Creek Watershed, Casino Project, 2008 59
Figure 26. Plot of WQ1 Scores on Sampling Date, Casino Creek Watershed, Casino Project, 2008 59
Figure 27. Plot of WQ1 Scores on Sampling Date, Dip Creek Watershed, Casino Project, 2008 60
Figure 28. Plot of Mean WQ2 Scores on Sampling Site, Casino Project, 2008..... 60
Figure 29. Plot of WQ2 Scores on Sampling Date, Yukon River and Sunshine Creek, Casino Project, 2008..... 61
Figure 30. Plot of WQ2 Scores on Sampling Date, Britannia Creek Watershed, Casino Project, 2008 62
Figure 31. Plot of WQ2 Scores on Sampling Date, Casino Creek Watershed, Casino Project, 2008 62
Figure 32. Plot of WQ2 Scores on Sampling Date, Dip Creek Watershed, Casino Project, 2008 63
Figure 33. Plot of Mean WQ3 Scores on Sampling Site, Casino Project, 2008..... 64

Figure 34. Plot of Mean WQ4 Scores on Sampling Site, Casino Project, 2008 65
Figure 35. Plot of Mean WQ5 Scores on Sampling Site, Casino Project, 2008 65
Figure 36. Plot of SQ1 Scores on Sampling Site 67
Figure 37. Plot of SQ2 Scores on Sampling Site 68
Figure 38. Plot of SQ3 Scores on Sampling Site 68
Figure 39. Mean Density of Periphyton by Site, Casino Project, 2008 69
Figure 40. Mean Taxonomic Richness of Periphyton Communities, Casino Project, 2008 71
Figure 41. Mean Shannon-Wiener Diversity Index of Periphyton Communities, Casino Project, 2008 72
Figure 42. Mean Density of Benthic Invertebrates by Site, Casino Project, 2008 73
Figure 43. Mean Taxonomic Richness of Benthic Invertebrate Communities, Casino Project, 2008 74
Figure 44. Mean Total EPT of Benthic Invertebrate Communities, Casino Project, 2008 75
Figure 45. Mean Shannon-Weiner Index of Diversity of Benthic Invertebrate Communities, Casino Project, 2008 75
Figure 46. Electrofishing CPUE, Arctic Grayling, Casino Project, 2008 78
Figure 47. Electrofishing CPUE, Slimy Sculpin, Casino Project, 2008 78
Figure 48. Length Frequencies of Arctic Grayling and Slimy Sculpin, Casino Project, 2008 80
Figure 49. Weight-length Regressions for Arctic Grayling and Slimy Sculpin, Casino Project, 2008 81
Figure 50. Age Frequency Distribution, Arctic Grayling, Casino Project, 2008 82
Figure 51. Length-Age Plot, Arctic Grayling, Casino Project, 2008 82
Figure 52. Length-Age Relationship, Arctic Grayling, Britannia Watershed, 1993-1994 and 2008 83
Figure 53. Length-Age Relationship, Arctic Grayling, Casino Watershed, 1993-1994 and 2008 83
Figure 54. Plot of PC2 Scores on PC1 Scores for Slimy Sculpin Tissue Metal Samples 86

List of Tables

Table 1. Sampling Trips, Aquatic Environment, Casino Project, 2008 14
Table 2. Summary of Hydrometric Stations and Datalogger Installation Dates, Casino Project, 2008 15
Table 3. Summary of Water Quality Sampling Sites, Casino Project, 2008 17
Table 4. Summary of Benthos and Periphyton Sampling Sites and Dates, Casino Project, 2008 19
Table 5. Summary of Fish and Fish Habitat Sampling Sites and Dates, Casino Project, 2008 20
Table 6. Co-ordinates of Electrofishing Upstream and Downstream, Minnow Trapping and Angling, Casino Project, 2008 21
Table 7. Locations of Fish Habitat Surveys, September 11-12, 2008 22
Table 8. Water Quality Parameters and Detection Limits 23
Table 9. Sediment Quality Parameters and Detection Limits 24
Table 10. Fish Tissue Metals and Detection Limits 27
Table 11. RPD Analysis of Replicate Water Quality Samples, Casino Project, 2008 29

Table 12. Summary of Manual Discharges and 'z' for Hydrometric Stations 36
Table 13. Water Quality Summary Statistics, Casino Creek Watershed, 2008 51
Table 14. Water Quality Summary Statistics, Britannia Creek Watershed, 2008 52
Table 15. Water Quality Parameters Exceeding CCME Guidelines, Casino Project, 2008 53
Table 16. Correlations of Water Quality Parameters with Principal Components 55
Table 17. Sediment Quality Parameters Exceeding CCME Guidelines, Casino Project, 2008 66
Table 18. Correlations of Sediment Quality Variables with Principal Components 67
Table 19. Percentage Composition of Periphyton Communities, Casino Project, 2008 70
Table 20. Percentage Composition of Benthic Invertebrate Communities, Casino Project, 2008 73
Table 21. Fish Catch, Casino Project, 2008 77
Table 22. Fish Species in the Aquatics Local Study Area, Casino Project, 1993 to 2008 79
Table 23. Mean Size and Age of Fish, Casino Project, 2008 80
Table 24. Mean Whole-Body Metal Concentrations, Slimy Sculpin, Casino Project, 2008 84
Table 25. Correlations of Principal Components with Slimy Sculpin Tissue Metal Concentrations 85
Table 26. Common and Scientific Names of Wildlife Observed at the Casino Project Area, 2008 100

List of Photos

Photo 1. Casino meteorological monitoring station equipped with (A) sonic ranger, (B) relative humidity and temperature probe, (C) solar panel, (D) datalogger enclosure, (E) satellite antenna and (F) rain gauge 13
Photo 2. Lower Reach of Britannia Creek Looking Upstream, September 11, 2008 87
Photo 3. Upper Reach of Britannia Creek Looking Upstream, September 11, 2008 88
Photo 4. Canadian Creek Above the Confluence with Britannia Creek (Site F03) Looking Upstream, July 8, 2008 88
Photo 5. Lower Reach of Canadian Creek Looking Upstream, September 11, 2008 89
Photo 6. Lower Reach of Canadian Creek (F04) Looking Downstream, July 8, 2008 90
Photo 7. Reach 2 of Canadian Creek (Cascade Pools) Looking Upstream, September 11, 2008 90
Photo 8. Upper Reach (number 3) of Canadian Creek Looking Upstream, September 11, 2008 91
Photo 9. Upper Reach (number 2) of Casino Creek Looking Upstream, September 12, 2008 92
Photo 10. Lower Reach (number 1) of Casino Creek Looking Downstream, September 12, 2008 92
Photo 11. Reach 1 of Meloy Creek Looking Upstream, September 12, 2008 93
Photo 12. Upper Reach of Brynelsen Creek Looking Upstream, September 12, 2008 94
Photo 13. Lower Reach of Brynelsen Creek Looking Upstream, September 12, 2008 94
Photo 14. Upper Reach of Austin Creek Looking Upstream, September 12, 2008 95
Photo 15. Lower Reach of Austin Creek Looking Upstream, September 12, 2008 96
Photo 16. Reach of Dip Creek Enclosing Site F14 Looking Downstream, September 12, 2008 96
Photo 17. Alpine Habitat, Casino Project, 2008 97
Photo 18. Felsenmeer Habitat (Exposed Broken Rock), Casino Project, 2008 98

Photo 19. Aspen Forest Habitat, Casino Project, 2008 98
Photo 20. Floodplain Habitat, Casino Project, 2008 99
Photo 21. Island Habitat, Yukon River, Casino Project, 2008 99
Photo 22. Mixedwood Forest Habitat, Casino Project, 2008 100

Appendices

A. Atmospheric Environment
- A1. Casino Mine – Methodology Report for Installation of Meteorological Station

B. Aquatic Environment
- B1. Stream Stage-Discharge Data, Casino Project, 2008
- B2. Surface Water Quality Data, Casino Project, May 2008
- B3. Surface Water Quality Data, Casino Project, July 2008
- B4. Surface Water Quality Data, Casino Project, September 2008
- B5. Surface Water Quality Data, Casino Project, October 2008
- B6. Surface Water Quality Replicate Data, Casino Project, 2008
- B7. Sediment Quality Data, Casino Project, September 2008
- B8. Periphyton Taxonomy, Casino Project, September 2008
- B9. Benthic Invertebrate Taxonomy, Casino Project, September 2008
- B10. FISS Reports for Watersheds of the Aquatic Regional Study Area of the Casino Project
- B11. Minnow Trapping Catch, Effort and CPUE, Casino Project, 2008
- B12. Electrofishing Effort, Catch and CPUE, Casino Project, 2008
- B13. Angling Catch, Casino Project, 2008
- B14. Fish Biological Characteristics, Casino Project, 2008
- B15. Fish Tissue Metal Concentrations, Casino Project, 2008
- B16. Fish Habitat Data, Casino Project, July 2008
- B17. Fish Habitat Data, Casino Project, September 2008

C. Terrestrial Environment
- C1. Ecosystem Classification Data, Casino Project, July 2008
- C2. Ecosystem Classification Data, Casino Project, September 2008
- C3. Wildlife Survey Data, Casino Project, 2008

1. Introduction

1.1 Overview

This report describes the studies conducted in 2008 on the atmospheric, aquatic and terrestrial environments of the Casino Project area. Studies on hydrogeology (AECOM in preparation) and geochemistry (Lorax 2009) are reported separately. The purpose of these studies was to characterize the pre-development environment in support of the permitting process for the Casino Project.

The Casino Project is a proposed porphyry copper-gold-molybdenum mine located at latitude 62°44'N and longitude 138°50'W in west-central Yukon, 300 km northwest of the territorial capital of Whitehorse. Figure 1 shows the location of the Casino Project, surrounded by the aquatic Regional Study Area (RSA), in relation to the Yukon River – to which all of the streams in the Casino Project area eventually discharge.

In August 2008, a pre-feasibility study of the Casino Project was completed (M3 Engineering 2008). It envisioned a conventional truck-shovel, open pit mine. Waste rock will be stored in three waste rock dumps located south and east of the open pit (Figure 2). Tailings, process water, treated sewage effluent, leachate from the waste rock dumps and surface runoff from the mine site will be stored in a Tailings Impoundment Area (TIA) located in the headwaters of Casino Creek south of the waste rock dumps. The TIA is intended to be a zero discharge operation, hence makeup water will be pumped to the TIA through a pipeline from a site on the Yukon River approximately 17 km to the north. A 187 km-long unpaved access road (see Figures 6a and 6b) will be built from the Alaskan Highway at a point about 48 km northwest of Burwash Landing out to the mine site. It will be used to bring in equipment, supplies and fuel and to truck out metal concentrate.

1.2 Project History

The first known recording of a lode mineral claim in the area was in 1917. Discovery of silverlead veins in the 1930's led to further exploration that eventually led to the discovery in 1969 of the large copper and molybdenum porphyry deposit on Patton Hill. Over the next 23 years, various parties including Brameda Resources, Quintana Minerals, Teck Corporation and Archer, Cathro and Associates Ltd. acquired the property and did more drilling. In 1992, Pacific Sentinel Gold Corp. acquired the property and ran a major drilling program from 1992 to 1995. In addition, they performed a considerable amount of metallurgical, geotechnical and environmental work and completed a scoping study in 1995. Soon thereafter, First Trimark Resources and CRS Copper Resources obtained the property. In 2004, the two firms combined to form Lumina Copper Corporation and in November 2006 Western Copper Corporation acquired Lumina Copper Corporation and the Casino property.

©2009 AECOM Canada Ltd. All Rights Reserved.
This document is protected by copyright law and may not be used, reproduced or modified in any manner or for any purpose except with the written permission of AECOM Canada Ltd. ("AECOM") or a party to which its copyright has been assigned. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses, reproduces, modifies, or relies on this document without AECOM's express written consent.

NTDB base data, Natural Resources Canada (1:50,000)
All other data, AECOM, 2009

N
W E
S

0 5 10
Kilometers

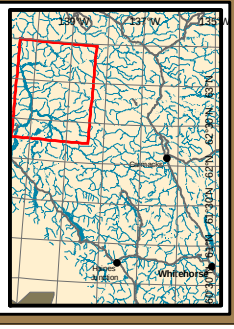
UTM Zone 7N, NAD 83
1:600,000

Legend

- Aquatic Regional Study Area
- Access Road
- Watercourse
- Waterbody

Topography

- Contour (Index 1000 ft)



Western Copper Corporation

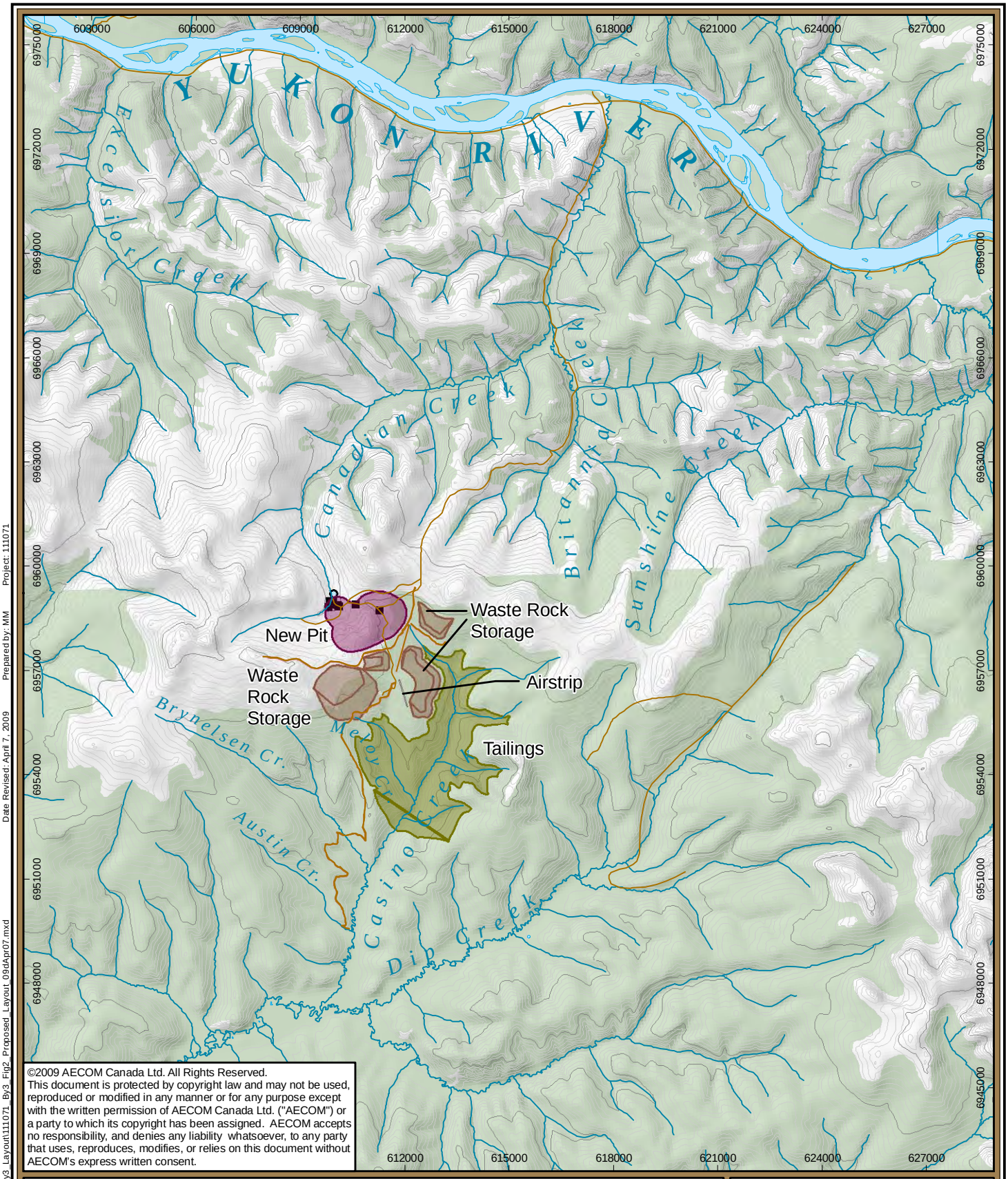
Aquatic Regional Study Area in Relation to the Yukon River

March 2009

AECOM

Figure 1

Map Document: E:\GIS\GIS_proj\Y2009\107402_Casino\By1_Aquatics\107402_By1_Fig1_RSA_and_Yukon_09oMar04.mxd Prepared by: MM Project: 107402


609000
606000
609000
612000
615000
618000
621000
624000
627000
6975000
6972000
6969000
6966000
6963000
6960000
6957000
6954000
6951000
6948000
6945000
YUKON RIVER
Excelsior Creek
Canadian Creek
Britannia Creek
Sunshine Creek
Waste Rock Storage
New Pit
Waste Rock Storage
Airstrip
Tailings
Brynelsen Cr.
Austin Cr.
Melody Creek
Casino Creek
Dip Creek
©2009 AECOM Canada Ltd. All Rights Reserved.
This document is protected by copyright law and may not be used, reproduced or modified in any manner or for any purpose except with the written permission of AECOM Canada Ltd. ("AECOM") or a party to which its copyright has been assigned. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses, reproduces, modifies, or relies on this document without AECOM's express written consent.
NTDB base data, Natural Resources Canada (1:50,000)
All other data, AECOM, 2008
N
W
E
S
0 1 2 3
Kilometers
UTM Zone 7N, NAD 83
1:150,000
Legend
Access Road
Watercourse
Waterbody
Topography
Contour (Index 1000 ft)
Contour (Interm. 100 ft)
overview map
Whitehorse
Western Copper Corporation
Proposed Casino Mine Site Layout
April 2009
AECOM
Figure 2
File Location: E:\GIS\GIS_proj\Y2009\111071_Casino\By3_Layout\111071_By3_Fig2_Proposed_Layout_09dApr07.mxd
Date Revised: April 7, 2009
Prepared by: MM
Project: 111071

1.3 Historical Sources of Environmental Data

In 1997, Hallam Knight Piésold Ltd. (HKP) completed a data report for Pacific Sentinel Gold Corp. summarizing the results of environmental baseline studies conducted from 1993 to 1995 (Hallam Knight Piésold 1997). The report provided data on meteorology, hydrology, surface water quality, groundwater quality, stream sediment quality, periphyton, benthic invertebrates, fish, soils, terrestrial vegetation and wildlife. Some of that data was compared to that collected in 2008 in this report.

Apart from Hallam Knight Piésold (1997), there are limited data available on the aquatic environment of the Casino area. Fisheries and Oceans Canada (DFO) has conducted surveys of fish and fish habitat in watersheds in the area, including the reaches of the Yukon River adjacent to the Casino property and the lower reaches of Dip Creek and the Klotassin, Donjek and White rivers. These were conducted for the purposes of managing Pacific salmon fisheries in the Yukon River, and for classifying fish habitat in support of the Yukon Placer Authorization (Government of Canada 2000). The results of these surveys are reported in DFO's Fisheries Information Summary System (FISS) (Appendix B10). The sources of the information listed in the FISS reports are Hallam Knight Piésold (1997) and memoranda, letters, personal communications and other relevant information held in the files of DFO's Whitehorse office.

Fish and Wildlife Branch of Yukon Department of Environment has conducted surveys of wildlife in the Casino study area and along its proposed access routes. Some of that data has been published, e.g., Farnell *et al.* (1991), but most of the baseline information on the relative abundance, seasonal distribution, movement and habitat use of wildlife in the Project area has yet to be collated and published. Some Traditional Knowledge of the Project area is available. For example, the current management plan for the Klaza Caribou Herd was derived in part from Traditional Knowledge of behaviour and habitat use provided by the Little Salmon/Carmacks First Nation (Yukon Environment 2004).

1.4 Study Areas

1.4.1 General

Two types of study area were defined for each of the three environmental components: a Local Study Area (LSA) and a Regional Study Area (RSA). The Canadian Environmental Assessment Agency (CEAA) defines a LSA as:

> "The area within which local effects are assessed (i.e., within close proximity to the action where direct effects are anticipated)" (CEAA 2008)

The boundaries of LSAs are defined by topographic features such as watershed boundaries (for aquatics) and slope breaks (for vegetation and wildlife). The LSA is of a size that lends itself to sampling and mapping at high intensity. CEAA (2008) defines a RSA as:

> "The area within which cumulative effects are assessed (i.e., extending a distance from the project footprint in which both direct and indirect effects are anticipated to occur)."

In practice, the RSA encompasses the LSA plus a larger surrounding area that is of sufficient size to evaluate the potential severity of Project-specific effects in combination with other past, present and reasonably foreseeable effects. The RSA may also include reference sampling sites that will be used as controls to assess Project-related effects on the LSA during the operational and post-closure phases of the Project. The RSA is defined by ecological boundaries and it is of a size that lends itself to sampling and mapping at lower intensities than an LSA.

1.4.2 Atmospheric Environment

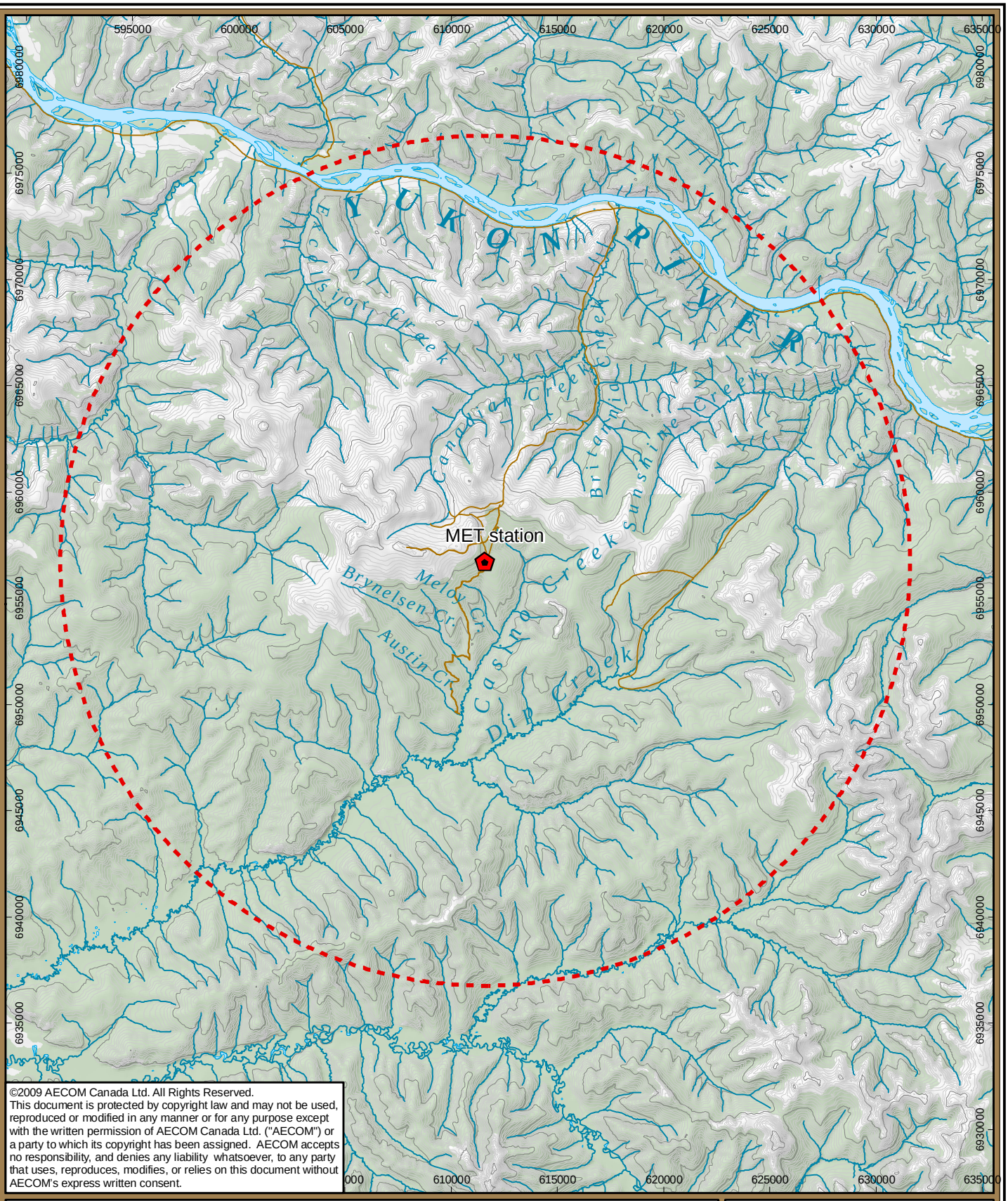
The atmospheric LSA was based on the assumption that the atmospheric conditions measured at the meteorological station at the mine site are representative of conditions up to 20 km away (Geoff Doerksen, RWDI, personal communication) (Figure 3). The atmospheric RSA has not yet been defined.

1.4.3 Aquatic Environment

The LSA for the aquatic environment was defined by the boundaries of the two watersheds surrounding the Casino deposit: the Britannia Creek Watershed to the north and the Casino Creek Watershed to the south (Figure 4). Most of the proposed mine infrastructure will be in the Casino Creek Watershed, but some (e.g., the northern corner of the open pit) will be in the Britannia Creek Watershed. The northern part of the LSA is drained by Britannia Creek and one of its tributaries, Canadian Creek. Britannia Creek flows into the Yukon River. The northern edge of the LSA includes a 2 km-long reach of the Yukon River. The southern part of the property is drained by Casino Creek which flows south to Dip Creek and thence to the Yukon River via the Klotassin, Donjek and White rivers. The southern edge of the LSA includes a 2 km-long reach of Dip Creek.

The aquatics RSA was defined as the LSA plus four adjacent areas:

- ***Dip Creek Watershed***. The headwaters of Dip Creek are not expected to be affected by Project activities, but the reaches of Dip Creek downstream of the confluence of Dip and Casino creeks will be affected by reduction in flows from Casino Creek caused by the impoundment of its headwaters. The effects of those flow reductions will decrease with downstream distance from the confluence of Dip and Casino creeks. One water quality site (W16) was placed approximately 11 km downstream of the confluence to monitor far-field effects.
- **Sunshine Creek Watershed**. This watershed, located to the east of the Britannia Creek Watershed, is not expected to be affected by Project activities. For that reason a reference water quality station – site W17 – was located on Sunshine Creek upstream of its confluence with the Yukon River.
- ***Excelsior Creek Watershed***. This watershed, located to the west of Britannia Creek Watershed, is also not expected to be affected by Project activities. It was originally intended to be the site of a reference water quality site, but that site (W17) was eventually moved to Sunshine Creek for logistical reasons. This watershed may serve as a location for a reference site in the future.



©2009 AECOM Canada Ltd. All Rights Reserved.
This document is protected by copyright law and may not be used, reproduced or modified in any manner or for any purpose except with the written permission of AECOM Canada Ltd. ("AECOM") or a party to which its copyright has been assigned. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses, reproduces, modifies, or relies on this document without AECOM's express written consent.

NTDB base data, Natural Resources Canada (1:50,000). All other data, AECOM, 2008

N
W E
S

0 2.5 5
Kilometers

UTM Zone 7N, NAD 83
1:250,000

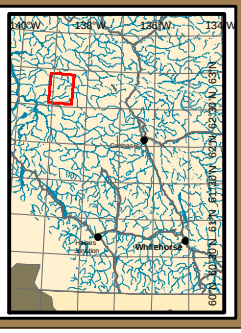
Legend

- MET station
- Atmospheric Local Study Area
- Access Road
- Watercourse
- Waterbody

Topography

- Contour (Index 1000 ft)
- Contour (Interm. 100 ft)

overview map



Western Copper Corporation

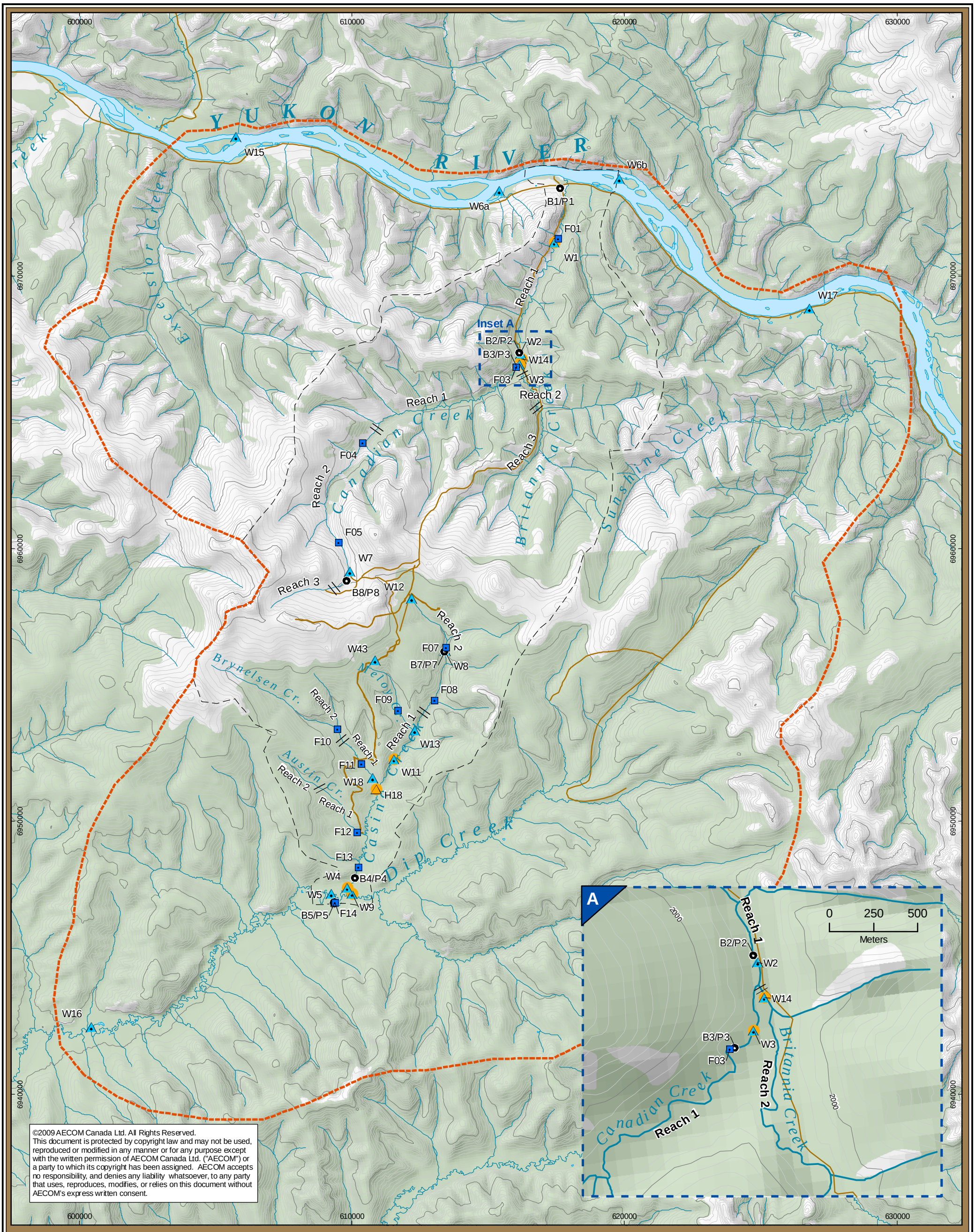
Atmospheric Local Study Area

April 2009

AECOM

Figure 3

File Location: E:\GIS\GIS_proj\Y2009\111071_Casino\By4_Atmospheric\111071_By4_Fig3_Atmospheric_LSA_09cApr07.mxd Date Revised: April 7, 2009 Prepared by: MM Project: 111071



©2009 AECOM Canada Ltd. All Rights Reserved.
This document is protected by copyright law and may not be used, reproduced or modified in any manner or for any purpose except with the written permission of AECOM Canada Ltd. ("AECOM") or a party to which its copyright has been assigned. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses, reproduces, modifies, or relies on this document without AECOM's express written consent.

Map Sources/Notes:
NTDB Basedata NRCAN (1:50 000)
Fish, hydrology and water quality sites, AECOM, 2008.
All other data, AECOM, 2008.

N
W E
S

0 1 2 3
Kilometres

UTM Zone 7N, NAD 83

1:130,000

Legend

Sampling Features

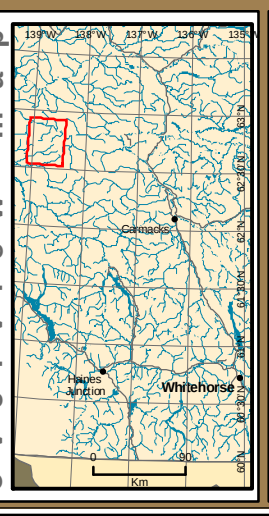
- Benthic Macroinvertebrate and Periphyton Sample Site
- Fish Sample Site
- Water Quality Site
- Hydrology Logger Location
- Water Quality Site and Hydrology Logger Location
- Reach Breaks

- Local Study Area
- Regional Study Area
- Access Road
- Watercourse
- Waterbody

Topography

- Contour (Index 1000 ft)
- Contour (Interm. 100 ft)

overview map



Western Copper Corporation

Casino

Aquatic Regional Study Area with Sampling Sites

June 2009

AECOM

Figure 4

File Location: E:\GIS\GIS_proj\Y2009\111071_Casino\By1_Aquatics\111071_By1_Fig4_WQ_Hyd_Fish_RLSA_09fJune08.mxd Date Revised: June 8, 2009 Prepared by: MM Project: 111071

- ***Yukon River***. This river will be the receiving environment for flows from Britannia Creek. Therefore, water quality sampling stations were placed upstream (W6b – a reference site) and downstream (W6a and W15) of the confluence of Britannia Creek and the Yukon River.

1.4.4 Terrestrial Environment

The terrestrial LSA was defined by the boundaries of the Casino Creek, Britannia Creek and Dip Creek watersheds (Figure 5). It is larger than the aquatics LSA but smaller than the aquatics RSA. The terrestrial RSA has not yet been defined. Figures 6a and 6b show the terrestrial LSA in relation to the proposed road route and the Wildlife Key Areas that have been identified by the Fish and Wildlife Branch of the Yukon Department of Environment.

1.5 Study Objectives

The overall objective of the 2008 environmental studies was to characterize the pre-development atmospheric, aquatic and terrestrial environments of the Casino Project area. The sampling strategy was to use, as much as was possible, the same sampling sites or areas that were monitored by Hallam Knight Piésold Ltd. from 1993 to 1995. This will develop further a multi-year database that will allow assessment of natural inter-annual variability.

The specific objective for the atmospheric studies was to install an automated meteorological station on Patton Hill that was capable of being remotely downloaded and that will record meteorological data continuously from the date of installation to the present. These measurements will provide the necessary observations for air quality modelling.

The specific objectives for the aquatic studies were the following:

- Install hydrometric stations on streams in the LSA that will continuously record stream flows and water temperatures.
- Develop stage-discharge curves for each hydrometric station from manual measurements of stream flow and staff gauge height collected over the open-water season.
- Sample stream water quality at sites in the LSA and RSA throughout the open-water season.
- Sample stream sediment quality at sites in the LSA once in 2008.
- Measure the density and taxonomic composition of the mid-summer periphyton communities in the LSA. Periphyton is the term given to the algal community that grows attached to stream substrates. It is the principal source of primary production for stream ecosystems and, because it is fixed to the substrate, it is useful for assessing mine effects on the aquatic environment.
- Measure the density and taxonomic composition of the stream benthic invertebrate communities in the LSA. Benthic invertebrates are a major source of prey for fish and, because they are attached to the substrate, are useful for assessing mine effects on the aquatic environment. Benthic invertebrates are a required component of the Environmental Effects Monitoring (EEM) guidelines of the Metal Mining Effluent Regulations (MMER) (Environment Canada 2002).

Site O1
- BC (x2)
- BS (x2)
- MD
- Veg Plot: 14 and 15

Site O2
- MD(x3)
- BS(x5)

Site O3
- BS(x3)
- BC(x2)
- RS
- H
- MD
- Veg Plot: 108, 109, and 110

Site O4
- MD(x8)
- GD

Site O5
- MD(x3)
- GD
- PC
- RS(x2)
- Veg Plot: 113

Site O6
- MD(x12)
- BS(x4)
- FS
- Bear ant Log
- SG
- RS(x3)
- M
- MA
- WS

Site O7
- GB
- BS(x3)
- CD(x5)
- MD

Site O8
- CD(x2)
- MD
- BS(x2)
- Veg Plot: 118 and 119

' 2008 Gartner Lee Limited All Rights Reserved. This document is protected by copyright law and may not me used, reproduced or modified in any manner or for any purpose except with the written permission of Gartner Lee Limited doing business as AECOM ("AECOM") or a party to which its copyright has been assigned. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses, reproduces, modifies, or relies on this document without AECOM's express written consent.

Map Sources/Notes:
NTDB Basedata NRCAN
Water Monitoring Locations, Gartner Lee Limited

N W E S

0 1 2 3 4 5
Kilometres

UTM Zone 7N, NAD 83

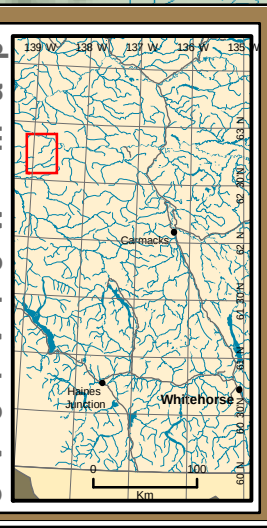
Scale 1:110,000
(when viewed in 11x17)

File Name: 111071_Wildlife_Vegetation_Observations_rh_6Mar09.mxd
Reviewed By:
Prepared By: RH
Date Issued: March 2009
Project Number: 111071-1.1.3

Legend
- Vegetation Plot

Wildlife
- BB - Black Bear
- BC - Bear Claw Marks
- BS - Bear Scat
- BV - Beaver
- CA - Caribou Antlers
- CB - Caribou
- CD - Caribou Droppings
- GB - Grizzly Bear
- GS - Ground Squirrel
- LX - Lynx
- M - Moose
- MA - Moose Antlers
- MD - Moose Droppings
- NBLB - N. Bog Lemming Burrow
- NH - Northern Harrier
- OW - N. Hawk Owl
- RP - Raptor Pellet
- RS - Red Squirrel
- W - Wolf
- WS - Wolf Scat

overview map



Western Copper Corporation

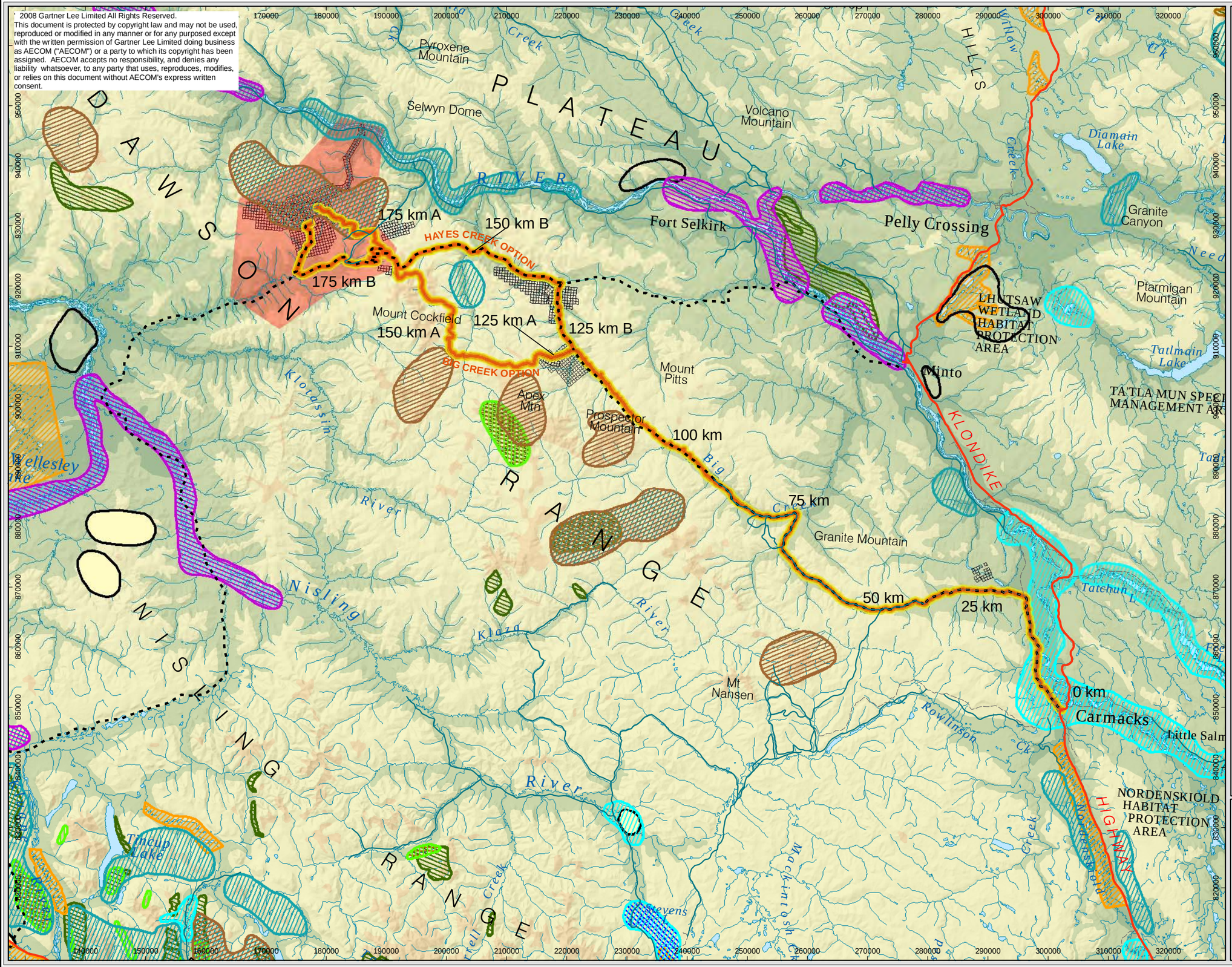
Casino

Terrestrial LSA with Wildlife Observations and Vegetation Plots

March 2009

AECOM

Figure 5



© 2008 Gartner Lee Limited All Rights Reserved.
This document is protected by copyright law and may not be used, reproduced or modified in any manner or for any purposed except with the written permission of Gartner Lee Limited doing business as AECOM ("AECOM") or a party to which its copyright has been assigned. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses, reproduces, modifies, or relies on this document without AECOM's express written consent.

LEGEND

Big Creek and Hayes Creek Buffer (metres)

250 | 500 | 750

L.S.A.

Mineral Claims

- Thinhorn Sheep (spring lambing)
- Thinhorn Sheep (early winter rut)
- Thinhorn Sheep (winter range)
- Thinhorn Sheep (migration corridor)
- Unspecified Raptor (summer nesting)
- Rough-legged Hawk (summer nesting)
- Merlin (summer nesting)
- Peregrine Falcon (summer nesting)
- Bald Eagle (summer nesting)
- Osprey (summer nesting)
- Gyrfalcon (summer nesting)
- Golden Eagle (summer nesting)
- Waterfowl (various seasons & functions)
- Sharp-tailed Grouse (all seasons & functions)

Elevation

- 0 - 1000
- 1001 - 2000
- 2001 - 3000
- 3001 - 4000
- 4001 - 5000
- 5001 - 6000
- 6001 - 7000
- 7001 - 8000
- 8001 - 9000

NTDB Basedata NRCAN

Km
0 5 10 15 20
1:600,000 UTM Zone 17N, NAD 83

Western Copper Corporation

Terrestrial LSA
Access Road and Areas of Interest for Sheep and Raptors

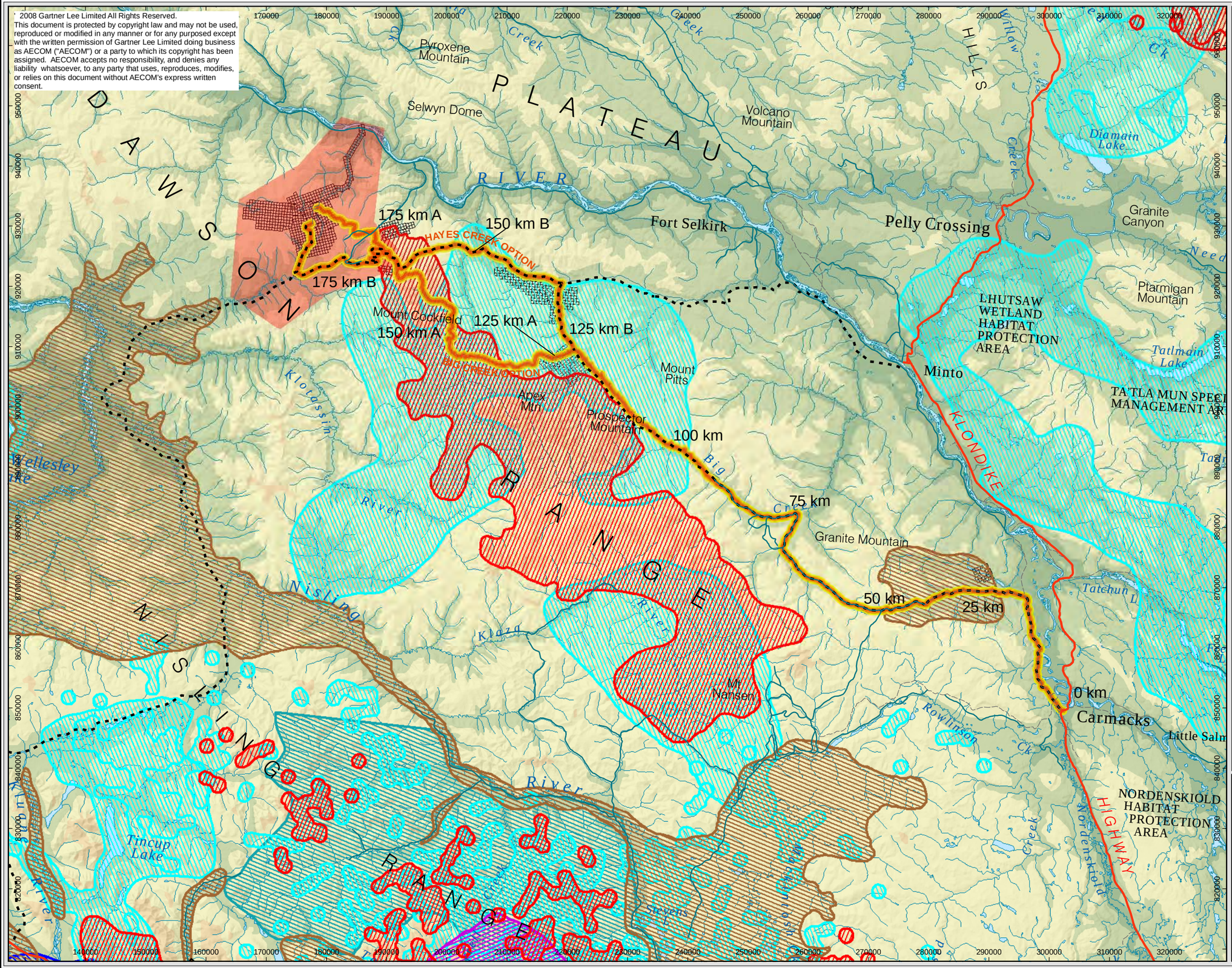
February 2009 - Project 111071 (1.1.3)

AECOM

Figure 6a

Map Document: (J:\Templates\11x17-Landscape_AECOM.mxd)
10/27/2008 -- 10:01:31 AM

' 2008 Gartner Lee Limited All Rights Reserved.
This document is protected by copyright law and may not be used, reproduced or modified in any manner or for any purposed except with the written permission of Gartner Lee Limited doing business as AECOM ("AECOM") or a party to which its copyright has been assigned. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses, reproduces, modifies, or relies on this document without AECOM's express written consent.



LEGEND

Big Creek and Hayes Creek Buffer (metres)

250 500 750

- L.S.A.
- Mineral Claims

- Woodland Caribou (fall rut - lsurvey data)
- Woodland Caribou (fall rut - local knowledge)
- Woodland Caribou (winter range - survey data)
- Woodland Caribou (winter range - local knowledge)
- Woodland Caribou (migration corridor)
- Moose (late winter range)
- Moose (all seasons & functions)

Elevation

- 0 - 1000
- 1001 - 2000
- 2001 - 3000
- 3001 - 4000
- 4001 - 5000
- 5001 - 6000
- 6001 - 7000
- 7001 - 8000
- 8001 - 9000

NTDB Basedata NRCAN
Km
0 5 10 15 20
1:600,000 UTM Zone 17N, NAD 83

Western Copper Corporation

Terrestrial LSA Access Road and Areas of Interest for Moose and Cariboo

February 2009 - Project 111071 (1.1.3)

AECOM

Figure 6b

Map Document: (J:\Templates\11x17-Landscape_AECOM.mxd)
10/27/2008 - 10:31:31 AM

- Identify the fish species present in the LSA, describe their spatial distributions and measure their relative abundance and biological characteristics. Fish are the principal predators of stream communities and are a required component of the EEM guidelines of the MMER.
- Measure the whole-body tissue metal concentrations of slimy sculpin (*Cottus cognatus*) from each of the two watersheds in the LSA. Slimy sculpin were chosen because they are a resident species, hence their tissue metal concentrations will reflect local background metal concentrations in water. Tissue metal concentrations are a required component of the EEM guidelines of the MMER.
- Measure the key physical characteristics of stream fish habitat in the LSA.

The specific objectives of the terrestrial ecosystem studies were to collect sufficient preliminary information on soils and vegetation to plan a future air photograph interpretation study of the vegetation communities of the terrestrial LSA and RSA, and to document wildlife presence and use of the various plant communities and habitats.

2. Methods

2.1 Atmospheric Environment

2.1.1 Location and Setup of Meteorological Station

The geomorphology of the Casino Project area – a ridge from which watersheds descend to the north and south – meant that the atmospheric characteristics of the study area could be adequately monitored with a single meteorological station installed near the top of the ridge. The Casino meteorological station was installed on Patton Hill on October 3, 2008, and has been recording data continuously since that day. The station is located at 62°43'27.837"N and 138°49'0.562"W (UTM co-ordinates of 611,609E and 6,956,775N) at an elevation of 1,203 m above sea level (asl) (Figure 3). Appendix A1 shows the letter report from RWDI Air Inc. that describes the station and its installation.

The station consists of a 10 m-high, free-standing tower equipped with instrumentation, datalogger, and logger enclosure (Photo 1). The station is sited in a transition zone between tree line and alpine with an unobstructed fetch of at least 100 m in all directions. The site is sparsely covered in low brush and trees that are approximately 10 m tall. The station has instrumentation capable of measuring wind speed and direction, rainfall, air temperature, barometric pressure, relative humidity and snow depth. Observations are recorded and stored by a datalogger, which is powered by a battery charged with a solar panel at the station. The datalogger is equipped with a satellite modem for remotely accessing the data.

2.1.2 Quality Assurance/Quality Control (QA/QC)

Because the meteorological station was installed late in 2008, too few data have been collected from that station to be presented and analyzed in this report. However, the data that are being collected will be processed according to the following QA/QC protocols.

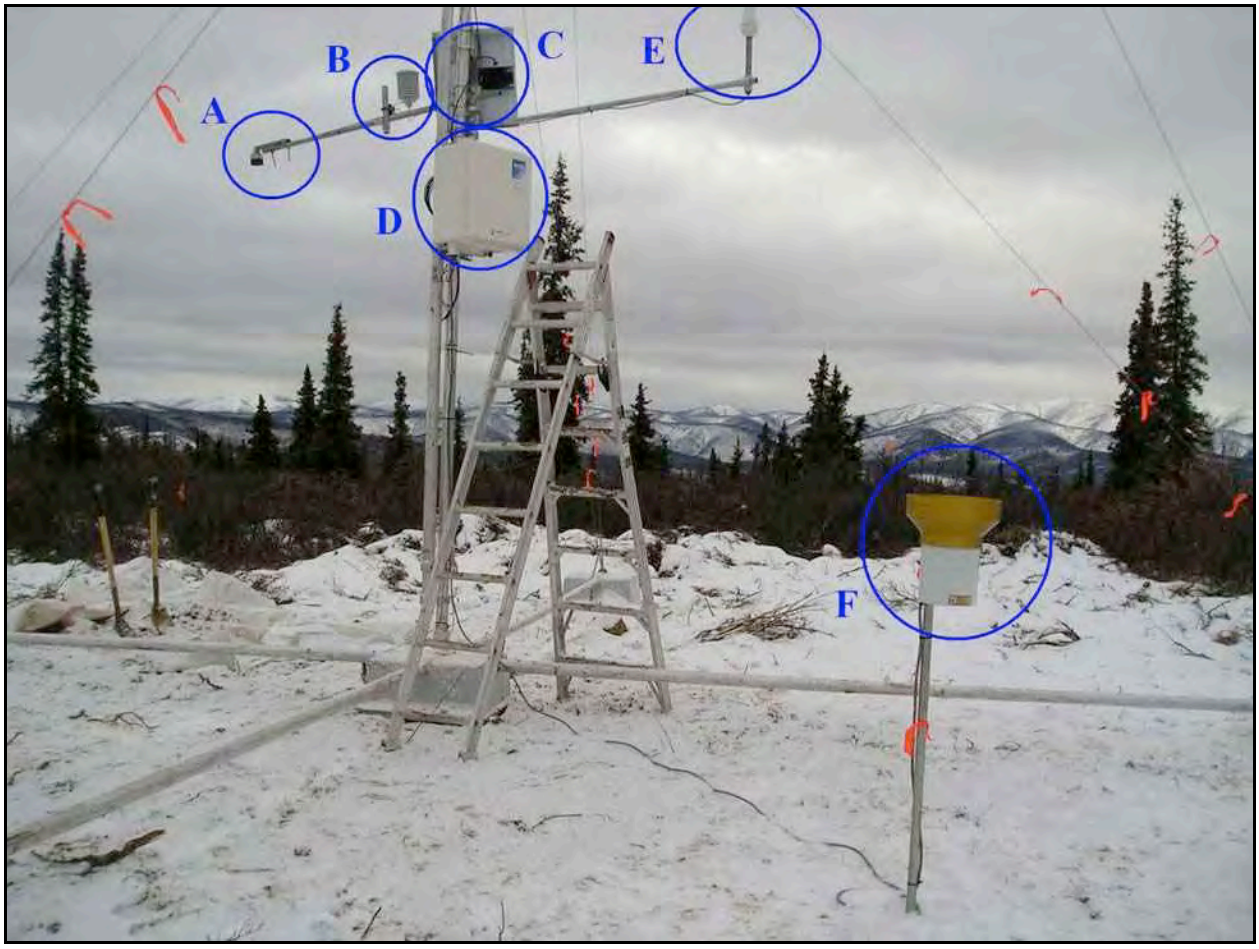


Photo 1. Casino meteorological monitoring station equipped with (A) sonic ranger, (B) relative humidity and temperature probe, (C) solar panel, (D) datalogger enclosure, (E) satellite antenna and (F) rain gauge

Three types of missing data are typically found in the datalogger of the meteorological station. The first is a missing timestamp or record for a particular averaging period. This occurs when the time series skips over a record or series of records entirely. Timestamps of missing periods are manually added to the final dataset. Values for each parameter are given a “Not a Number” (NAN) value for these periods. If missing periods persist or occur regularly, then appropriate action (e.g., send a field technician to the station) will be taken to investigate and resolve the issue.

The second type of missing data is a value for one or more parameters reported as NAN. This flag is typically given to invalid or erroneous data and is excluded in any analysis of data. If one or more parameters persistently shows NAN, then appropriate action (e.g., send a field technician to the station) will be taken to investigate and resolve the issue.

The third type of missing data is a value for one or more parameters that is reported as “0”. This may or may not be an erroneous value, depending on the parameter in question. It is not acceptable under any circumstances for barometric pressure, relative humidity and battery voltage. Values that are reported as zero for those variables will be replaced with NAN and are noted and documented in the final dataset.

Data are checked to see if they are within acceptable upper and lower limits by examining the range of values for each parameter. These limits does not reflect the instrument’s operational range, but they give the physical bounds in which the measurement makes sense. Any values outside the following limits will be considered to be erroneous and will be replaced with NAN:

- Wind speed (0 to 110 km/h);
- Wind direction (0 to 360°);
- Standard deviation of wind direction (0 to 100°);
- Air temperature (-50°C to 35°C);
- Barometric pressure (90 to 110 kPa);
- Relative humidity (0.1% to 100%);
- Rainfall (daily) (0 to 60 mm); and
- Battery voltage (10 to 15 Volts).

2.2 Aquatic Environment

2.2.1 Dates and Locations of Sampling and Surveying

2.2.1.1 General

The study design for the 2008 aquatics work was similar to the sampling design used in the 1993-1995 study by Hallam Knight Piésold. With a few exceptions, the same sampling locations were used and similar sampling techniques were employed. Five sampling trips were made from May to October (Table 1). For each trip, a fixed-wing aircraft was chartered from Alkan Air to fly from Whitehorse to the Casino property. While on the property, aquatic scientists travelled to sampling sites by helicopter (chartered from Capitol Helicopters), by all-terrain vehicles or by foot, depending on weather and trail conditions.

Table 1. Sampling Trips, Aquatic Environment, Casino Project, 2008

Date	Reconnaissance	Hydrology	Water Quality	Sediment Quality	Periphyton and Benthos	Fish and Fish Habitat
May 9	X	-	-	-	-	-
May 20-24	-	X	X	-	-	-
Jul 7-11	-	X	X	-	-	X
Sep 9-13	-	X	X	X	X	X
Oct 9-11	-	X	X	-	-	-

Dashes indicate no data were collected.

2.2.1.2 Hydrology

A total of seven hydrometric stations were installed in 2008. From May 21 to 23, dataloggers (Model 3001 Levelogger Gold, Solinst Corporation) were installed at six hydrometric stations: W1, W3, W4, W9, W11 and W14 (Table 2). This instrument uses a pressure transducer to measure water surface elevation and a thermometer to measure water temperature every hour. Pressure and temperature data were stored in the datalogger and were downloaded on subsequent trips in July, September and October. A barologger was installed at the airstrip to collect barometric air pressure (for barometric compensation for the hydrometric station loggers) and air temperature. On October 9, a seventh hydrometric station was added (H18) on Casino Creek.

Table 2. Summary of Hydrometric Stations and Datalogger Installation Dates, Casino Project, 2008

Watershed	Creek	Site	GPS Co-ordinates*			Dates	
			Easting	Northing		Installation	Winterization
Airstrip	-	-	612,244	6,957,050		May 22	-
Britannia Creek	Britannia	W1	617,439	6,971,241		May 22	Oct 10
	Canadian	W3**	616,141	6,966,789		May 23	Oct 11
	Britannia	W14	616,205	6,966,952		May 23	Oct 10
Casino Creek	Casino	W11	611,557	6,952,289		May 22	Oct 9
	Casino	H18	610,860	6,951,451		Oct 9	Oct 9
	Casino	W4	609,833	6,947,575		May 22	Oct 10
Dip Creek	Dip	W9**	610,018	6,947,352		May 22	Oct 10

**UTM Zone 7N, NAD 83.*

***reference site.*

Dashes indicate no data were available.

During the May field visit, the dataloggers were surveyed using a standard survey rod and level. The water level, the streambed, and the height of the datalogger in the water were determined at each logger station in relation to benchmarks (i.e., large spikes) installed on the creek bank. This allowed for water level measurements to be calculated relative to a fixed land-based benchmark.

Three of the six hydrometric stations were located in the Britannia Creek Watershed:

- W1 on the lower reaches of Britannia Creek;
- W3 on Canadian Creek upstream of the confluence of Canadian and Britannia creeks; and
- W14 on Britannia Creek upstream of its confluence with Canadian Creek.

Two stations were located in the Casino Creek Watershed:

- W11 installed in the upper reach of Casino Creek outside of the southern edge of the proposed TIA; and
- W4 installed on Casino Creek upstream of its confluence with Dip Creek.

One station was located in the Dip Creek Watershed – W9 on Dip Creek upstream of its confluence with Casino Creek.

On October 9, a seventh hydrometric station, H18, was installed in Casino Creek downstream of its confluence with Brynelsen Creek. This station was added to quantify the contribution of flow from Brynelsen Creek.

Two of the seven stations – W3 and W9 – are reference stations, which means they will not be affected by Project activities.

From October 9 to 11, the six dataloggers were winterized by covering each instrument in a latex balloon filled with glycol to prevent damage to the sensors when the surrounding water freezes during winter. Each datalogger was then installed inside a heavy duty, 10 cm-diameters plastic pipe that was partially buried in the stream substrate. Holes were drilled in the pipe to provide hydraulic connection between the stream and the datalogger. Pipes were secured to the stream bank with steel rods anchored by 2 m-long pieces of rebar. All dataloggers were attached with direct read cables for efficient data downloading.

Instantaneous stream flows were also measured manually at additional sites (e.g., W7, W8, W12, W13, W16 and W16 in May). Those sites are summarized in Section 2.2.1.3.

2.2.1.3 Water Quality

A total of 19 sites were chosen for water quality sampling of which six were the hydrometric stations installed in May 2008 (Table 3). Five sites were in the Britannia Creek Watershed:

- hydrometric stations W1, W3 and W14;
- W2 on Britannia Creek just downstream of the confluence of Canadian and Britannia creeks; and
- W7 located on upper Canadian Creek.

Table 3. Summary of Water Quality Sampling Sites, Casino Project, 2008

Watershed	Creek/River	Site	GPS Co-ordinates	
			Easting	Northing
Britannia Creek	Britannia	W2	616,158	6,967,156
	Canadian	W7	609,913	6,959,158
Casino Creek	Casino	W12	612,163	6,958,175
	Casino	W8	613,398	6,956,258
	Meloy	W43	610,823	6,955,906
	Meloy	W13	612,275	6,953,326
	Brynelsen	W18	610,893	6,951,180
Dip Creek	Dip	W9*	610,018	6,947,352
	Dip	W5	609,219	6,947,348
	Dip	W16	600,423	6,942,454
Sunshine Creek	Sunshine	W17*	626,775	6,968,802
Yukon River	Yukon	W6a	615,375	6,973,129
	Yukon	W6b*	619,781	6,973,576
	Yukon	W15	605,721	6,975,108

Dashes indicate no data were available.

Water quality sampling was also conducted at the six hydrometric stations listed in Table 2.

**reference site.*

Five sites were in the Casino Creek Watershed:

- hydrometric stations W11 and W4;
- W12 in Proctor Gulch, the uppermost reach of Casino Creek;
- W8 in the upper reach of Casino Creek upstream of the confluence of Meloy Creek;
- W43 on the adit discharge pipe of the lower camp (which discharges into upper Meloy Creek);
- W13 on Meloy Creek upstream of its confluence with Casino Creek; and
- W18 on Brynelsen Creek upstream of its confluence with Casino Creek.

Three sites were in the Dip Creek Watershed:

- hydrometric station W9;
- W5 on Dip Creek downstream of its confluence with Casino Creek; and
- W16 on Dip Creek 11 km west of site W5 – a far-field site.

One site – W17 – was on Sunshine Creek upstream of its confluence with the Yukon River.

Three sites were located on the Yukon River:

- W6a downstream from the outflow of Britannia Creek;
- W6b upstream of the outflow of Britannia Creek; and
- W15 upstream of the outflow of Excelsior Creek.

Of these 19 sites, three – W9, W17 and W6b – are reference sites, 15 sites are potentially affected by future mine activities, and one – W43 – has already been disturbed.

2.2.1.4 Sediment Quality

A total of 12 stream sites were sampled for sediment quality between September 9 and 10:

- five sites in the Britannia Creek Watershed (W1, W2, W3, W7 and W14);
- five sites in the Casino Creek Watershed (W4, W11, W12, W8 and W13); and
- two sites in the Dip Creek Watershed (W9 and W5).

Only W9 is a reference site. The co-ordinates of the sites are shown in Tables 2 and 3.

2.2.1.5 Periphyton and Benthic Invertebrates

Periphyton and benthic invertebrates were sampled from September 10 to 13. The two communities were sampled at that date because they were expected to have reached their maximum density and diversity after a summer of growth. Four sites were sampled in the Britannia Creek Watershed (Figure 4 and Table 4):

- B1/P1 (where “B” refers to benthos and “P” to periphyton) in lower Britannia Creek upstream of its confluence with the Yukon River;

- B2/P2 in Britannia Creek downstream of the confluence of Canadian and Britannia creeks;
- B3/P3 in Canadian Creek upstream of the confluence of Canadian and Britannia creeks; and
- B8/P8 at the head of Canadian Creek in an area that is proposed to become part of the open pit of the Casino Mine.

Table 4. Summary of Benthos and Periphyton Sampling Sites and Dates, Casino Project, 2008

Watershed	Creek	Site	GPS Co-ordinates		Date
			Easting	Northing	
Britannia Creek	Britannia	B1/P1	617,661	6,973,246	Sep 11
	Britannia	B2/P2	616,163	6,967,197	Sep 10
	Canadian	B3/P3	616,043	6,966,702	Sep 10
	Canadian	B8/P8	609,807	6,958,838	Sep 12
Casino Creek	Casino	B7/P7	613,396	6,956,247	Sep 10
	Casino	B4/P4	610,115	6,947,946	Sep 10
Dip Creek	Dip	B5/P5	609.363	6,947,024	Sep 10

Two sites were sampled in the Casino Creek Watershed – site B4/P4 located upstream of the confluence of Dip and Casino creeks, and site B7/P7 located at the head of Casino Creek in an area that is proposed to be covered by the Casino TIA.

One site were sampled in the Dip Creek Watershed – B5/P5 on Dip Creek, downstream of the confluence of Casino and Dip creeks.

None of these seven sites are reference sites – all are potentially affected by future mine activities.

2.2.1.6 Fish Communities

Fish communities were sampled from July 8 to 11 and from September 10 to 13. Sampling in late May was planned but was cancelled after reconnaissance on May 9 showed that most streams were too turbid to allow visual counts of Arctic grayling spawners or to allow electrofishing.

Four sites were sampled for fish in the Britannia Creek Watershed (Figure 4 and Tables 5 and 6):

- F01 (where “F” refers to fish) on lower Britannia Creek upstream of site B1/P1;
- F03 on lower Britannia Creek below the confluence of Canadian and Britannia creeks;
- F04 on Canadian creek approximately mid-way between sites F03 and F05; and
- F05 on upper Canadian Creek.

Sites F02 and F06 were Hallam Knight Piésold sites that were not sampled in 2008.

Seven sites were sampled for fish in the Casino Creek Watershed:

- F07 on upper Casino Creek downstream of the confluence of an unnamed tributary;
- F08 on upper Casino Creek approximately 2 km downstream of site F07 at the confluence of another unnamed tributary;
- F09 on Meloy Creek, a tributary of Casino Creek;
- F10 and F11 on Brynelsen Creek, another tributary to Casino Creek;
- F12 on Austin Creek upstream of its confluence with Casino Creek; and
- F13 on lower Casino Creek upstream of its confluence with Dip Creek.

One fish sampling site was located in the Dip Creek Watershed – site F14 on Dip Creek downstream of its confluence with Casino Creek.

There were no reference sites for fish in 2008 – all sites may potentially be affected by future mine activities. In particular, sites F07, F08 and F09 are located in an area of Casino Creek that is proposed to be covered by the TIA.

Table 5. Summary of Fish and Fish Habitat Sampling Sites and Dates, Casino Project, 2008

Watershed	Creek	Site	Electrofishing	Minnow Trapping	Angling	Fish Habitat Assessment
Britannia Creek	Britannia	F01	Jul 10	Jul 11	-	-
	Canadian	F03	Jul 8	-	-	Jul 8
	Canadian	F04	Jul 8	-	-	Jul 8
	Canadian	F05	Jul 9	Jul 11	-	-
Casino Creek	Casino	F07	Jul 9	Jul 11	-	Jul 9
	Casino	F08	Jul 9, Sep 12	Jul 11, Sep 12	Jul 11	Jul 9
	Meloy	F09	Jul 9	Jul 11	-	-
	Brynelsen	F10	Jul 9	-	-	-
	Brynelsen	F11	Jul 10, Sep 12	Sep 12	-	-
	Austin	F12	Jul 10	-	-	-
	Casino	F13	Jul 10	-	-	-
Dip Creek	Dip	F14	Sep 12	Jul 11, Sep 12	Jul 11	-

Dashes indicate no sampling at that site and date.

Stations F02 and F06 were not sampled in 2008.

Table 6. Co-ordinates of Electrofishing Upstream and Downstream, Minnow Trapping and Angling, Casino Project, 2008

Method	Site	GPS Co-ordinates	
		Easting	Northing
Electrofishing	F03-us	615,977	6,966,612
	F03-ds	616,015	6,966,696
	F04-us	610,252	6,963,764
	F04-ds	610,392	6,963,879
	F07-us	613,466	6,956,473
	F07-ds	613,449	6,956,383
	F08-us	613,044	6,954,528
	F08-ds	613,032	6,954,443
	F09-us	611,670	6,954,231
	F09-ds	611,689	6,954,068
	F10-us	609,353	6,953,502
	F10-ds	609,456	6,953,369
	F05-us	609,631	6,960,021
	F05-ds	609,518	6,960,215
	F11-us	610,122	6,952,279
	F11-ds	610,346	6,952,105
	F12-us	610,087	6,949,723
	F12-ds	610,190	6,949,589
	F13-us	610,260	6,948,372
	F13-ds	610,245	6,948,318
	F14-ds	609,367	6,947,025
	F01-us	617,439	6,971,280
	F01-ds	617,561	6,971,369
Minnow Trapping	F14	609,480	6,950,644
	F09	611,689	6,954,068
	F08	613,044	6,954,528
	F07	613,449	6,956,383
	F05	609,631	6,960,021
	F01	617,561	6,971,369
Angling	F14	609,480	6,947,025
	F08	613,044	6,954,528

us = upstream and ds = downstream.

In addition to direct sampling of fish communities, an aerial survey of Britannia and Canadian creeks was conducted on September 11 to search for Pacific salmon spawners. The survey was followed by foot surveys of selected stream reaches to ground-truth the aerial observations.

2.2.1.7 Fish Habitat

In July, sections of stream 75 to 200 m length centred over fish sampling sites were surveyed (Table 5): two in Britannia Creek Watershed (F07 and F08) and two in Casino Creek Watershed (F03 and F04).

In September, the focus shifted to surveying representative sections of stream reaches. The reaches and reach breaks were similar to those used by Hallam Knight Piésold (1997) (Figure 4). Table 7 shows the reach numbers for each stream and the GPS co-ordinates of the centre of the representative section that was surveyed.

Table 7. Locations of Fish Habitat Surveys, September 11-12, 2008

Site	Reach	Co-ordinates		Date
		Easting	Northing	
Lower Reach of Britannia Creek	1	617,126	6,970,199	11-Sep
Upper Reach of Britannia Creek	2	616,279	6,966,540	11-Sep
Lover Reach of Canadian Creek	1	615,314	6,966,030	11-Sep
Placer Mine on Canadian Creek	2	614,725	6,965,616	11-Sep
Cascade pools on Canadian Creek	2	609,160	6,960,684	11-Sep
Near Tank Farm on Canadian Creek	4	609,776	6,958,820	11-Sep
Upper Reach of Canadian Creek	3	609,622	6,958,679	11-Sep
At site F14 on Dip Creek	1	609,367	6,947,025	12-Sep
Meloy Creek	1	611,661	6,954,143	12-Sep
Upper Reach of Casino Creek	2	613,087	6,954,573	12-Sep
Lower Reach of Casino Creek	1	610,515	6,950,136	12-Sep
Lower Reach of Brynelsen Creek	1	610,209	6,952,288	12-Sep
Upper Reach of Brynelsen Creek	2	609,448	6,953,393	12-Sep
Lower Reach of Austin Creek	1	610,157	6,949,620	12-Sep
Upper Reach of Austin Creek	2	608,816	6,951,236	12-Sep

2.2.2 Sample Collection

2.2.2.1 Hydrology

In accordance with conventional stream gauging protocols for propeller-type meters, all hydrometric stations were established in straight channels, free from obstructions. Each site was selected to ensure representative hydraulic conditions.

Manual stream velocities were measured with a Marsh-McBirney Flo-mate 2000. The stream discharge (Q, m^3/s) was calculated following the United States Geological Survey mid-section method. The width of the stream was 'discretized' into 'panels', the number of which depending on the total width of the stream and the variation in stream velocity across the section. A stream velocity measurement was taken in the middle of each panel. In most instances, the number of panels was such that only between 5% and 10% of the flow passes though each panel. Stream velocity measurements were collected at 60% of the total depth at each measurement point in the cross-section. At points with depths greater than 50 cm, two velocity measurements were taken: one at 20% of the total depth; and, the other at 80% of the total depth. Flow was calculated at both points and the average of the two flows were used as the contribution of flow from that panel. Flows were summed over all the panels to obtain the total stream flow on that date.

Water stage (h, cm) was measured in two ways: measuring the height of the water at the logger installation, and measuring the depth of water at the thalweg – the deepest, fastest section of water in the cross-section.

2.2.2.2 Water Quality

All surface water samples were grab samples, collected in mid-stream approximately 20 cm under the surface with the bottle mouths facing upstream. Water quality samples were collected for general chemical parameters in pre-cleaned 500 mL plastic bottles supplied by the analytical laboratory. Samples for total metals were collected in 250 mL acid-washed plastic bottles supplied by the laboratory and preserved in the

field with laboratory-supplied nitric acid. Samples for dissolved metals were vacuum filtered in the field through 0.45-micron disposable filterware and preserved with laboratory-supplied nitric acid immediately after filtration. Samples for nutrients – ammonia, total Kjeldhal nitrogen (TKN) and dissolved orthophosphate – were collected in 250 mL bottles and preserved in the field with laboratory-supplied sulphuric acid. Total cyanide was collected in 1 L bottles containing laboratory-supplied sodium hydroxide as a preservative. Total Organic Carbon (TOC) was collected in 125 mL glass-amber bottles and preserved with laboratory-supplied hydrochloric acid. Dissolved Organic Carbon (TOC) was collected in 125 mL glass-amber bottles and preserved with laboratory-supplied hydrochloric acid immediately after filtration.

All samples were kept cold and were not allowed to freeze. They were shipped via air cargo from Whitehorse to Maxxam Analytics in Vancouver, BC. Maxxam Analytics is accredited by the Canadian Association for Environmental Analytical Laboratories. Chain of Custody forms accompanied all samples. Table 8 shows the water quality variables that were measured and their Reported Detection Limits (RDL).

Table 8. Water Quality Parameters and Detection Limits

Parameter	Units	RDL	Parameter	Units	RDL
Physical			Cadmium	mg/L	0.000005
Conductivity	µS/cm	1	Calcium	mg/L	0.05
pH	pH units	0.1	Chromium	mg/L	0.0001
Hardness	mg/L $CaCO_3$	0.5	Cobalt	mg/L	0.000005
Total Dissolved Solids (TDS)	mg/L	1	Copper	mg/L	0.00005
Total Suspended Solids (TSS)	mg/L	1	Iron	mg/L	0.001
Turbidity	NTU	0.1	Lead	mg/L	0.000005
Anions			Lithium	mg/L	0.0005
Alkalinity	mg/L $CaCO_3$	0.5	Magnesium	mg/L	0.05
Chloride	mg/L	0.5	Manganese	mg/L	0.00005
Sulphate	mg/L	0.5	Mercury	mg/L	0.00001
Cyanide (Total)	mg/L	0.0005	Molybdenum	mg/L	0.00005
Cyanide (Weak Acid Dissociable)	mg/L	0.0005	Nickel	mg/L	0.00002
Nutrients			Phosphorus	mg/L	0.002
Ammonia (as N)	mg/L	0.005	Potassium	mg/L	0.05
Nitrate (as N)	mg/L	0.005	Selenium	mg/L	0.00004
Nitrite (as N)	mg/L	0.002	Silicon	mg/L	0.1
Total Kjeldahl Nitrogen	mg/L	0.02	Silver	mg/L	0.000005
Ortho-phosphate (as P)	mg/L	0.001	Sodium	mg/L	0.05
Total and Dissolved Metals			Strontium	mg/L	0.00005
Aluminum	mg/L	0.0002	Thallium	mg/L	0.000002
Antimony	mg/L	0.00002	Tin	mg/L	0.00001
Arsenic	mg/L	0.00002	Titanium	mg/L	0.0005
Barium	mg/L	0.00002	Uranium	mg/L	0.000002
Beryllium	mg/L	0.00001	Vanadium	mg/L	0.0002
Bismuth	mg/L	0.000005	Zinc	mg/L	0.0001
Boron	mg/L	0.005	Zirconium	mg/L	0.0001

RDL = Reported Detection Limit from Maxxam Analytics.

µS = micro-Siemens, and NTU = nephelometric units.

Field measurements of pH, temperature and specific electrical conductivity were made at each site using a YSI Pro pH/conductivity/temperature meter.

2.2.2.3 Sediment Quality

One sample of stream bottom sediment was collected in September 2008 from each of the 12 sites listed in Section 2.2.1.4. The sediment was collected using established protocols from depositional areas of the stream. Where possible, sediment samples were collected by using the jar provided by the analytical lab as a scoop. Appropriate measures were taken to reduce potential for sample contamination. For example, field staff wore disposable nitrile gloves when sampling. All samples were kept cold at all times between sample collection and delivery to the laboratory. Chain of Custody forms accompanied all samples. Table 9 shows the sediment quality variables that were measured and their detection limits.

Table 9. Sediment Quality Parameters and Detection Limits

Parameter	Units	RDL	Parameter	Units	RDL
Physical					
Percent moisture	%	0.3	Manganese	mg/kg	0.2
pH	pH units	0.01	Mercury	mg/kg	0.05
Total Metals			Molybdenum	mg/kg	0.1
Aluminum	mg/kg	100	Nickel	mg/kg	0.8
Antimony	mg/kg	0.1	Phosphorus	mg/kg	10
Arsenic	mg/kg	0.2	Potassium	mg/kg	100
Barium	mg/kg	0.1	Selenium	mg/kg	0.5
Beryllium	mg/kg	0.1	Silver	mg/kg	0.05
Bismuth	mg/kg	0.1	Sodium	mg/kg	100
Cadmium	mg/kg	0.05	Strontium	mg/kg	0.1
Calcium	mg/kg	100	Thallium	mg/kg	0.05
Chromium	mg/kg	1	Tin	mg/kg	0.1
Cobalt	mg/kg	0.3	Titanium	mg/kg	1
Copper	mg/kg	0.5	Vanadium	mg/kg	2
Iron	mg/kg	100	Zinc	mg/kg	1
Lead	mg/kg	0.1	Zirconium	mg/kg	0.5
Magnesium	mg/kg	100			

RDL = Reported Detection Limit from Maxxam Analytics.

All units are mg/kg dry weight unless otherwise noted.

2.2.2.4 Periphyton

Five samples of periphyton were collected from each of the seven sampling sites from September 10 to 11, for a total of 35 samples. Each sample was collected from one rock selected from the stream bed. Each rock was scraped with a scalpel and the scrapings were washed into a sterile 500 mL plastic bottle jar with a squeeze bottle containing stream water. Each sample was preserved by adding Lugol's iodine solution.

All samples were stored in coolers and kept cool until they could be shipped to Fraser Environmental Services Ltd. (FES) of Surrey, BC, for analysis of taxonomic composition. Chain of Custody forms accompanied all samples.

Periphyton density (cells/cm^2) was calculated for each sample by dividing the total number of cells estimated for a sample by the surface area that was scraped for each sample. Sub-sampling was required to estimate numbers of cells (FES 1994). Sample surface area was estimated by tracing the outlines of each rock on a sheet of wax paper. Back in the office, the wax paper outlines were scanned to JPG file format at high resolution. The images were then rasterized and imported into AutoCAD where new vector boundaries were created based on the outside edge of the wax paper for each sample. This process ensured minimal margin of error and allowed for quick calculation once the scans were complete.

2.2.2.5 Benthic Invertebrates

Five samples of benthic invertebrates were collected from each of the seven sampling sites from September 10 to 11, for a total of 35 samples. Samples of benthic invertebrates were taken from areas of riffle habitat with similar stream depths and velocities. The Surber sampler has a surface area of 0.093 m^2 and mesh size of 250 µm. It was placed facing into the stream current with the hinged frame resting on the streambed. Substrate within the area defined by the frame was disturbed by hand for approximately 5 minutes to dislodge benthic organisms, which were swept into the net by the stream current. The organisms caught in the net were then washed into a sample bottle and preserved with 85% ethanol. This was repeated four more times at nearby areas to obtain five replicate samples at each site.

Samples of benthos were shipped to Cordillera Consulting in Summerland, BC, for taxonomic identification to the lowest practical taxonomic level, which was to the Order level for most aquatic insects, to the Class level for oligochaetes and to the Phylum level for nematodes. Chain of Custody forms accompanied all samples. All organisms in each sample were counted and identified – no sub-sampling was required.

Total density of benthic invertebrates collected by a Surber sampler was calculated by dividing the total number of organisms counted from a sample by the sampling area of the Surber sampler.

2.2.2.6 Fish Community

Three gears were used to sample fish: minnow traps, backpack electrofishers and angling. Three minnow traps were installed at each of five sites in July and two traps were installed at each of three sites in September for a total of 21 minnow trap installations. Minnow traps are made of galvanized steal wire and are conical in shape with a length of 42 cm, a width of 23 cm and a mesh size of 0.6 cm. Minnow traps were placed at each site in deep pools or among large woody debris or in slow-moving eddies. They were anchored to large woody debris or rocks and rocks were placed within the traps to weight them down. They were marked with red or yellow fluorescent flagging tape. Each trap was baited with canned salmon placed in a small perforated bag. Traps were soaked for 24 hours.

A mixture of one-pass and three-pass electrofishing was conducted. Three-pass electrofishing was conducted wherever flows were low enough that blocking nets could be installed in streams, but flows were

high enough at many sites to wash blocking nets out. For those sites, only one-pass electrofishing with no blocking nets were used.

For three-pass electrofishing, blocking nets were installed at the upstream and downstream ends of a stream section 75 m in length. Then, a two-person crew walked the stream section in an upstream direction repeatedly sweeping the stream from bank to bank with the wand of the electrofishing unit. Fish that were temporarily stunned by the electric field were scooped up with a dipnet and stored in a water-filled live bucket. After a pass was complete, the crew processed the captured fish on the stream bank. After waiting one half hour, another pass was conducted. After three passes, the blocking nets were removed and all processed fish were released live back into the stream except for those sculpin that were retained for tissue metals analysis.

Between passes, captured fish were identified to species and counted. Then, fork length was measured to the nearest 1 mm with a measuring board (total length was measured for slimy sculpin), and wet weight was measured to the nearest 0.1 g with a balance. Scales were collected from Arctic grayling for age analysis. The collection site was always on the side of the fish mid-way between the lateral line and the dorsal fin. Arctic grayling scales were sent to North Shore Environmental Services Ltd. In Thunder Bay, ON, where the scales were mounted on micro-fiches and the annuli were counted. A Chain of Custody form accompanied the samples.

Angling was conducted at two sites in July using standard angling gear. Angling effort (i.e., time spent angling) was not recorded. Fish were not processed for biological characteristics and no aging structures were collected.

2.2.2.7 Fish Tissue Metals Concentrations

A sub-set of slimy sculpin captured by electrofishing in July and September were collected for analysis of whole-body tissue metals concentrations. Each fish was placed in a labelled plastic bag and frozen immediately. The samples were sent to CANTEST analytical laboratories in Vancouver, BC. Chain of Custody forms accompanied all samples. At CANTEST, samples were digested using a nitric acid-hydrogen peroxide procedure based on U.S. EPA method 200.3. The concentrations of 32 metals were measured using Inductively Coupled Argon Plasma Spectroscopy (ICP) or ICP Mass Spectroscopy (Table 10). The concentrations of mercury were measured using Cold Vapour Atomic Absorption Spectrophotometry or Cold Vapour Atomic Fluorescence Spectrophotometry.

Table 10. Fish Tissue Metals and Detection Limits

Metal	RDL	Metal	RDL
Aluminum	0.5	Nickel	0.1
Antimony	0.1	Phosphorus	0.5
Arsenic	0.1	Potassium	1
Barium	0.1	Selenium	0.2
Beryllium	0.02	Silicon	10
Boron	2	Silver	0.01
Cadmium	0.02	Sodium	1
Calcium	1	Strontium	0.05
Chromium	0.1	Tellurium	0.1
Cobalt	0.1	Thallium	0.02
Copper	0.1	Tin	0.1
Iron	5	Titanium	0.3
Lead	0.1	Uranium	0.04
Magnesium	0.5	Vanadium	0.5
Manganese	0.1	Zinc	0.5
Mercury	0.01	Zirconium	3
Molybdenum	0.1		

All units are µg/g wet weight.

RDL = Reported Detection Limit.

2.2.2.8 Fish Habitat

Fish habitat was characterized following a modified version of the methods described in the *Fish Habitat Assessment Procedures* guide for the British Columbia government (Johnston and Slaney 1994). Stream length and stream width (i.e., wetted and bankfull width) was measured with surveyor's measuring tape. Gradient was measured with a clinometer. Stream depth was measured with a meter stick. Stream stage was assessed as low, medium or high visually by comparison between stream surface height and bankfull height. Habitat was visually assessed into the following five types:

- ***Pools*** have zero gradient, slow-moving water and a concave bottom;
- ***Runs*** (also called glides) are sections of non-turbulent, fast-flowing water;
- ***Riffles*** are areas of turbulent, fast-flowing water with gravel or cobble substrates and with obvious surface turbulence;
- ***Cascades*** are steep, stepped "riffles" of bedrock or emergent cobble or boulders in channels with gradients greater than about 4%;
- ***Other*** includes wetland complexes that lack an identifiable primary channel, sloughs, lakes, areas of sub-surface flow or areas where the channel cannot be observed (e.g., under large log jams).

Stream substrate was assessed visually into the following classes:

- fines (or silt);
- small gravel (2-16 mm particle diameter);
- large gravel (16-54 mm);
- small cobble (64-128 mm);
- large cobble (128-256 mm);

- boulder (>256 mm) or
- bedrock.

The percent of the stream surface that provided fish with cover was described using the following classes:

- deep pool;
- large woody debris (LWD);
- boulder;
- cutbank;
- instream vegetation; and
- overhanging vegetation.

The percentage of the overhead forest canopy that was closed was estimated visually.

The percentages of a stream section that belonged to each habitat type had to add to 100%, as did the percentages of the substrate of a stream section that belonged to each size class and the percent of the canopy that was closed. However, the percentages of cover provided by the various classes did not have to add up to 100%.

Stream confinement was assessed as:

- unconfined (UC) – the stream bank is not touching the valley wall;
- occasionally confined (OC) – the stream bank is occasionally confined by the valley wall or terraces;
- frequently confined (FC) – the stream bank is frequently confined by the valley wall or terraces;
- confined (CO) – the stream bank is in continuous or repeated contact at the outside of meander bends;
- entrenched (EN) – the stream bank is in continuous contact with the valley walls or terraces due to downcutting; and
- not applicable (NA) – no valley walls exist (e.g., alluvial fans).

The stream section was classified as braided or non-braided and the percent of the stream surface area made up of gravel bars was recorded.

Finally, a suite of water quality variables were measured with field instruments (e.g., YSI model 556): pH, water temperature, TDS, conductivity and dissolved oxygen concentration.

2.2.3 QA/QC

2.2.3.1 Water Quality

All field equipment were maintained in good working condition and measuring instruments were calibrated frequently. For example, the pH meter was calibrated prior to each field trip using prepared solutions with pHs of 4 and 7, and the conductivity meter was checked prior to each field trip using the standard 1,413 µS/cm conductivity solution.

Water quality samples were collected by a qualified aquatic biologist and were carried out by the same individual at each sampling site to insure consistency. All water samples were collected using industry standard sampling protocols. Appropriate measures were taken to reduce potential for sample contamination. Field staff wore disposable nitrile gloves when sampling and used bottles and preservative supplied by the analytical laboratory. All samples were collected with the mouth of the sampling bottle facing upstream. Care was taken to ensure that no upstream disturbances occurred as the result of walking within the creek bed prior to sampling.

Ten percent of the number of water quality samples were replicated, hence a total of five replicate samples were collected: two in May, two in July and one in September. Replicate sample locations were chosen randomly. Appendix B6 shows the results of analysis of replicate samples. Relative Percent Difference (RPD) was used to assess analytical variability. RPD was defined as:

$$\%RPD = \frac{2(X_1 - X_2)}{(X_1 + X_2)} * 100$$

where X_1 = the concentration of a parameter in the first sample and X_2 = the concentration of the same parameter in the second sample (i.e., the replicate). An RPD less than 25% is considered an acceptable difference, and an RPD greater than 25% warrants further examination to ensure that the result was not due to sampling error or analytical error. RPD is only relevant when both values are greater than the Practical Quantitation Limit (PQL), which was defined for this project as three times the detection limit. The PQL is considered the lowest concentration that can be accurately measured, as opposed to just detected.

As shown in Appendix B6 and Table 11, between one and seven of the 89 parameters that were measured from each sample had RPDs greater than 25% and met PQL restrictions. This was equivalent to between 1% and 8% of all parameters, which is considered to be an acceptable level of variability.

Table 11. RPD Analysis of Replicate Water Quality Samples, Casino Project, 2008

Month	Replicate	Number of Parameters with RPD>25%	Percent of Parameters with RPD>25%
May	1	7	8
May	2	3	3
July	3	1	1
July	4	3	3
September	5	2	2

A total of 89 parameters were measured from each sample.

The sites, dates and parameters for which RPD was greater than 25% were as follows:

- W1, May, turbidity, sulphate, total iron, total lead, total phosphorus, total titanium and total vanadium;
- W5, May, TSS, turbidity and dissolved thorium;

- W1, July, chloride;
- W43, July, TKN, dissolved aluminum and dissolved silver; and
- W43, September, TKN and dissolved nickel.

Sites W1, W5 and W43 should be targeted in future QA/QC monitoring to investigate further these results.

The results of the field and travel blanks are shown in Appendices B2 to B5. All values were below detection limits, indicating no contamination of samples.

Maxxam Analytics, which conducted the analyses of water and sediment samples, is a certified member of the Canadian Association of Environmental Analytical Laboratories. Maxxam split several samples into duplicates and analyzed each one separately to provide a measure of their laboratories analytical precision. Duplicates were chosen randomly by Maxxam. The results, which are not reported here, met Maxxam's standards for QA/QC.

2.2.3.2 Sediment Quality

Sediment quality samples were collected by a qualified aquatic biologist and were carried out by the same individual at each sampling site to insure consistency. All sediment samples were collected using industry standard sampling protocols. Appropriate measures were taken to reduce potential for sample contamination. Field staff wore disposable nitrile gloves when sampling and used sample bottles supplied by the analytical laboratory.

No replicate sediment quality samples were collected.

2.2.3.3 Periphyton and Benthos

Periphyton and benthic invertebrates samples were collected by a qualified aquatic biologist and were carried out by the same individual at each sampling site to insure consistency.

Fraser Environmental Services Ltd. (FES) has over ten years experience in analysis of periphyton from streams and rivers of western Canada. FES has the following standard QA/QC procedures (FES 1994):

- all microscopes are calibrated on a regular basis;
- consistent sample concentration and sub-sampling techniques are employed for identifications;
- taxonomic identifications are verified by comparison with reference collections, including an in-house reference collection;
- difficult, typical or dominant specimens are sent to external experts for confirmation. Part of this process includes compiling a list of experts for different groups of organisms. Verified specimens are incorporated into FES' reference collection; and
- all FES personnel actively participate in a taxonomists' working group.

Cordillera Consulting has over ten years experience in taxonomic analysis of benthic invertebrates from streams, rivers and lakes of western Canada. The following QA/QC procedures are followed by Cordillera Consulting (http://www.cordilleraconsulting.com):

- sorting efficiency – 10% of the whole sample number was resorted with an expectation of >90% efficiency in the sorting process.
- taxonomic efficiency – 10% of the identified sample vials were sent to another taxonomist. The two results were compared with simple statistics and the taxonomists discussed how best to correct their differences and make appropriate changes to the results.
- taxonomic precision – an externally verified reference collection is maintained by Cordillera Consulting. Any new specimens are sent away to experts of that taxon and the collection is reviewed every five years.

2.2.3.4 Fish and Fish Habitat

All fish and fish habitat field data were recorded on paper field notes and then transferred to electronic spreadsheets in the office. The spreadsheets were compared with the field notes to identify and correct transcription errors. A variety of other measures were taken to further ensure the validity of the data. For example, fish weights were plotted on fish lengths for each species separately to identify outliers that may have been due to errors in recording or transcription. Outliers were then corrected, if possible, or excluded from the analyzed dataset.

Blanks and duplicates were run by CANTEST for each of the two batches of slimy sculpin tissue that were analyzed for metals concentration. Appendix B15 shows those data. In both cases the blanks were below detection limits, indicating no contamination of equipment. RPDs were calculated for each metal from the duplicate samples. In all cases, the RPDs were below the 20% limit specified by the *British Columbia Environmental Laboratory Manual for the Analysis of Water, Wastewater, Sediment, Biological Material and Discrete Ambient Air Samples* (BC MOE 2007).

2.2.4 Data Analysis

2.2.4.1 Hydrology

In order to reconstruct a discharge hydrograph for each hydrometric station, a relationship between manual measurements of discharge and water stage (referred herein as a rating curve) was developed. A power function is used to predict discharge from water stage:

$$Q = a(h - z)^b$$

where *Q* is discharge (m^3/s), h is stage (m), z is gauge height at “zero flow” (m), and a and b are constants. An estimate of z was obtained by plotting log(Q) versus log (h) – z was the y-intercept when log(Q) = 0. Then, the power function was converted to a linear regression equation by taking logarithms:

$$\log(Q) = \log a + b \log(h - z)$$

and regression analysis was used to estimate values for a and b for each hydrometric site.

To reconstruct a hydrograph at each site, the continuous stage readings recorded by the datalogger were converted to hourly flows using the fitted stage-discharge relationship for each site. Daily mean discharges were calculated from the hourly discharges.

2.2.4.2 Water Quality

The minimum, median and maximum concentrations of selected water quality parameters were calculated for each site sampled in 2008. The median, rather than the arithmetic mean, was assumed to be the best estimate of the central tendency of the data because many water quality variables tend not to be normally distributed. To calculate statistics, all data for each site were pooled over the May-October sampling period and values below detection limits were replaced with one-half the detection limit.

Concentrations of water quality parameters were compared to guidelines for the protection of freshwater aquatic life issued by the Canadian Council of the Ministers of the Environment (CCME) (CCME 2008), and exceedances of the guidelines were identified.

Principal components analysis (PCA) of water quality was used to reduce the redundancy within the dataset and identify underlying trends. The first step in PCA of water quality was to remove all variables for which 90% of the records were below detection limits. For the remaining variables, all values below detection limits were replaced with one-half the detection limit. Concentrations of total and dissolved metals were transformed with natural logarithms to normalize the frequency distributions. The varimax option was used to rotate components in order to maximize the contrast between components and improve comprehension of the results.

2.2.4.3 Sediment Quality

The minimum, median and maximum concentrations of each sediment quality parameter were not calculated because only one sample was taken for each site sampled in September 2008.

The 2008 sediment quality data was compared to the CCME (2008) sediment guidelines for the protection of freshwater aquatic life. There are two classes of guidelines: the Probable Effects Level (PEL), which defines the level above which adverse effects are expected to occur frequently; and the Interim Sediment Quality Guideline (ISQG), which is lower than the PEL and which defines the concentration below which minimal effects on the aquatic environment are expected.

PCA of sediment quality was calculated in the same way as PCA of water quality. All metals for which 90% of the records were below detection limits were removed. For the remaining metals, all values below detection limits were replaced with one-half the detection limit. Metal concentrations were transformed with natural logarithms to normalize the frequency distributions, and the varimax option was used to rotate components.

2.2.4.4 Periphyton and Benthos

One-way Analysis of Variance (ANOVA) was used to compare mean densities of periphyton and of benthic invertebrates between sites. ANOVA assesses the statistical significance of differences using F-ratios. Significance was assessed as none ($P>0.05$), low ($0.01<P<0.05$), medium ($0.001<P<0.01$) and high ($P<0.001$), where P is the probability of making a Type I error (i.e., rejecting a true null hypothesis). Densities were ln-transformed to normalize the frequency distributions and to satisfy the assumption of equal variances – two prerequisites of parametric statistics.

The taxonomic composition of periphyton and benthos communities were assessed using tabular means after pooling replicates for each site.

Two indices of taxonomic diversity were calculated for each sample of periphyton and three indices were calculated for each sample of benthic invertebrates using the protocols recommended by the Canadian Aquatic Biomonitoring Network (CABIN), which is supported by the National Water Research Institute (NWRI) of Environment Canada (NWRI 2008):

- taxonomic richness (S), calculated as the total number of families in a sample, regardless of their relative abundances;
- EPT abundance (EPT), defined as the total number of mayflies (Ephemeroptera), stoneflies (Plecoptera) and caddisflies (Trichoptera) in a sample. These three orders of aquatic insects are typically most sensitive to habitat disturbance. EPT was not calculated for periphyton; and
- Shannon-Weiner diversity index (H'), calculated as $-\Sigma(p_i \ln(p_i))$, where $p_i = n_i/N$, n_i = the total number of individuals in the ith species, N = the total number of organisms in the sample, and H' was calculated by summing over all species (i.e., over S).

For the purposes of calculating S and H', those taxa that could not be identified to the family or species level (e.g., unidentified flagella for periphyton and Phylum Nematoda for benthos) were treated as if they were a family or a species. The periphyton data reported by Fraser Environmental Services included less than signs (<) for some species or genus, indicating that the species or genus were present in the sample but not in sufficient numbers to allow density to be calculated. Those data were used to calculate periphyton richness, but they were not used to calculate densities and Shannon-Wiener diversity indices.

2.2.4.5 Fish and Fish Habitat

The standard error (SE) was the index of dispersion for all arithmetic means shown in this report, and n was the sample size.

Total catch-per-unit-effort (CPUE) of minnow traps was not calculated because the traps caught no fish. Electrofishing CPUE was defined as the number of fish captured per 100 seconds of electrofishing effort. Angling CPUE was not calculated because fishing effort (i.e., angling time) was not recorded.

One-way ANOVA was used to compare mean fish CPUE between seasons and sites and mean fish length and weight between watersheds.

Weight-length regressions for fish were calculated as ln(W) = a + bln(L), where W = weight (g) and L = fork length (mm), a = the intercept of the regression and b = the slope of the regression. Both weight and length were ln-transformed to normalize their frequency distributions and produce homogenous variances. The coefficient of determination (i.e., r^2) for all regressions were adjusted for the number of degrees of freedom.

The length-age relationship for Arctic grayling was estimated by fitting a von Bertalanffy growth model with non-linear regression. The model is $L = L_\infty(1 – \exp(-K(t – t_0)))$ where L = length (mm), t = age (year), L_∞ = length (mm) at infinite age (also known as asymptotic length), K = growth coefficient ($year^{-1}$) and t_0 = the age (year) at which L = 0 mm. The advantage to using a von Bertalanffy model is that it predicts non-zero lengths for 0-age fish.

Analysis of slimy sculpin tissue metal concentrations was similar to that of water quality and sediment quality: remove all metals for which 90% of the records were below detection limits, replace all values below detection limits with one-half the detection limit, and use PCA to identify underlying trends. Metal concentrations were transformed with natural logarithms to normalize the frequency distributions, and the varimax option was used to rotate components.

2.3 Terrestrial Environment

Two terrestrial reconnaissance surveys were conducted in 2008: one from July 7 to 11 and a second from September 8 to 11. Aerial surveys of the terrestrial LSA were conducted in a helicopter at low altitudes (mean height of 150 m above ground level) and low speeds (40 to 55 knots). Two observers scanned the ground with binoculars and recorded observations on vegetation communities and wildlife in field notes and on a map of the LSA. Photographs of vegetation communities were taken.

Aerial surveys were followed by ground-based surveys conducted by foot or with ATVs. A total of 33 sites – 17 in July and 16 in September – were surveyed (Figure 5). At each site, wildlife habitat was classified (e.g., aspen forest, riparian, alpine subalpine, etc.), surficial geology was classified (e.g., collivial, fluvial, bedrock, etc.), and general features of the habitat were described (e.g., slope, aspect, drainage, etc.). Soil pits were dug to a minimum 40 cm (where possible) or to the C layer. Samples of vegetation were collected and animal sighting and signs (claw marks, paw prints, antlers, scat, etc.) were photographed and their GPS co-ordinates recorded with a Garmin 76 handheld GPS with accuracy of between 5 and 10 m.

The vegetation sampling strategy was guided by the *Standards for Terrestrial Ecosystem Mapping (TEM) in British Columbia* (RIC 1998). This system provides an established and uniform means of describing vegetation, soils and terrain characteristics based on air photo interpretation and field data collection programs. Sampling of vegetation used a combination of ground inspection plots (GIF) and visual checks, using Ecosystem Field Forms adapted from methodology outlined in the *Field Manual for Describing Terrestrial Ecosystems* (BC MELP and MOF 1998). Ground inspections used FS212 (adapted) field forms to record site, soil and vegetation information. Notes describing the plot, in context and variability within the polygon, were recorded. Photographs were taken at each plot.

Visual checks involved recording brief point or area characteristics made from the air (helicopter) or ground, and were used to note the basic ecosystem unit, vegetation, and other key features. The primary function of visual plots was to aid in the delineation of polygon and to confirm the placement of polygon boundaries during the photo interpretation and mapping phases proposed for 2009.

Vegetation nomenclature followed that of the *Flora of the Yukon Territory* Second Edition (Cody 2000). A detailed rare plant survey of the Project area was not within the scope of this assessment. Instead, attempts were made to identify potentially rare, sensitive and/or endangered vegetation or vegetation communities within the study area. In general, alpine/sub-alpine and riparian communities across the LSA were expected to possess the greatest potential of harbouring rare plants or sensitive plant communities because they are sensitive to disturbance and may take above mean lengths of time to recover from disturbance. Riparian areas also provide high wildlife habitat value.

The terrestrial data collected in 2008 were reconnaissance-level only and hence were not subjected to extensive analysis. They primary purpose was to provide sufficient data to effectively plan more comprehensive surveys in the future.

3. Results and Discussion

3.1 Atmospheric Environment

There were too few meteorological data to be analyzed in this report because the Casino meteorological station has only been operating since October 3, 2008. Air temperatures recorded by the barologger at the Casino airstrip are shown in Section 3.2.1.2 below.

3.2 Aquatic Environment

3.2.1 Hydrology

3.2.1.1 Stage-Discharge Rating Curves

Appendix B1 shows the stage-discharge data for the six hydrometric stations. Table 12 summarizes the manual discharge measurements and shows the estimates of the gauge height at zero flow (z) for each of the hydrometric stations.

Table 12. Summary of Manual Discharges and 'z' for Hydrometric Stations

Creek	Site	May (m^3/s)	July (m^3/s)	September (m^3/s)	October (m^3/s)	Gauge at Zero Flow (z, m)
Britannia	W1	2.539	0.840	2.136	0.403	0.06
Canadian	W3	1.621	0.332	1.568	0.375	0.26
Casino	W4	1.499	0.495	2.118	0.809	0.18
Dip	W9	3.988	3.613	3.252	1.105	0.29
Casino	W11	0.865	0.136	0.707	0.401	0.06
Britannia	W14	0.864	0.290	0.398	0.145	0.03

Figures 7 through 12 show the stage-discharge rating curves for sites W1, W3, W4, W9, W11 and W14 respectively. The regression statistics shown in each figure – sample size (n), coefficient of determination (r^2) and the probability that the slope is equal to zero (P) – are the results of the log-linear regression analysis. In each case, the regression provided an apparently fair to strong fit to the data. However, two of the regressions – those for W9 and W11 – were not significant (P>0.05) due to the small sample size.

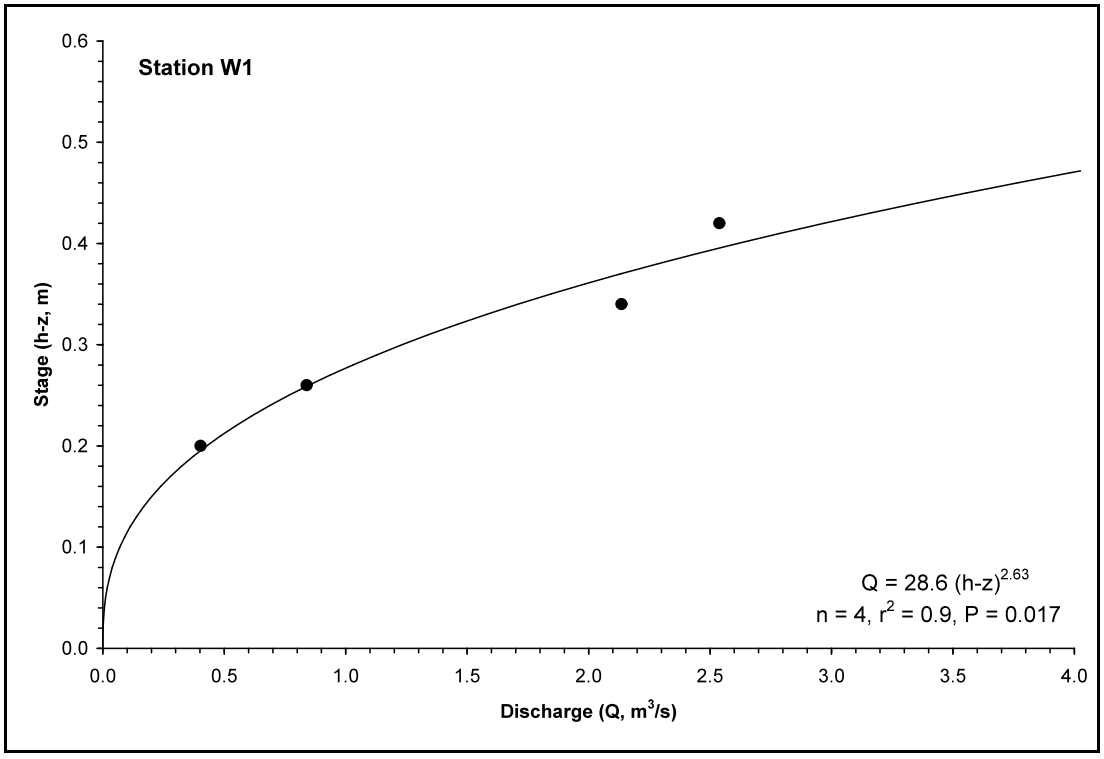


Figure 7. Stage-Discharge Rating Curve for Site W1, Britannia Creek, Casino Project, 2008

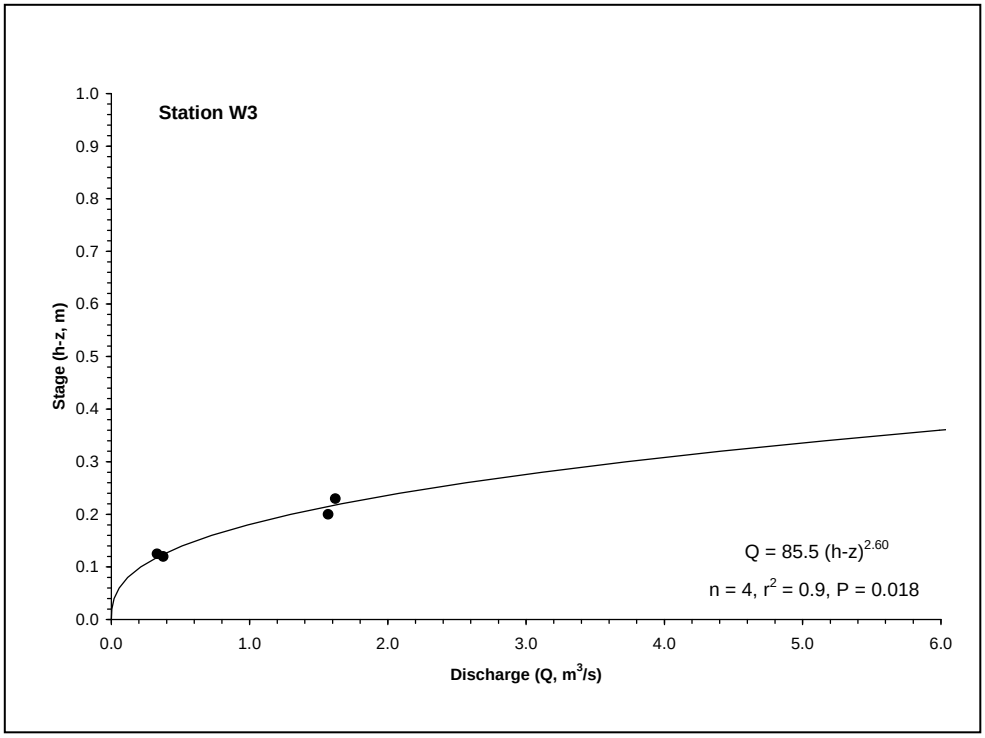


Figure 8. Stage-Discharge Rating Curve for Site W3, Canadian Creek, Casino Project, 2008

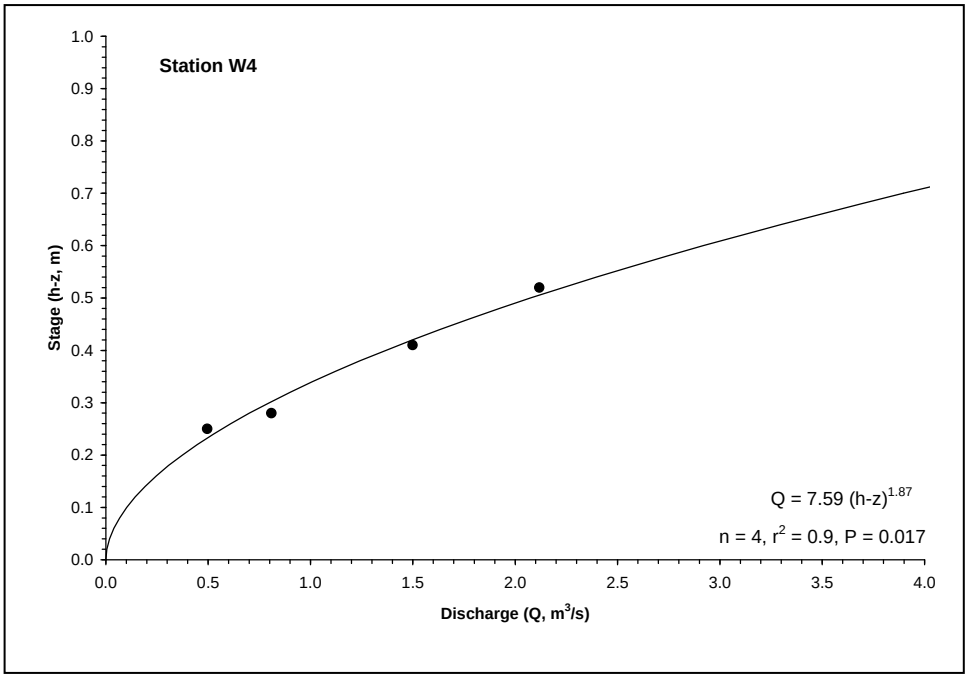


Figure 9. Stage-Discharge Rating Curve for Site W4, Casino Creek, Casino Project, 2008

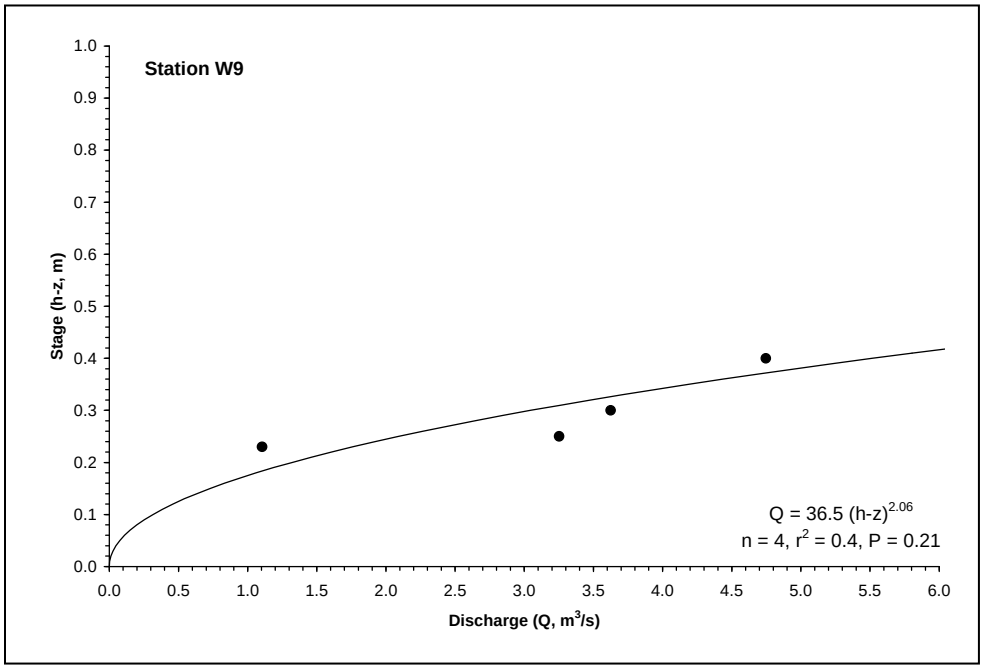


Figure 10. Stage-Discharge Rating Curve for Site W9, Dip Creek, Casino Project, 2008

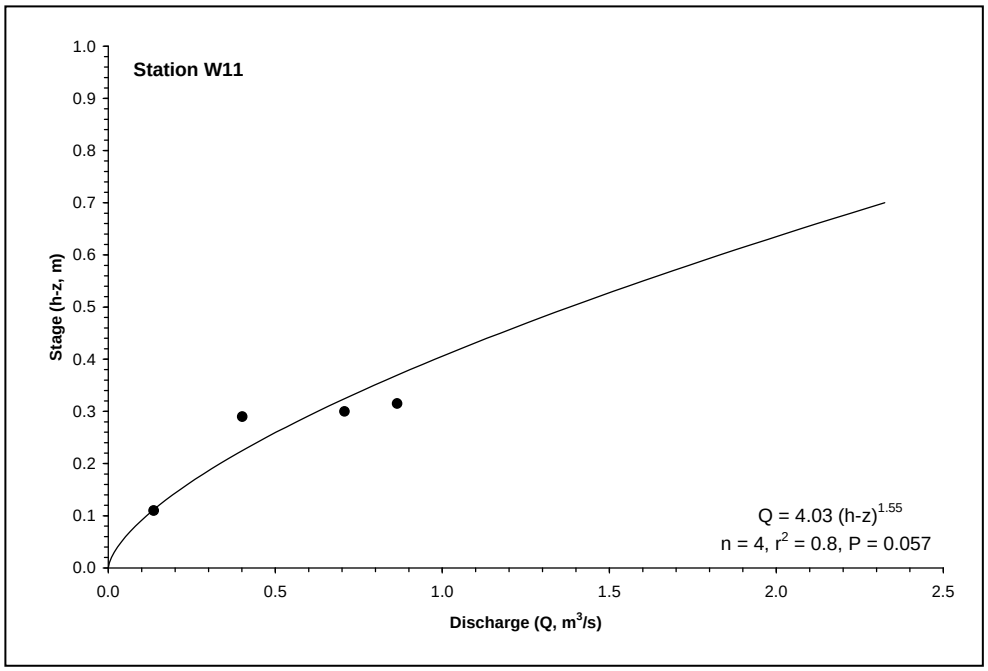


Figure 11. Stage-Discharge Rating Curve for Site W11, Casino Creek, Casino Project, 2008

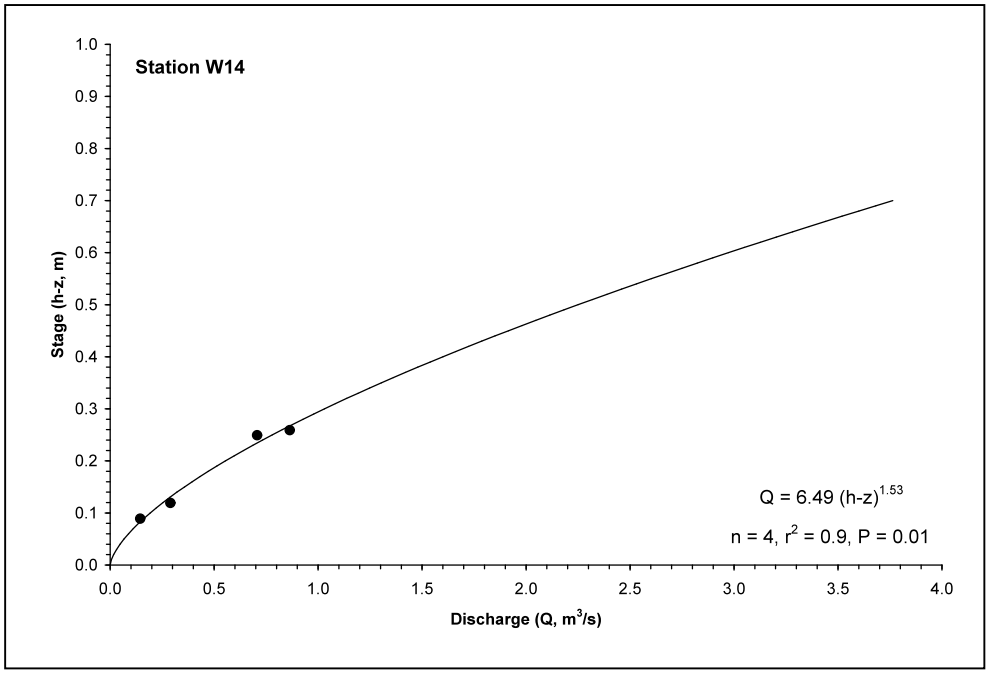


Figure 12. Stage-Discharge Rating Curve for Site W14, Britannia Creek, Casino Project, 2008

In general, the manual measurements during each field visit were conducted during medium to high flow events. Consequently, the reconstruction of discharge at lower flows is less reliable. Future field visits should attempt to capture, if possible, lower flows in efforts to produce more representative stage-discharge rating curves.

3.2.1.2 Hydrographs

Figures 13 to 18 show the hydrographs for stations W1, W3, W4, W9, W11 and W14, respectively. Discharge is shown as a solid blue line, water temperature as the dashed green line and air temperature as the dotted orange line. Due to a logger malfunction at station W4 (Figure 15), data was not collected between May 22 and July 9, 2008.

In the absence of meteorological data, it is difficult to ascertain the source (snow melt, precipitation, permafrost melting, etc.) of specific peaks in discharge for each station. However, The following observations can be made with a moderate degree of confidence, based on the temporal patterns of stream temperature and air temperature, in conjunction with the temporal pattern of specific discharge peaks:

Figure 13. Hydrograph for Station W1, Britannia Creek, Casino Project, 2008

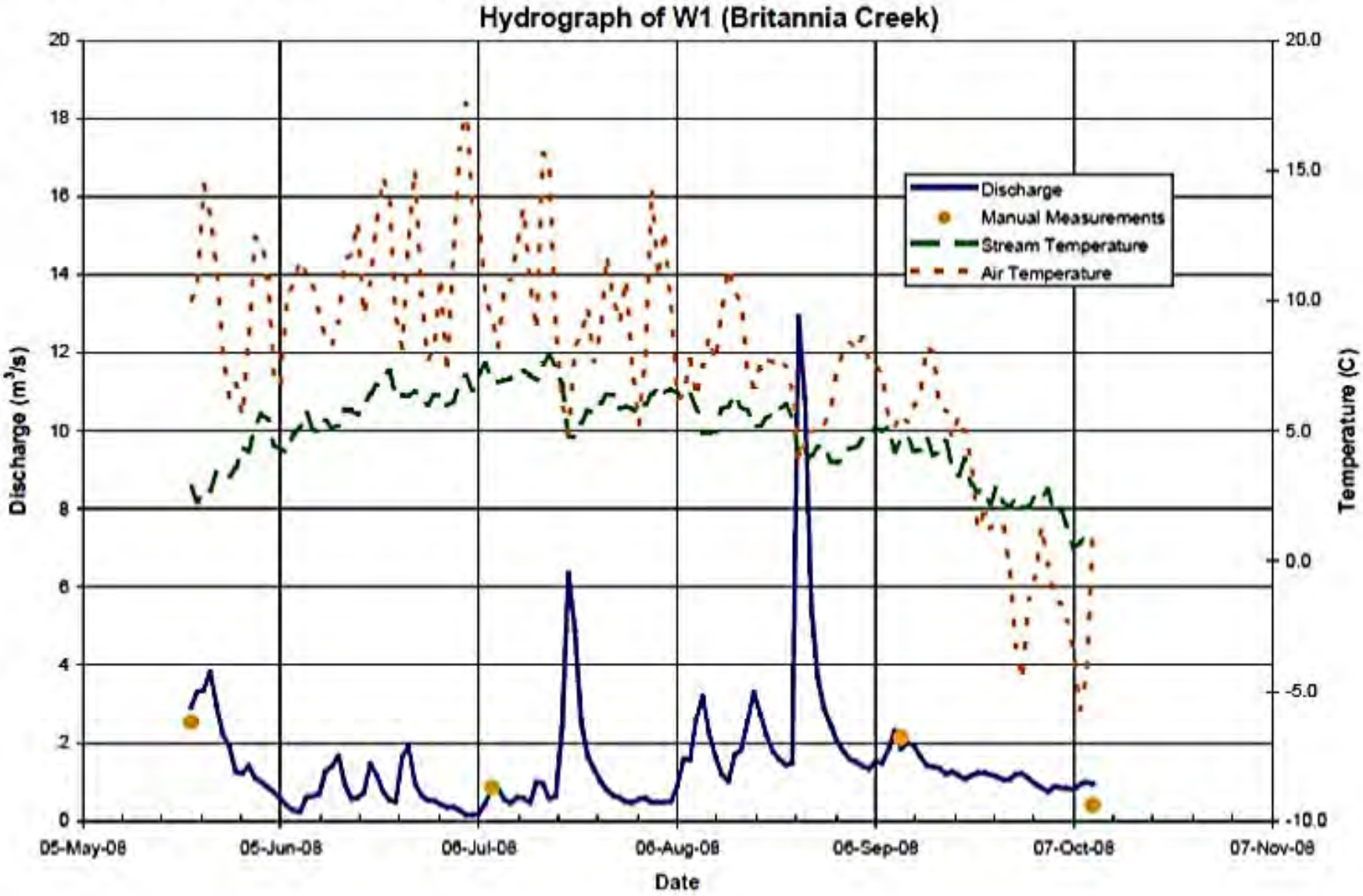


Figure 14. Hydrograph for Station W3, Canadian Creek, Casino Project, 2008

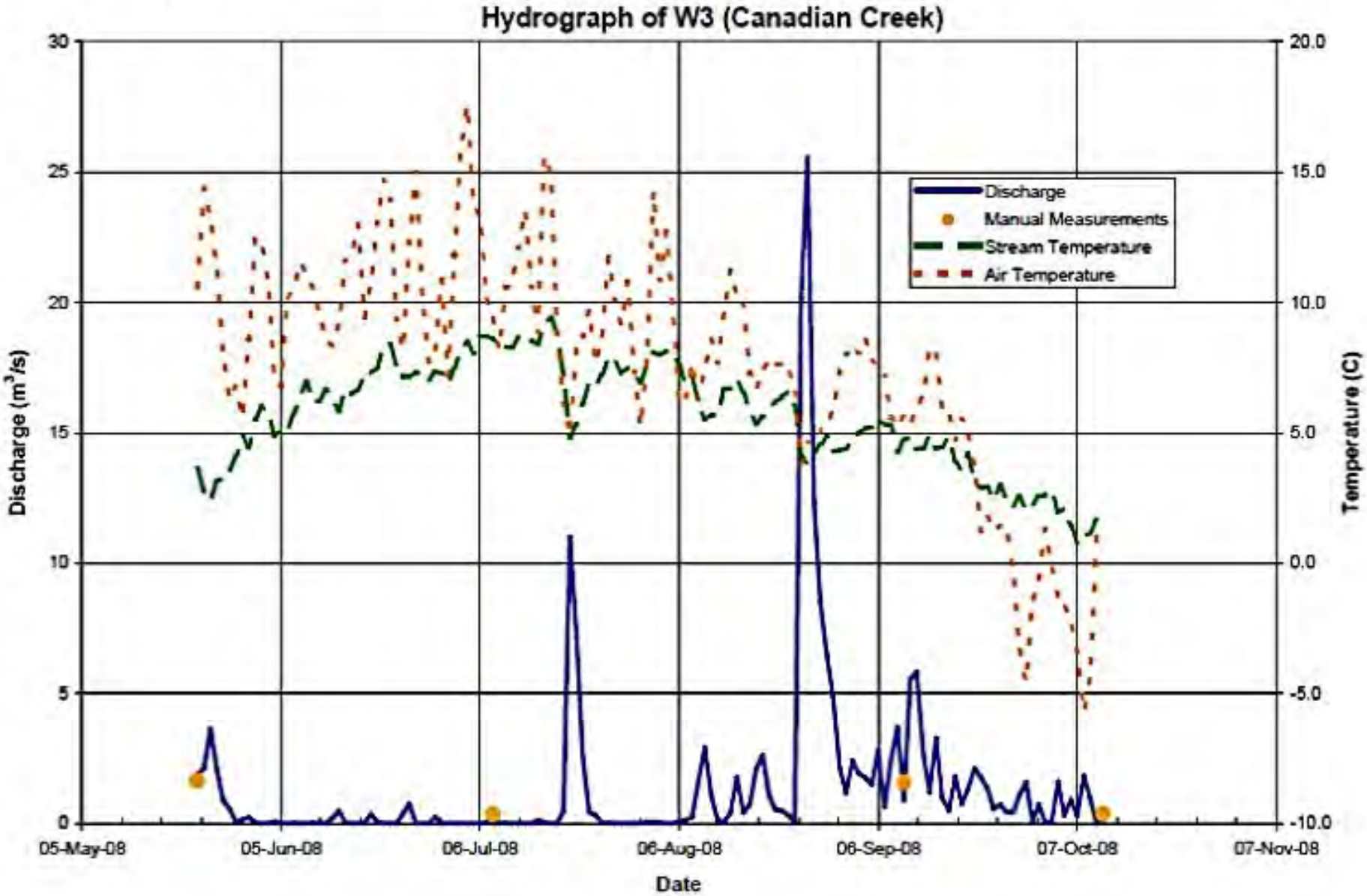


Figure 15. Hydrograph for Station W4, Britannia Creek, Casino Project, 2008

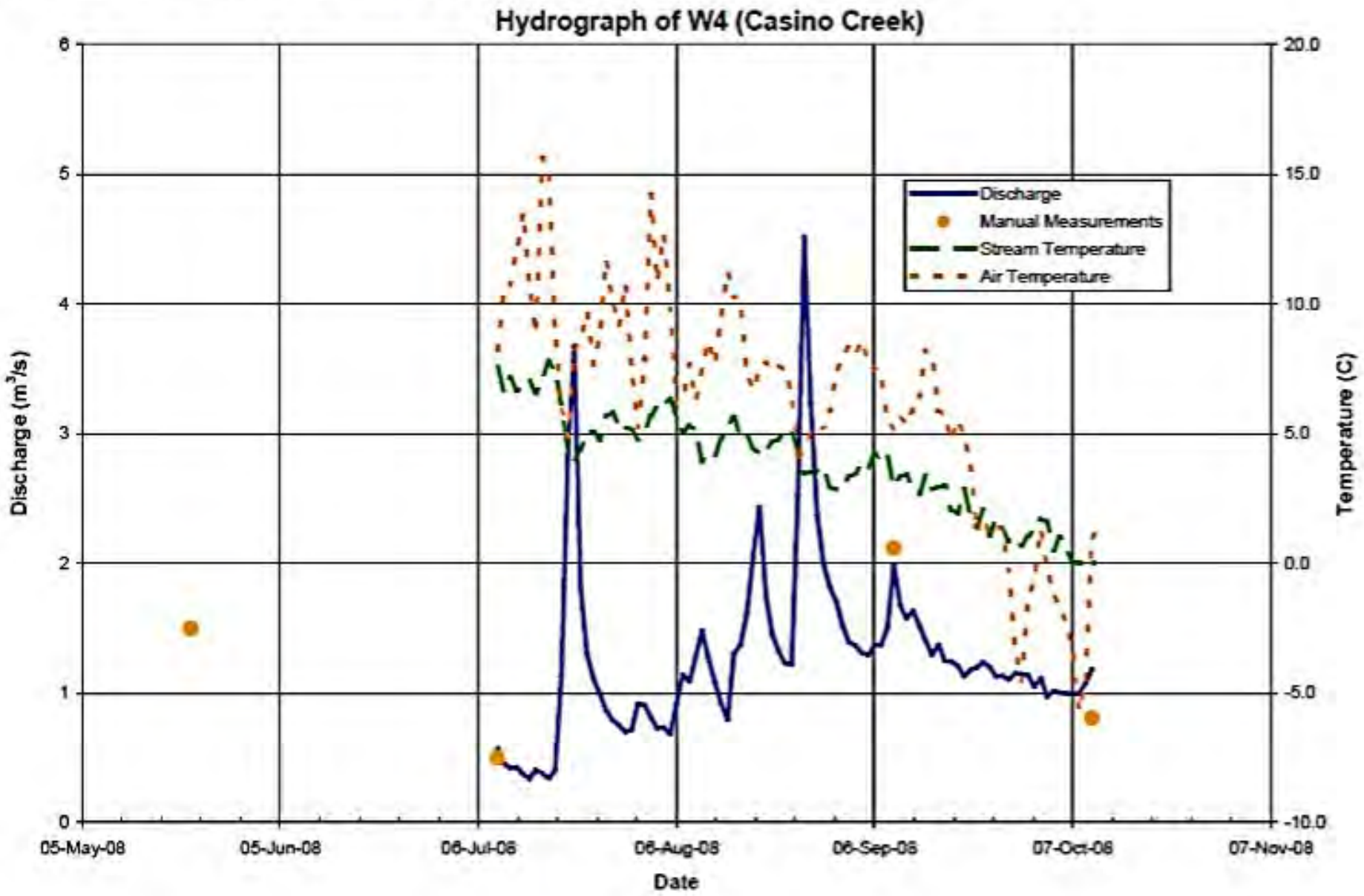


Figure 16. Hydrograph for Station W9, Deep Creek, Casino Project, 2008

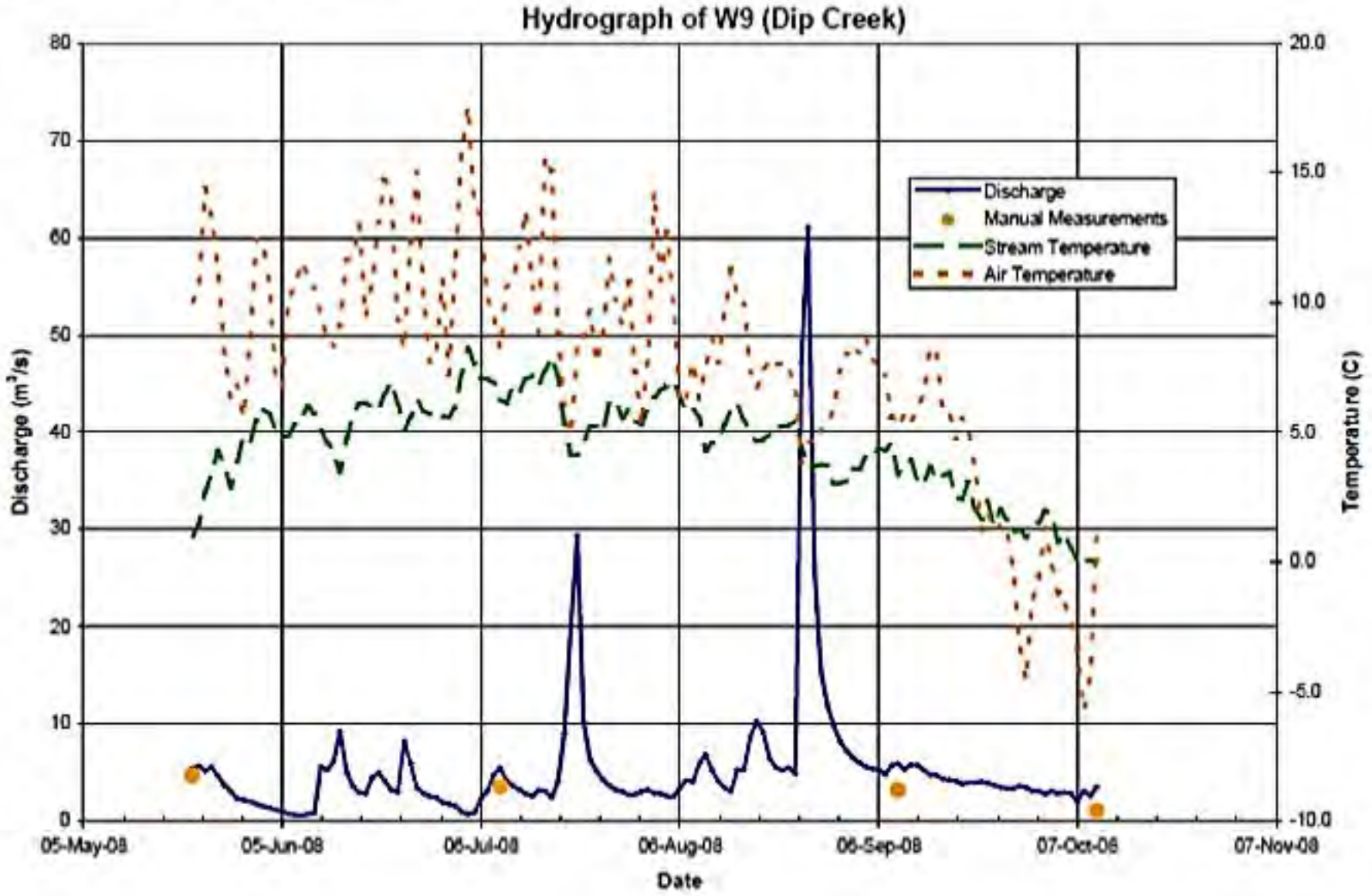


Figure 17. Hydrograph for Station W11, Casino Creek, Casino Project, 2008

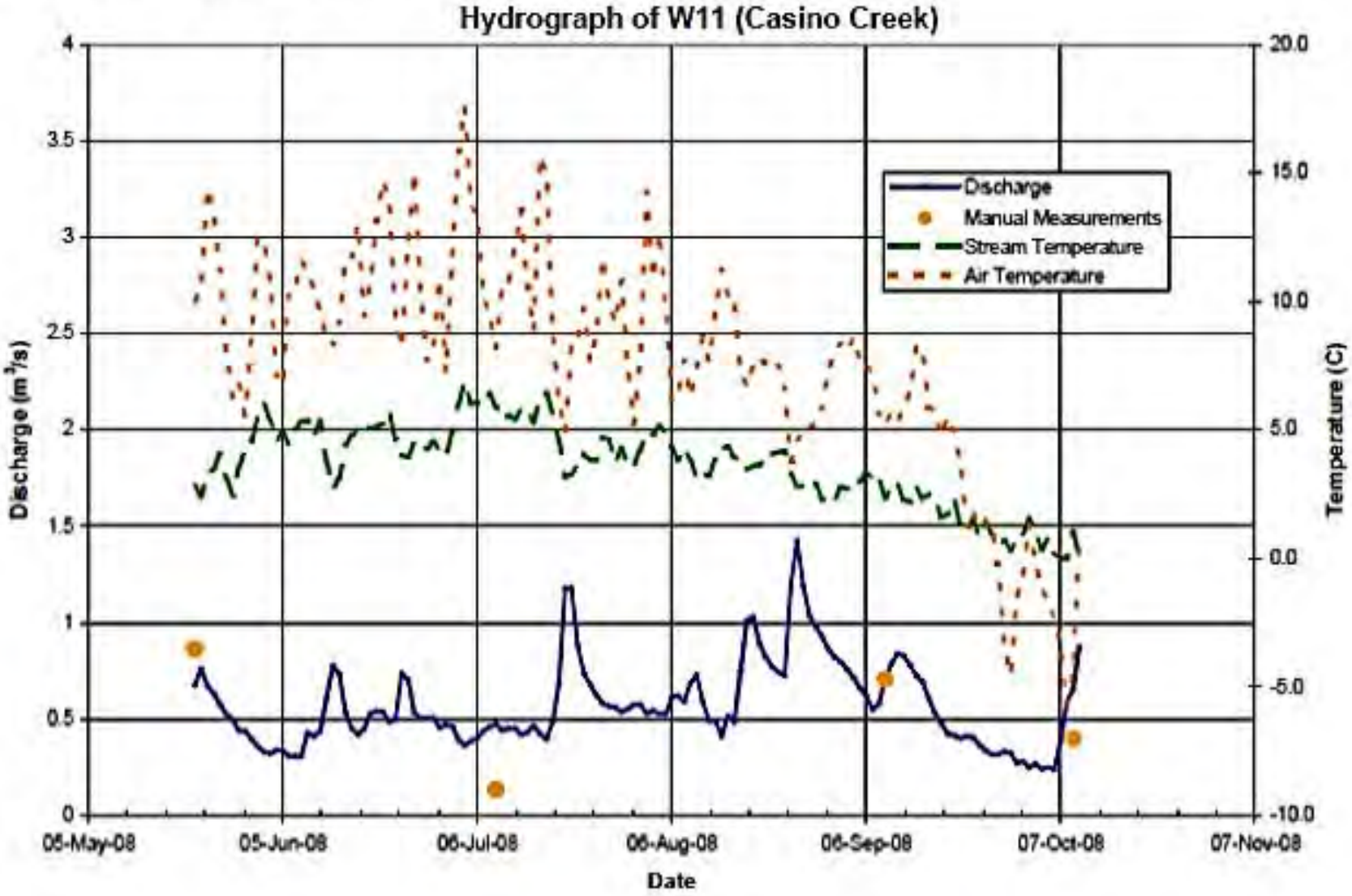
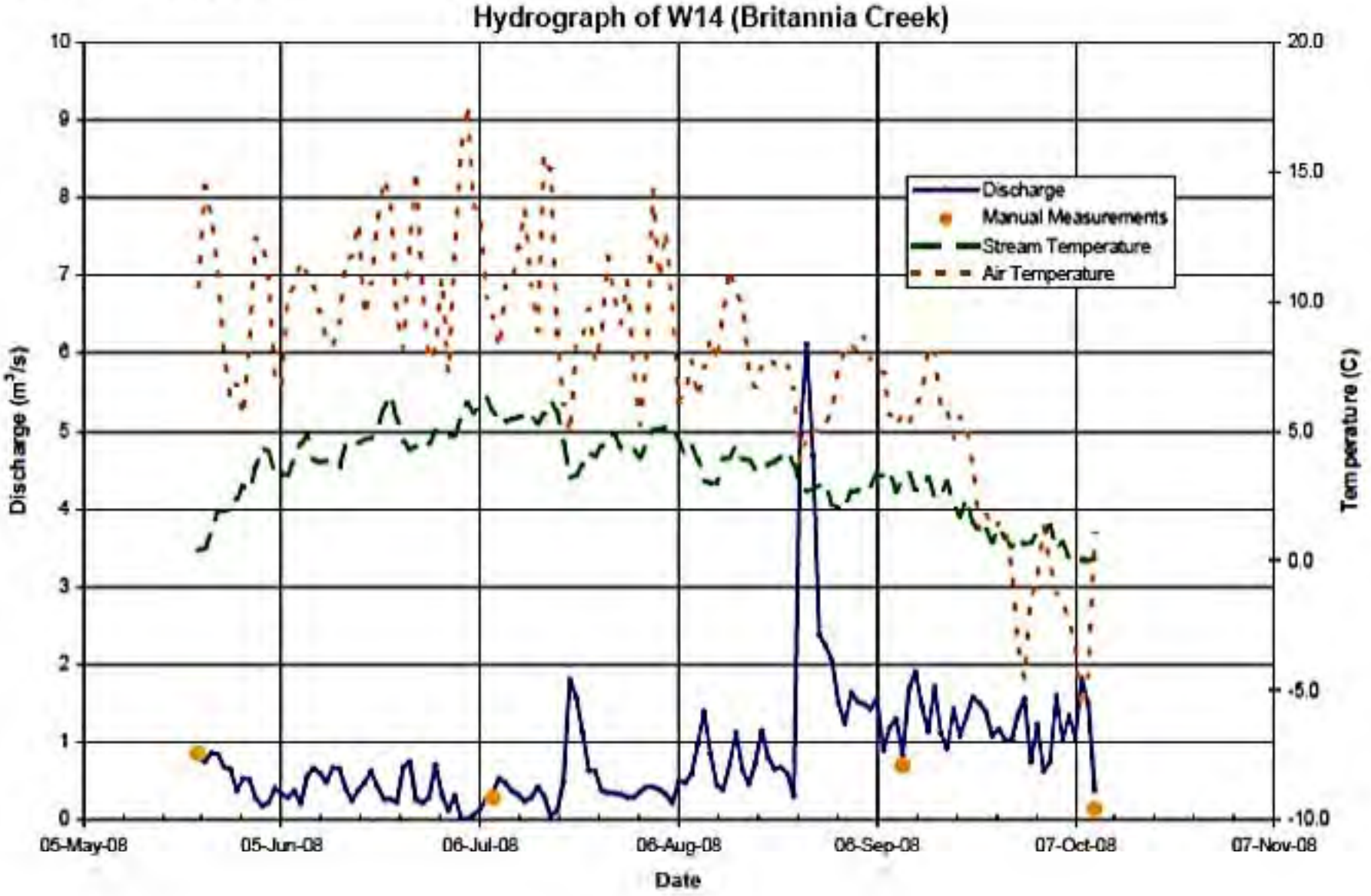


Figure 18. Hydrograph for Station W14, Britannia Creek, Casino Project, 2008



- The peak discharge of freshet, and associated 'falling limb', was only captured at sites along Britannia and Canadian creek (W1 and W3 - Figures 13 and 14).
- A large, regional precipitation event appeared to have occurred, as was evident from a decrease in stream and air temperatures, around July 20, causing a large peak in discharge on July 20 and 21 at all stations.
- A very large, regional precipitation event appeared to have occurred, as was evident from a decrease in stream and air temperatures, around August 25, causing the largest peak in discharge on August 26 for all stations. This peak discharge was large enough to overflow stream banks, as was noted by the presence of overflow channels, newly deposited silt on floodplains and newly deposited debris on floodplain during the September field visit.
- The fluctuating pattern of discharge along Casino Creek (sites W4 and W11 – Figures 15 and 17) and Dip Creek (site W9 – Figure 16) are similar, although unique when comparing these creeks to Canadian Creek (site W3 – Figure 14) and Britannia Creek (sites W1 and W14 – Figures 13 and 18).
- Britannia and Canadian creeks appear to be more "flashy" than Casino and Dip creeks. That is, they appear more responsive to assumed smaller scale precipitation events. However, meteorological data are needed to confirm this conclusion because it is possible that fluctuations in air temperature could be causing melt of permafrost, creating a similar pattern in discharge peaks.
- On several occasions it appears that there no stream flow in Canadian Creek (site W3 – Figure 14), although it is assumed that there was discharge during these times. Additional low flow manual measurements are needed to improve the rating curve at this station.

3.2.1.3 Historic Flow Data

Figures 19 to 21 show the historic flow data calculated from the HKP data that were collected in 1993 and 1994 for hydrometric sites W1, W3 and W4, respectively. When compared to the flow data that was collected in 2008, the following observations can be made:

- peak flow events at site W1 for the HKP data (Figure 19) are similar in magnitude and character (i.e., flashy response) to the peaks observed in 2008 (Figure 13);
- peak flow events at site W3 for the HKP data (Figure 20) are much lower than peak flows observed in 2008 (Figure 14). Both sets of flow data appear to have a flashy response to precipitation events; and
- peak flow events at site W4 for the HKP data (Figure 21) are similar in magnitude and characteristics to the peaks observed in 2008 (Figure 15).

It is important to note that a detailed comparative analyses between the HKP and AECOM flow data are limited due to the relatively small sample size of the manual measurements used to construct the rating curves for the 2008.

3.2.2 Water Quality

3.2.2.1 Statistical Summary

Appendices B2 to B5 show the surface water quality data for the months of May, July, September and October 2008, and Tables 13 and 14 show the minimum, median and maximum values for selected water quality parameters for sites in Casino Creek and Britannia Creek, respectively.

Figure 19. Hydrograph for Station W1, Britannia Creek, Casino Project, 1993-1994

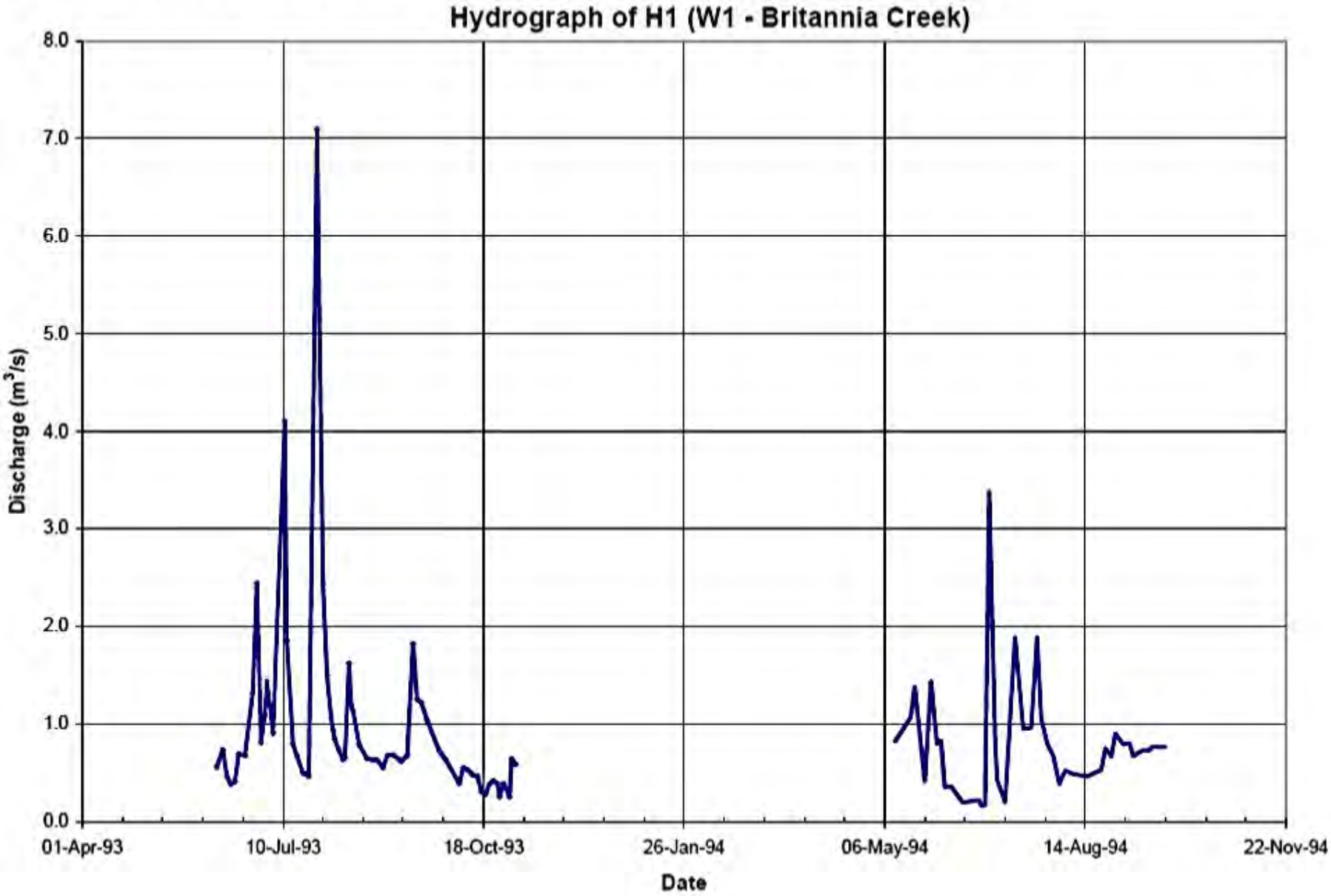


Figure 20. Hydrograph for Station W3, Canadian Creek, Casino Project, 1993-1994

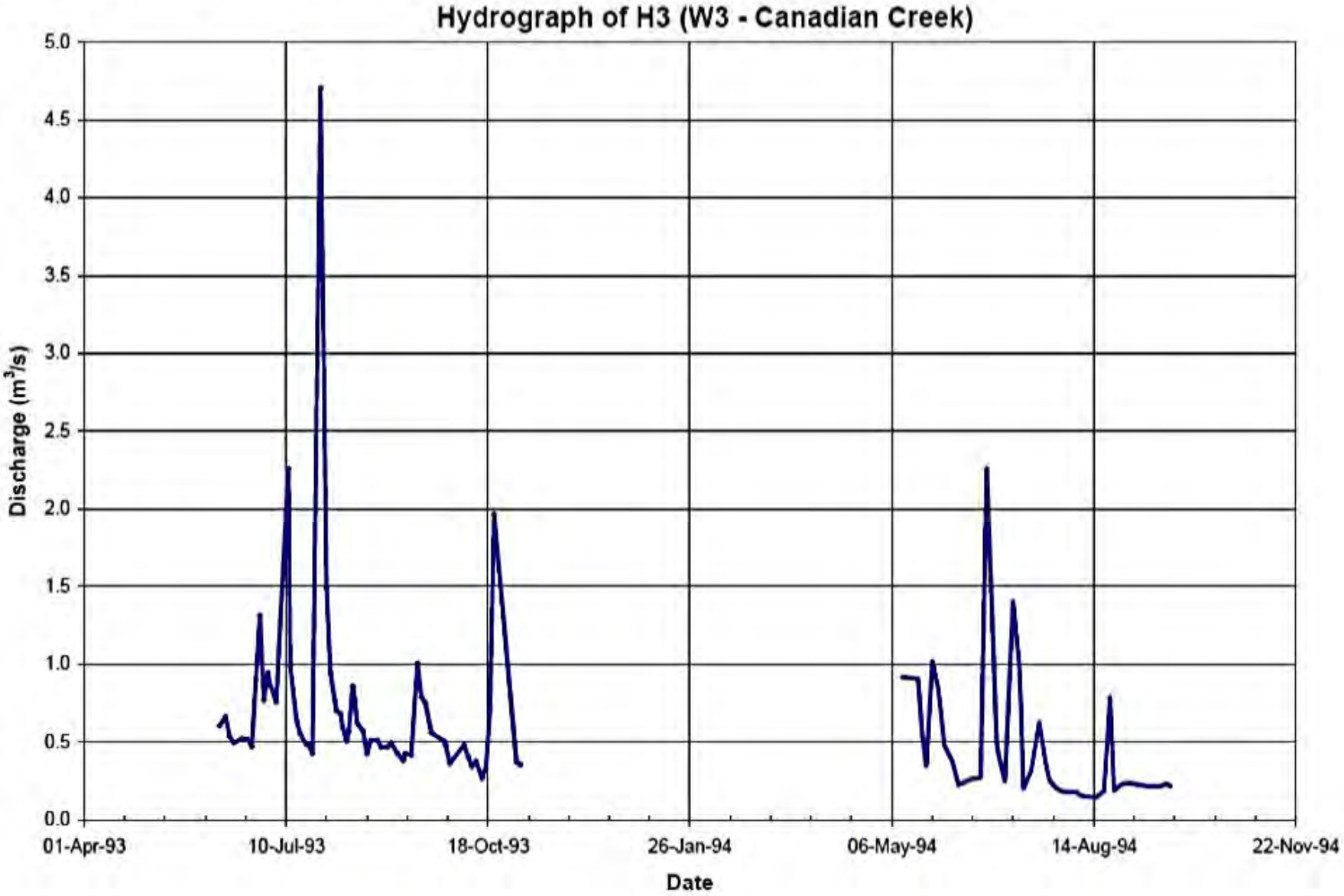


Figure 21. Hydrograph for Station W3, Canadian Creek, Casino Project, 1993-1994

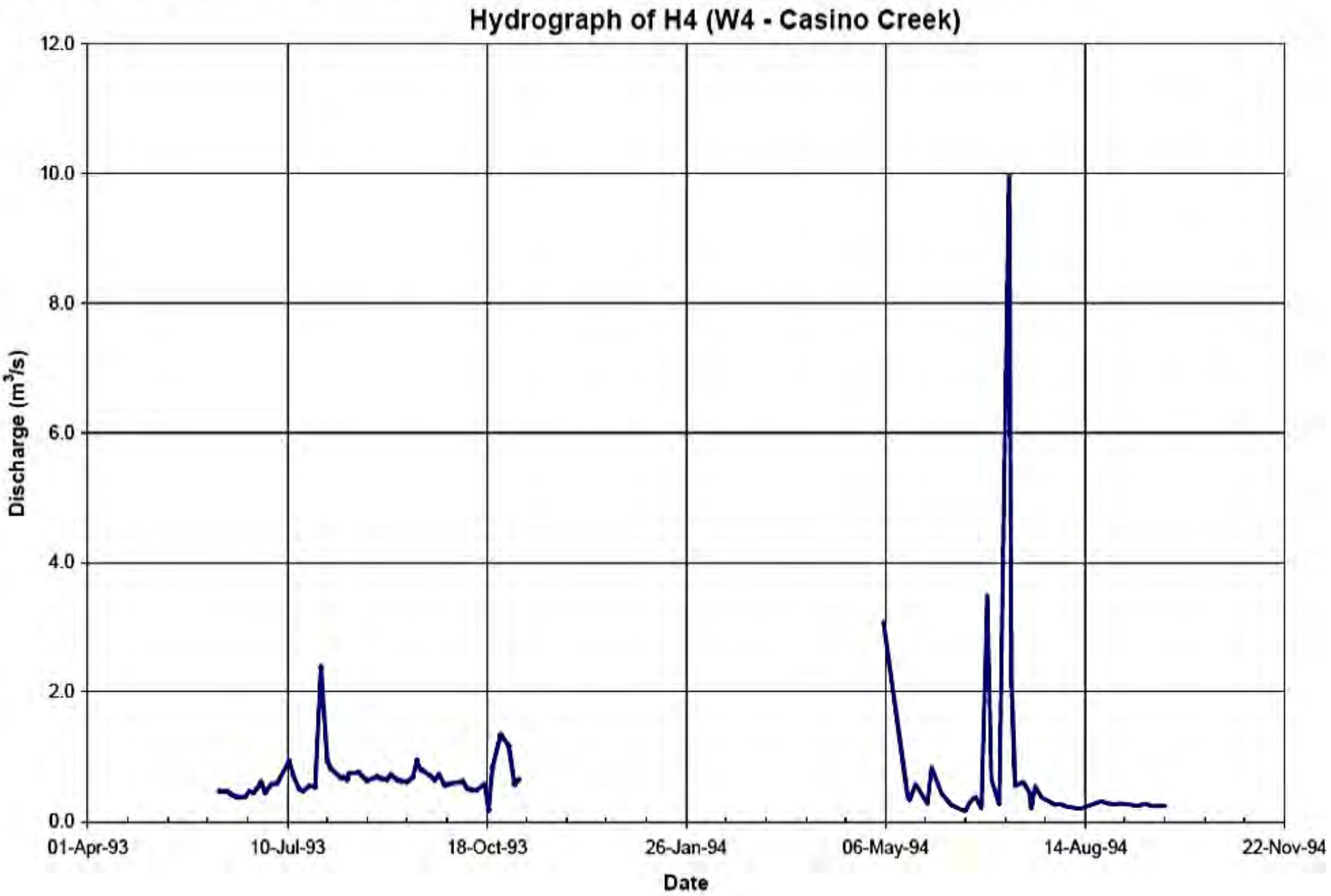


Table 13. Water Quality Summary StatIstics, Casino Creek Watershed, 2008

Station		Hardness (mg/L $CaCO_3$)	Conductivity (µS/cm)	pH	Total Suspended Solids	Total Alkalinity (as mg/L $CaCO_3$)	Sulfate	Total Cyanide	Total Aluminum	Total Arsenic	Total Cadmium	Total Chromium	Total Copper	Total Iron	Total Lead	Total Molybdenum	Total Nickel	Total Selenium	Total Zinc
Water Quality Guidelines	**CCME [a]**	**-**	**-**	**6.5-9.0**	**-**	**-**	**-**	**0.005**	**0.005-0.1**	**0.005**	**0.000017**	**0.001**	**0.002-0.004 [c]**	**0.3**	**0.001-0.007 [d]**	**0.073**	**0.025-0.15**	**0.001**	**0.03**
W43 - Adit Discharge																			
Min		94.4	220	7.5	<1	67	39	<0.0005	0.0024	0.00049	*0.0425*	<0.0001	*0.0608*	0.025	*0.00587*	<0.00005	0.00049	<0.00004	*2.35*
Median		107.55	230	7.5	0.5	75	46.5	<0.0005	0.0088	0.000755	*0.0513*	<0.0001	*0.0717*	0.055	*0.0149*	<0.00005	0.000525	<0.00004	*2.85*
Max		141	300	7.6	4	90	54	<0.0005	0.0235	0.00152	*0.068*	<0.0001	*0.078*	0.112	*0.0181*	<0.00005	0.00057	<0.00004	*3.62*
n		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
W12 - Proctor Gulch																			
Min		75.8	270	*3.2*	2	<0.5	93	<0.0005	*2.43*	0.00027	*0.000799*	0.0003	*0.219*	*6.62*	0.000661	<0.00005	0.00263	0.00008	*0.0575*
Median		285	870	*3.4*	7	<0.5	345	0.00025	*8.33*	0.000275	*0.0021*	0.00055	*0.785*	*20.2*	0.001061	0.000135	0.0054	0.000195	*0.158*
Max		411	1200	*3.9*	14	<0.5	550	0.0101	*12.2*	0.00031	*0.00317*	0.0006	*1.13*	*32.5*	*0.00203*	0.00021	0.00782	0.00025	*0.237*
n		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
W8 - Upper Casino Creek																			
Min		42.3	91	6.9	5	8.8	25	<0.0005	*0.533*	0.00026	*0.000181*	0.0001	*0.0554*	*0.654*	0.000225	0.00014	0.0008	0.00004	0.0128
Median		91.7	210	7.7	13	35	62	0.0006	*0.534*	0.00052	*0.000253*	0.0003	*0.0581*	*0.873*	0.000547	0.00023	0.00113	0.00005	0.0192
Max		125	280	7.8	14	42	90	0.0008	*0.592*	0.00055	*0.00026*	0.0004	*0.0615*	*1.03*	0.00137	0.00025	0.00126	0.00006	0.0214
n		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
W13 - Mouth of Meloy Creek																			
Min		59.1	110	7.5	<1	40	0.6	<0.0005	0.0162	0.00089	*0.000026*	0.0001	0.00054	0.024	0.000218	0.00034	0.00023	<0.00004	0.0014
Median		93.9	200	8.1	3	82	18	0.0007	0.0452	0.00135	*0.000041*	0.0002	0.00098	0.06	0.000662	0.00053	0.0003	0.00004	0.0025
Max		164	330	8.2	5	130	47	0.0009	*0.153*	0.0018	*0.000092*	0.0003	*0.00294*	0.162	*0.00314*	0.00083	0.00084	0.00005	0.0063
n		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
W11 - Casino Creek at proposed tailings impundment																			
Min		56.1	110	7.3	<1	25	21	<0.0005	0.0475	0.00054	*0.000043*	<0.0001	*0.00787*	0.071	0.000041	0.00035	0.0003	<0.00004	0.0018
Median		109.2	240	8.0	2	69.5	46.5	0.000525	*0.142*	0.0006	*0.0000735*	0.000125	*0.0162*	0.236	0.0001325	0.000625	0.000505	0.000075	0.0048
Max		146	300	8.1	4	83	67	0.0009	*0.308*	0.00065	*0.000093*	0.0003	*0.0328*	*0.344*	0.000893	0.00095	0.00092	0.00013	0.0072
n		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
W18 - Brynelsen Creek																			
min/max		70.3	160.0	8.0	1	60	25	0.0005	0.0325	0.00034	0.000008	<0.0001	0.00079	0.025	0.000018	0.00123	0.00019	<0.00004	0.0005
n		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
W4 - Mouth of Casino Creek																			
Min		47.7	92	7.3	1	25	8.8	<0.0005	0.0446	0.00038	0.000013	<0.0001	*0.00371*	0.076	0.000028	0.0005	0.00027	<0.00004	0.0005
Median		94	195	8.0	7	67	32.5	0.0006	*0.122*	0.00046	*0.000031*	0.00025	*0.00697*	0.1835	0.000144	0.000985	0.00045	0.00005	0.00205
Max		111	240	8.0	20	80	42	0.001	*0.368*	0.0007	*0.000066*	0.0004	*0.0164*	*0.414*	0.000847	0.0012	0.00095	0.00006	0.0048
n		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
W9 - Dip Creek upstream of Casino Creek Confluence																			
Min		37.4	65	7.2	3	22	<0.5	0.0009	0.0354	0.00028	<0.000005	0.0001	0.00091	0.072	0.000073	0.00031	0.00032	<0.00004	0.0007
Median		57.15	115	7.9	21	48.5	8.7	0.00095	*0.2525*	0.000525	0.000016	0.0005	0.001885	*0.4075*	0.000457	0.000545	0.000725	0.00003	0.00205
Max		79.7	170	8.0	76	74	15	0.001	*0.583*	0.00086	*0.000057*	0.0007	*0.00333*	*0.931*	*0.00213*	0.0007	0.00146	0.00006	0.0049
n		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
W5 - Dip Creek downstream of Casino Creek Confluence																			
Min		41.4	74	7.3	2	24	<0.5	<0.0005	0.0307	0.00034	0.000015	<0.0001	*0.00226*	0.058	0.000065	0.0004	0.00031	<0.00004	0.001
Median		62.85	130	7.85	21	51.5	13.5	0.0008	*0.313*	0.0006	*0.000028*	0.0005	*0.00341*	*0.504*	0.000664	0.000605	0.0008	0.000035	0.00275
Max		88.2	190	8.0	58	75	25	0.001	*0.489*	0.00077	*0.000054*	0.0006	*0.00669*	*0.724*	*0.00152*	0.00082	0.0011	0.00006	0.0042
n		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
W16 - Dip Creek Far Field Site																			
Min		68.1	140	7.6	13	45	18	<0.0005	*0.203*	0.00063	*0.000018*	0.0005	*0.00296*	*0.384*	0.000222	0.00055	0.00087	<0.00004	0.0015
Median		68.9	140	7.8	18	49	18	0.001	*0.256*	0.00063	*0.000021*	0.0006	*0.00362*	*0.524*	0.000334	0.00057	0.00129	0.00005	0.0029
Max		69	150	7.9	74	56	24	0.0012	*0.413*	0.00123	*0.000048*	0.0007	*0.00529*	*1.09*	0.00104	0.00067	0.00136	0.00008	0.0036
n		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Foot Notes:

All units mg/L unless otherwise noted

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007

b) 0.005mg/L at pH < 6.5, [Ca2+] < 4 mg/L, DOC < 2 mg/L: 0.1 mg/L at pH ≥ 6.5, [Ca2+] ≥ 4 mg/L, DOC ≥ 2 mg/L

c) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] =120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180mg/L

d) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] =60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180mg/L; 0.007 mg/L at [CaCO3] > 180mg/L

e) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] =60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 -180mg/L; 0.150 mg/L at [CaCO3] > 180mg/L

Italic results exceed CCME Aquatic Life Guidelines

Table 14. Water Quality Summary Statistics, Britannia Creek Watershed, 2008

Station		Hardness (mg/L $CaCO_3$)	Conductivity (uS/cm)	pH	Total Suspended Solids	Total Alkalinity (as mg/L $CaCO_3$)	Sulfate	Total Cyanide	Total Aluminum	Total Arsenic	Total Cadmium	Total Chromium	Total Copper	Total Iron	Total Lead	Total Molybdenum	Total Nickel	Total Selenium	Total Zinc
Water Quality Guidelines	**CCME [a]**	**-**	**-**	**6.5-9.0**	**-**	**-**	**-**	**0.005**	**0.005-0.1[b]**	**0.005**	**0.000017**	**0.001**	**0.002-0.004[c]**	**0.3**	**0.001-0.007**	**0.073**	**0.025-0.15[d]**	**0.001**	**0.03**
W7 - Upper Brittania Creek																			
Min		15.1	34.0	*5.5*	1.0	0.6	39.0	0.0006	0.0253	0.00016	*0.000087*	0.0001	0.00139	0.019	0.000031	0.0002	0.00063	0.00005	0.0061
Median		39.5	115	7.0	1.0	5.85	43.0	0.0008	0.0754	0.00026	*0.000187*	0.0002	*0.00275*	0.064	0.000117	0.00026	0.00084	0.00006	0.0136
Max		44.7	130	7.1	34.0	7.3	47.0	0.0010	*0.479*	0.00065	*0.000261*	0.0004	*0.0107*	*0.574*	0.000513	0.00033	0.00169	0.00006	0.0195
n		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
W3 - Canadia Creek upstream of Brittania Creek Confluence																			
Min		45.8	89.0	7.4	1.0	22.0	15.0	0.0007	0.0159	0.00057	0.000014	0.0002	*0.00217*	0.016	0.00001	0.00037	0.00066	0.00006	0.0005
Median		101	220	7.9	3.0	57.5	45.0	0.00085	*0.126*	0.000915	*0.0000425*	0.0005	*0.00390*	0.125	0.00023	0.000755	0.00097	0.00006	0.0040
Max		121	260	8	18.0	72	57.0	0.001	*0.415*	0.0012	*0.000084*	0.0008	*0.0081*	*0.540*	0.00147	0.00093	0.00211	0.00007	0.0133
n		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
W14 - Britannia Creek upstream of Canadian Creek Confluence																			
Min		28.3	49	7	2.0	10.0	30.0	0.0007	0.0494	0.0005	0.000007	0.0002	0.00158	0.037	0.000072	0.00009	0.0005	0.00006	0.0006
Median		115	245	7.9	7.0	75.0	52.0	0.00125	*0.203*	0.00078	*0.000020*	0.0004	*0.00211*	0.264	0.00019	0.000505	0.00073	0.00007	0.0016
Max		158	320	8.1	34	100	91.0	0.0017	*0.542*	0.00103	*0.000031*	0.0007	*0.00423*	*0.567*	0.0015	0.000550	0.00105	0.00008	0.0033
n		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
W2 - Britannia Creek downstream of Canadian Creek Confluence																			
Min		41.1	78.0	7.1	3.0	15.0	8.8	0.0006	*0.105*	0.00082	*0.000021*	0.0003	0.00277	0.107	0.000321	0.00026	0.00087	<0.00004	0.0016
Median		83.0	180	7.9	20	50.0	38.0	0.0012	*0.236*	0.00099	*0.000023*	0.0004	*0.00339*	*0.344*	0.000393	0.00057	0.00090	0.00005	0.0016
Max		138	290	8	25	83	60.0	0.0012	*0.46*	0.0011	*0.000069*	0.0007	*0.00603*	*0.549*	0.000443	0.00071	0.00164	0.00008	0.0049
n		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
W1 - Lower Britannia Creek																			
Min		49.6	92	7.2	<1	21.0	17.0	0.0008	0.0222	0.0005	0.000011	<0.0001	0.00194	0.017	0.00003	0.0003	0.0006	<0.00004	0.0003
Median		114	240	8.0	3.5	68.0	43.0	0.001	0.0852	0.000635	0.000015	0.0003	*0.00261*	0.095	0.000062	0.00068	0.00077	0.00008	0.0008
Max		143	300	8.1	190	82.0	63.0	0.0013	*0.723*	0.00162	*0.00008*	*0.0011*	*0.00663*	*1.00*	0.000866	0.00077	0.00227	0.00011	0.0062
n		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
W6b - Yukon River upstream of Britannia Creek																			
Min		98.1	170	7.8	14	61.0	19.0	<0.0005	*0.124*	0.00059	*0.000077*	0.0002	0.00139	0.193	0.000224	0.00059	0.0021	0.00042	0.0061
Median		106	205	8.1	23.5	76.0	28.5	<0.0005	*0.226*	0.00068	*0.000089*	0.0004	0.00168	*0.408*	0.000318	0.00095	0.0027	0.0005	0.0078
Max		109	220	8.1	190	81.0	33.0	<0.0005	*0.678*	0.00212	*0.000621*	*0.0011*	*0.00808*	*2.17*	0.0029	0.0010	0.0101	0.00068	*0.0436*
n		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
W6a - Yukon River downstream of Britannia Creek																			
Min		76.1	150	7.8	12	61.0	13.0	<0.0005	0.0954	0.00051	*0.000032*	0.0002	0.00114	0.152	0.000169	0.00068	0.00117	0.00023	0.0028
Median		84.1	180	8.1	20	68.0	18.5	0.00025	*0.1715*	0.000595	*0.000051*	0.00035	0.00139	0.2845	0.000535	0.00095	0.00152	0.00030	0.0052
Max		93.4	180	8.1	140	73.0	25.0	0.0008	*0.636*	0.00177	*0.000369*	*0.0011*	*0.00595*	*1.56*	0.00183	0.00101	0.00662	0.00033	0.0248
n		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
W15 - Yukon River far field site																			
Min		84.6	160	7.8	32	63.0	17.0	<0.0005	*0.137*	0.00064	*0.000056*	0.0002	0.00143	0.225	0.00027	0.00066	0.00192	0.00034	0.0045
Median		103	180	7.9	32	64.0	24.0	<0.0005	*0.276*	0.00073	*0.000088*	0.0006	0.00176	*0.487*	0.00037	0.00088	0.00219	0.00046	0.0065
Max		107	220	8.1	200	80.0	31.0	<0.0005	*0.708*	0.00204	*0.000591*	*0.0012*	*0.00724*	*1.95*	*0.00249*	0.00102	0.00925	0.00053	*0.0381*
n		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
W17- Sunshine Creek																			
Min		49.9	96.0	7.4	1	30.0	1.6	0.001	0.06	0.00062	*0.000018*	0.0003	0.00175	0.058	0.000094	0.00021	0.00057	0.00004	0.0012
Median		83.9	180	7.9	6	63.0	26.0	0.0011	*0.136*	0.00064	*0.000021*	0.0003	0.00194	0.191	0.00014	0.0004	0.00071	0.00006	0.0014
Max		97.4	190	7.9	7	68.0	27.0	0.0013	*0.214*	0.00092	*0.000022*	0.0003	0.00199	0.196	0.000145	0.00041	0.00083	0.00007	0.0014
n		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Foot Notes:
All units mg/L unless otherwise noted
a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007
b) 0.005mg/L at pH < 6.5, [Ca2+] < 4 mg/L, DOC < 2 mg/L: 0.1 mg/L at pH ≥ 6.5, [Ca2+] ≥ 4 mg/L, DOC ≥ 2 mg/L
c) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] =120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180mg/L
d) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] =60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180mg/L; 0.007 mg/L at [CaCO3] > 180mg/L
e) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] =60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 -180mg/L; 0.150 mg/L at [CaCO3] > 180mg/L
Italic results exceed CCME Aquatic Life Guidelines

3.2.2.2 Exceedances of Water Quality Guidelines

Table 15 shows that CCME guidelines for protection of freshwater aquatic life were exceeded for pH, total cyanide (CN) and eight total metals: aluminum (Al), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), lead (Pb), silver (Ag) and zinc (Zn). Exceedances of at least one parameter were found at all sites except W18, but that station was only sampled in October. The number of exceedances was highest for cadmium, copper and aluminum and least for cyanide (Figure 22). Exceedances of cadmium, copper and aluminum often occurred together at the same stations. Exceedances were most numerous in May (n = 84), similar between July (n = 46) and September (n = 50), and least numerous in October (n = 24), indicating a seasonal trend related to hydrological factors such as snow melt and stream flow.

Table 15. Water Quality Parameters Exceeding CCME Guidelines, Casino Project, 2008

Site	May	July	September	October
W7	pH, Al, Cd, Cu, Fe	Cd, Cu	Al, Cd, Cu	Cd
W3	Al, Cd, Cu, Fe	-	Al, Cd, Cu	Cu
W14	Al, Cd, Cu, Fe	Al	Al, Cd, Cu, Fe	-
W2	Al, Cd, Cu, Fe	Al, Cd, Fe	Al, Cd, Cu	NS
W1	Al, Cd, Cr, Cu, Fe	-	Cu	-
W6b	Al, Cd, Cr, Cu, Fe, Pb, Zn	Al, Cd, Fe	Al, Cd	Al, Cd, Fe
W6a	Al, Cd, Cr, Cu, Fe	Al, Cd, Fe	Cd	Al, Cd
W15	Al, Cd, Cr, Cu, Fe, Pb, Zn	Al, Cd, Fe	Al, Cd	NS
W17	Al, Cd	Al, Cd	Cd	NS
W43	Cd, Cu, Pb, Zn	Cd, Cu, Pb, Zn	Cd, Cu, Pb, Ag, Zn	Cd, Cu, Pb, Ag, Zn
W12	pH, Al, Cd, Cu, Pb, Fe, Zn	pH, Al, Cd, Cu, Fe, Zn	pH, Al, Cd, Cu, Fe, Zn	pH, CN, Al, Cd, Cu, Fe, Zn
W8	Al, Cd, Cu, Fe	Al, Cd, Cu, Fe	Al, Cd, Cu, Fe	NS
W13	Al, Cd, Cu, Pb	Cd	Cd	NS
W11	Al, Cd, Cu, Fe	Cd, Cu	Al, Cd, Cu	Cd, Cu
W18	NS	NS	NS	-
W4	Al, Cd, Cu, Fe	Cu	Al, Cd, Cu	Cd, Cu
W9	Al, Cd, Cu, Fe, Pb	Al, Cu, Fe	Al	-
W5	Al, Cd, Cu, Fe, Pb	Al, Cd, Cu, Fe	Al, Cd, Cu, Fe	Cu
W16	Al, Cd, Cu, Fe	Al, Cd, Cu, Fe	Al, Cd, Cu, Fe	NS

Dashes indicate no parameters exceeded CCME guidelines. NS = Not sampled.

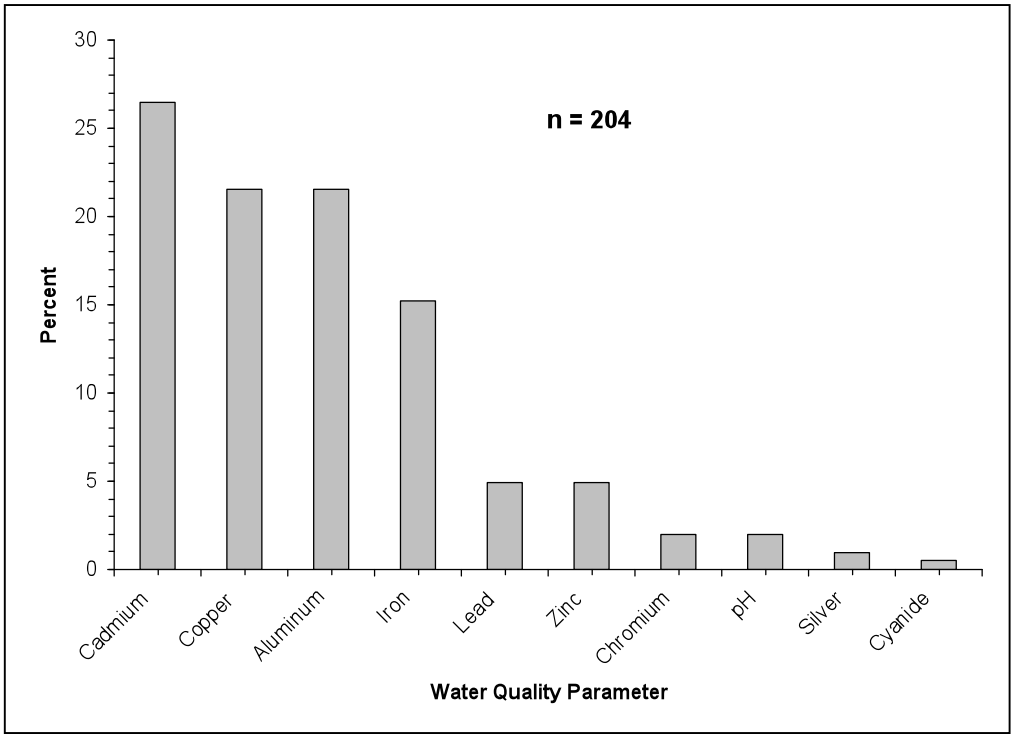


Figure 22. Water Quality Exceedances of CCME Guidelines, Casino Project, 2008

3.2.2.3 Principal Component Analysis

Data

Field measurements of pH and conductivity were excluded from the dataset because the laboratory measurements of pH and conductivity were assumed to be more accurate. Acidity and TOC were excluded because they were measured in less than 10% of the records. Six variables were excluded (total boron, total tin, dissolved bismuth, dissolved boron, dissolved mercury and dissolved tin) because 90% or more of the records were below detection limits. For the remaining 79 variables, a total of 822 records (or 14% of the dataset) were replaced: 732 records of metal concentrations below detection limits were replaced by one-half the detection limit, 60 absent records of DOC for May, July and September were replaced by the mean for October and 30 absent records of dissolved metals for station W3 on September 10 were replaced with the geometric means of dissolved metals that were calculated from records for May, July and October. All metals were ln-transformed to normalize their distributions.

Components and Their Correlations

Eleven components were extracted from the data matrix, but the first five components accounted for 70.5% of the explained variance and a scree plot (not shown here) indicated that the remaining six factors were of little significance (Table 16).

Table 16. Correlations of Water Quality Parameters with Principal Components

Parameter	WQ1	WQ2	WQ3	WQ4	WQ5
Percent explained variance	19.2	16.6	15.4	11.9	7.4
Cumulative explained variance	19.2	35.8	51.2	63.1	70.5
Total Cadmium	0.95	-0.03	0.03	-0.15	0.16
Total Zinc	0.95	0.00	-0.01	-0.12	0.15
Dissolved Cadmium	0.94	-0.04	0.02	-0.27	0.05
Dissolved Zinc	0.93	-0.03	0.01	-0.10	0.00
Total Silver	0.91	0.01	-0.06	0.05	0.05
Dissolved Silver	0.87	0.16	0.17	-0.16	-0.11
Dissolved Lead	0.86	0.07	0.03	0.06	-0.10
Total Lead	0.84	0.01	-0.07	0.37	0.05
Dissolved Manganese	0.83	0.33	0.12	-0.02	-0.17
Total Thallium	0.79	0.36	0.18	0.20	0.28
Total Manganese	0.78	0.32	0.11	0.21	0.14
Dissolved Copper	0.76	0.50	0.20	-0.21	-0.13
Dissolved Thallium	0.74	0.24	0.38	-0.18	0.21
Total Copper	0.74	0.51	0.23	-0.15	-0.02
Total Antimony	0.69	-0.52	0.37	-0.02	-0.12
Dissolved Antimony	0.65	-0.53	0.36	-0.04	-0.15
Total Molybdenum	-0.91	-0.09	0.09	0.13	0.19
Dissolved Molybdenum	-0.90	-0.08	0.02	0.19	0.22
Dissolved Iron	0.09	0.93	0.06	0.26	0.04
Dissolved Aluminum	-0.09	0.91	0.00	0.23	0.08
Dissolved Beryllium	0.24	0.85	-0.02	0.17	0.02
Total Aluminum	-0.09	0.81	-0.01	0.36	0.28
Total Beryllium	0.16	0.78	-0.01	0.38	0.33
Total Iron	0.16	0.75	0.07	0.38	0.31
Dissolved Cobalt	0.55	0.75	0.15	-0.08	-0.08
Total Cobalt	0.45	0.71	0.12	0.19	0.30
Dissolved Chromium	-0.11	0.64	-0.03	0.59	-0.01
Sulfate	0.22	0.57	0.56	-0.25	0.18
Nitrite	0.02	0.45	-0.17	0.08	-0.06
Ammonia	0.08	0.43	0.24	-0.10	0.32
Total Mercury	0.15	0.39	-0.27	0.09	-0.10
pH	-0.40	-0.78	-0.08	0.15	-0.11
Alkalinity	-0.18	-0.75	0.51	-0.04	0.02
Dissolved Barium	-0.13	-0.67	0.12	0.00	-0.22
Total Barium	-0.10	-0.63	-0.01	0.36	0.13
Nitrate	0.20	-0.46	0.43	-0.15	-0.51
Total Magnesium	-0.01	-0.11	0.95	-0.08	0.16
Dissolved Calcium	0.14	0.04	0.88	-0.28	0.23
Total Calcium	0.13	0.03	0.88	-0.28	0.24
Total Strontium	0.18	-0.27	0.85	-0.21	-0.09
Dissolved Strontium	0.20	-0.26	0.85	-0.22	-0.12
Hardness	0.15	0.30	0.82	-0.23	0.24
Total Uranium	-0.18	0.14	0.81	0.13	-0.36
Dissolved Uranium	-0.21	0.07	0.73	0.12	-0.39
Total Potassium	0.30	-0.01	0.72	0.04	0.06
Dissolved Potassium	0.31	0.02	0.71	0.03	0.04
Conductivity	0.20	0.45	0.71	-0.27	0.20
Total Sodium	-0.06	-0.07	0.68	-0.36	-0.24
Dissolved Magnesium	-0.05	-0.20	0.64	-0.03	0.05
TDS	0.16	0.42	0.64	-0.24	0.22
Dissolved Lithium	0.35	0.04	0.41	-0.03	0.22
Total Lithium	0.30	0.02	0.37	0.00	0.26

Parameter	WQ1	WQ2	WQ3	WQ4	WQ5
Total Vanadium	-0.24	0.07	-0.34	0.83	0.20
Total Titanium	-0.30	0.15	-0.34	0.79	0.14
Total Chromium	-0.16	0.45	-0.10	0.78	0.28
Total Phosphorus	-0.01	0.20	-0.33	0.76	0.37
Total Zirconium	-0.30	0.27	-0.17	0.74	-0.20
Total Arsenic	0.15	-0.35	0.10	0.72	0.16
Dissolved Vanadium	-0.20	0.14	-0.19	0.66	-0.07
Dissolved Titanium	0.03	0.46	-0.32	0.65	-0.03
Dissolved Phosphorous	0.09	0.50	-0.37	0.62	-0.03
Dissolved Zirconium	-0.27	0.41	-0.01	0.62	-0.36
TSS	0.06	0.02	-0.14	0.60	0.45
Dissolved Arsenic	-0.19	-0.29	0.24	0.47	-0.03
TKN	-0.15	0.41	-0.26	0.43	-0.18
Dissolved Silicon	0.12	0.00	0.36	-0.46	-0.21
Total Silicon	0.11	-0.01	0.38	-0.49	-0.17
Total Selenium	-0.21	0.09	0.20	0.00	0.87
Dissolved Selenium	-0.27	0.12	0.17	0.11	0.86
Total Nickel	0.18	0.48	-0.02	0.37	0.74
Turbidity	0.13	0.19	0.02	0.29	0.67
Dissolved Nickel	0.25	0.49	-0.08	0.24	0.64
Total Cyanide	-0.04	0.20	0.18	0.09	-0.05
Cyanide WAD	0.03	0.26	0.06	0.16	-0.06
Dissolved Sodium	0.02	0.11	0.53	-0.21	-0.05
Ortho-Phosphorus	0.06	-0.22	0.02	-0.27	0.28
Chloride	0.03	-0.10	0.15	0.04	-0.07
Total Bismuth	0.13	0.22	-0.43	0.41	0.22
DOC	-0.24	-0.01	0.18	0.11	-0.12

The first component, WQ1, was positively correlated with 16 dissolved and total metals, including cadmium, zinc, silver, lead, manganese, thallium, copper and antimony, and negatively correlated with total and dissolved molybdenum. This was called the “heavy metals” component because it reflects the magnitudes of the concentrations of heavy metals. The first component extracted from a water quality data set is almost always a “size” or “magnitude” component.

The second component, WQ2, was positively correlated with ten dissolved and total metals, including iron, aluminum, beryllium, cobalt, chromium and mercury, one anion – sulphate – and two nutrients – nitrite and ammonia – and negatively correlated with pH, alkalinity, barium and nitrate. This was called the “iron-pH” component because it reflects a pH- and alkalinity-related difference in metal concentrations among sites and dates.

The third component, WQ3, was positively correlated with hardness, conductivity, TDS, and 13 total and dissolved metals, including magnesium, calcium, strontium, uranium, potassium, sodium and lithium. The metals are all those associated with TDS, which typically reflects the influence of groundwater flows. Therefore, WQ3 was called the “TDS” component.

The fourth component, WQ4, was positively correlated with 12 dissolved and total metals, including vanadium, titanium chromium, phosphorus, zirconium and arsenic, TSS and TKN and negatively correlated with dissolved and total silicon. It was called the “vanadium-silicon” component.

The fifth component, WQ5, was positively correlated with dissolved and total selenium and nickel and turbidity. It was called the "selenium-nickel-turbidity" component.

Seven parameters – total cyanide, cyanide WAD, dissolved sodium, ortho-phosphorus, chloride, total bismuth and DOC – were not significantly correlated with any of the first six components.

Spatial and Temporal Variation in WQ1 Scores

The highest mean WQ1 score was observed at site W43, the discharge pipe of the adit of the lower camp, which discharges into upper Meloy Creek of the Casino Creek Watershed (Figure 23). The second highest mean WQ1 score was observed for site W12 in Proctor Gulch, the uppermost reach of Casino Creek, and the third highest mean score was at site W8 in the upper reach of Casino Creek upstream of the confluence of Meloy Creek. The lowest mean WQ1 score was for site W18 in Brynelsen Creek. Mean WQ1 scores for the other 15 sites fell within a narrow range. These findings indicate that WQ1 represents the geochemical signal of drainage from the adit of the lower camp, and that adit drainage flows downstream through all of the water quality sampling sites of Casino Creek except for Brynelsen Creek.

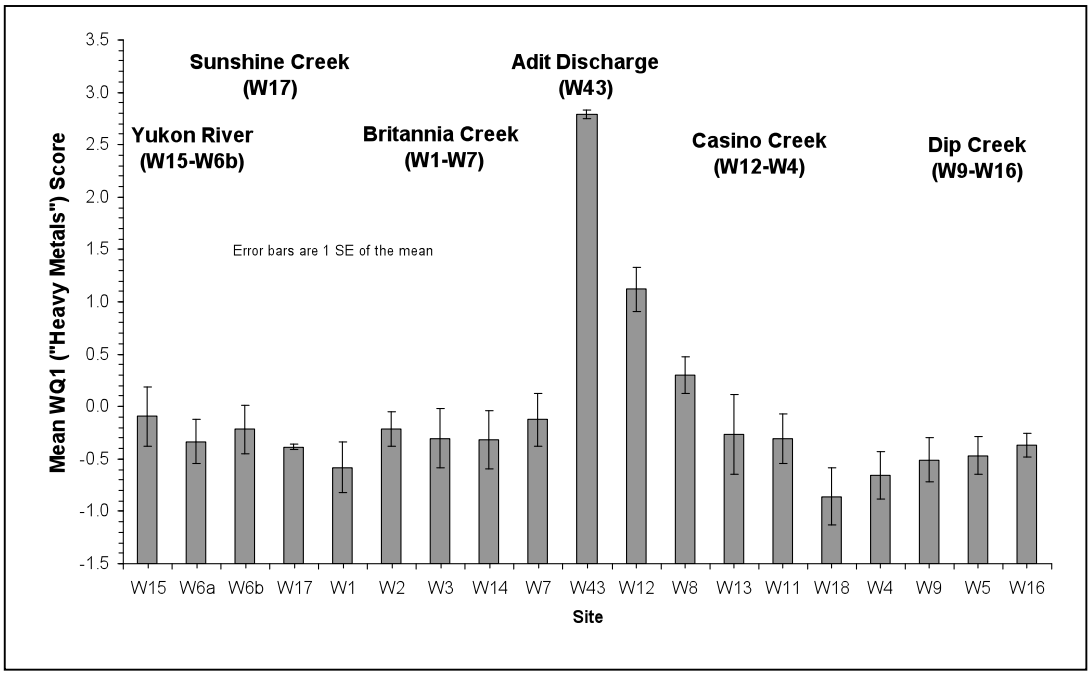


Figure 23. Plot of Mean WQ1 Scores on Sampling Site, Casino Project, 2008

WQ1 scores were highest in May and decreased continuously over the open-water season at all three Yukon River sites (Figure 24). The WQ1 scores for site W17 in Sunshine Creek did not show a seasonal trend. WQ1 scores for the five sites in the Britannia Creek Watershed showed a strong seasonal trend with the highest scores in May and September and the lowest in July and October (Figure 25). WQ1 scores in the Casino Creek Watershed showed the downstream gradient. WQ1 scores for site W43 did not show a seasonal trend, but WQ1 scores for the other five sites showed a bimodal seasonal pattern similar to that

observed in the Britannia Creek Watershed (Figure 26). WQ1 scores for the three sites along Dip Creek showed a strong decreasing seasonal trend with less of a bimodal pattern. (Figure 27). The seasonal trends, particularly the bimodal pattern observed in Britannia and Casino creeks, indicate that WQ1 scores vary directly with stream flow.

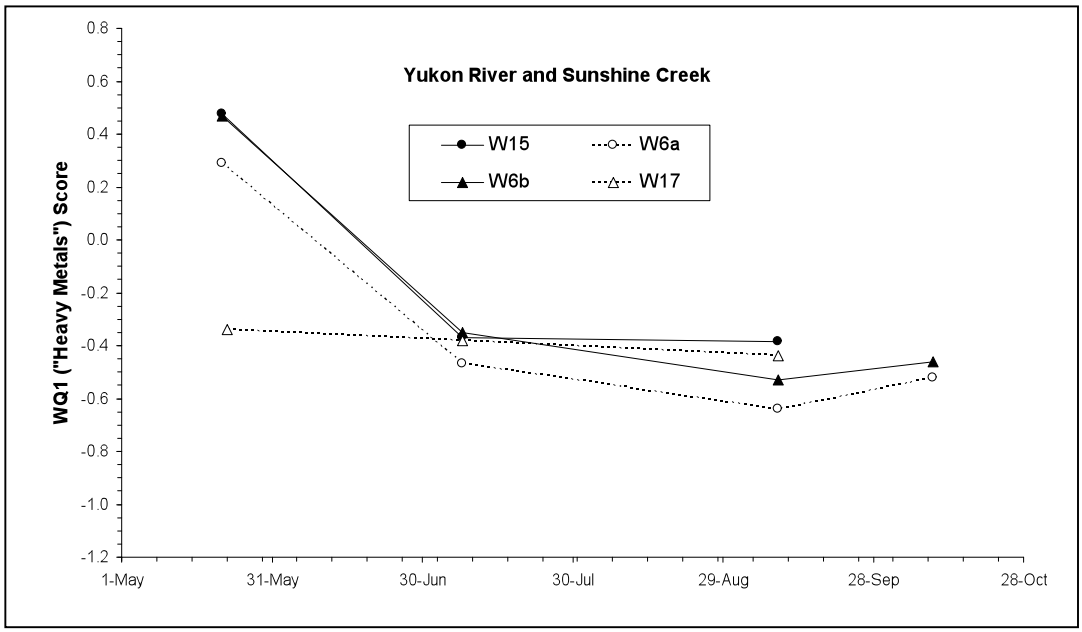
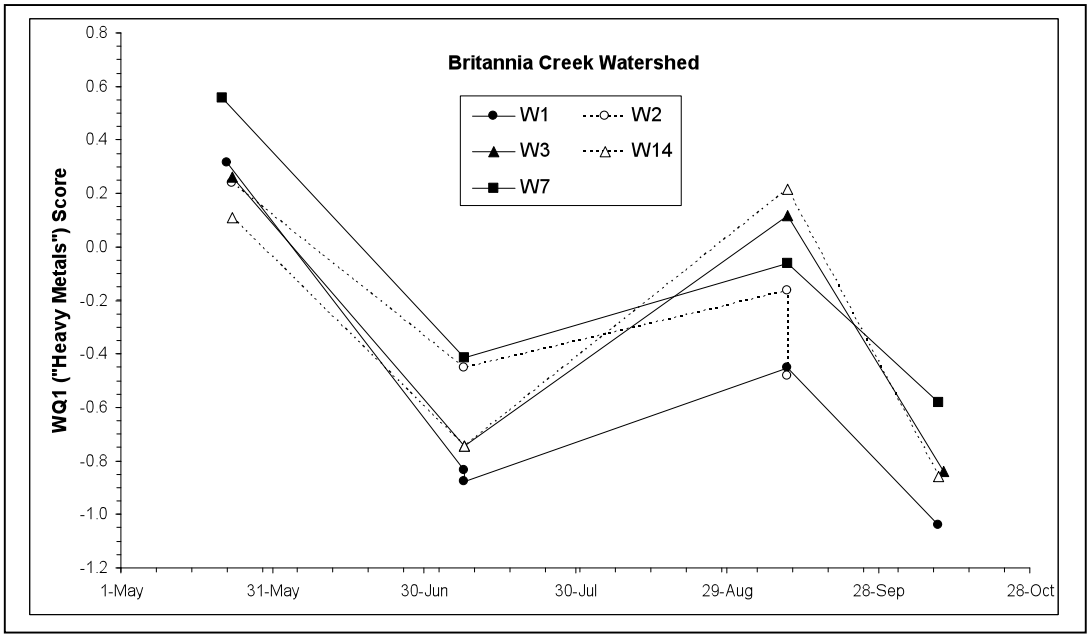


Figure 24. Plot of WQ1 Scores on Sampling Date, Yukon River and Sunshine Creek, Casino Project, 2008



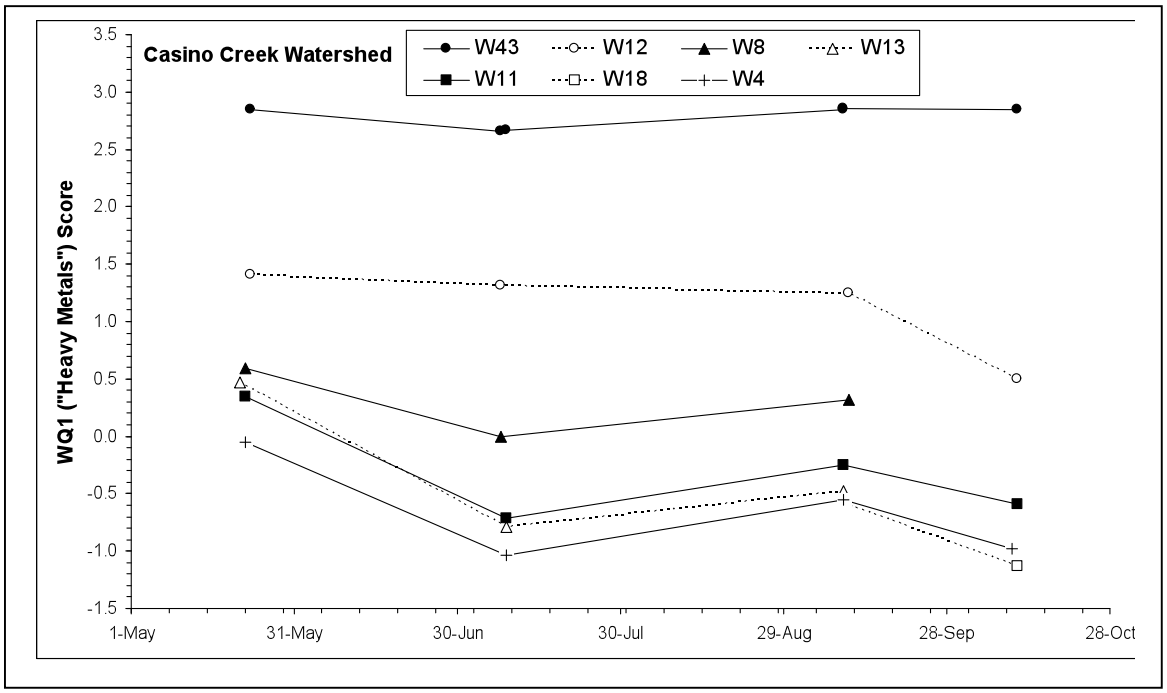
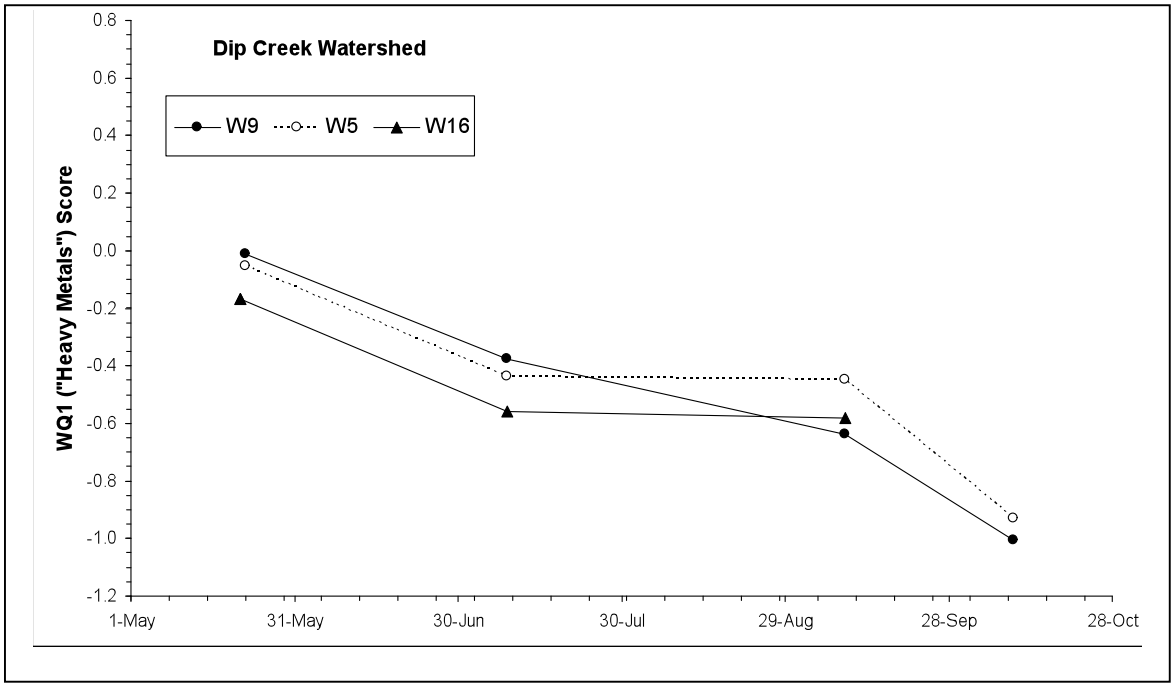


Figure 25. Plot of WQ1 Scores on Sampling Date, Britannia Creek Watershed, Casino Project, 2008

Figure 26. Plot of WQ1 Scores on Sampling Date, Casino Creek Watershed, Casino



Project, 2008

Figure 27. Plot of WQ1 Scores on Sampling Date, Dip Creek Watershed, Casino Project, 2008

In summary, these findings indicate that WQ1 represents the geochemical signal of drainage from the adit of the lower camp, and that adit drainage flows downstream through all of the water quality sampling sites of Casino Creek except for Brynelsen Creek. However, since WQ1 shows spatial and seasonal variation at sites in Dip Creek, Britannia Creek and the Yukon River, it also reflects a geochemical signature found elsewhere in the study area, albeit at lower concentrations than at the adit drainage site.

Spatial and Temporal Variation in WQ2 Scores

The highest mean WQ2 score was observed for site W12 at the head of Casino Creek and the lowest mean WQ2 score was observed at site W43, the adit discharge pipe (Figure 28). Upstream-downstream gradients in mean WQ2 score were observed for the Britannia Creek Watershed and for the upper mainstem of the Dip Creek Watershed (i.e., sites W12, W8 and W13). Mean WQ2 scores were uniformly low for the three sites in the Yukon River. The mean WQ2 score for site W17 in Sunshine Creek was between the values for the Yukon River sites and site W1 in Britannia Creek. Mean WQ2 scores for the three sites in Dip Creek were similar to those at the head of Britannia Creek (i.e., site W7). Therefore, WQ2 reflects the geochemical signature of the surficial geology of Proctor Gulch, the upper Casino Creek and Britannia Creek.

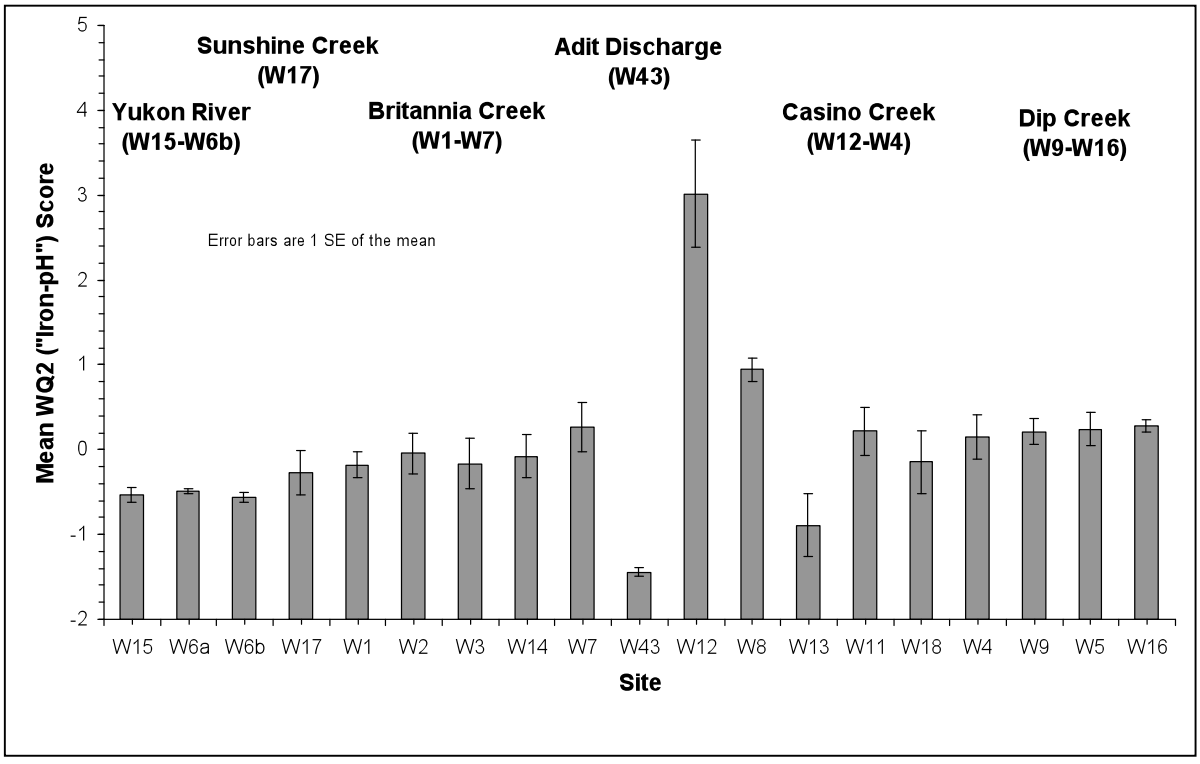


Figure 28. Plot of Mean WQ2 Scores on Sampling Site, Casino Project, 2008

With the exception of sites in the Britannia Creek Watershed, site W17 of Sunshine Creek and site W12 in upper Casino Creek, there was less seasonal variation in WQ2 scores than in WQ1 scores (Figures 29 to 32). As with WQ1, seasonal variation indicates that WQ2 scores vary directly with stream flow.

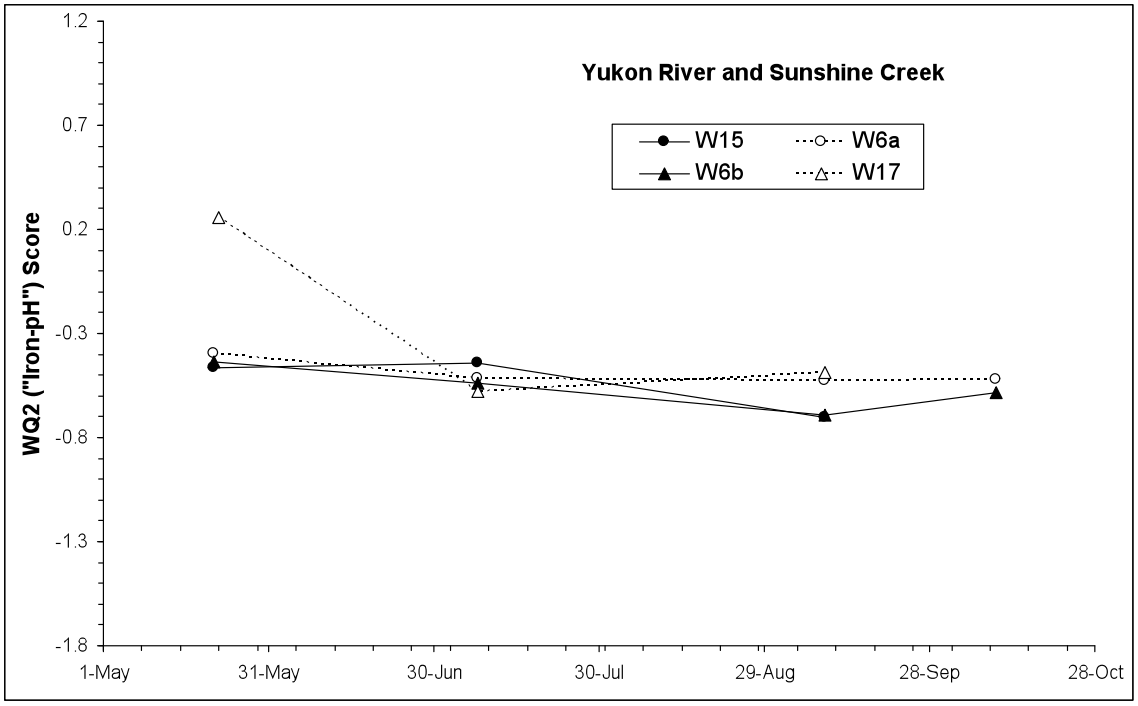


Figure 29. Plot of WQ2 Scores on Sampling Date, Yukon River and Sunshine Creek, Casino Project, 2008

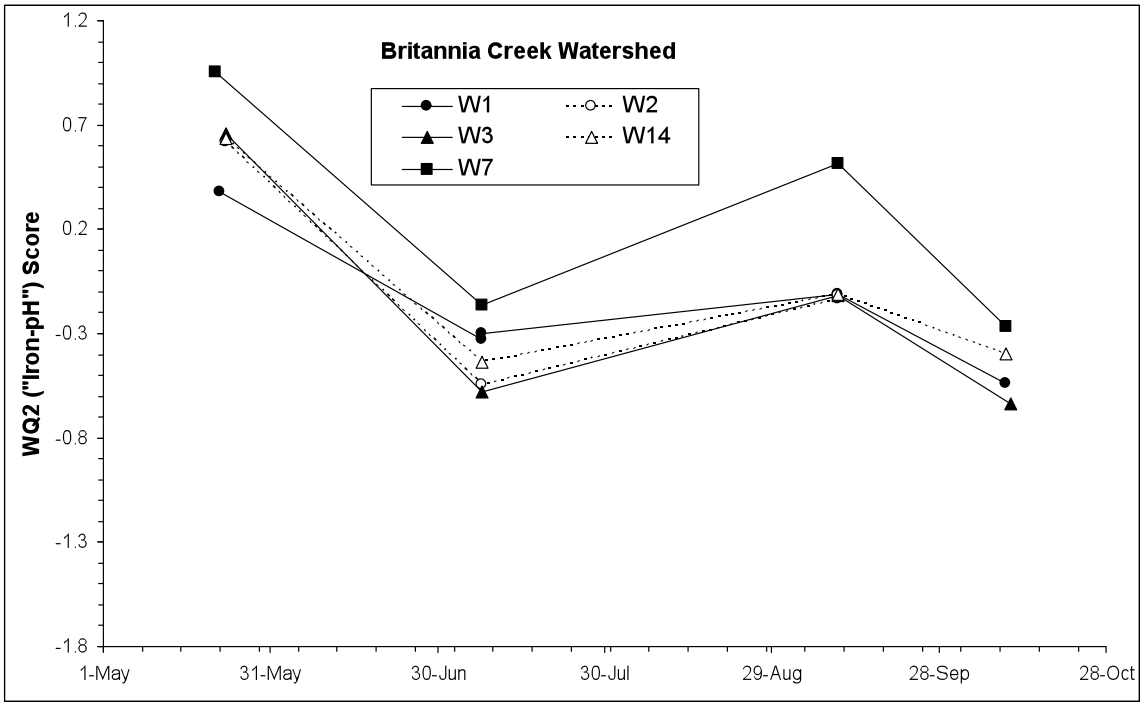


Figure 30. Plot of WQ2 Scores on Sampling Date, Britannia Creek Watershed, Casino Project, 2008

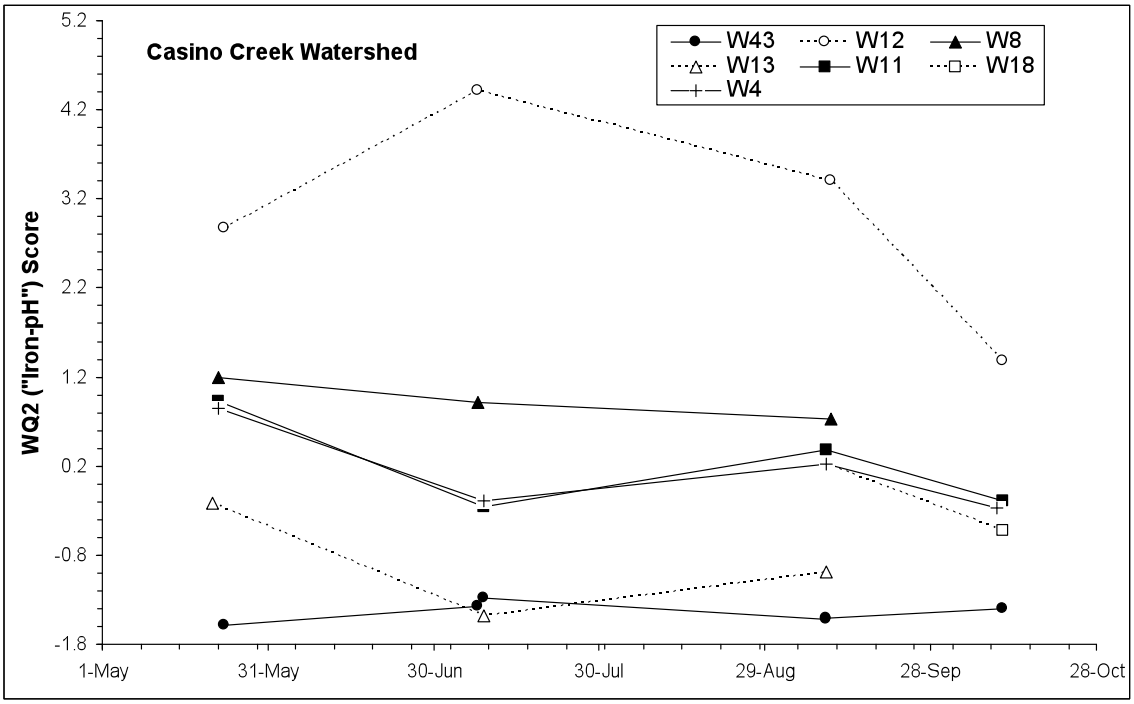


Figure 31. Plot of WQ2 Scores on Sampling Date, Casino Creek Watershed, Casino Project, 2008

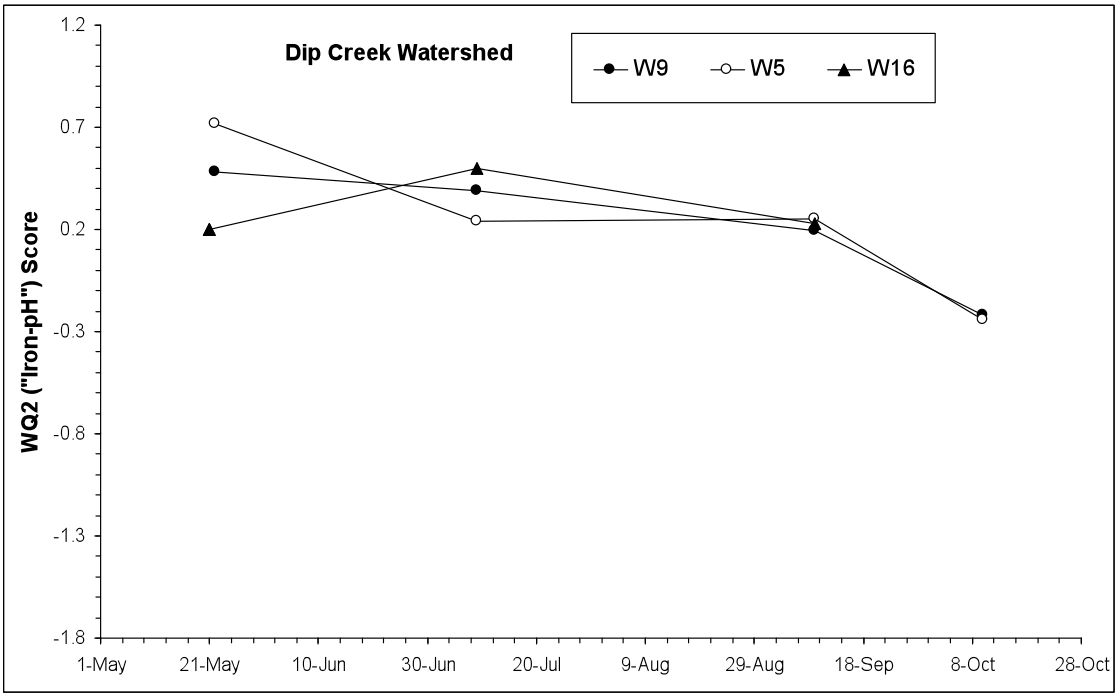


Figure 32. Plot of WQ2 Scores on Sampling Date, Dip Creek Watershed, Casino Project, 2008

In summary, these findings indicate that WQ2 reflects the geochemical signature of the surficial geology of Proctor Gulch, the upper Casino Creek and Britannia Creek. Seasonal trends in WQ2 reflect stream flows.

Spatial Variation in WQ3 Scores

Mean WQ3 scores were lowest for site W7, the uppermost site in Britannia Creek, and highest for site W12 in Proctor Gulch (Figure 33). Since WQ3 is assumed to reflects the influence of groundwater, then site W7 is much less influenced by groundwater than all other sites.

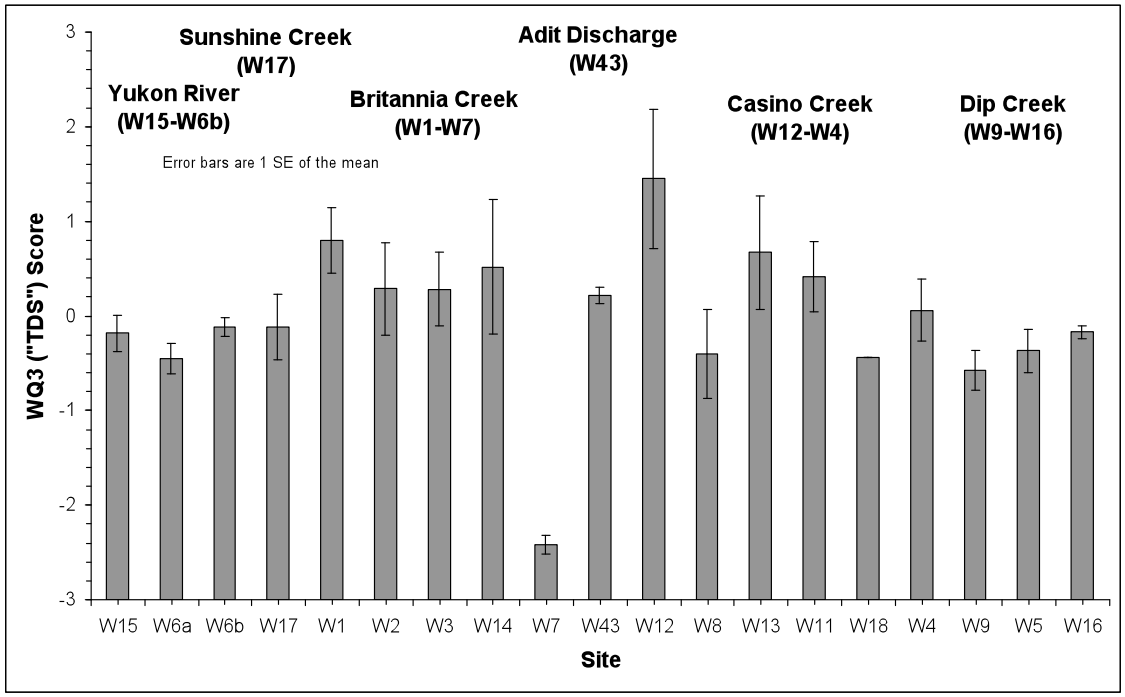


Figure 33. Plot of Mean WQ3 Scores on Sampling Site, Casino Project, 2008

Spatial Variation in WQ4 Scores

Mean WQ4 scores were lowest for sites in Casino Creek and in upper Britannia Creek, and highest for sites in Dip Creek, Britannia Creek, Sunshine Creek and the Yukon River (Figure 34). Therefore, WQ4 represents a geochemical signal found at all sites except those in Casino Creek and upper Britannia Creek.

Spatial Variation in WQ5 Scores

Mean WQ5 scores were highest for sites in the Yukon River (Figure 35). Hence, WQ5 represents a geochemical signal associated with the Yukon River.

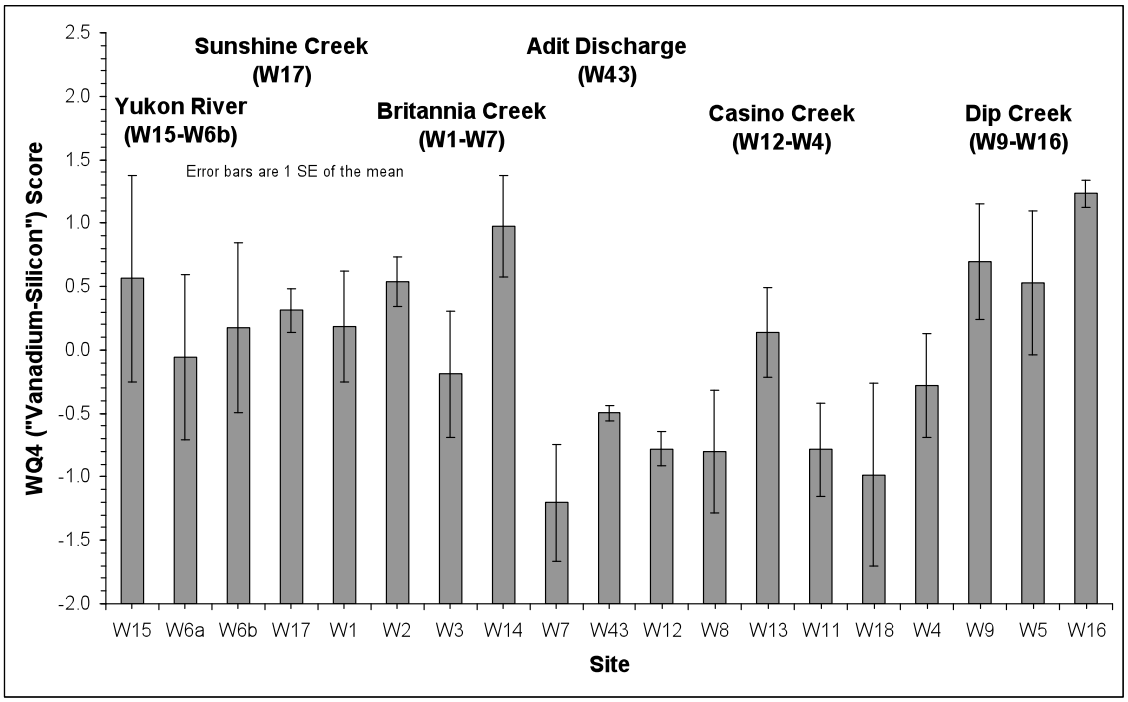


Figure 34. Plot of Mean WQ4 Scores on Sampling Site, Casino Project, 2008

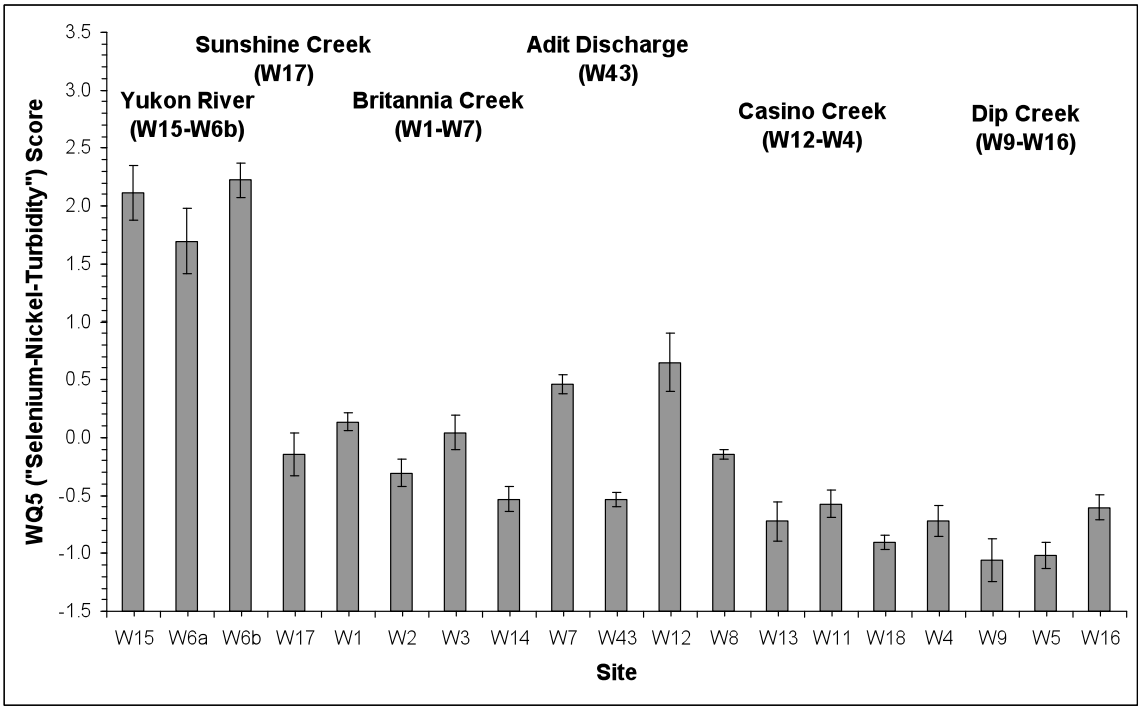


Figure 35. Plot of Mean WQ5 Scores on Sampling Site, Casino Project, 2008

3.2.3 Sediment Quality

3.2.3.1 Exceedances of Sediment Quality Guidelines

Appendix B7 shows the sediment quality data. Table 17 shows that exceedances of CCME sediment guidelines were observed for five total metals: arsenic (As), cadmium (Cd), copper (Cu), lead (Pb) and zinc (Zn). All of those metals except arsenic were also observed to exceed CCME water quality guidelines at some stations on some dates.

Table 17. Sediment Quality Parameters Exceeding CCME Guidelines, Casino Project, 2008

Site	Interim Freshwater Sediment Quality Guideline (ISQG)	ISQG and Probable Effects Level (PEL)
W7	As, Cd, Cu	-
W3	-	As
W14	As	-
W2	-	As
W1	As	-
W12	Pb, Zn	As, Cu
W8	Cd, Pb, Zn	As, Cu
W13	Cd, Zn	As, Pb
W11	Cd, Cu, Zn	As, Pb
W4	As	-
W9	As	-
W5	As	-

Dashes indicate sample did not exceed CCME Guidelines.

3.2.3.2 Principal Component Analysis

Mercury and selenium were removed from PCA because all values of those two metals were below detection limits. Of the remaining metals, a total of 10 concentrations below detection limits (or 3% of the total number of values) were replaced with one-half the detection limit. Then, pH and ln-transformed metal concentrations were entered into PCA. The first run extracted six components of which only the first three explained significant amounts of explained variance. Twelve metals (beryllium, calcium, chromium, copper, iron, magnesium, molybdenum, nickel, potassium, strontium, thallium and zirconium) were not highly correlated with those six components, hence they were removed and PCA was run a second time.

Three components were extracted that accounted for 87.7% of the explained variance: 48.1% for SQ1, 28.2% for SQ2 and 11.4% for SQ3. Table 18 shows that SQ1 was positively correlated with manganese, cadmium, cobalt, zinc, lead and antimony; SQ2 was positively correlated with vanadium, titanium, aluminum, tin, phosphorus, sodium and barium; and SQ3 was positively correlated with bismuth, silver and arsenic and negatively correlated with pH.

Table 18. Correlations of Sediment Quality Variables with Principal Components

Variable	SQ1	SQ2	SQ3
Manganese	0.941	0.279	-0.030
Cadmium	0.927	0.007	0.217
Cobalt	0.833	0.064	0.062
Zinc	0.806	0.321	0.467
Lead	0.798	0.255	0.499
Antimony	0.656	-0.079	0.629
Vanadium	0.185	0.952	0.082
Titanium	0.240	0.919	-0.110
Aluminum	0.289	0.905	0.220
Tin	0.269	0.869	0.268
Phosphorous	-0.177	0.862	0.031
Sodium	-0.369	0.796	-0.425
Barium	0.517	0.721	0.229
Bismuth	0.264	0.039	0.789
Silver	0.472	0.206	0.758
Arsenic	0.476	-0.372	0.706
pH	0.242	-0.238	-0.888

A plot of SQ1 scores on sampling site (Figure 36) showed that the highest scores were at three adjacent sites in Casino Creek (W8, W11 and W13). A plot of SQ2 scores on sampling site (Figure 37) showed a general decreasing north-south trend with the lowest scores in reach 1 of Britannia Creek and the highest scores at two sites in Dip Creek and at site W4 in lower Casino Creek. A plot of SQ3 scores on sampling site (Figure 38) showed the highest score at site W12 in the headwaters of Casino Creek.

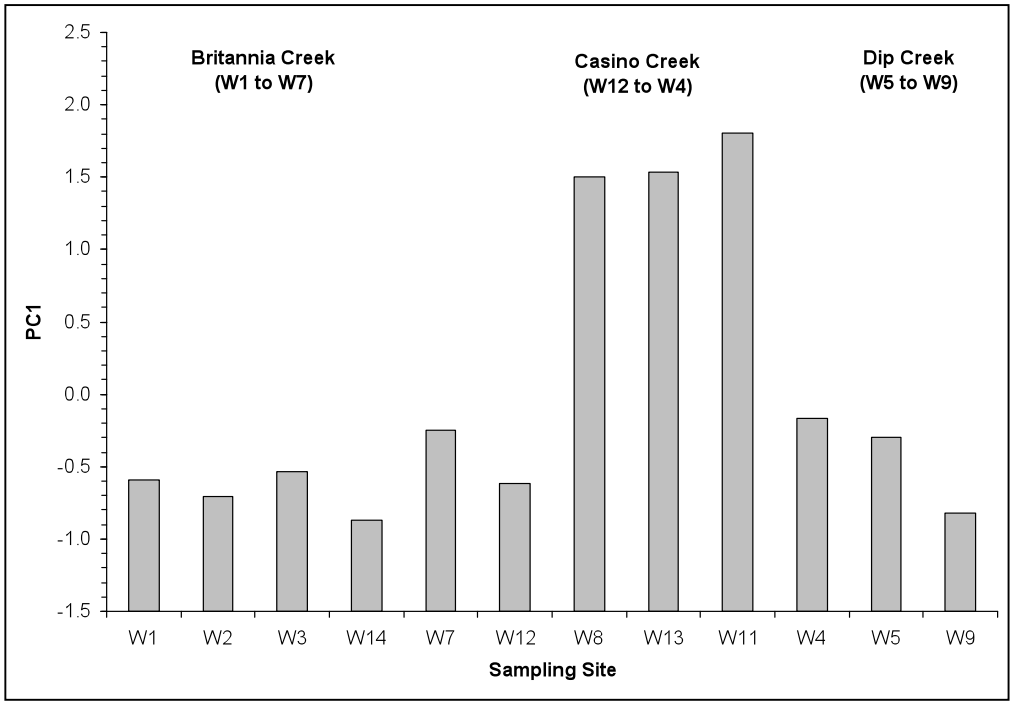


Figure 36. Plot of SQ1 Scores on Sampling Site

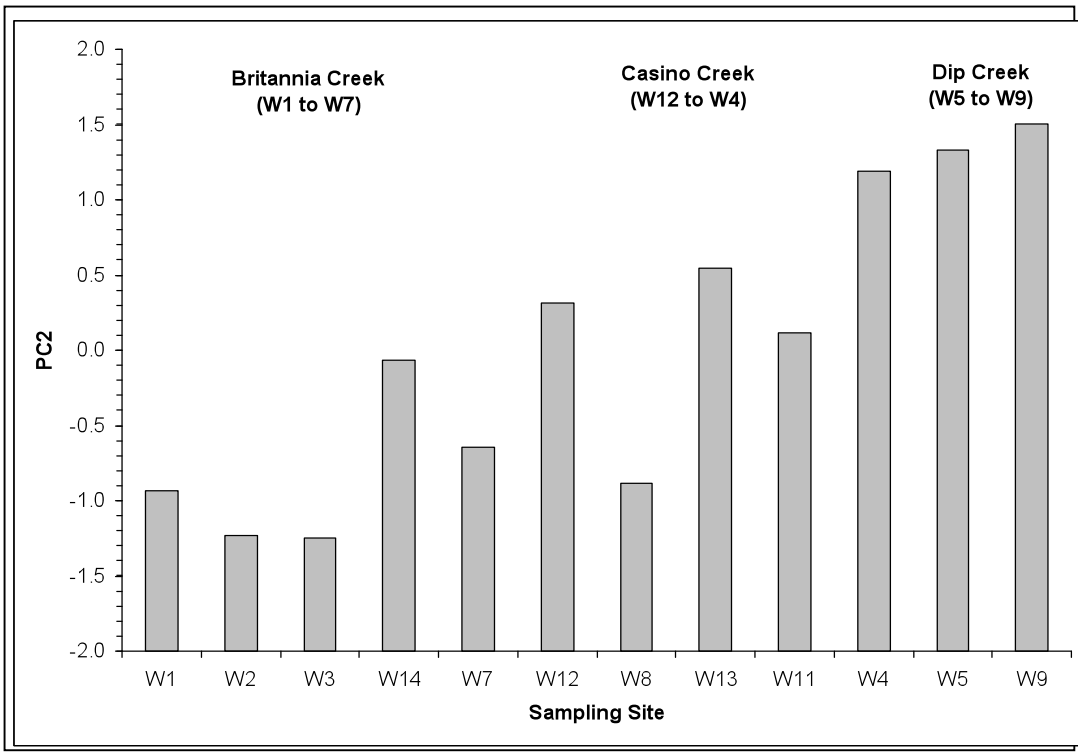


Figure 37. Plot of SQ2 Scores on Sampling Site

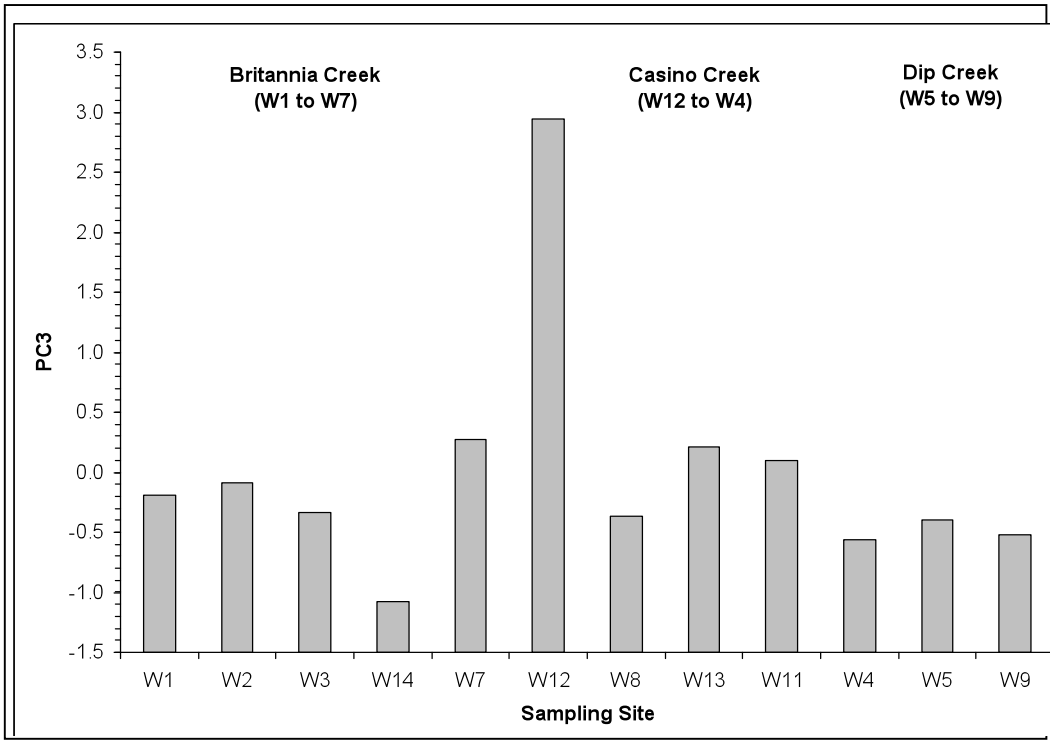


Figure 38. Plot of SQ3 Scores on Sampling Site

3.2.4 Periphyton

Appendix B8 shows the densities (cells/cm^2) by taxa for each of the 35 samples of periphyton collected from the seven sampling sites in September 2008.

Figure 39 shows the mean densities of periphyton for each site. One-way ANOVA of the ln-transformed densities showed there were highly significant differences in mean density among sites ($F_{6,28}$ = 14.34, P<0.001). Post-hoc comparisons of means using the Bonferroni test showed that mean density at sites P8, P7 and P4 were significantly (P<0.05) higher than at other sites.

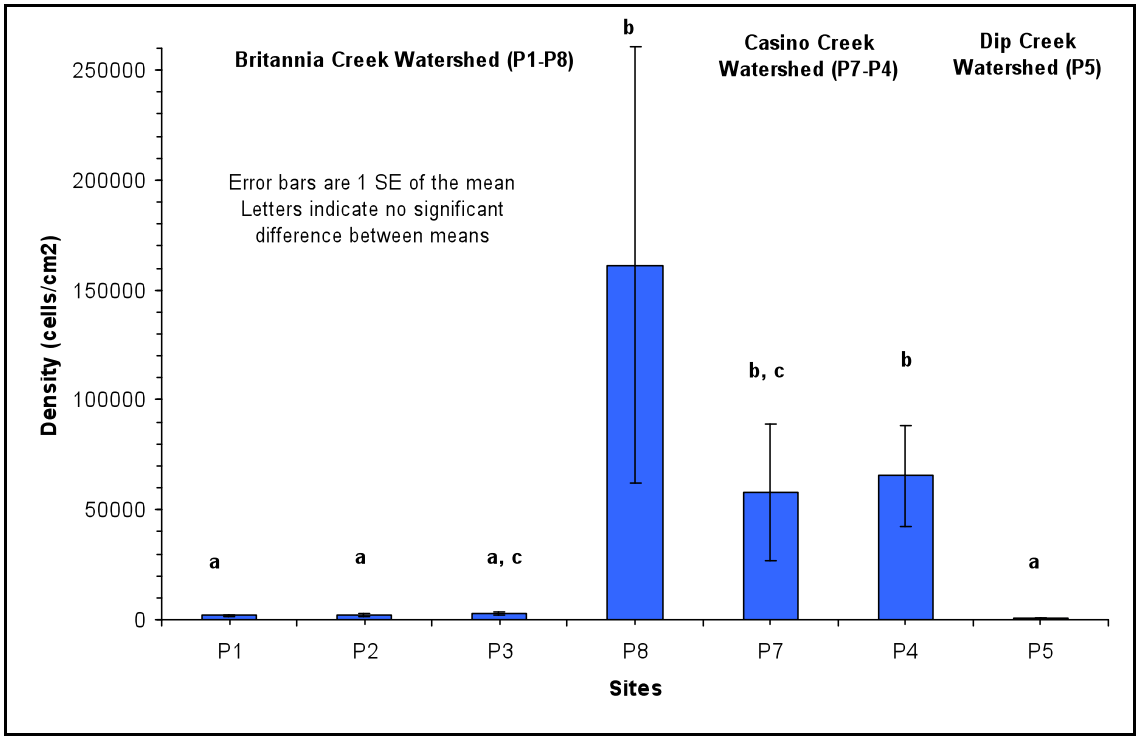


Figure 39. Mean Density of Periphyton by Site, Casino Project, 2008

Table 19 shows the percentage composition of the periphyton community at each sampling site. Britannia Creek sites P1, P2, and P3 were dominated by *Diatoma elongatum* and yellow-brown algae, *Chromulina sp.*, whereas site P8 was dominated by yellow-brown algae, *Homoeothrix varians*, and blue-green algae. Casino Creek site P4 was dominated by two blue-green algae, *Oscillatoria cf. agardhii* and *Homoeothrix varians*, whereas site P7 within the Casino Creek watershed was solely dominated by *Homoeothrix varians*. Dip Creek watershed site,P5 was dominated by blue-green algae, *Chromulina sp.*, followed by *Ceratuneis arcus*.

Table 19. Percentage Composition of Periphyton Communities, Casino Project, 2008

Taxon	Percentage of Number of Cells/cm^2						
	P1	P2	P3	P8	P7	P4	P5
Achnanthes lanceolata	0.00	0.00	0.00	0.04	0.04	0.00	0.00
Achnanthes minutissima	3.22	0.73	0.87	0.01	2.15	1.04	2.26
Achnanthes spp.	0.96	0.76	1.38	0.05	2.62	0.87	2.73
Caloneis spp.	0.00	0.00	0.00	0.00	0.06	0.00	0.00
Ceratoneis arcus	3.13	1.51	2.58	3.15	0.66	3.02	16.70
Cocconeis placentula	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Cymbella cf. cestaii	0.00	0.01	0.01	0.00	0.00	0.00	0.00
Cymbella cistula	0.00	0.00	0.04	0.00	0.00	0.01	0.00
Cymbella minuta	0.52	0.30	0.22	0.00	0.18	0.33	1.08
Cymbella sinuata	0.13	0.52	0.43	0.00	0.11	0.05	1.25
Diatoma elongatum	21.91	37.06	32.69	0.00	0.00	3.16	2.73
Diatoma mesodon	0.01	0.00	0.00	8.82	0.10	0.00	0.00
Didymosphenia geminata	0.00	0.00	0.00	0.00	0.00	0.04	0.00
Eunotia spp.	0.00	0.00	0.00	0.01	0.02	0.00	0.00
Fragilaria capucina	0.00	0.00	0.00	0.00	0.02	0.01	0.37
Fragilaria vaucheriae	5.32	0.73	0.63	0.49	2.24	3.31	5.48
Fragilaria spp.	3.10	1.38	1.23	2.23	0.18	1.43	2.13
Gomphonema acuminatum / parvulum	3.03	0.73	0.35	0.02	0.33	2.56	3.23
Gomphonema spp.	0.09	0.56	0.53	0.04	0.22	3.00	1.95
Meridion circulare	6.37	0.33	0.10	0.49	0.21	0.17	2.61
Navicula radiosa	0.00	0.03	0.04	0.00	0.00	0.00	0.00
Navicula spp.	0.13	0.07	0.09	0.00	0.00	0.03	2.33
Nitzschia spp.	1.83	0.31	0.32	0.01	0.37	0.47	6.13
Pinnularia spp.	0.01	0.08	0.12	0.03	0.23	0.04	0.14
Synedra ulna	0.01	0.34	0.68	0.00	0.00	0.02	0.00
Synedra spp.	1.06	0.41	0.19	0.13	0.06	1.73	2.16
Tabellaria fenestrata	0.00	0.00	0.00	0.02	0.00	0.00	0.00
Tabellaria flocculosa	0.00	0.00	0.00	0.03	0.00	0.00	0.00
UID girdle view	0.00	0.00	0.50	0.00	0.01	0.03	0.14
Chlorophyta							
Stigeoclonium sp.	0.00	0.00	0.00	0.01	0.00	0.00	0.00
UID Chaetophorales	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Hormidium sp.?	0.00	0.00	0.11	0.00	0.00	0.00	0.00
Microspora sp.	0.00	0.00	0.00	0.04	0.00	0.00	0.00
UID Chlorophyta colonial	0.79	0.00	0.00	0.00	0.00	0.00	0.00
UID Chlorophyta filamentous	0.00	0.00	0.79	0.00	0.00	0.00	0.00
UID Chlorophyta unicellular	0.20	0.00	0.09	0.04	0.00	0.00	0.00
Chrysophyta							
Chromulina sp.	38.05	44.68	25.91	22.72	0.06	0.75	34.43
Tribonema spp.	0.00	0.00	0.00	0.05	0.00	0.00	0.00
UID Chrysophyte colonial	2.68	1.92	3.18	0.02	0.00	0.00	0.00
UID Chrysophyte cyst	0.00	0.21	0.00	0.01	0.12	0.01	0.05
UID Chrysophyte flagellate	0.00	0.00	0.01	0.02	0.00	0.00	0.25
UID Chrysophyte unicellular	0.37	0.00	0.00	2.79	0.00	0.00	0.00
Cyanophyta							
Chamaesiphon spp.	0.00	0.00	0.00	11.87	13.38	8.95	0.00
Clastidium setigerum	0.00	0.00	0.00	0.78	8.04	0.03	0.00
UID Chrooccocales	0.00	2.21	3.35	4.95	3.58	4.47	0.00
Nostoc sp. / Anabaena sp.	0.00	0.00	0.00	0.00	0.00	0.16	0.00
Nostoc sp.	0.00	0.00	0.00	0.00	0.14	0.00	0.00
Tolypothrix sp.	0.00	0.00	1.42	0.00	0.00	0.00	0.00
Lyngbya spp.	0.00	0.00	0.32	0.00	0.11	0.00	0.00
Homoeothrix varians	0.00	0.00	0.00	35.00	58.71	25.14	3.47
Microcoleus sp.	0.00	0.00	0.00	0.04	0.00	0.00	0.00

Taxon	Percentage of Number of Cells/cm^2						
	P1	P2	P3	P8	P7	P4	P5
Oscillatoria cf. agardhii	0.00	0.00	15.04	3.77	0.00	27.44	0.00
Oscillatoria spp.	0.00	0.00	0.00	0.08	0.00	0.00	0.00
Pseudoanabaena spp.	0.00	0.26	0.00	0.08	1.23	0.16	0.19
UID Oscillatoriales	0.00	0.00	1.18	0.16	1.54	1.18	0.75
Rhodophyta							
Audouinella sp.	0.00	0.00	0.00	0.04	0.00	1.77	0.00
Batrachospermum sp.	0.00	0.00	0.00	0.00	0.00	4.32	0.00
UID flagellate	0.14	0.00	0.00	0.03	0.00	3.42	0.00
UID colonial	0.00	0.00	0.00	0.00	0.00	0.01	0.61
UID filamentous	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UID unicellular	6.92	4.85	5.57	1.90	3.26	0.88	6.84

**UID = unidentified.*

Figures 40 and 41 show the mean taxonomic richness and Shannon-Wiener diversity index by site. There were no significant differences among sites in diversity ($F_{6,28}$ = 1.94, P = 0.11), but there were highly significant differences among sites in richness ($F_{6,28}$ = 17.70, P < 0.001). Post-hoc tests using Bonferroni test for richness showed that the main cause for variation is the higher richness for sites P8, P7 and P4 compared to most of the other sites.

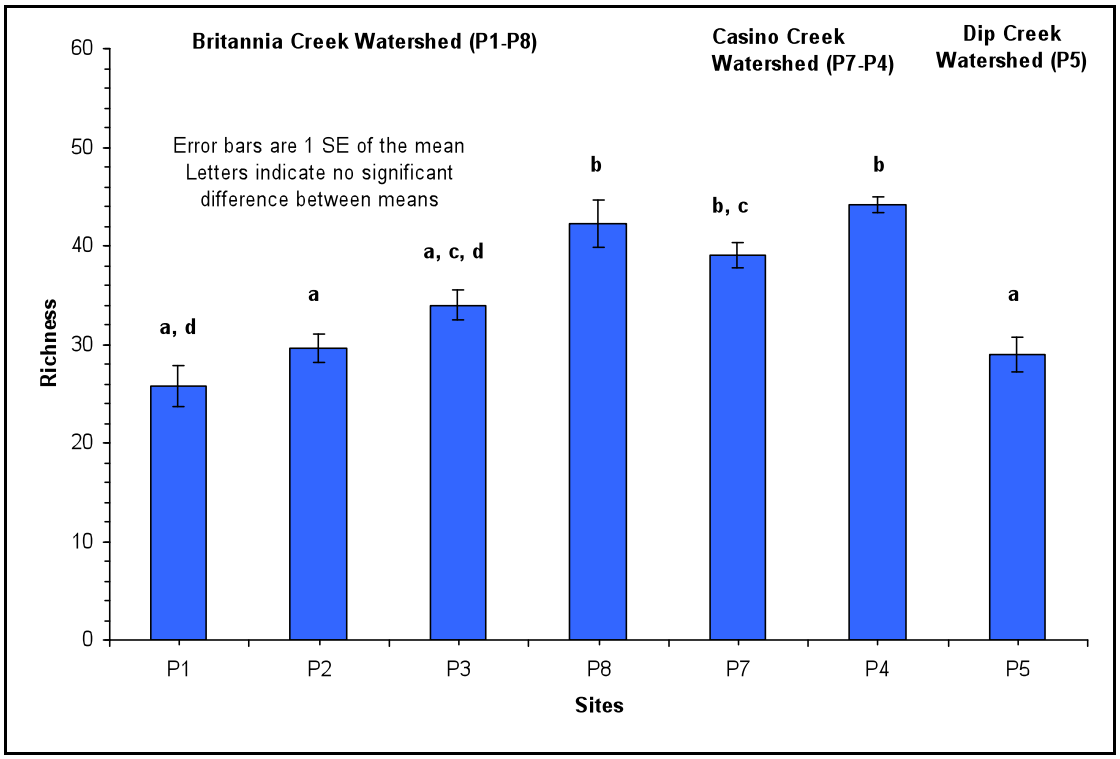


Figure 40. Mean Taxonomic Richness of Periphyton Communities, Casino Project, 2008

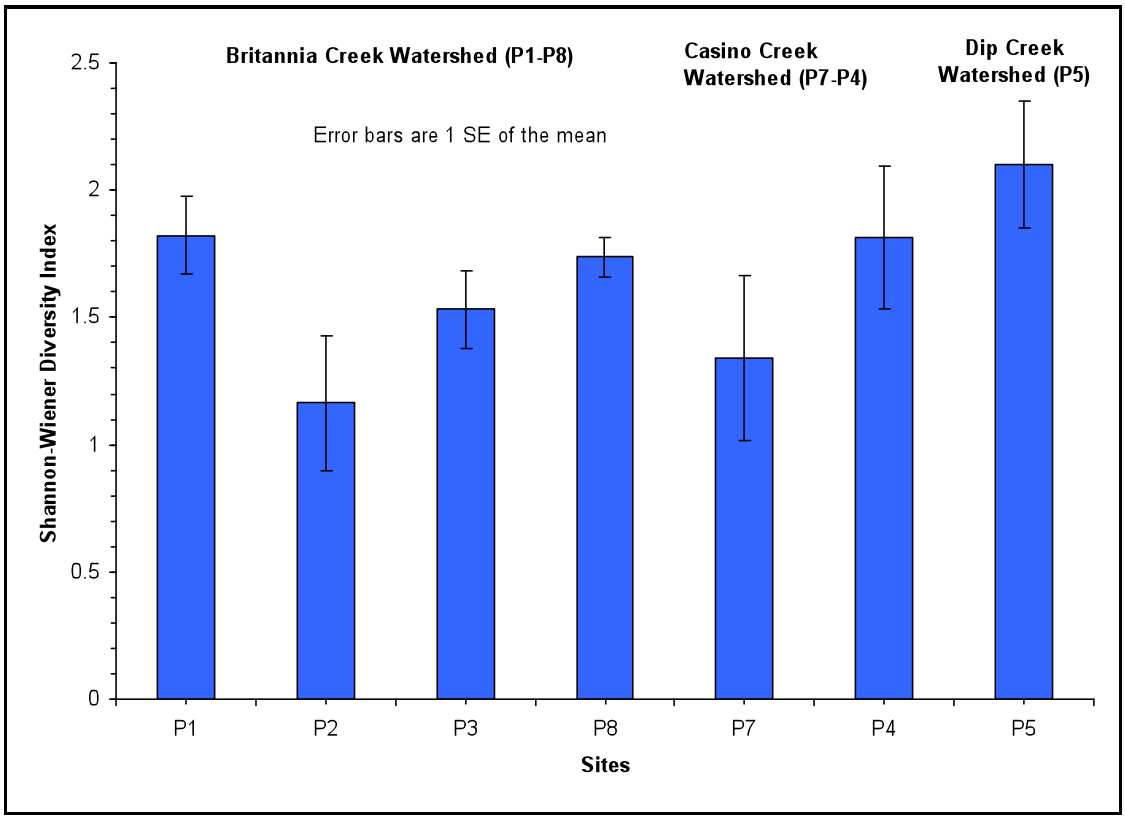


Figure 41. Mean Shannon-Wiener Diversity Index of Periphyton Communities, Casino Project, 2008

3.2.5 Benthic Invertebrates

Appendix B9 shows the number of organisms counted and identified to taxa in each of the 35 samples of benthos collected from the seven sampling sites in September 2008.

Figure 42 shows the mean densities of benthic invertebrates for each site. One-way ANOVA of the ln-transformed densities showed there were highly significant differences in mean density among sites ($F_{5,28}$ = 16.64, P<0.001). Post-hoc comparisons of means using the Bonferroni test showed that mean density at site B8 was significantly higher than the densities at all other sites except for B2 and that mean densities at sites B7 and B4 were significantly lower than mean densities at sites B2 and B3.

Table 20 shows the percentage composition of the benthic invertebrate community at each sampling site. Dipterans dominated the communities at all sites. Over 95% of the organisms at each site belonged to eight taxa: the insect Orders of Diptera, Plecoptera, Ephemeroptera, Trichoptera, Prostigmata and Collembola plus the worms of Class Oligochaeta and Phylum Nematoda.

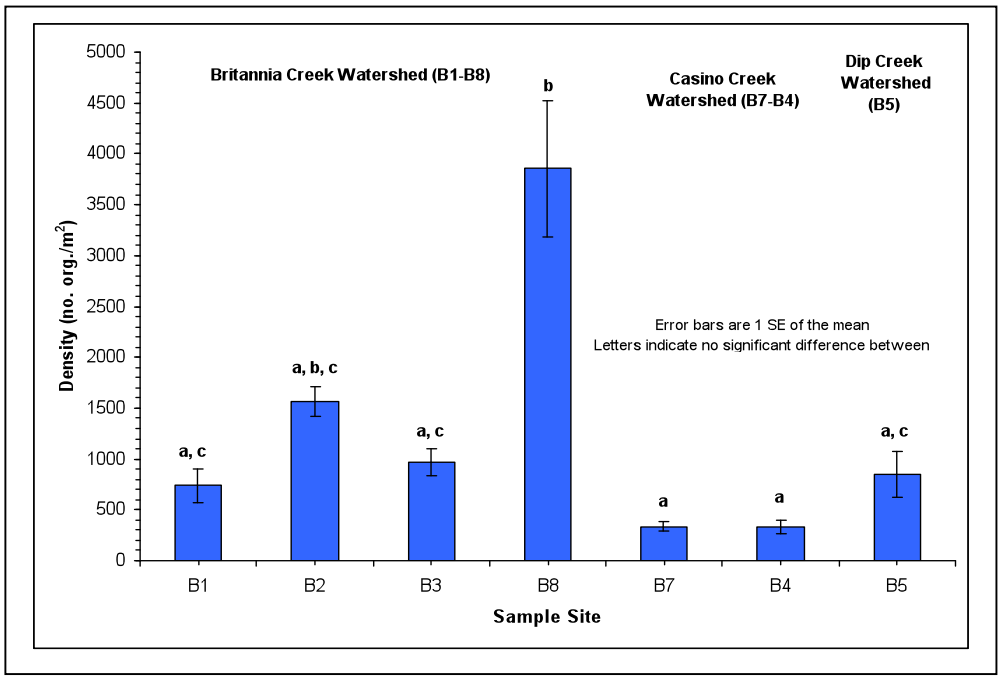


Figure 42. Mean Density of Benthic Invertebrates by Site, Casino Project, 2008

Table 20. Percentage Composition of Benthic Invertebrate Communities, Casino Project, 2008

Taxon	Percent of Total Number of Organisms						
	B1	B2	B3	B4	B5	B7	B8
Order Diptera	43.8	47.7	49.9	31.8	32.8	36.8	31.5
Order Plecoptera	20.4	22.5	7.8	13.2	12.7	29.0	21.7
Order Ephemeroptera	15.4	25.2	31.2	13.2	32.8	1.9	17.3
Class Oligochaeta	9.2	0.3	1.3	17.9	2.8	2.6	25.8
Order Trichoptera	4.4	0.4	1.8	9.9	3.3	0.0	0.2
Order Prostigmata	2.4	1.9	2.2	9.3	9.2	5.8	0.6
Phylum Nematoda	2.1	0.0	0.2	1.3	1.0	5.2	0.4
Order Collembola	1.2	0.8	2.9	0.7	0.8	18.1	2.2
Order Copepoda	0.9	0.3	0.7	2.0	2.3	0.0	0.1
Order Ostracoda	0.3	0.3	0.7	0.0	1.3	0.0	0.3
Order Coleoptera	0.0	0.0	0.2	0.0	0.5	0.0	0.0
Order Lepidoptera	0.0	0.3	0.2	0.7	0.3	0.6	0.0
Order Cladocera	0.0	0.1	0.7	0.0	0.3	0.0	0.0
Order Bivalvia	0.0	0.0	0.2	0.0	0.0	0.0	0.0
Order Gastropoda	0.0	0.1	0.0	0.0	0.0	0.0	0.0

Figures 43 to 45 show the mean taxonomic richness, total EPT abundance and Shannon's index of diversity, respectively, by site. There were highly significant differences among sites in richness ($F_{6,28}$ = 4.79, P<0.001), total EPT ($F_{6,28}$ = 17.07, P<0.001) and in Shannon-Wiener diversity index ($F_{6,28}$ = 7.18, P<0.001). Post-hoc tests using the Bonferroni test showed that the main cause for variation in richness was low richness at site B7 compared to high richness at sites B2 and B5. Post-hoc tests using the Bonferroni test showed that the main cause for variation in total EPT was high total EPT at site B8 compared to low total EPT at all the other sites. Also, site B2 had

significantly higher total EPT than sites B7 and B4. Post-hoc tests using the Bonferroni test showed that the main cause for variation in Shannon-Wiener diversity index was higher diversity for sites B4, B5 and B1 than for sites B2, B3, B8, and B7. Also, diversity was significantly higher for site B4 compared to sites B8 and B7.

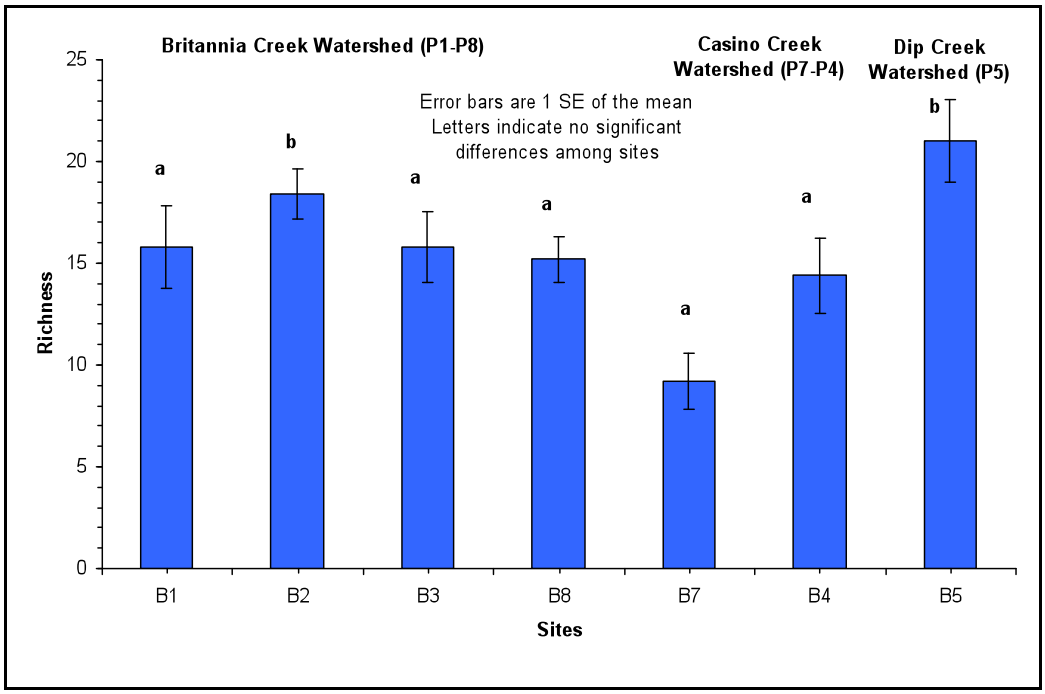


Figure 43. Mean Taxonomic Richness of Benthic Invertebrate Communities, Casino Project, 2008

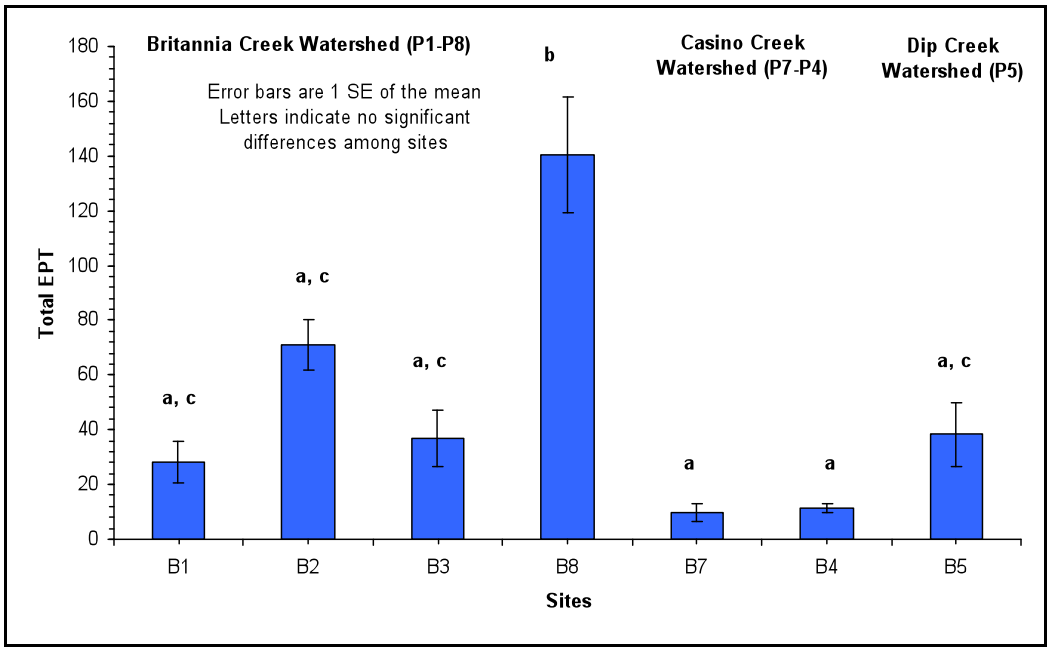


Figure 44. Mean Total EPT of Benthic Invertebrate Communities, Casino Project, 2008

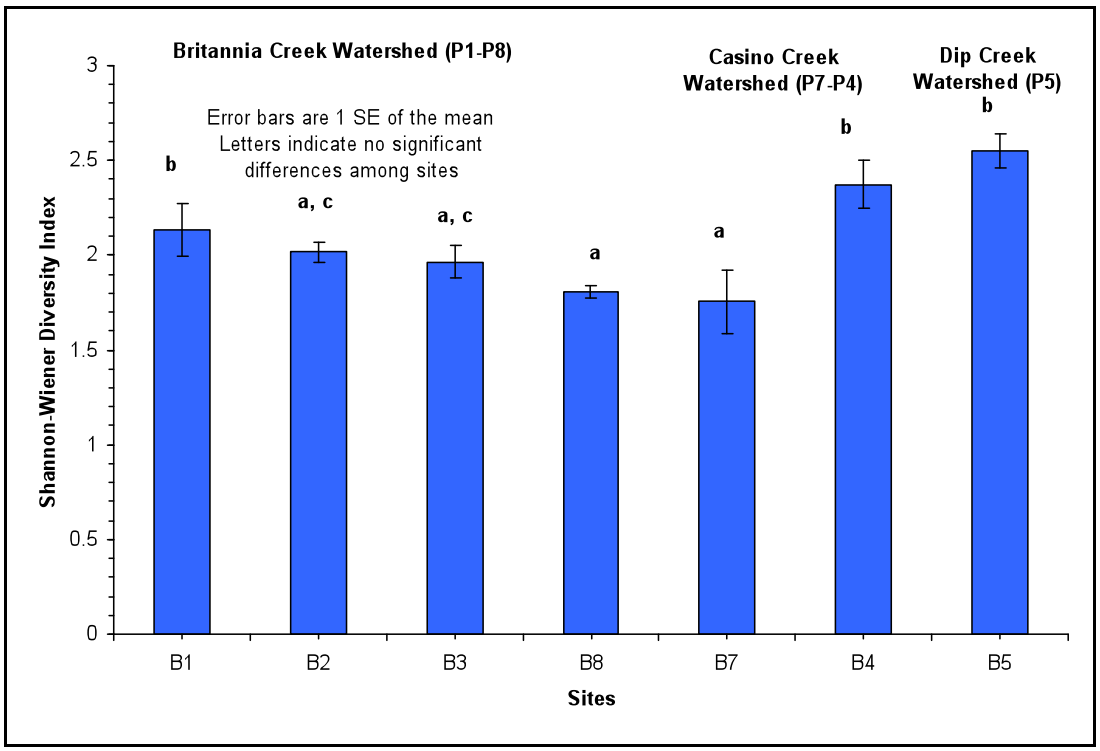


Figure 45. Mean Shannon-Weiner Index of Diversity of Benthic Invertebrate Communities, Casino Project, 2008

3.2.6 Fish Community

3.2.6.1 Catch, Effort and CPUE

Appendices B11, B12 and B13 show the fish catch, effort and CPUE for minnow traps, electrofishing and angling, respectively. A total of 40 fish from two species – Arctic grayling (*Thymallus arcticus*) and slimy sculpin – were captured from the Casino Project LSA in July and September 2008 (Table 21). Apart from one Arctic grayling caught by angling, all were captured by electrofishing.

Only Arctic grayling were found in the Britannia Creek Watershed, but both Arctic grayling and slimy sculpin were found in Casino Creek and Dip Creek watersheds. Slimy sculpin made up the majority of the catch (81 to 86%) in those two watersheds, respectively.

A total of 15 sites were electrofished – 12 in July and three in September. Three sites were electrofished twice. Of those 15 surveys, four were three-pass and 11 were single pass, for a total of 23 separate passes.

Stream sections ranged in length from 75 to 220 m with a mean of 140 m (n = 12, SE = 18). Voltage for each of the passes ranged from 300 to 750 V with a mean of 556 V (n = 23, SE = 23) and effort ranged from 340 to 1,591 sec with a mean of 669 sec (n = 23, SE = 70).

Table 21. Fish Catch, Casino Project, 2008

Gear	Arctic grayling	Slimy sculpin	Total
Britannia Creek Watershed			
Minnow Trap	0	0	0
Electrofishing	7	0	7
Angling	0	0	0
subtotal	7	0	7
Casino Creek Watershed			
Minnow Trap	0	0	0
Electrofishing	6	20	26
Angling	0	0	0
subtotal	5	21	26
Dip Creek Watershed			
Minnow Trap	0	0	0
Electrofishing	0	6	6
Angling	1	0	1
subtotal	1	6	7
Combined			
Minnow Trap	0	0	0
Electrofishing	12	27	39
Angling	1	0	1
Total	13	27	40

Of the four three-pass surveys, one caught no fish (F07 on July 9) and two (F03 on July 8 and F08 on July 9) did not show decreases in catch of Arctic grayling with successive passes. The fourth survey (F13 on July 10) did not show a decrease in catch of Arctic grayling with successive passes, but it did show clear decreases for slimy sculpin. Such decreases are required to estimate total fish number using the three-pass method (e.g., Peterson *et al*. 2004). The low number of three-pass surveys and the general lack of decreasing catch per pass meant that total fish number was not estimated using the three-pass algorithm. Instead, the CPUE of each survey was used as an index of population abundance.

A plot of CPUE on fish sampling site along a north-south trend line (Figure 46) shows that mean CPUE of Arctic grayling in the streams of the LSA was higher in July (mean = 0.10, SE = 0.04, n = 13) than in September (mean = 0.00 fish/100 sec, SE = 0.00, n = 3). This was due to outmigration of Arctic grayling in late summer in search of overwintering habitat. Arctic grayling from the Britannia Creek Watershed migrated to the Yukon River and those from Casino Creek Watershed moved downstream into Dip Creek.

Figure 47 shows that slimy sculpin were absent from the Britannia Creek Watershed in July and September 2008. Unlike Arctic grayling, the mean CPUE of slimy sculpin for Casino and Dip Creeks in September (mean = 0.24, SE = 0.21, n = 3) was not significantly different ($F_{1,8}$ = 0.091, P = 0.08) than the mean for July (mean = 0.16, SE = 0.16, n = 7), indicating that slimy sculpin did not outmigrate from Casino Creek until later in the year.

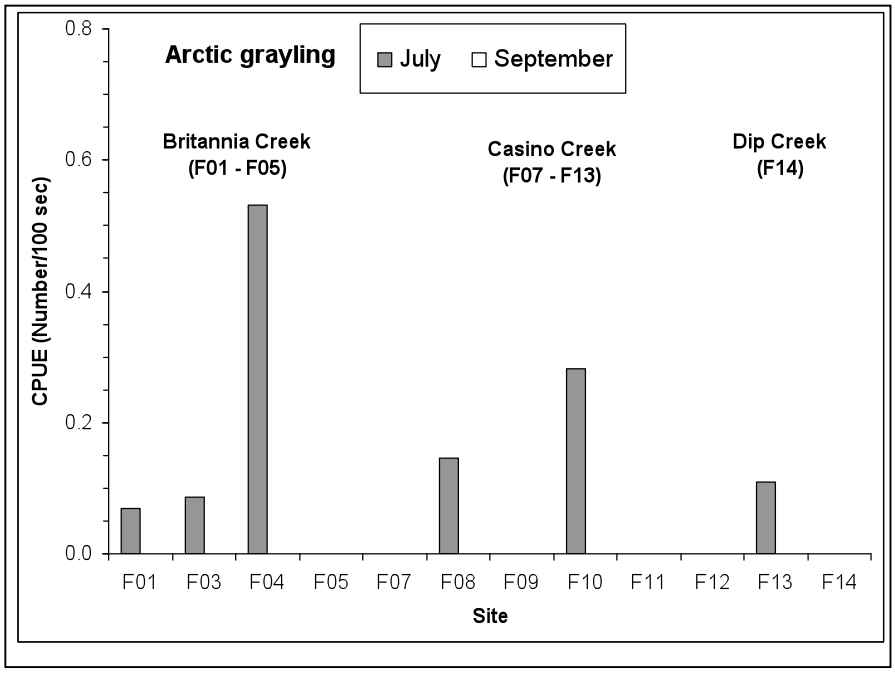


Figure 46. Electrofishing CPUE, Arctic Grayling, Casino Project, 2008

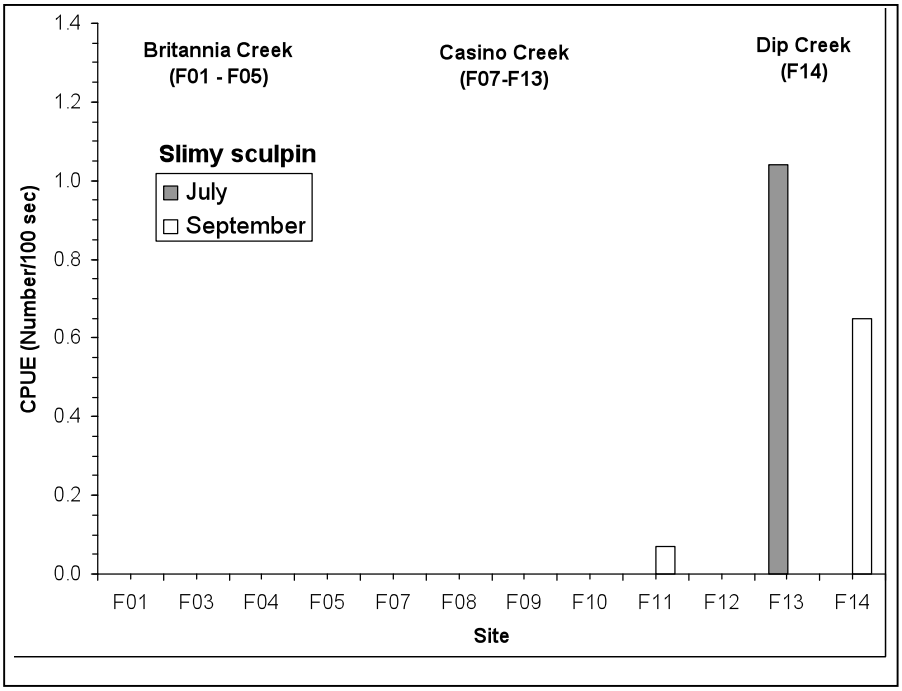


Figure 47. Electrofishing CPUE, Slimy Sculpin, Casino Project, 2008

Although the maximum CPUE of sculpin in Casino and Dip creeks for the combined July and September surveys was higher than the maximum for Arctic grayling in the LSA, the variance of both sets of CPUE was sufficiently high that the mean CPUE of slimy sculpin of Casino and Dip Creeks for the combined July and

September surveys (mean = 0.18, SE = 0.12, n = 10) was not significantly different ($F_{1,20}$ = 0.042, P = 0.52) from the mean CPUE of Arctic grayling in July.

These results were similar to those reported for 1993 and 1994 by Hallam Knight Piésold (1997), but with some important differences. As in 2008, Arctic grayling were observed throughout the Britannia Creek Watershed (Table 22). However, Arctic grayling fry were only observed in lower Britannia Creek near the confluence with the Yukon River in August 1993, indicating that this area provides spawning and rearing habitat for Arctic grayling, but not on a consistent basis.

Table 22. Fish Species in the Aquatics Local Study Area, Casino Project, 1993 to 2008

Species	Life Stage	Britannia Creek Watershed				Casino Creek Watershed		
		1993	1994	2008		1993	1994	2008
Arctic grayling	juveniles/adults fry	Jun, Aug. Sep Aug	Jun, Aug -	Jul -		Jun, Aug, Sep -	Jun, Aug, Sep Aug	Jul
Slimy sculpin	Juveniles/adults	Aug	Aug	-		Jun, Auig, Sep	Jun, Aug, Sep	Jul, Sep
Chinook salmon	juveniles fry	Aug June	- -	- -		- -	- -	- -
Round whitefish	juveniles	Aug	-	-		-	-	-
Burbot	juvenile	Sep	-	-		-	-	-

Unlike 2008, slimy sculpin were observed in the lower reach of Britannia Creek in 1993 and 1994, as were several round whitefish (*Prosopium cylindraceum*), one juvenile burbot (*Lota lota*) and several juvenile chinook salmon (*Oncorhynchus tshawytscha*). Therefore, lower Britannia Creek appears to provide temporary rearing habitat for juvenile fish from the Yukon River fish community. It is not clear why slimy sculpin do not move further upstream in the Britannia Creek Watershed, as they do in the Casino Creek Watershed. The presence of chinook salmon fry in lower Britannia Creek in June 1993 suggests the presence of some chinook salmon rearing habitat in lower Britannia Creek, but the absence of spawners in 1993, 1994 and 2008 indicates little spawning potential.

As in 2008, only slimy sculpin and Arctic grayling were observed in Casino Creek Watershed in 1993 and 1994, but Arctic grayling were found in September 1993 – later than in 2008 – indicating that the time of outmigration varies among years. No Arctic grayling fry were observed in the Casino Creek Watershed in any year, indicating that it offers poor rearing habitat for that species.

3.2.6.2 Size, Age and Growth

Appendix B14 shows lengths, weights and ages for fish captured in the Casino LSA in 2008. There were no significant differences in mean length ($F_{1,10}$ = 1.59, P = 0.24), weight ($F_{1,8}$ = 3.74, P = 0.09) or age ($F_{1,8}$ = 3.6, P = 0.09) of Arctic grayling between Britannia Creek and Casino Creek watersheds, which would be expected based on their geographic proximity. Hence, those data were pooled to calculate mean length, weight and age (Table 23). Since all slimy sculpin were captured from Casino and Dip creeks, which are directly connected, all those data were also pooled to calculate mean length and weight.

Table 23. Mean Size and Age of Fish, Casino Project, 2008

	Arctic Grayling				Slimy Sculpin	
Statistic	Length (mm)	Weight (g)	Age (year)		Length (mm)	Weight (g)
Mean	257	194.2	5		72	4.8
SE	14	25.0	1		9	8.8
n	13	11	11		26	26
minimum	173	44.5	2		29	0.5
maximum	300	260.0	6		129	19.3

SE = standard error and n = sample number.

The length frequency distribution for Arctic grayling shows two modes: one at a length range of 150-199 mm that are assumed to represent juveniles and a second mode at 250-299 mm that are assumed to represent adults (Figure 49). The length frequency distribution for slimy sculpin showed only one mode one at a length range of 50-99 mm that is assumed to represent a mixture of juveniles and adults.

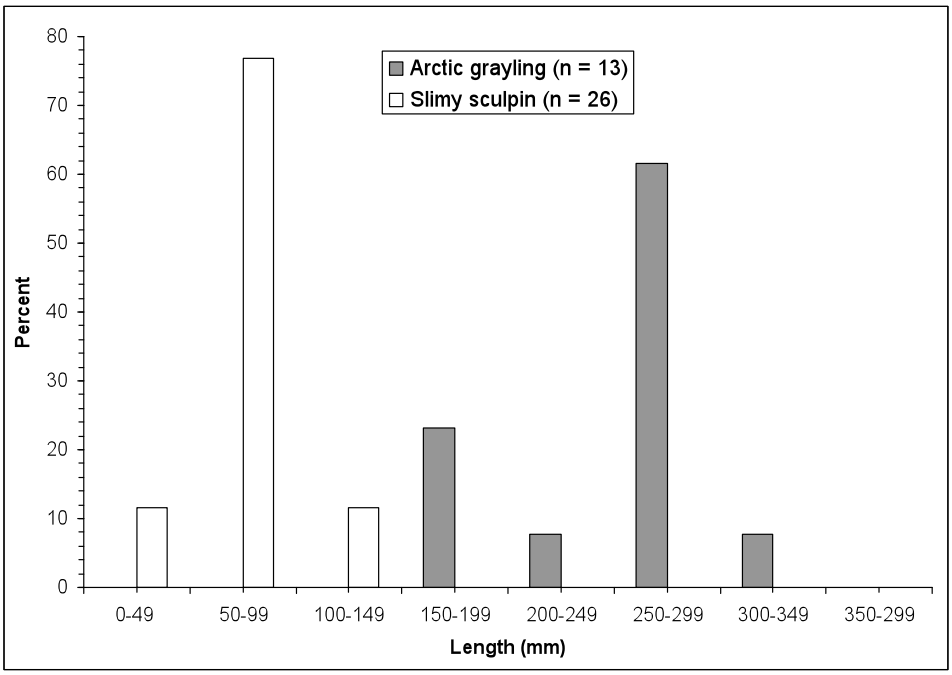


Figure 48. Length Frequencies of Arctic Grayling and Slimy Sculpin, Casino Project, 2008

Linear regressions of weight on length were highly significant for both species and explained between 96 and 97% of the variance in ln(weight) (Figure 50). The slopes of the regressions were both close to the value of 3.0 that is commonly assumed for fish.

The age frequency distribution for Arctic grayling shows two modes: one for fish aged two to three years (juveniles) and a second for fish aged five to six years (adults) (Figure 51). A plot of mean length on age showed that growth rate slows over age and hence mean length begins to approach an asymptote by age five or six years (Figure 52).

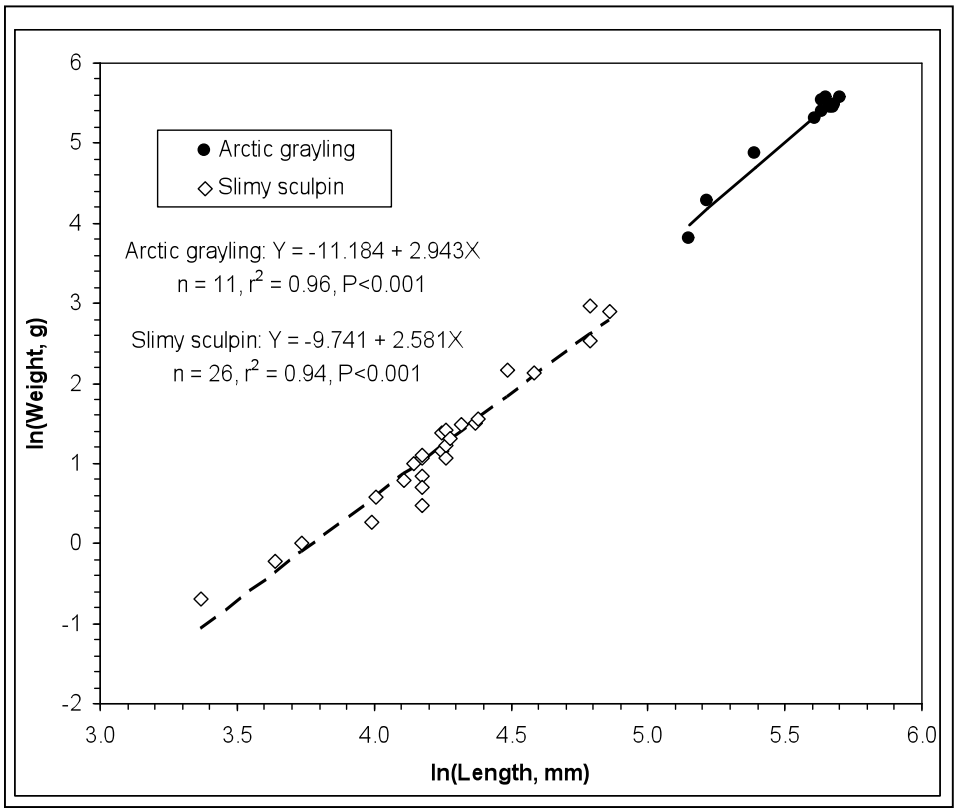


Figure 49. Weight-length Regressions for Arctic Grayling and Slimy Sculpin, Casino Project, 2008

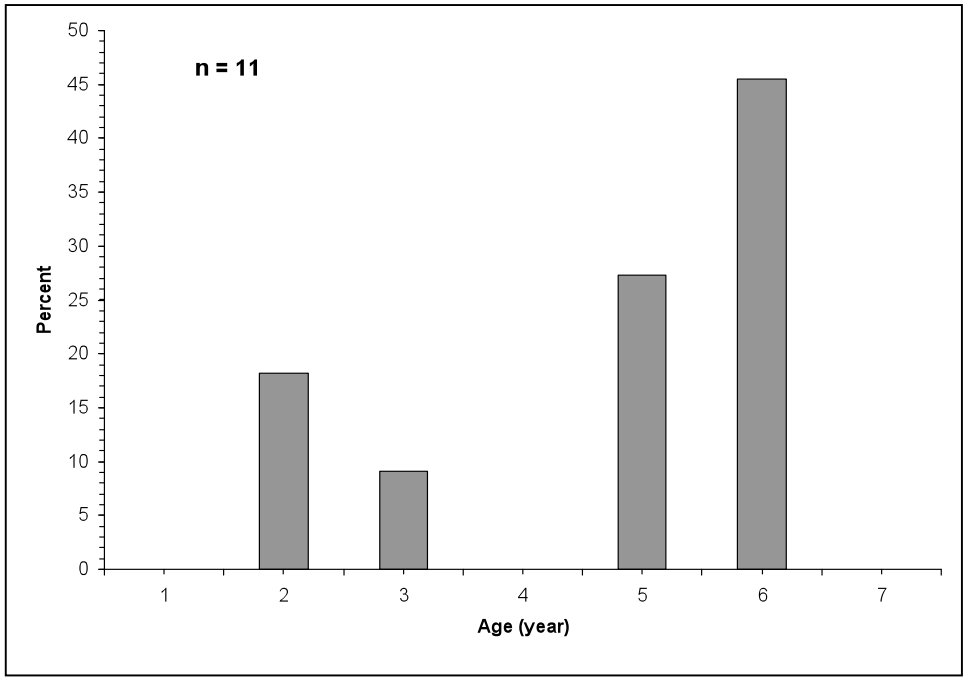


Figure 50. Age Frequency Distribution, Arctic Grayling, Casino Project, 2008

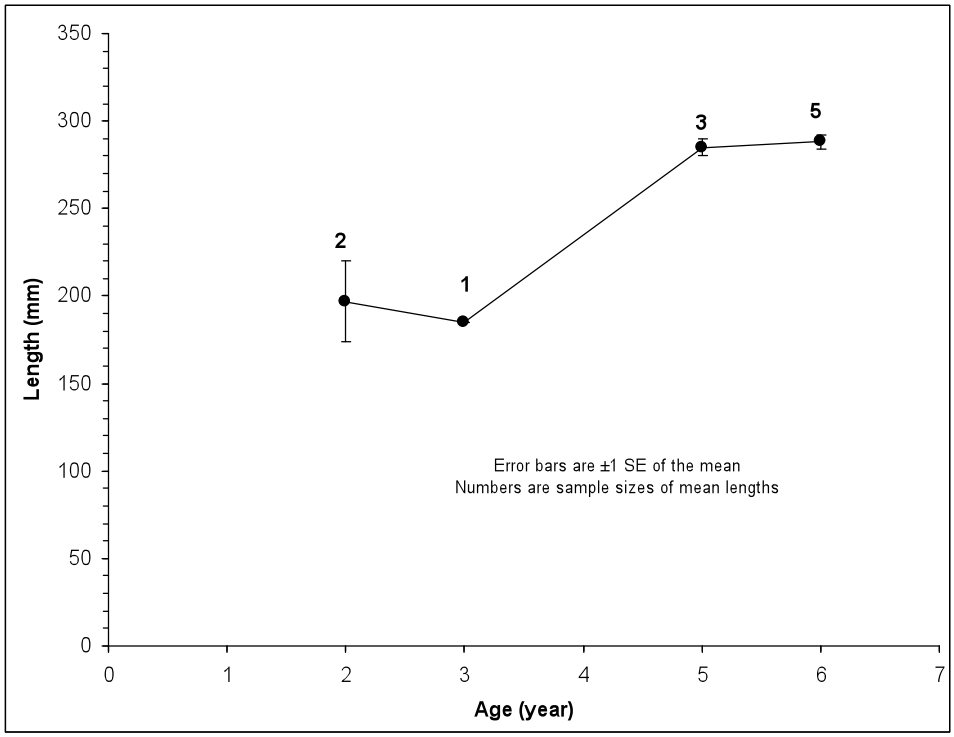


Figure 51. Length-Age Plot, Arctic Grayling, Casino Project, 2008

Too few Arctic grayling were captured in 2008 to permit growth modelling even if data were pooled from both Britannia and Casino watersheds. Therefore, length and age data reported by Hallam Knight Piésold (1997) for 1993 and 1994 were pooled with the 2008 data and von Bertalanffy growth curves were fit to data for Britannia and Casino watersheds separately (Figures 53 and 54). Both models explained 98% or more of the variance in length. There were sufficient data for the Britannia Watershed, particularly length-age data for the critical ages of zero and one years, to provide a good fit to length-at-age data. There were insufficient data for Casino Watershed as is shown by the predicted length at age zero years of 111 mm – twice the value predicted for Britannia Watershed and biologically unrealistic.

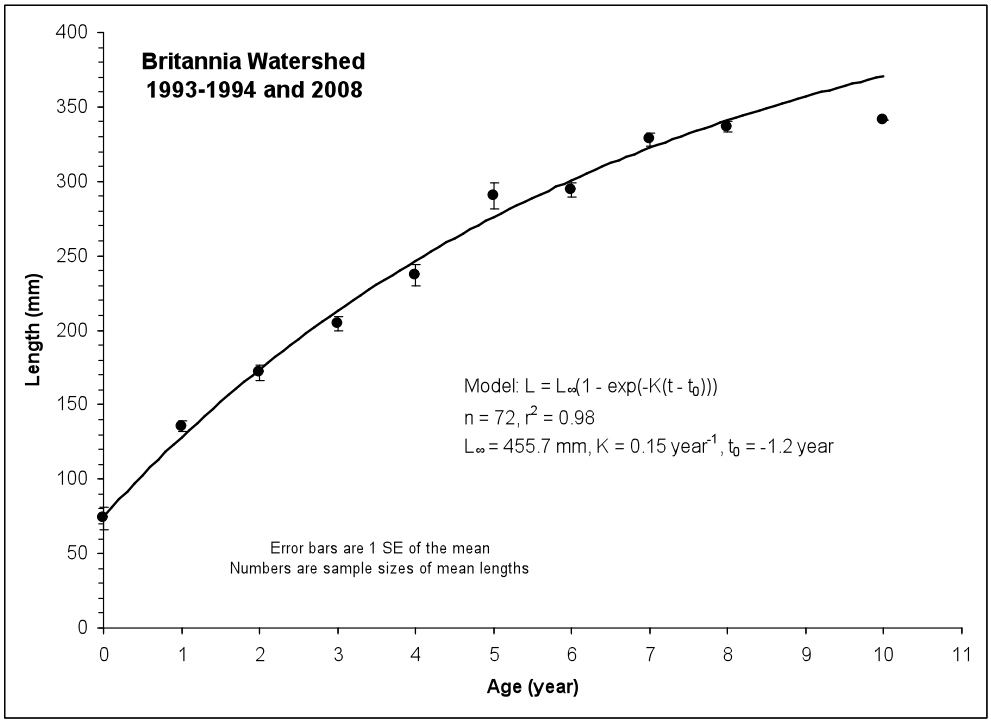


Figure 52. Length-Age Relationship, Arctic Grayling, Britannia Watershed, 1993-1994 and 2008

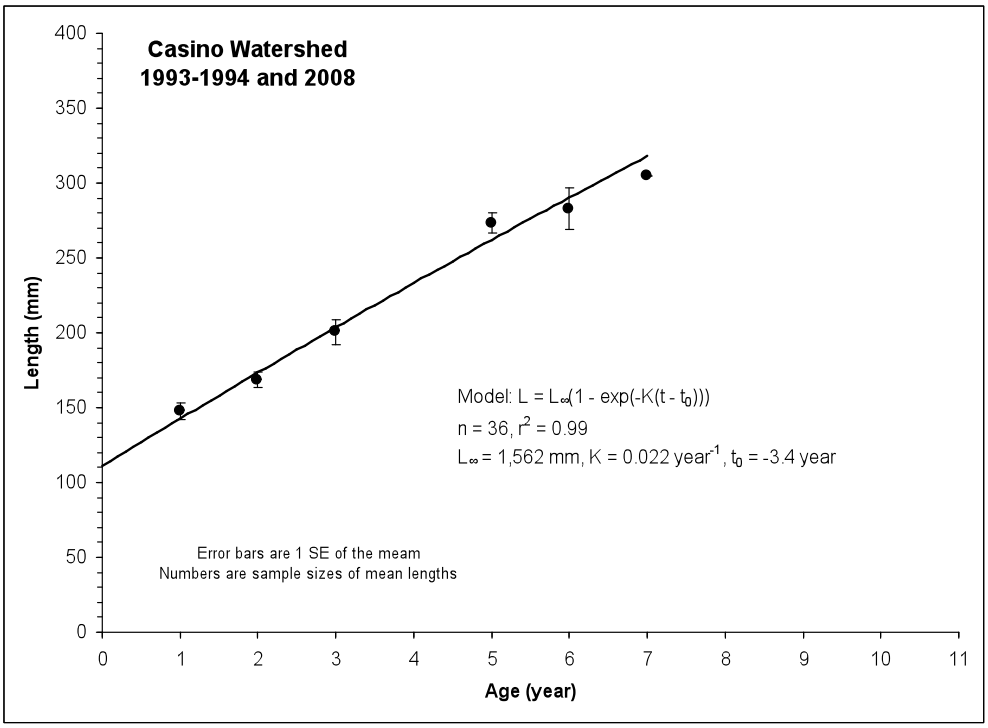


Figure 53. Length-Age Relationship, Arctic Grayling, Casino Watershed, 1993-1994 and 2008

3.2.6.3 Tissue Metals Concentrations

Appendix B15 shows the concentrations of metals measured in nine whole-body samples of slimy sculpin collected from Casino and Dip creeks in July and September 2008. Of the 33 metals, eight (antimony, beryllium, boron, molybdenum, tellurium, thallium, tin and zirconium) were excluded from analysis because all nine values were below detection limits. For the remaining 25 metals, all values below detection limits were replaced by one-half the detection limit to allow statistical analysis. This resulted in replacing 20% of the concentrations (i.e., 44 of 225). Table 24 shows the mean concentrations of metals, sorted in ascending order of mean concentration.

Table 24. Mean Whole-Body Metal Concentrations, Slimy Sculpin, Casino Project, 2008

Metal	Concentration (µg/g wet weight)			
	mean	SE	min	max
Silver	0.006	0.001	0.005	0.010
Mercury	0.040	0.008	0.020	0.090
Cadmium	0.07	0.02	0.00	0.24
Lead	0.08	0.03	0.05	0.30
Nickel	0.08	0.03	0.05	0.30
Chromium	0.09	0.03	0.05	0.30
Cobalt	0.09	0.03	0.05	0.30
Uranium	0.10	0.03	0.02	0.29
Arsenic	0.1	0.02	0.1	0.3
Vanadium	0.48	0.14	0.25	1.50
Selenium	0.7	0.1	0.4	1.1
Copper	1.2	0.1	0.9	2.1
Barium	4.3	0.9	1.2	9.8
Titanium	7.9	2.3	3.7	24.6
Manganese	10.6	2.3	3.1	25.4
Strontium	20.91	4.33	4.89	52.40
Zinc	27.5	3.9	19.2	57.4
Silicon	43	5	22	66
Aluminum	56.8	29.9	9.8	294.0
Iron	143	70	49	693
Magnesium	459	58	295	900
Sodium	1,526	232	1,090	3,360
Potassium	3,447	325	2,510	5,860
Phosphorus	9540	1758	4590	22900
Calcium	13,222	3,196	3,760	37,400

SE = standard error, min = minimum and max = maximum.

N = 9 for all metals.

None of the sculpin had mercury concentrations that exceeded the 0.5 µg/g guideline established by Health Canada (http://www.hc-sc.gc.ca/ahc-asc/media/advisories-avis/_2002/2002_41-eng.php).

PCA extracted two components from the dataset of ln-transformed metals. Four metals – mercury, cadmium, silicon and selenium – were not correlated with either component. Therefore, PCA was run a second time after removing those four metals. The first component, PC1, accounted for 60.8% of the explained variance and the second component, PC2, accounted for another 27.4% for a total of 88.2% of the explained

variance. Table 25 shows the correlations of the metals with each component. PC1 was highly correlated with ten metals including those often associated with metal deposits such as iron, lead and nickel. PC2 was highly correlated with 11 metals many of which are essential biological structural elements such as phosphorus, sodium and calcium and which are present in relatively high concentrations in whole-body tissue samples.

Table 25. Correlations of Principal Components with Slimy Sculpin Tissue Metal Concentrations

Metal	PC1	PC2
iron	0.99	0.13
lead	0.98	0.12
nickel	0.98	0.12
arsenic	0.94	0.30
aluminum	0.94	-0.03
chromium	0.94	-0.07
cobalt	0.93	0.10
titanium	0.91	0.39
vanadium	0.90	0.34
manganese	0.74	0.48
phosphorus	0.09	0.98
sodium	0.11	0.96
calcium	0.10	0.96
magnesium	0.34	0.93
zinc	0.32	0.91
silver	0.14	0.88
strontium	0.08	0.88
potassium	-0.13	0.83
copper	0.13	0.81
barium	0.57	0.74
uranium	0.50	0.68

A plot of PC2 scores on PC1 scores for the nine sculpin showed that seven of the nine fish clustered together in a region with relatively low scores, and that fish from all three sampling sites were present in that cluster (Figure 55). Two fish were outliers; one from site F13 had a relatively high PC2 score and one from site F14 had relatively a high PC1 score.

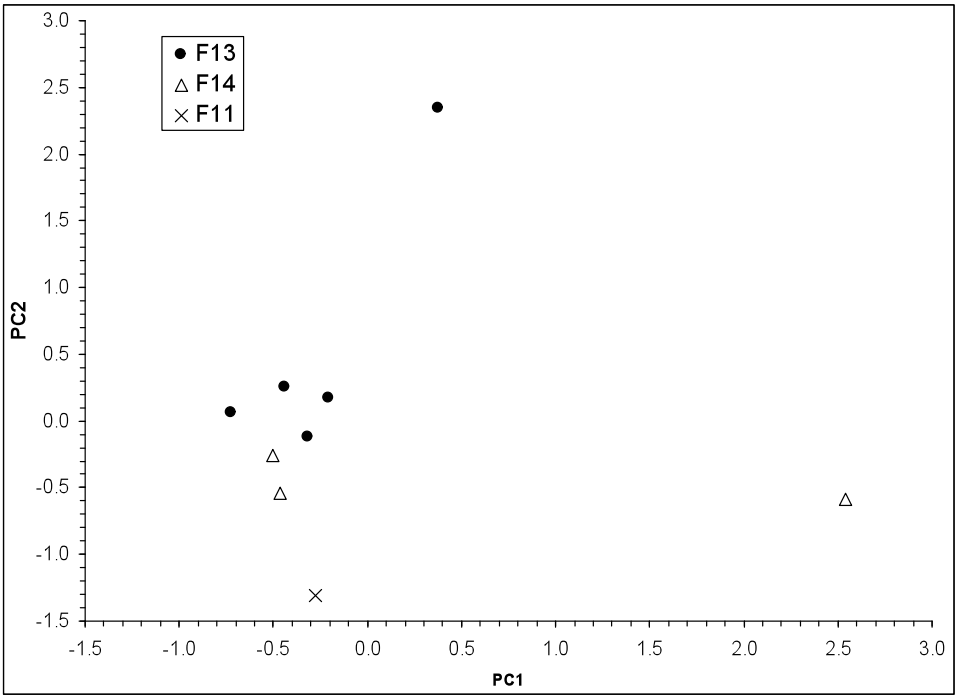


Figure 54. Plot of PC2 Scores on PC1 Scores for Slimy Sculpin Tissue Metal Samples

3.2.6.4 Salmon Spawning Survey

No Pacific salmon spawners were observed during the aerial survey of September 11, but good spawning habitat was observed in 50% of reach 2 of Britannia Creek and approximately 40 m^2 of spawning habitat was observed in Canadian Creek upstream from the confluence with Britannia Creek.

3.2.7 Fish Habitat

3.2.7.1 General

Appendices B16 and B17 show the stream habitat records for the July and September surveys, respectively.

3.2.7.2 Britannia Creek Watershed

The lower reach of Britannia Creek was surveyed on September 11 (Photo 2). At that time the stream stage was classified as high. Habitat consisted of 50% riffles, 30% runs and 20% pools. Gradient was close to 0%. Wetted depth ranged from 0.20 to 0.35 m with a mean of 0.28 m. The substrate was composed of 20% fines, 20% small gravel, 50% small cobble and 10% large cobble. Only 10% of the stream area provided cover and 80% of that area was provided by LWD and 20% by deep pools. Approximately 20% of the stream area consisted of gravel bars. The stream was classified as occasionally confined. This reach was classified as salmonid rearing habitat class II by DFO under the Yukon Placer Authorization (Government of Canada 2000).

Photo 2. Lower Reach of Britannia Creek Looking Upstream, September 11, 2008

The upper reach of Britannia Creek (i.e., reach 2) was also surveyed on September 11 (Photo 3). Habitat consisted of 70% riffle, 20% run and 10% pools. At that time its stage was high, hence its mean wetted width (4.1 m) was the same as its bankfull width. Wetted depth ranged from 0.16 m to 0.42 m with a mean of 0.29 m. Gradient was 1%. The substrate consisted of 30% small gravel, 30% large gravel, 20% large cobble and 10% boulder. Only 10% of the stream area provided cover of which 70% was provided by LWD, 20% by cutbank and 10% by overstream vegetation. The stream was unconfined and contained 10% gravel bars. The crown closure was 20%.

The lower reach of Canadian Creek, upstream of the confluence with Britannia Creek, was surveyed on July 8 (at fish site F03) and on September 11. In early July, the stream stage was low, hence mean wetted width (5.0 m) was lower than mean bankfull width (8.3 m) (Photo 4). Habitat consisted of 90% riffles and 10% pools. Gradient was 3%. The substrate consisted of 10% fines, 15% small gravel, 35% small cobble, 30% large cobble and 10% boulder. Forty five percent of the stream area provided cover of which 40% was provided by LWD, 40% by overhanging vegetation, 15% by cutbanks and 5% by boulders. The stream was unconfined and contained no gravel bars or braids. The crown closure was 7%.

Photo 3. Upper Reach of Britannia Creek Looking Upstream, September 11, 2008

Photo 4. Canadian Creek Above the Confluence with Britannia Creek (Site F03) Looking Upstream, July 8, 2008

In September, habitat consisted of 40% riffle, 40% run and 20% pools. Although the stream stage of the lower reach of Canadian Creek was high, the mean wetted width (4.8 m) was only 61% of the bankfull width (7.9 m) (Photo 5). Wetted depth ranged from 0.26 to 1.00 m with a mean of 0.63 m. Gradient was close to 0%. The substrate consisted of 10% fines, 10% small gravel, 10% large gravel, 20% small cobble and 50% large cobble. Only 10% of the stream area provided cover of which 80% was provided by LWD and 20% by deep pools. The stream was unconfined and contained no gravel bars. The crown closure was 10%.

Photo 5. Lower Reach of Canadian Creek Looking Upstream, September 11, 2008

Reach 2 of Canadian Creek (the cascade pools) was surveyed on July 8 and September 11. In July, the stream stage was low, hence the mean wetted width (5.2 m) was lower than the mean bankfull width (6.5 m) (Photo 6). Habitat consisted of 100% cascade pools. Gradient was 4%. The substrate consisted of 5% fines, 20% large gravel, 15% small cobble, 10% large cobble and 50% boulders. Fifty percent of the stream area provided cover of which 80% was provided by boulders, 10% by LWD and 10% by overhanging vegetation. The stream was unconfined and contained no gravel bars, but it was braided. The crown closure was 17%.

In September, habitat consisted of 100% cascade pools and gradient was 15%. The stream stage of the lower reach of Canadian Creek was high, hence its mean wetted width (8.0 m) was the same as its bankfull width (Photo 7). Wetted depth was 0.43 m. The substrate consisted of 90% boulder, 5% small gravel and 5% fines. Fifty percent of the stream area provided cover of which 100% was provided by boulders. The stream was frequently confined and contained no gravel bars. The crown closure was 0%.

Photo 6. Lower Reach of Canadian Creek (F04) Looking Downstream, July 8, 2008

Photo 7. Reach 2 of Canadian Creek (Cascade Pools) Looking Upstream, September 11, 2008

The upper reach (reach 3) of Canadian Creek was surveyed on September 11 (Photo 8). Habitat consisted of 80% riffles, 10% runs and 10% pools. The stream stage was high, hence its mean wetted width (3.0 m) was the same as its bankfull width. Wetted depth ranged from 0.16 to 0.36 m with a mean of 0.26 m. Gradient was 3%. The substrate consisted of 60% large cobble, 20% boulder, 15% small cobble and 5% fines. Twenty percent of the stream area provided cover of which 100% was provided by boulders. The stream was unconfined and contained no gravel bars. The crown closure was 0%.

Photo 8. Upper Reach (number 3) of Canadian Creek Looking Upstream, September 11, 2008

3.2.7.3 Casino Creek Watershed

The upper reach (reach 2) of Casino Creek was surveyed on September 12 (Photo 9). Habitat consisted of 50% pools, 40% riffles and 10% runs. The stream stage was high, hence its mean wetted width (5.4 m) was the same as its bankfull width. Wetted depth ranged from 0.08 to 0.40 m with a mean of 0.27 m. Gradient was 3%. The substrate consisted of 40% boulders, 20% large cobble, 20% small cobble, 10% large gravel and 10% fines. Thirty percent of the stream area provided cover of which 80% was provided by boulders and 20% by overstream vegetation. The stream was unconfined and contained no gravel bars. The crown closure was 0%.

The lower reach (reach 1) of Casino Creek was surveyed on September 12 (Photo 10). Habitat consisted of 40% runs, 30% riffles and 30% pools. The stream stage was high, hence its mean wetted width (5.7 m) was the same as its bankfull width. Wetted depth ranged from 0.27 to 1.50 m with a mean of 0.71 m. Gradient was 2%. The substrate consisted of 40% large cobble, 30% fines, 20% small cobble, 5% large gravel and 5% small gravel. Thirty percent of the stream area provided cover of which 70% was provided by deep pools and 30% by LWD. The stream was unconfined and contained no gravel bars. The crown closure was 20%.

Photo 9. Upper Reach (number 2) of Casino Creek Looking Upstream, September 12, 2008

Photo 10. Lower Reach (number 1) of Casino Creek Looking Downstream, September 12, 2008

Reach 1 of Meloy Creek, the most upstream named tributary of Casino Creek, was surveyed on September 12 (Photo 11). Habitat consisted of 50% runs, 30% riffles and 20% pools. The stream stage was high, hence its mean wetted width (1.1 m) was the same as its bankfull width. Wetted depth ranged from 0.21 to 0.40 m with a mean of 0.30 m. Gradient was 2.5%. The substrate consisted of 80% fines, 10% boulders, 5% small cobble and 5% small gravel. Seventy percent of the stream area provided cover of which 80% was provided by overstream vegetation and 20% by deep pools. The stream was unconfined and contained no gravel bars. The crown closure was 10%.

Photo 11. Reach 1 of Meloy Creek Looking Upstream, September 12, 2008

The upper reach (Reach 2) of Brynelsen Creek was surveyed on September 12 (Photo 12). Habitat consisted of 70% riffles and 30% pools. The stream stage was high, hence its mean wetted width (4.1 m) was the same as its bankfull width. Wetted depth ranged from 0.35 to 0.40 m with a mean of 0.38 m. Gradient was 2.5%. The substrate consisted of 70% boulders, 20% large cobble and 10% small cobble. Twenty percent of the stream area provided cover of which 80% was provided by boulders and 20% by LWD. The stream was unconfined and contained no gravel bars. The crown closure was 10%.

The lower reach (Reach 1) of Brynelsen Creek was surveyed on September 12 (Photo 13). Habitat consisted of 60% riffles, 20% runs and 20% pools. The stream stage was high, hence its mean wetted width (5.4 m) was the same as its bankfull width. Wetted depth ranged from 0.12 to 0.49 m with a mean of 0.29 m. Gradient was 2%. The substrate consisted of 30% fines, 20% large gravel, 20% small cobble, 20% large cobble and 10% boulders. Ten percent of the stream area provided cover of which 90% was provided by boulders and 10% by overstream vegetation. The stream was unconfined and braided and contained no gravel bars. The crown closure was 10%.

Photo 12. Upper Reach of Brynelsen Creek Looking Upstream, September 12, 2008

Photo 13. Lower Reach of Brynelsen Creek Looking Upstream, September 12, 2008

The upper reach (Reach 2) of Austin Creek was surveyed on September 12 (Photo 14). Habitat consisted of 70% pools, 20% runs and 10% riffles. The stream stage was high, mean wetted width was 1.1 m and mean bankfull width was 0.9 m. Wetted depth ranged from 0.29 to 0.56 m with a mean of 0.43 m. Gradient was not measured. The substrate consisted of 90% fines and 10% boulders. Ninety percent of the stream area provided cover of which 90% was provided by overstream vegetation and 10% by deep pools. The stream was unconfined and braided contained no gravel bars. Crown closure was 0%.

Photo 14. Upper Reach of Austin Creek Looking Upstream, September 12, 2008

The lower reach (Reach 1) of Austin Creek was surveyed on September 12 (Photo 15). Habitat consisted of 70% pools and 30% runs. The stream stage was high, hence the mean wetted width (1.8 m) was the same as mean bankfull width. Wetted depth ranged from 0.39 to 0.54 m with a mean of 0.47 m. Gradient was close to 0%. The substrate consisted of 100% fines. One hundred percent of the stream area provided cover of which all was provided by overstream vegetation. The stream was unconfined and braided contained no gravel bars. Crown closure was 0%.

3.2.7.4 Dip Creek

The reach of Dip Creek that encloses site F14 was surveyed on September 12 (Photo 16). Habitat consisted of 40% riffles, 30% runs and 30% pools. The stream stage was high, hence its mean wetted width (10.5 m) was the same as its bankfull width. Wetted depth was 1.25 m. Gradient was close to 0%. The substrate consisted of 50% fines, 30% small cobble, 10% large cobble and 10% small gravel. Twenty five percent of the stream area provided cover of which 50% was provided by LWD and 50% was provided by deep pools. The stream was unconfined and braided contained no gravel bars. The crown closure was 10%.

?.

Photo 15. Lower Reach of Austin Creek Looking Upstream, September 12, 2008

Photo 16. Reach of Dip Creek Enclosing Site F14 Looking Downstream, September 12, 2008

3.3 Terrestrial Environment

3.3.1 Soils and Vegetation

Surveys of the Casino LSA in July and September showed that it is characterized by smooth, rolling topography with moderate to deeply incised valleys.

Wildlife habitat consists of a variety of plant communities ranging from sparsely vegetated bare rock, large expanses of heath tundra, wet sedge meadows with tall riparian shrubland and treed slopes dominated by spruce, aspen, birch and willows. Open stands of black spruce and white spruce occur in valleys and lower slopes, with black spruce on wetter sites and white spruce on better drained sites. Willow, shrub birch, Labrador tea, mosses and lichens are principal understory species.

During the July and September surveys, a total of 33 soil pits were dug and plants were sampled and described for the various cover types: spruce, spruce/aspen, spruce/birch, shrub birch/willow, heath tundra, wet sedge meadow, and burns. Appendices C1 and C2 show the data for each of the sampling sites, and Photos 17 to 22 show representative examples of wildlife habitat.

Photo 17. Alpine Habitat, Casino Project, 2008

Photo 18. Felsenmeer Habitat (Exposed Broken Rock), Casino Project, 2008

Photo 19. Aspen Forest Habitat, Casino Project, 2008

Photo 20. Floodplain Habitat, Casino Project, 2008

Photo 21. Island Habitat, Yukon River, Casino Project, 2008

Photo 22. Mixedwood Forest Habitat, Casino Project, 2008

3.3.2 Wildlife Observations

3.3.2.1 General

Appendix C3 shows the observations of wildlife made in July and September of 2008, as well as observations made by other field crews in May and August. Table 26 lists the common names and scientific names of observed wildlife.

Table 26. Common and Scientific Names of Wildlife Observed at the Casino Project Area, 2008

Common Name	Scientific Name	Common Name	Scientific Name
Mammals		**Birds**	
Moose	*Alces alces*	American robin	*Turdus migratorius*
Black bear	*Ursus americanus*	Northern hawk owl	*Surnia ulula*
Grizzly bear	*Ursus arctos horribilis*	Northern harrier	*Circus cyaneus hudsonius*
Beaver	*Castor canadensis*	Spruce grouse	*Dendragapus canadensis*
Wolf	*Canis lupus*	Gray jay	*Perisoreus canadensis*
Caribou	*Rangifer tarandus*	Northern flicker	*Colaptes auratus*
Lynx	*Felis lynx*	Tundra swans	*Cygnus columbianus*
Snowshoe hare	*Lepus americanus*	Ptarmigan	*Lagopus muta*
Porcupine	*Erithizon dorsatum*	Great horned owl	*Bubo virginianus*
Arctic ground squirrel	*Spermophilus parryii*	Golden eagle	*Aquila chrysaetos*
Northern bog lemming	*Synaptomys borealis*		
Vole	*Microtus spp.*		
American red squirrel	*Tamiasciurus hudsonicus*		
Red fox	*Vulpes vulpes*		

Least chipmunk	*Eutamias minimus*		

3.3.2.2 July 7 to 11 Survey

Moose were observed along the Yukon River and along Casino and Dip creeks. The area being considered for the proposed Casino Project appears to be a preferred moose wintering area. No caribou were seen in the LSA, however caribou sign (e.g., pellets, shed antlers, trails, etc.) were found on ridge tops. Several small groups of caribou were observed south of the LSA during the flight from Whitehorse. Terrestrial lichens occur primarily on north-facing slopes and provide an abundant food source for caribou.

Numerous wolf tracks and scats were observed along Dip Creek, suggesting the presence of a den site close by, but it could not be located. Three individual grizzly bears (two blonde and one chocolate brown) and one black bear were observed during the July survey. Bear scats were also observed in the major creek drainages (Canadian, Britannia, Austin, Dip), and on the trails between the airstrip and the lower camp, and the airstrip and tank farm. Bear use appeared to be concentrated at this time of year in areas with buffaloberries, bearberries, and *Hedysarum*.

Small mammals observed in the LSA included snowshoe hare, red squirrel and voles. Well-developed small mammal trails were observed in some spruce habitat.

The rock outcrops on Patton Hill, and various treed habitat types were surveyed by helicopter and on foot for raptors but none were observed or heard. However, waterfowl, upland birds (e.g., ptarmigan) and various songbirds were seen or heard.

3.3.2.3 September 8 to 11 Survey

Wolves were heard howling along Dip Creek, and observed by Casino camp construction personnel on Britannia Creek. Lynx were also seen at the lower camp and on Britannia Creek.

Black and grizzly bears were observed by Casino camp construction personnel on six separate occasions in August and September. Grizzly bear observations included a sow with two, 2-year-old cubs, and a lone, chocolate-brown grizzly bear. Black bear observations included three lone bears, and one sow with two yearling cubs. Bear scats were also observed in the major drainages (Canadian, Britannia, Austin and Dip creeks), and on the trails between the airstrip and the lower camp, and the airstrip and tank farm. Bear use appeared to be concentrated at this time of year in areas with buffaloberries, cranberries, and blueberries.

Moose were observed along the Yukon River, Britannia, Casino and Dip creeks. Caribou were seen in the LSA by Casino camp construction personnel on five separate occasions, and caribou sign (e.g., pellets, shed antlers, trails) were found on ridge tops. One small group of caribou were observed along the proposed road route east of the Casino mine site.

Potential summer and winter range, lambing areas and escape terrain for sheep are limited within the survey area. No thinhorn sheep were observed along the Yukon River bank directly across from Britannia Creek during a survey conducted on September 9.

Small mammals observed in the LSA included snowshoe hare, red squirrel, bog lemmings, Arctic ground squirrel and voles.

The rock outcrops on Patton Hill, and various treed habitat types were surveyed by helicopter and on foot for raptors. Raptors observed or heard included great horned owl, northern harrier, northern hawk owl, and golden eagle. Other birds including tundra swans, ptarmigan, grouse and various songbirds were seen or heard.

4. References

AECOM, in preparation:

Casino Project: Hydrogeological Studies 2008. Prepared for Western Copper Corporation by AECOM Canada Ltd.

BC MELP and MOF, 1998:

Field Manual for Describing Terrestrial Ecosystems. British Columbia Ministry of Environment, Lands and Parks (BC MELP) and BC Ministry of Forests (BC MOF), Land Management Handbook Number 25.

BC MOE, 2007:

British Columbia Environmental Laboratory Manual for the Analysis of Water, Wastewater, Sediment, Biological Material and Discrete Ambient Air Samples. British Columbia Ministry of Environment, Environmental Quality Branch, Water and Air Monitoring and Reporting Section. Victoria, BC. April 2007.

CCME, 2008:

Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment, Winnipeg.

CEAA, 2008:

Cumulative Effects Assessment Practitioner's Guide. Appendix A Glossary. Canadian Environmental Assessment Agency, Ottawa.

Cody, W.J., 2000:

Flora of the Yukon Territory, Second Edition. NRC Research Press, Ottawa.

Environment Canada, 2002:

Metal Mining Guidance Document for Aquatic Environmental Effects Monitoring. Hull, QC: National Environmental Effects Monitoring Office, Environment Canada.

Farnell, R., R. Sumanik, J. McDonald and B. Gilroy, 1991:

The Distribution, Movements, Demography, and Habitat Characteristics of the Klaza Caribou in Relation to the Casino Trail Development, Yukon Territory. Fish and Wildlife Branch, Yukon Department of Environment, Whitehorse.

FES, 1994:

Quality Assurance Program. Fraser Environmental Services Ltd., Surrey, BC. April 1994.

Government of Canada, 2000:

The Yukon Placer Authorization and Supporting Documents Applicable to Placer Mining in the Yukon Territory. Rationale for Stream Classes, Effluent Standards and Maps. Fisheries and Oceans Canada, Whitehorse, Yukon Territory.

Hallam Knight Piésold, 1997:

Casino Project: Data Report 1993-1995. Prepared for Pacific Sentinel Gold Corp. March 1997.

Johnston, N.T., and P.A. Slaney, 1994:

Fish Habitat Assessment Procedures. Revised 1996. British Columbia Ministry of Environment, Lands and Parks and Ministry of Forests, Watershed Restoration Technical Circular No. 8.

Lorax, 2009:

Casino Phase I Geochemical Assessment Report. Prepared for Western Copper Corporation by Lorax Environmental Services Ltd. January 2009.

M3 Engineering, 2008:

Casino Project Pre-feasibility Study, Yukon Territory, Canada. Prepared for Western Copper Corporation by M3 Engineering and Technology Corporation. August 5, 2008.

MWLAP, 2003:

British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment and Biological Samples. British Columbia Ministry of Water, Land and Air Protection. Victoria, BC.

NWRI, 2008:

CABIN (Canadian Aquatic Biomonitoring Network) Invertebrate Biomonitoring Field and Laboratory Manual. National Water Research Institute, Environment Canada. Accessed from: http://cabin.cciw.ca/Application/Downloads/cabin_protocol.doc.

Peterson, J.T., R.F. Thurow and J.W. Guzevich, 2004:

An Evaluation of Multipass Electrofishing for Estimating the Abundance of Stream-Dwelling Salmonids. Transactions of the American Fisheries Society 133: 462-475.

RIC, 1998:

Standard for Terrestrial Ecosystem Mapping (TEM) in British Columbia. Prepared by Ecosystems Working Group, Terrestrial Ecosystems Task Force, Resource Inventory Committee (RIC). May 1998.

Yukon Environment, 2004:

Community-Based Fish and Wildlife Management Plan. Little Salmon/Carmacks First Nation Traditional Territory. 2004-2009. Yukon Department of Environment, Little Salmon/Carmacks First Nation and the Carmacks Renewable Resource Council. Whitehorse.

AECOM

Appendix A

Atmospheric Environment

A1. Casino Mine – Methodology Report for Installation of Meteorological Station

November 26, 2008

AECOM
6400 Roberts Street, Suite 490
Burnaby, BC, V5G4C9
Canada

RWDI AIR Project: W08-1104

RWDI AIR Inc.
999 West Broadway
Suite 830
Vancouver, BC
Canada V5Z 1K5

A member of the RWDI Group of Companies

Attention: **Rick Palmer**

Subject: **Casino Mine – Methodology Report for Installation of Meteorological Station**

RWDI AIR Inc. (RWDI) was retained by Gartner Lee Limited to install a meteorological monitoring station at the Casino Mine. This report provides a discussion on the status of this project and a description of the station.

On September 30, 2008, Geoff Doerksen and Jackson Mak from RWDI arrived at Casino Mine to install the meteorological station. Installation of the meteorological tower was started that afternoon and the tower was erected by the following morning. By the evening of October 1, 2008, all the instruments were mounted on the tower. While configuring the equipment the morning of October 2, 2008, a connection with the data logger could not be established remotely by either the RWDI Vancouver office or by the equipment supplier. It was suspected that the Iridium modem or the antenna was not functioning properly. The satellite modem system was therefore returned to Vancouver for further testing. The removal of the satellite modem system from the station did not affect the meteorological observations as they continued to be collected and stored on the data logger. Data recorded at the station are valid from October 3, 2008 at midnight to present.

Mr. Doerksen and Mr. Mak were scheduled to leave Casino Mine on Thursday afternoon. However, due to poor visibility, the Alkan Air plane was unable to land at the mine site and Mr. Doerksen and Mr. Mak were forced to spend an extra night at camp. The following day they were picked up by a helicopter late in the morning and spent the remainder of the day travelling back to Vancouver.

Upon returning to Vancouver, the satellite modem system was further tested with support provided by the equipment supplier. While there were no apparent problems with the system it was thought that a lose connection with the antenna cable may have been the cause of the problem. The antenna cable was properly secured and a remote connection was established while testing the equipment in Vancouver. The equipment was subsequently shipped back to Casino Mine on October 22, 2008. The satellite modem system was re-installed at the site by Scott Casselmen, the camp manager of Casino Mine. After installation a remote connection with the station was attempted; however it was unsuccessful.

In discussions with the equipment supplier it was determined that the only way to resolve the problem with the satellite modem system was for a technician to travel to the site and replace the non-working equipment. On November 7, 2008 Mark Milner from RWDI travelled to Casino Mine and replaced several components of the satellite modem system including the modem, antenna and data kit. Subsequent tests on the system were successful and a remote connection with the station was established. The station including the satellite modem system is now currently functioning properly and a remote connection with the station is now possible. Data was successfully downloaded remotely on November 7, 14, and 21, 2008.

STATION DESCRIPTION

The meteorological station consists of a 10-m free-standing tower equipped with instrumentation, data logger, and logger enclosure. As shown in Figure 1, the tower is secured by two sets of guy wires attached to the base of the tower. One set of guy wires is attached at the top of the mast while the other set is attached midway up the mast. The guy wires may be a potential hazard; therefore they are flagged with orange flagging tape. The tower base is constructed from five fibreglass pods arranged in a square formation with one pod located at the centre. The four outer pods are connected to the centre pod by aluminum pipes for support. The fibreglass pods are filled with soil to give the base of the tower weight and ensure that the tower is properly secured. The design of the tower has been approved by an engineer.

Figure 1: Meteorological Tower at Casino Mine

The meteorological station is located approximately 300 km northwest of Whitehorse. The station is sited in a transition zone between tree line and alpine with an unobstructed fetch of at least 100 m in all directions. The site is sparsely covered in low brush and trees that are approximately 10 m tall. Figure 2 shows the location of the monitoring station. The map coordinates of the station are summarized in Table 1.

Figure 2: Location of Casino Meteorological Station South of the Yukon River

Table 1: Location of Casino Meteorological Station

Latitude	62º 43’ 27.837” North
Longitude	138º 49’ 0.562” East
Easting (m)	611,609
Northing (m)	6,956,775
UTM Grid Reference	Zone 7
Datum	NAD83
Elevation (m)	1,203

The meteorological station has instrumentation capable of measuring wind speed and direction, rainfall, air temperature, barometric pressure, relative humidity and snow depth. These measurements will provide the necessary observations to calculate atmospheric stability class needed as input for air quality modelling. Observations are recorded and stored by a data logger, which is powered by a battery charged with a solar panel at the station. The data logger is equipped with a satellite modem for remotely accessing the data. The specific model numbers of the equipment are summarized in Table 2.

Table 2: Casino Station Equipment

Equipment	**Model Number**
Datalogger with 4M RAM Memory	CR800-XT
Solar Panel 20 Watt 12 Volt	MSX20R
Iridium Satellite Remote Modem	A3LA-MPT
Iridium Modem Accessory Antenna 1616-1626 MHz	SAF5350A
Iridium Modem Accessory Remote Power & Data Kit	SYN-DC-936R
Relay Kit Crydom 7 Amp c/w Wires	C1701
Enclosure Fiberglass 16” x 18”	ENC 16/18
Sonic Ranger 50 KHz Module	SR50A
Relative Humidity & Air Temperature Probe	HC-S3-XT
RM Young Wind Monitor	05103-10-L
RM Young Barometric Pressure Sensor	61205V
Texas Electronics Tipping Bucket Metric Rain Gauge	TE525M

As shown in Figure 3, the snow depth instrument (Sonic Ranger) is mounted on a cross arm three metres above ground from the main mast. The relative humidity and air temperature probe is housed in a radiation shield mounted on the same cross arm as the Sonic Ranger. The anemometer is mounted at the top of the 10 m tower. The rain gauge has been installed approximately two metres from the tower on a separate post that is approximately one metre above ground.

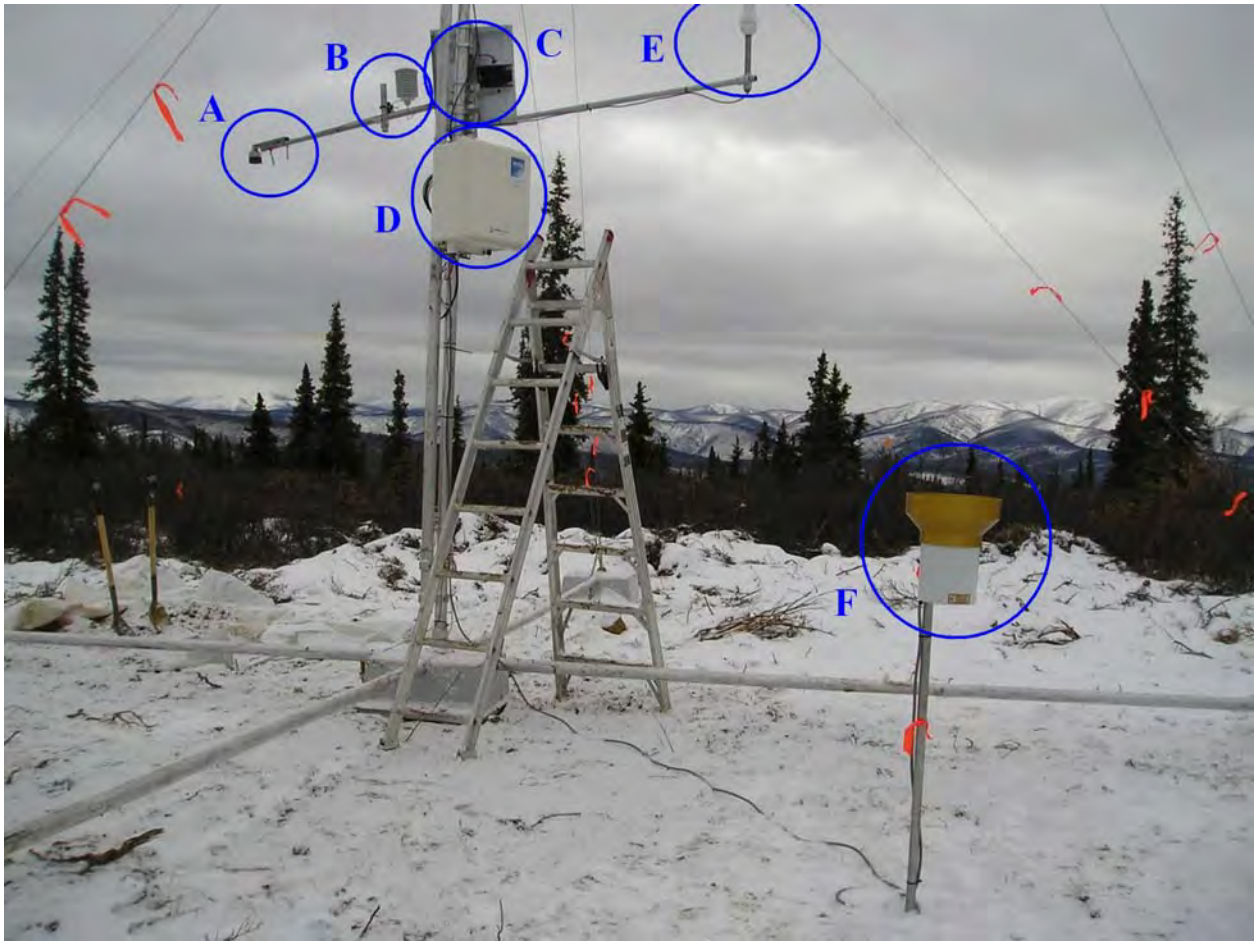


Figure 3: Casino Meteorological Monitoring Station Equipped with A) Sonic Ranger, B) Relative Humidity and Temperature Probe, C) Solar Panel, D) Data Logger Enclosure, E) Satellite Antenna and F) Rain Gauge

The barometric pressure sensor is housed in the data logger enclosure at a height of 2.8 m above ground. The pressure sensor is vented to the outside of the logger enclosure by way of a poly tube attached to a small port on the enclosure. By convention, barometric pressure observations are corrected to report sea-level pressure. The following equation is used to determine the pressure correction factor:

P = 1013.25 [1 – (1 – Elevation/44307.69231) ^5.253283]

where P is the correction factor (in hPa) and elevation is given in metres above sea level.

The solar panel is mounted about three metres above ground facing due south on the main mast. The solar panel is tilted at an angle of 78º relative to ground to receive maximum insolation and prevent the collection of snow. This angle is calculated based on manufacturer's specifications. The data logger enclosure, which houses the data logger, Iridium modem and pressure sensor, has been mounted at a height of 2.8 m above ground. The satellite modem antenna is mounted on a second cross arm extending from the main mast located approximately three metres above ground. A summary of instrumentation measurement heights is provided in Table 3.

Table 3: Measurement Height

Measurement	Height Above Ground (m)
Snow Depth	3
Relative Humidity and Air Temperature	3
Barometric Pressure	2.8
Rainfall	1
Wind Speed and Direction	10

We trust that this report meets your information requirements. If you have any questions or require further information, please contact the undersigned at (604) 730-5688 ext. 3227.

Sincerely,
RWDI AIR Inc.

Geoff Doerksen, M.Sc.
Project Manager

AECOM

Appendix B

Aquatic Environment

B1. Stream Stage-Discharge Data, Casino Project, 2008

Appendix B1. Stream Stage-Discharge Data, Casino Project, 2008

Station	Date	Stage (m)	Discharge (m^3/s)
W1	22-May-08	0.48	2.54
	8-Jul-08	0.32	0.84
	10-Sep-08	0.40	2.14
	10-Oct-08	0.26	0.40
W3	23-May-08	0.49	1.62
	8-Jul-08	0.39	0.33
	10-Sep-08	0.46	1.57
	11-Oct-08	0.38	0.38
W4	22-May-08	0.59	1.50
	9-Jul-08	0.43	0.50
	9-Sep-08	0.70	2.12
	10-Oct-08	0.46	0.81
W9	22-May-08	0.69	4.75
	9-Jul-08	0.59	3.63
	9-Sep-08	0.54	3.25
	10-Oct-08	0.52	1.11
W11	22-May-08	0.38	0.87
	9-Jul-08	0.17	0.14
	9-Sep-08	0.36	0.71
	9-Oct-08	0.35	0.40
W14	23-May-08	0.29	0.86
	8-Jul-08	0.15	0.29
	10-Sep-08	0.28	0.71
	10-Oct-08	0.12	0.15

B2. Surface Water Quality Data, Casino Project, May 2008

Appendix B2. Surface Water Quality Data, Casino Project, May 2008

AECOM

Station	Detection Limits	Water Quality Guidelines	W7 - Upper Canadian Creek	W3 - Canadian Creek us of Confluence with Britannia Creek	W14 - Mouth of Britannia Creek	W2 - Canadian Creek Downstream of Confluence with Britannia Creek	W1 - Mouth of Canadian Creek	W6b - Yukon River Upstream of Canadian Creek	W6a - Yukon River Sownstream of Canadian Creek	W15 - Yukon River Dar Field Site	W17 - Sunshine Creek	W43 - Adit Discharge Pipe at Lower Camp
Date		CCME [a]	21-May-08	23-May-08	23-May-08	23-May-08	22-May-08	21-May-08	21-May-08	21-May-08	22-May-08	23-May-08
Physical Tests												
Temperature C	-		0.1	2	0.1	1.8	3.4	7.9	7.1	9.4	0.7	4.1
Conductivity (Field) µS/cm	-		30.7	82	35	72	65.8	163	147	164	87.9	274
pH (Field)	-		*6.2*	7.4	7.1	7.4	7.5	7.9	8.1	8.1	7.9	6.8
Hardness $CaCO_3$	0.5		15.1	45.8	28.3	41.1	49.6	105	93.4	103	49.9	141
Conductivity µS/cm	1		34.0	89	49	78	92	170.0	180.0	180.0	96	300
pH	-	6.5-9.0	*5.5*	7.4	7.0	7.1	7.2	7.8	7.8	7.8	7.4	7.5
Total Suspended Solids	1		34	18	34	25	190	190	140	200	6	<1
Total Dissolved Solids	1		32	88	46	78	92	130	150	150	94	210
Turbidity NTU	0.1		3.4	2.5	1.5	1.7	3.6	21.4	35.1	19.1	0.7	0.4
Dissolved Anions & Nutrients												
Ammonia as N	0.005		<0.005	0.031	0.01	0.006	0.011	<0.005	0.017	0.012	<0.005	<0.005
Alkalinity, Total (as $CaCO_3$)	0.5		0.6	22.0	10.0	15.0	21.0	61.0	61.0	63.0	30.0	90.0
Chloride (Cl)	0.5		1.10	1.20	1.40	1.20	1.20	0.90	1.00	0.90	1.30	0.50
Sulfate (SO_4)	0.5		<0.5	15.0	<0.5	8.8	17.0	19.0	25.0	24.0	1.6	54.0
Nitrate (as N)	0.002	13	<0.002	0.05	0.046	0.043	0.05	0.019	0.017	0.016	0.052	0.128
Nitrite (as N)	0.002	0.06	0.004	0.004	0.005	0.005	0.003	0.002	0.002	0.002	0.004	0.002
Total Kjeldahl Nitrogen	0.02		0.52	0.4	0.54	0.54	0.41	0.190	0.210	0.220	0.44	<0.02
Ortho Phosphate as P	0.001		0.001	<0.001	<0.001	0.002	<0.001	0.001	0.002	0.002	<0.001	0.006
Cyanide, Weak Acid Diss	0.0005		0.0008	0.0009	0.001	0.0009	0.001	<0.0005	<0.0005	<0.0005	0.0008	<0.0005
Total Cyanide	0.0005	0.005	0.001	0.001	0.0015	0.0012	0.0013	<0.0005	<0.0005	<0.0005	0.001	<0.0005
Total Metals												
Aluminum	0.0002	0.005-0.1 [b]	*0.479*	*0.415*	*0.542*	*0.46*	*0.723*	*0.678*	*0.636*	*0.708*	*0.214*	0.0024
Antimony	0.00002		0.00007	0.0002	0.00012	0.00018	0.00019	0.00021	0.00017	0.00023	0.00013	0.00323
Arsenic	0.00002	0.005	0.00065	0.0012	0.0009	0.0011	0.00162	0.00212	0.00177	0.00204	0.00064	0.00152
Barium	0.00002		0.0385	0.0381	0.0559	0.0455	0.059	0.148	0.112	0.139	0.0458	0.0465
Beryllium	0.00001		0.00005	0.00004	0.00004	0.00004	0.00006	0.0001	0.00008	0.0001	0.00002	<0.00001
Bismuth	0.000005		0.000021	0.00001	<0.000005	0.000008	0.000009	0.000013	0.000016	0.000015	<0.000005	<0.000005
Boron	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	0.000005	0.000017	*0.000261*	*0.000084*	*0.000028*	*0.000069*	*0.00008*	*0.000621*	*0.000369*	*0.000591*	*0.000022*	*0.068*
Calcium	0.05		4.49	11.4	7.03	10.3	12.4	28	25.3	27.6	12.5	38.9
Chromium	0.0001	0.001	0.0004	0.0008	0.0005	0.0007	*0.0011*	*0.0011*	*0.0011*	*0.0012*	0.0003	<0.0001
Cobalt	0.000005		0.00064	0.000545	0.000418	0.000492	0.000848	0.00193	0.00116	0.0014	0.000105	0.000247
Copper	0.00005	0.002-0.004 [c]	*0.0107*	*0.0081*	*0.00245*	*0.00603*	*0.00663*	*0.00808*	*0.00595*	*0.00724*	0.00199	*0.078*
Iron	0.001	0.3	*0.574*	*0.54*	*0.567*	*0.549*	*1.00*	*2.17*	*1.56*	*1.95*	0.191	0.112
Lead	0.000005	0.001-0.007 [d]	0.000513	0.000432	0.000305	0.000443	0.000866	*0.0029*	0.00183	*0.00249*	0.000094	*0.0178*
Lithium	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	0.0007	0.0026	0.002	0.0026	0.0005	0.003
Magnesium	0.05		0.93	4.18	2.61	3.76	4.54	8.47	7.36	8.32	4.5	10.7
Manganese	0.00005		0.0721	0.0329	0.0418	0.0369	0.0689	0.197	0.132	0.173	0.0125	0.351
Mercury	0.00001	0.000026	<0.00001	0.00001	0.00001	0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Molybdenum	0.00005	0.073	0.00025	0.00037	0.00009	0.00026	0.0003	0.00059	0.00068	0.00066	0.00021	<0.00005
Nickel	0.00002	0.025-0.15 [e]	0.00169	0.00211	0.00105	0.00164	0.00227	0.0101	0.00662	0.00925	0.00083	0.00057
Phosphorous	0.002		0.042	0.03	0.036	0.039	0.084	0.268	0.197	0.234	0.014	0.002
Potassium	0.05		1.12	1.2	1.02	1.15	1.3	1.1	1.07	1.11	1.01	1.62
Selenium	0.00004	0.001	0.00005	0.00006	<0.00004	0.00005	<0.00004	0.00042	0.00031	0.00046	0.00004	<0.00004
Silicon	0.1		2.5	2.8	1.6	2.4	2.6	3.2	3.5	3.6	2.3	5.9
Silver	0.000005	0.0001	0.000013	0.000013	0.000006	0.000012	0.00001	0.000005	0.000011	0.000012	0.000006	0.000063
Sodium	0.05		0.92	1.47	0.87	1.3	1.39	1.67	1.87	1.69	1.72	3.75
Strontium	0.00005		0.0309	0.071	0.0546	0.0674	0.0809	0.129	0.123	0.128	0.0888	0.342
Thallium	0.000002	0.0008	0.000008	0.000008	0.000006	0.000008	0.000011	0.00002	0.000016	0.00002	0.000003	0.000027
Tin	0.00001		0.00001	<0.00001	<0.00001	0.00003	<0.00001	0.00003	<0.00001	<0.00001	<0.00001	<0.00001
Titanium	0.0005		0.0103	0.0128	0.0161	0.0134	0.0254	0.0134	0.0172	0.0161	0.0037	<0.0005
Uranium	0.000002		0.000305	0.00339	0.00125	0.0029	0.00361	0.000975	0.001	0.00105	0.00139	0.00219
Vanadium	0.0002		0.0009	0.0008	0.0014	0.001	0.002	0.0032	0.0028	0.0032	0.0004	<0.0002
Zinc	0.0001	0.03	0.0145	0.0073	0.0026	0.0049	0.0062	*0.0436*	0.0248	*0.0381*	0.0014	*3.62*
Zirconium	0.0001		0.0003	0.0004	0.0004	0.0004	0.0005	0.0003	0.0006	0.0007	0.0003	<0.0001

Appendix B2. Surface Water Quality Data, Casino Project, May 2008

AECOM

Station	Detection Limits	Water Quality Guidelines	W7 - Upper Canadian Creek	W3 - Canadian Creek us of Confluence with Britannia Creek	W14 - Mouth of Britannia Creek	W2 - Canadian Creek Downstream of Confluence with Britannia Creek	W1 - Mouth of Canadian Creek	W6b - Yukon River Upstream of Canadian Creek	W6a - Yukon River Sownstream of Canadian Creek	W15 - Yukon River Dar Field Site	W17 - Sunshine Creek	W43 - Adit Discharge Pipe at Lower Camp
Date		**CCME [a]**	**21-May-08**	**23-May-08**	**23-May-08**	**23-May-08**	**22-May-08**	**21-May-08**	**21-May-08**	**21-May-08**	**22-May-08**	**23-May-08**
Dissolved Metals												
Aluminum	0.0002		0.337	0.233	0.36	0.272	0.289	0.0809	0.0642	0.0693	0.185	0.0023
Antimony	0.00002		0.00005	0.00018	0.0001	0.00016	0.00018	0.00017	0.00013	0.00016	0.00013	0.0033
Arsenic	0.00002		0.00038	0.00073	0.00054	0.00065	0.0007	0.00055	0.00053	0.00055	0.00055	0.0003
Barium	0.00002		0.0281	0.0313	0.0429	0.036	0.0368	0.0471	0.0406	0.0434	0.0434	0.048
Beryllium	0.00001		0.00005	0.00002	0.00003	0.00002	0.00002	0.00001	0.00001	0.00001	0.00002	<0.00001
Bismuth	0.000005		<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Boron	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	0.000005		0.000229	0.000066	0.000018	0.000049	0.000039	0.000094	0.000064	0.000095	0.000018	0.0705
Calcium	0.05		4.49	11.5	6.83	10.3	12.3	25.5	24.1	25.6	12.9	40.4
Chromium	0.0001		0.0002	0.0003	0.0004	0.0003	0.0004	0.0002	0.0002	0.0002	0.0003	<0.0001
Cobalt	0.000005		0.00041	0.000255	0.000225	0.000241	0.000204	0.000098	0.000073	0.000083	0.000084	0.000245
Copper	0.00005		0.00756	0.00724	0.00191	0.00527	0.00508	0.00255	0.00214	0.00261	0.00198	0.07
Iron	0.001		0.312	0.227	0.278	0.236	0.236	0.17	0.128	0.159	0.14	0.015
Lead	0.000005		0.000079	0.000083	0.000084	0.000054	0.000064	0.000137	0.000091	0.000125	0.000028	0.00415
Lithium	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.002	0.0015	0.002	0.0005	0.0032
Magnesium	0.05		0.87	4.14	2.43	3.74	4.44	7.7	6.95	7.69	4.73	11
Manganese	0.00005		0.0548	0.0147	0.023	0.0186	0.016	0.0247	0.0117	0.0131	0.00379	0.361
Mercury	0.00001		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Molybdenum	0.00005		0.00078	0.00037	0.00015	0.00028	0.00033	0.00088	0.00101	0.00086	0.00027	<0.00005
Nickel	0.00002		0.00148	0.00161	0.0008	0.00129	0.00135	0.00386	0.00252	0.00378	0.0007	0.00061
Phosphorous	0.002		0.018	0.013	0.014	0.013	0.013	0.01	0.008	0.009	0.011	<0.002
Potassium	0.05		1.14	1.19	1.01	1.15	1.25	1.06	1.03	1.07	1.05	1.68
Selenium	0.00004		0.00006	0.00005	<0.00004	<0.00004	0.00006	0.00048	0.00033	0.00048	0.00004	<0.00004
Silicon	0.1		2.4	2.4	1.3	2.1	2.2	2.9	3	2.9	2.2	5.7
Silver	0.000005		0.000006	0.000007	<0.000005	0.000006	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	0.000022
Sodium	0.05		0.99	1.55	0.96	1.4	1.5	1.79	1.98	1.78	1.95	3.95
Strontium	0.00005		0.0301	0.0714	0.0528	0.0685	0.0786	0.117	0.114	0.115	0.0903	0.362
Thallium	0.000002		0.000005	<0.000002	<0.000002	<0.000002	0.000005	0.000005	0.000005	0.000005	<0.000002	0.000025
Tin	0.00001		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Titanium	0.0005		0.002	0.0022	0.0039	0.0026	0.0029	0.0022	0.0021	0.0022	0.0017	<0.0005
Uranium	0.000002		0.000225	0.00317	0.00109	0.00275	0.00304	0.00075	0.000842	0.000799	0.00136	0.00217
Vanadium	0.0002		0.0003	0.0003	0.0005	0.0004	0.0003	0.0003	0.0003	0.0003	0.0003	<0.0002
Zinc	0.0001		0.0164	0.0098	0.0083	0.0081	0.0069	0.009	0.0069	0.0084	0.0086	3.73
Zirconium	0.0001		0.0002	0.0003	0.0003	0.0003	0.0004	0.0002	0.0002	0.0002	0.0003	<0.0001

Notes:

All units mg/l unless otherwise noted.

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007.

b) 0.005 mg/L at pH <6.5, [Ca2+] <4 mg/L, DOC <2 mg/L: 0.1 mg/L at pH ≥6.5, [Ca2+] ≥4 mg/L, DOC ≥2 mg/L.

c) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] = 120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180 mg/L.

d) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] = 60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180 mg/L; 0.007 mg/L at [CaCO3] >180 mg/L.

e) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] = 60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 - 180 mg/L; 0.150 mg/L at [CaCO3] >180 mg/L.

Italic *Results exceed CCME Aquatic Life uidelines.*

Appendix B2. Surface Water Quality Data, Casino Project, May 2008

AECOM

Station	Detection Limits	Water Quality Guidelines	W12 - Proctor Gulch before Confluence with Casino Creek	W8 - Upper Casino Creek	W13 - Meloy Creek	W11 - Casino Creek (proposed dam outflow)	W4 - Mouth of Casino Creek	W9 - Dip Creek us of Confluence with Casino Creek	W5 - Dip Creek ds Casino Confluence	W16 - Dip Creek Far Field	W41 - Field Blank	Maxxam Travel Blank
Date		CCME [a]	23-May-08	22-May-08	21-May-08	22-May-08	22-May-08	22-May-08	22-May-08	21-May-08		
Physical Tests												
Temperature C	-		4.2	2.5	0	2.6	1.6	0.2	1.1	0	-	-
Conductivity (Field) µS/cm	-		203	84	102	101.2	85	60	58.2	127	-	-
pH (Field)	-		*4.0*	7.3	7.8	7.5	7.5	7.2	7.4	7.6	-	-
Hardness $CaCO_3$	0.5		75.8	42.3	59.1	56.1	47.7	37.4	41.4	69	<0.5	<0.5
Conductivity µS/cm	1		*270*	91	110	110	92.0	65	74.0	140.0	1	1
pH	-	6.5-9.0	3.9	6.9	7.5	7.3	7.3	7.2	7.3	7.6	4.5	4.5
Total Suspended Solids	1		14	13	5	4	20	76	58	74	<1	<1
Total Dissolved Solids	1		190	90	110	110	92	64	74	120	6	2
Turbidity NTU	0.1		11.5	1	0.6	0.7	0.8	6.1	4.2	2	0.2	<0.1
Dissolved Anions & Nutrients												
Ammonia as N	0.005		0.012	0.028	<0.005	<0.005	0.044	<0.005	<0.005	<0.005	0.071	<0.005
Alkalinity, Total (as $CaCO_3$)	0.5		<0.5	8.8	40.0	25.0	25.0	22.0	24.0	45.0	<0.5	<0.5
Chloride (Cl)	0.5		0.70	1.20	1.10	1.10	1.30	1.00	1.20	1.10	0.9	1.3
Sulfate (SO_4)	0.5		93.0	25.0	0.6	21.0	8.8	<0.5	<0.5	18.0	3.5	0.9
Nitrate (as N)	0.002	13	0.023	0.011	0.086	0.031	0.038	0.026	0.024	0.026	<0.002	<0.002
Nitrite (as N)	0.002	0.06	0.003	0.004	0.003	0.003	0.004	0.003	0.004	0.003	<0.002	0.002
Total Kjeldahl Nitrogen	0.02		0.4	0.330	0.300	0.45	0.480	0.430	0.420	0.270	<0.02	<0.02
Ortho Phosphate as P	0.001		<0.001	0.002	0.002	<0.001	<0.001	0.002	<0.001	0.002	<0.001	<0.001
Cyanide, Weak Acid Diss	0.0005		<0.0005	0.0007	0.0007	0.0009	0.0008	0.0007	0.0007	<0.0005	<0.0005	<0.0005
Total Cyanide	0.0005	0.005	<0.0005	0.0008	0.0009	0.0009	0.0007	0.0009	0.0008	<0.0005	<0.0005	<0.0005
Total Metals												
Aluminum	0.0002	0.005-0.1 [b]	*2.43*	*0.533*	*0.153*	*0.308*	*0.368*	*0.583*	*0.489*	*0.413*	<0.0002	<0.0002
Antimony	0.00002		0.00009	0.00009	0.00021	0.00012	0.00011	0.00008	0.00009	0.0001	<0.00002	<0.00002
Arsenic	0.00002	0.005	0.00027	0.00052	0.00135	0.00065	0.0007	0.00086	0.00077	0.00123	<0.00002	<0.00002
Barium	0.00002		0.0439	0.0385	0.0517	0.0388	0.0392	0.0526	0.0467	0.0618	<0.00002	0.00006
Beryllium	0.00001		0.00015	0.00004	0.00002	0.00003	0.00003	0.00006	0.00005	0.00004	<0.00001	<0.00001
Bismuth	0.000005		0.000014	0.000007	0.000007	<0.000005	0.000005	0.000012	0.000006	0.000006	<0.000005	<0.000005
Boron	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	0.000005	0.000017	*0.000799*	*0.000181*	*0.000092*	*0.000093*	*0.000066*	*0.000057*	*0.000054*	*0.000048*	<0.000005	<0.000005
Calcium	0.05		22.2	12.6	16.2	15.6	13	9.75	10.9	17.3	<0.05	<0.05
Chromium	0.0001	0.001	0.0003	0.0003	0.0003	0.0003	0.0004	0.0007	0.0006	0.0007	<0.0001	<0.0001
Cobalt	0.000005		0.00864	0.00113	0.000081	0.000346	0.000331	0.00052	0.00041	0.000575	<0.000005	<0.000005
Copper	0.00005	0.002-0.004 [c]	*0.219*	*0.0581*	*0.00294*	*0.0328*	*0.0164*	*0.00333*	*0.00669*	*0.00529*	0.00009	0.00007
Iron	0.001	0.3	*6.62*	*0.654*	0.162	*0.344*	*0.414*	*0.931*	*0.724*	*1.09*	<0.001	0.003
Lead	0.000005	0.001-0.007 [d]	*0.00203*	0.000547	*0.00314*	0.000893	0.000847	*0.00213*	*0.00152*	0.00104	0.000014	0.000074
Lithium	0.0005		0.0012	<0.0005	0.0007	0.0007	0.0006	0.0018	0.0014	0.0014	<0.0005	<0.0005
Magnesium	0.05		4.98	2.65	4.51	4.19	3.73	3.17	3.42	6.28	<0.05	<0.05
Manganese	0.00005		0.325	0.0557	0.0511	0.029	0.0305	0.107	0.0785	0.133	<0.00005	0.00008
Mercury	0.00001	0.000026	0.00002	<0.00001	<0.00001	0.00001	0.00001	<0.00001	0.00001	<0.00001	<0.00001	<0.00001
Molybdenum	0.00005	0.073	<0.00005	0.00014	0.00034	0.00035	0.0005	0.00031	0.0004	0.00057	<0.00005	<0.00005
Nickel	0.00002	0.025-0.15 [e]	0.00263	0.00113	0.00084	0.00092	0.00095	0.00146	0.0011	0.00129	<0.00002	<0.00002
Phosphorous	0.002		0.02	0.018	0.015	0.015	0.025	0.073	0.052	0.052	<0.002	<0.002
Potassium	0.05		1.18	0.76	0.98	0.83	0.81	0.65	0.71	0.85	<0.05	<0.05
Selenium	0.00004	0.001	0.00008	0.00005	0.00004	<0.00004	0.00005	0.00004	0.00005	0.00005	<0.00004	<0.00004
Silicon	0.1		2.8	3	3.1	3.2	3.1	2.9	3	3.6	<0.1	<0.1
Silver	0.000005	0.0001	0.000026	0.000022	0.000018	0.000016	0.000011	0.000007	0.00001	0.000007	<0.000005	<0.000005
Sodium	0.05		1.52	1.43	1.84	1.66	1.74	1.5	1.61	2.78	<0.05	<0.05
Strontium	0.00005		0.0675	0.0852	0.103	0.1	0.0803	0.0787	0.0806	0.121	<0.00005	<0.00005
Thallium	0.000002	0.0008	0.000023	0.000008	0.000003	0.000006	0.000006	0.000008	0.000007	0.000006	<0.000002	<0.000002
Tin	0.00001		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Titanium	0.0005		0.0029	0.0049	0.0027	0.0034	0.0059	0.0196	0.0138	0.0169	<0.0005	<0.0005
Uranium	0.000002		0.00276	0.0012	0.00412	0.00278	0.00222	0.0034	0.003	0.00351	0.000005	0.000007
Vanadium	0.0002		<0.0002	0.0003	0.0004	0.0004	0.0009	0.0023	0.0017	0.0025	<0.0002	<0.0002
Zinc	0.0001	0.03	*0.0575*	0.0128	0.0063	0.0072	0.0048	0.0049	0.0042	0.0036	<0.0001	0.0011
Zirconium	0.0001		0.0003	0.0003	0.0003	0.0003	0.0004	0.0005	0.0004	0.0004	<0.0001	<0.0001

Appendix B2. Surface Water Quality Data, Casino Project, May 2008

AECOM

Station	Detection Limits	Water Quality Guidelines	W12 - Proctor Gulch before Confluence with Casino Creek	W8 - Upper Casino Creek	W13 - Meloy Creek	W11 - Casino Creek (proposed dam outflow)	W4 - Mouth of Casino Creek	W9 - Dip Creek us of Confluence with Casino Creek	W5 - Dip Creek ds Casino Confluence	W16 - Dip Creek Far Field	W41 - Field Blank	Maxxam Travel Blank
Date		CCME [a]	23-May-08	22-May-08	21-May-08	22-May-08	22-May-08	22-May-08	22-May-08	21-May-08		
Dissolved Metals												
Aluminum	0.0002		2.44	0.434	0.139	0.268	0.247	0.182	0.197	0.0701	0.0017	<0.0002
Antimony	0.00002		0.00008	0.00008	0.00022	0.00012	0.0001	0.00006	0.00007	0.00009	<0.00002	<0.00002
Arsenic	0.00002		0.00023	0.00035	0.0012	0.00051	0.00047	0.00034	0.00037	0.00053	<0.00002	<0.00002
Barium	0.00002		0.0436	0.0332	0.0476	0.0343	0.0322	0.0293	0.0314	0.0415	<0.00002	<0.00002
Beryllium	0.00001		0.00015	0.00003	0.00002	0.00003	0.00002	0.00002	0.00002	0.00001	<0.00001	<0.00001
Bismuth	0.000005		0.00001	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Boron	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	0.000005		0.000805	0.000156	0.000049	0.000074	0.000031	0.000011	0.000016	0.000011	<0.000005	<0.000005
Calcium	0.05		22.2	13.1	16.6	15.5	13.3	9.29	10.6	17	<0.05	<0.05
Chromium	0.0001		0.0004	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002	<0.0001	<0.0001
Cobalt	0.000005		0.00855	0.000914	0.000053	0.000234	0.000104	0.000082	0.000086	0.000125	<0.000005	<0.000005
Copper	0.00005		0.215	0.0493	0.00263	0.0292	0.0146	0.00192	0.00523	0.00314	<0.00005	0.00007
Iron	0.001		6	0.419	0.108	0.237	0.201	0.207	0.197	0.24	<0.001	0.001
Lead	0.000005		0.0019	0.000216	0.00164	0.000407	0.000161	0.000172	0.000157	0.000065	<0.000005	0.000058
Lithium	0.0005		0.0012	0.0005	0.0007	0.0007	0.0006	0.0014	0.0012	0.0012	<0.0005	<0.0005
Magnesium	0.05		5	2.73	4.56	4.21	3.89	3.1	3.38	6.16	<0.05	<0.05
Manganese	0.00005		0.327	0.0446	0.019	0.0158	0.00578	0.0122	0.0106	0.0504	<0.00005	<0.00005
Mercury	0.00001		<0.00001	<0.00001	<0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Molybdenum	0.00005		<0.00005	0.00018	0.00034	0.00031	0.00056	0.00037	0.00044	0.00067	<0.00005	<0.00005
Nickel	0.00002		0.00261	0.00101	0.00075	0.00081	0.00079	0.00069	0.00069	0.00063	<0.00002	<0.00002
Phosphorous	0.002		0.016	0.011	0.01	0.01	0.012	0.012	0.013	0.007	<0.002	<0.002
Potassium	0.05		1.18	0.78	1.01	0.82	0.85	0.62	0.69	0.84	<0.05	<0.05
Selenium	0.00004		0.00007	0.00006	0.00005	0.00007	0.00005	0.00004	0.00004	0.00007	<0.00004	<0.00004
Silicon	0.1		2.6	3	3.1	3	3	2.4	2.6	3.3	<0.1	<0.1
Silver	0.000005		0.000019	0.00001	0.000011	0.000011	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Sodium	0.05		1.6	1.53	1.85	1.7	1.9	1.63	1.73	2.85	0.07	<0.05
Strontium	0.00005		0.0696	0.086	0.103	0.099	0.0803	0.0757	0.0803	0.119	<0.00005	<0.00005
Thallium	0.000002		0.000022	0.000006	0.000003	0.000005	<0.000002	<0.000002	<0.000002	<0.000002	<0.000002	<0.000002
Tin	0.00001		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	<0.00001	<0.00001	<0.00001
Titanium	0.0005		0.0025	0.0014	0.0014	0.0017	0.0021	0.0023	0.0021	0.0012	<0.0005	<0.0005
Uranium	0.000002		0.00269	0.00101	0.00398	0.00263	0.00201	0.00222	0.00223	0.00279	<0.000002	0.000003
Vanadium	0.0002		<0.0002	<0.0002	0.0002	<0.0002	0.0003	0.0004	0.0004	0.0005	<0.0002	<0.0002
Zinc	0.0001		0.0731	0.016	0.0084	0.0098	0.0069	0.0059	0.0053	0.0064	0.0056	0.0008
Zirconium	0.0001		0.0003	0.0003	0.0002	0.0003	0.0003	0.0003	0.0003	0.0002	<0.0001	<0.0001

Notes:

All units mg/l unless otherwise noted.

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007.

b) 0.005 mg/L at pH <6.5, [Ca2+] <4 mg/L, DOC <2 mg/L: 0.1 mg/L at pH ≥6.5, [Ca2+] ≥4 mg/L, DOC ≥2 mg/L.

c) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] = 120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180 mg/L.

d) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] = 60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180 mg/L; 0.007 mg/L at [CaCO3] >180 mg/L.

e) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] = 60 - 120 mg/L, 0.110 mg/L at [CaCO3] =120 - 180 mg/L; 0.150 mg/L at [CaCO3] >180 mg/L.

Italic *Results exceed CCME Aquatic Life u*

B3. Surface Water Quality Data, Casino Project, July 2008

Appendix B3. Surface Water Quality Data, Casino Project, July 2008

AECOM

Station	Detection Limits	Water Quality Guidelines	W7 - Upper Canadian Creek	W3 - Canadian Creek us of Confluence with Britannia Creek	W14 -Mouth of Britannia Creek	W2 - Canadian Creek Downstream of Confluence with Britannia Creek	W1 - Mouth of Canadian Creek	W1 - Replicate taken as W101	W6b - Yukon River Upstream of Canadian Creek	W6a - Yukon River Downstream of Canadian Creek	W15 - Yukon River Far Field Site	W17 - Sunshine Creek	W43 - Adit Discharge Pipe at Lower Camp
Date		CCME [a]	8-Jul-08	8-Jul-08	8-Jul-08	8-Jul-08	8-Jul-08	8-Jul-08	8-Jul-08	8-Jul-08	8-Jul-08	8-Jul-08	8-Jul-08
Physical Tests													
Temperature C	-		7.9	8.2	5	6.5	7.4	7.4	14.5	13.9	14.2	5.3	3.6
Conductivity (Field) µS/cm	-		107	263	318	287	280	280	187	149	162	185	242
pH (Field)	-		7.1	7.7	7.7	7.5	7.9	7.9	8.2	8.0	8.1	7.7	6.7
Hardness $CaCO_3$	0.5		38.0	121	158	138	143	144	98.1	76.1	84.6	97.4	116
Conductivity µS/cm	1		110	260	320	290	280	280	190	150	160	190	240
pH	-	6.5-9.0	7.1	8.0	8.0	8.0	8.1	8.1	8.1	8.1	7.9	7.9	7.5
Total Suspended Solids	1		<1	1	7	20	4	4	33	28	32	7	<1
Total Dissolved Solids	1		98	180	220	210	200	200	110	110	100	150	170
Turbidity NTU	0.1		0.3	0.4	0.4	0.3	0.5	0.3	6.9	4.2	8.4	0.6	0.2
Dissolved Anions & Nutrients													
Ammonia as N	0.005		0.013	<0.005	0.006	<0.005	0.013	0.015	0.008	0.008	0.032	0.032	0.016
Alkalinity, Total (as $CaCO_3$)	0.5		6.9	70	100	83	81	82	71	64	64	68	83
Acidity (pH 8.3) as $CaCO_3$	0.5		-	-	-	-	-	-	-	-	-	-	-
Chloride (Cl)	0.5		<0.5	0.7	1.0	0.8	2.5	5.3	0.6	0.6	0.6	1.1	0.8
Sulfate (SO_4)	0.5		39	57	91	60	63	59	25	13	17	27	44
Nitrate (as N)	0.002	13	<0.002	0.096	0.207	0.135	0.169	0.164	0.019	0.024	0.026	0.148	0.214
Nitrite (as N)	0.002	0.06	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Total Kjeldahl Nitrogen	0.02		0.11	0.32	0.22	0.29	0.24	0.19	0.13	0.11	0.10	0.23	0.07
Ortho Phosphate as P	0.001		<0.001	<0.001	<0.001	0.001	0.001	<0.001	<0.001	0.003	<0.001	0.002	<0.001
Cyanide, Weak Acid Diss	0.0005		<0.0005	<0.0005	0.0007	<0.0005	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0007	<0.0005
Total Cyanide	0.0005	0.005	<0.0005	0.0007	0.0007	0.0006	0.0008	0.0008	<0.0005	<0.0005	<0.0005	0.0011	<0.0005
Total Metals													
Aluminum	0.0002	0.005-0.1 [b]	0.0388	0.0321	*0.134*	*0.236*	0.0821	0.0752	*0.244*	*0.236*	*0.276*	*0.136*	0.0036
Antimony	0.00002		0.00008	0.00044	0.00022	0.00034	0.00028	0.00027	0.00013	0.00009	0.00011	0.00026	0.00342
Arsenic	0.00002	0.005	0.00026	0.00072	0.00066	0.00099	0.00057	0.00059	0.00076	0.00065	0.00073	0.00092	0.00049
Barium	0.00002		0.0406	0.0570	0.0839	0.0744	0.0627	0.0598	0.0585	0.0441	0.0514	0.0695	0.0517
Beryllium	0.00001		<0.00001	<0.00001	0.00001	0.00002	0.00001	0.00001	0.00002	0.00001	0.00003	0.00002	<0.00001
Bismuth	0.000005		<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	0.000011	0.000006	0.000008	<0.000005	<0.000005
Boron	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	0.000005	0.000017	*0.000087*	0.000017	0.000011	*0.000021*	0.000014	0.000011	*0.000077*	*0.000032*	*0.000056*	*0.000021*	*0.0553*
Calcium	0.05		11.5	31.1	37.7	34.3	35.8	36.1	26.8	21.2	23.5	24.5	32.3
Chromium	0.0001	0.001	0.0001	0.0002	0.0003	0.0004	0.0003	0.0003	0.0005	0.0005	0.0006	0.0003	<0.0001
Cobalt	0.000005		0.000032	0.000050	0.000114	0.000254	0.000099	0.000088	0.000307	0.000298	0.000343	0.000133	0.000164
Copper	0.00005	0.002-0.004 [c]	*0.00267*	0.00258	0.00177	0.00277	0.00243	0.00240	0.00176	0.00156	0.00176	0.00194	*0.0608*
Iron	0.001	0.3	0.028	0.042	0.157	*0.344*	0.104	0.099	*0.448*	*0.400*	*0.487*	0.196	0.025
Lead	0.000005	0.001-0.007 [d]	0.000079	0.000032	0.000083	0.000321	0.000059	0.000051	0.000382	0.000794	0.000366	0.000140	*0.00587*
Lithium	0.0005		0.0006	0.0005	0.0010	0.0009	0.0009	0.0009	0.0020	0.0013	0.0016	0.0008	0.0024
Magnesium	0.05		2.25	10.4	15.4	12.7	13.0	13.0	7.56	5.61	6.27	8.77	8.58
Manganese	0.00005		0.00079	0.00355	0.00747	0.0188	0.00454	0.00465	0.0289	0.0236	0.0285	0.0137	0.266
Mercury	0.00001	0.000026	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Molybdenum	0.00005	0.073	0.00033	0.00093	0.00053	0.00071	0.00077	0.00075	0.00094	0.00089	0.00088	0.00040	<0.00005
Nickel	0.00002	0.025-0.15 [e]	0.00067	0.00072	0.00062	0.00090	0.00077	0.00082	0.00210	0.00143	0.00192	0.00071	0.00050
Phosphorous	0.002		0.004	<0.002	0.009	0.022	0.005	0.005	0.034	0.032	0.038	0.009	0.002
Potassium	0.05		0.56	1.88	1.94	1.93	2.08	2.08	0.77	0.75	0.76	1.16	1.43
Selenium	0.00004	0.001	0.00006	0.00007	0.00008	0.00008	0.00011	0.00011	0.00047	0.00023	0.00034	0.00007	<0.00004
Silicon	0.1		7.6	4.8	4.0	4.6	4.5	4.8	3.4	3.3	3.4	4.0	5.8
Silver	0.000005	0.0001	0.000006	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	0.000009	0.000008	0.000012	0.000008	0.000090
Sodium	0.05		3.49	4.25	4.99	4.64	4.39	4.40	1.66	1.61	1.62	3.87	3.52
Strontium	0.00005		0.0811	0.204	0.316	0.251	0.236	0.234	0.113	0.0908	0.100	0.163	0.280
Thallium	0.000002	0.0008	0.000002	0.000003	0.000006	0.000006	0.000004	0.000003	0.000007	0.000006	0.000008	0.000004	0.000023
Tin	0.00001		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Titanium	0.0005		0.0008	0.0014	0.0071	0.0151	0.0031	0.0027	0.0095	0.0102	0.0106	0.0063	<0.0005
Uranium	0.000002		0.000073	0.00708	0.0103	0.00976	0.00928	0.00907	0.000946	0.000860	0.000884	0.00188	0.00149
Vanadium	0.0002		0.0002	<0.0002	0.0006	0.0011	0.0004	0.0004	0.0010	0.0009	0.0011	0.0007	<0.0002
Zinc	0.0001	0.03	0.0061	0.0005	0.0006	0.0016	0.0008	0.0008	0.0061	0.0029	0.0045	0.0012	*3.06*
Zirconium	0.0001		<0.0001	0.0001	0.0003	0.0003	0.0002	0.0002	0.0001	0.0001	0.0001	0.0002	<0.0001

Appendix B3. Surface Water Quality Data, Casino Project, July 2008

AECOM

Station	Detection Limits	Water Quality Guidelines	W7 - Upper Canadian Creek	W3 - Canadian Creek us of Confluence with Britannia Creek	W14 -Mouth of Britannia Creek	W2 - Canadian Creek Downstream of Confluence with Britannia Creek	W1 - Mouth of Canadian Creek	W1 - Replicate taken as W101	W6b - Yukon River Upstream of Canadian Creek	W6a - Yukon River Downstream of Canadian Creek	W15 - Yukon River Far Field Site	W17 - Sunshine Creek	W43 - Adit Discharge Pipe at Lower Camp
Date		CCME [a]	8-Jul-08	8-Jul-08	8-Jul-08	8-Jul-08	8-Jul-08	8-Jul-08	8-Jul-08	8-Jul-08	8-Jul-08	8-Jul-08	8-Jul-08
Dissolved Metals													
Aluminum	0.0002		0.0336	0.0197	0.0493	0.0334	0.0438	0.0429	0.0346	0.0268	0.0334	0.0546	0.0056
Antimony	0.00002		0.00008	0.00044	0.00024	0.00036	0.00027	0.00030	0.00012	0.00008	0.00010	0.00025	0.00335
Arsenic	0.00002		0.00024	0.00070	0.00055	0.00062	0.00056	0.00054	0.00045	0.00044	0.00045	0.00069	0.00028
Barium	0.00002		0.0400	0.0554	0.0789	0.0669	0.0591	0.0608	0.0426	0.0345	0.0371	0.0627	0.0495
Beryllium	0.00001		<0.00001	<0.00001	0.00001	<0.00001	0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Bismuth	0.000005		<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Boron	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Calcium	0.05		11.1	31.3	37.6	33.7	33.3	33.5	24.8	20.1	21.4	22.3	30.1
Cadmium	0.000005		0.000084	0.000014	0.000006	0.000013	0.000008	0.000008	0.000023	0.000015	0.000023	0.000013	0.0515
Chromium	0.0001		0.0002	0.0002	0.0003	0.0002	0.0003	0.0002	0.0002	0.0002	0.0002	0.0003	<0.0001
Cobalt	0.000005		0.000031	0.000035	0.000047	0.000051	0.000051	0.000042	0.000021	0.000016	0.000020	0.000044	0.000157
Copper	0.00005		0.00272	0.00261	0.00166	0.00219	0.00205	0.00211	0.00089	0.00082	0.00082	0.00153	0.0510
Iron	0.001		0.016	0.015	0.035	0.025	0.044	0.045	0.029	0.027	0.029	0.053	0.007
Lead	0.000005		0.000011	0.000008	0.000011	0.000065	<0.000005	<0.000005	0.000029	0.000021	0.000022	0.000016	0.00205
Lithium	0.0005		0.0007	0.0005	0.0010	0.0008	0.0008	0.0008	0.0017	0.0010	0.0013	0.0008	0.0024
Magnesium	0.05		2.30	10.7	16.0	12.9	12.1	12.4	7.19	5.33	5.89	8.31	8.13
Manganese	0.00005		0.00052	0.00255	0.00178	0.00287	0.00131	0.00128	0.00226	0.00182	0.00186	0.00325	0.252
Mercury	0.00001		<0.00001	<0.00001	<0.00001	<0.00001	0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Molybdenum	0.00005		0.00033	0.00094	0.00057	0.00083	0.00073	0.00078	0.00100	0.00095	0.00097	0.00040	<0.00005
Nickel	0.00002		0.00065	0.00077	0.00059	0.00064	0.00075	0.00068	0.00103	0.00067	0.00077	0.00064	0.00045
Phosphorous	0.002		0.002	<0.002	0.003	0.002	<0.002	<0.002	0.002	<0.002	<0.002	0.003	<0.002
Potassium	0.05		0.56	1.91	1.95	1.92	1.94	1.95	0.70	0.69	0.69	1.07	1.33
Selenium	0.00004		0.00005	0.00007	0.00009	0.00008	0.00012	0.00010	0.00048	0.00024	0.00034	0.00008	<0.00004
Silicon	0.1		7.5	5.0	4.5	4.6	3.8	4.1	3.2	3.2	3.2	4.1	6.0
Silver	0.000005		<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	0.000026
Sodium	0.05		3.69	4.42	5.30	4.84	4.20	4.20	1.66	1.63	1.63	3.71	3.44
Strontium	0.00005		0.0790	0.203	0.306	0.250	0.214	0.217	0.109	0.0866	0.0925	0.157	0.265
Thallium	0.000002		0.000002	0.000003	0.000003	0.000003	0.000004	0.000004	0.000004	0.000003	0.000003	0.000002	0.000022
Tin	0.00001		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Titanium	0.0005		<0.0005	<0.0005	0.0007	<0.0005	0.0006	<0.0005	<0.0005	0.0006	0.0006	<0.0005	<0.0005
Uranium	0.000002		0.00009	0.00685	0.00971	0.00923	0.00864	0.00890	0.000863	0.000802	0.000800	0.00172	0.00128
Vanadium	0.0002		0.0002	<0.0002	0.0004	0.0002	0.0003	0.0003	0.0002	<0.0002	0.0002	0.0003	<0.0002
Zinc	0.0001		0.0107	0.0055	0.0058	0.0061	0.0045	0.0042	0.0062	0.0046	0.0065	0.005	2.84
Zirconium	0.0001		0.0001	0.0002	0.0003	0.0002	0.0002	0.0002	<0.0001	<0.0001	<0.0001	0.0002	<0.0001

Notes:

All units mg/l unless otherwise noted.

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007.

b) 0.005 mg/L at pH <6.5, [Ca2+] <4 mg/L, DOC <2 mg/L: 0.1 mg/L at pH ≥6.5, [Ca2+] ≥4 mg/L, DOC ≥2 mg/L.

c) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] = 120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180 mg/L.

d) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] = 60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180 mg/L; 0.007 mg/L at [CaCO3] >180 mg/L.

e) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] = 60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 - 180 mg/L; 0.150 mg/L at [CaCO3] >180 mg/L.

Italic *Results exceed CCME Aquatic Life guidelines.*

Appendix B3. Surface Water Quality Data, Casino Project, July 2008

AECOM

Station	Detection Limits	Water Quality Guidelines	W43 - Replicate taken as W102	W12 - Proctor Gulch before Confluence with Casino Creek	W8 - Upper Casino Creek	W13 - Meloy Creek	W11 - Casino Creek (proposed dam outflow)	W4 - Mouth of Casino Creek	W9 - Dip Creek us of Confluence with Casino Creek	W5 - Dip Creek ds Casino Confluence	W16 - Dip Creek Far Field	Field Blank (W40)	Maxxam Travel Blank
Date		CCME [a]	9-Jul-08	8-Jul-08	8-Jul-08	9-Jul-08	9-Jul-08	9-Jul-08	9-Jul-08	9-Jul-08	9-Jul-08	9-Jul-08	5-Jul-08
Physical Tests													
Temperature C	-		3.6	7	3.1	3	7.5	6.4	5.7	6.1	6.9	-	-
Conductivity (Field) µS/cm	-		242	1034	281	324	298	232	103	119	141	-	-
pH (Field)	-		6.7	*3.3*	7.4	7.8	7.8	7.7	7.5	7.6	7.5	-	-
Hardness $CaCO_3$	0.5		117	411	125	164	146	111	51.6	58.5	68.1	<0.5	<0.5
Conductivity µS/cm	1		240	1200	280	330	300	230	100	120	140	<1	<1
pH	-	6.5-9.0	7.3	*3.2*	7.8	8.2	8.1	8.0	7.8	7.8	7.8	5.2	5.8
Total Suspended Solids	1		<1	3	5	<1	<1	1	25	17	13	<1	<1
Total Dissolved Solids	1		160	790	200	210	200	150	94	110	120	2	<1
Turbidity NTU	0.1		0.3	2.5	5.1	0.1	0.4	0.2	1.3	1.1	0.9	0.1	<0.1
Dissolved Anions & Nutrients													
Ammonia as N	0.005		<0.005	0.050	0.008	0.005	0.014	<0.005	<0.005	<0.005	<0.005	0.009	0.014
Alkalinity, Total (as $CaCO_3$)	0.5		80	<0.5	42	130	83	79	43	48	49	<0.5	<0.5
Acidity (pH 8.3) as $CaCO_3$	0.5		-	153	-	-	-	-	-	-	-	-	-
Chloride (Cl)	0.5		0.9	0.7	0.7	0.8	0.7	0.9	1.1	1.0	0.9	0.7	<0.5
Sulfate (SO_4)	0.5		45	550	90	47	67	42	7.5	12	24	1.8	1.3
Nitrate (as N)	0.002	13	0.216	0.030	0.073	0.249	0.107	0.087	0.068	0.066	0.035	0.012	<0.002
Nitrite (as N)	0.002	0.06	<0.002	0.003	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.002	<0.002	<0.002
Total Kjeldahl Nitrogen	0.02		0.10	0.18	0.15	0.15	0.21	0.16	0.26	0.27	0.39	0.05	0.04
Ortho Phosphate as P	0.001		<0.001	0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001
Cyanide, Weak Acid Diss	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	0.0005	<0.0005	<0.0005
Total Cyanide	0.0005	0.005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0010	0.0008	0.0012	<0.0005	<0.0005
Total Metals													
Aluminum	0.0002	0.005-0.1[b]	0.0030	*12.2*	*0.534*	0.0162	0.0475	0.0446	*0.348*	*0.272*	*0.256*	0.0013	0.0012
Antimony	0.00002		0.00342	0.00013	0.00010	0.00027	0.00015	0.00014	0.00009	0.00011	0.00010	<0.00002	<0.00002
Arsenic	0.00002	0.005	0.00048	0.00031	0.00026	0.00180	0.00060	0.00042	0.00059	0.00054	0.00063	<0.00002	<0.00002
Barium	0.00002		0.0496	0.0102	0.0540	0.0904	0.0643	0.0550	0.0446	0.0455	0.0439	0.00057	<0.00002
Beryllium	0.00001		<0.00001	0.00059	0.00003	<0.00001	<0.00001	<0.00001	0.00003	0.00002	0.00002	<0.00001	<0.00001
Bismuth	0.000005		<0.000005	<0.000005	0.000005	<0.000005	<0.000005	<0.000005	0.000005	0.000006	0.000006	<0.000005	<0.000005
Boron	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	0.000005	0.000017	*0.0550*	*0.00317*	*0.000253*	*0.000026*	*0.000043*	0.000013	*0.000017*	*0.000021*	*0.000018*	0.000006	<0.000005
Calcium	0.05		32.7	124	37.4	43.6	39.5	29.6	13.4	15.1	16.4	0.07	<0.05
Chromium	0.0001	0.001	<0.0001	0.0006	0.0001	0.0001	<0.0001	0.0002	0.0006	0.0005	0.0006	<0.0001	<0.0001
Cobalt	0.000005		0.000161	0.0510	0.00222	0.000018	0.000048	0.000045	0.000265	0.000228	0.000268	<0.000005	<0.000005
Copper	0.00005	0.002-0.004[c]	*0.0604*	*1.13*	*0.0554*	0.00054	*0.00787*	*0.00371*	*0.00214*	*0.00228*	*0.00296*	0.00006	<0.00005
Iron	0.001	0.3	0.023	*32.5*	*1.03*	0.024	0.071	0.076	*0.556*	*0.441*	*0.524*	<0.001	0.003
Lead	0.000005	0.001-0.007[d]	*0.00567*	0.00116	0.000225	0.000218	0.000041	0.000028	0.000609	0.000596	0.000222	0.000008	0.000042
Lithium	0.0005		0.0025	0.0065	0.0010	0.0020	0.0013	0.0010	0.0022	0.0020	0.0013	<0.0005	<0.0005
Magnesium	0.05		8.66	25.0	7.68	13.3	11.5	9.11	4.40	5.04	6.57	<0.05	<0.05
Manganese	0.00005		0.268	1.39	0.0676	0.00448	0.0145	0.00498	0.0347	0.0287	0.0294	0.00015	<0.00005
Mercury	0.00001	0.000026	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Molybdenum	0.00005	0.073	<0.00005	0.00012	0.00023	0.00083	0.00095	0.00120	0.00050	0.00060	0.00055	<0.00005	<0.00005
Nickel	0.00002	0.025-0.15[e]	0.00042	0.00782	0.00080	0.00023	0.00030	0.00035	0.00085	0.00077	0.00136	<0.00002	<0.00002
Phosphorous	0.002		0.002	0.004	<0.002	0.003	0.003	0.003	0.021	0.018	0.015	0.043	<0.002
Potassium	0.05		1.41	2.19	0.86	1.22	0.99	1.02	0.52	0.57	0.60	<0.05	<0.05
Selenium	0.00004	0.001	<0.00004	0.00025	0.00006	0.00005	0.00010	0.00006	0.00006	0.00006	0.00008	<0.00004	<0.00004
Silicon	0.1		6.1	9.2	5.6	5.1	4.8	4.9	4.2	4.3	4.2	<0.1	<0.1
Silver	0.000005	0.0001	0.000088	0.000026	<0.000005	<0.000005	<0.000005	<0.000005	0.000007	0.000007	<0.000005	<0.000005	<0.000005
Sodium	0.05		3.52	7.57	3.86	5.17	4.15	4.13	2.41	2.60	2.72	<0.05	<0.05
Strontium	0.00005		0.281	0.317	0.250	0.269	0.248	0.177	0.110	0.118	0.111	0.00094	<0.00005
Thallium	0.000002	0.0008	0.000023	0.000094	0.000006	<0.000002	0.000003	0.000002	0.000006	0.000006	0.000004	<0.000002	<0.000002
Tin	0.00001		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Titanium	0.0005		<0.0005	0.0005	<0.0005	0.0005	0.0006	0.0014	0.0159	0.0118	0.0093	<0.0005	<0.0005
Uranium	0.000002		0.00154	0.0145	0.00217	0.0180	0.00961	0.00558	0.00250	0.00272	0.00178	0.000004	<0.000002
Vanadium	0.0002		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0004	0.0013	0.0011	0.0013	<0.0002	<0.0002
Zinc	0.0001	0.03	*2.99*	*0.237*	0.0192	0.0014	0.0018	0.0005	0.0022	0.0020	0.0015	0.0022	0.0008
Zirconium	0.0001		<0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.0002	0.0004	0.0003	0.0005	<0.0001	<0.0001

Appendix B3. Surface Water Quality Data, Casino Project, July 2008

AECOM

Station	Detection Limits	Water Quality Guidelines	W43 - Replicate taken as W102	W12 - Proctor Gulch before Confluence with Casino Creek	W8 - Upper Casino Creek	W13 - Meloy Creek	W11 - Casino Creek (proposed dam outflow)	W4 - Mouth of Casino Creek	W9 - Dip Creek us of Confluence with Casino Creek	W5 - Dip Creek ds Casino Confluence	W16 - Dip Creek Far Field	Field Blank (W40)	Maxxam Travel Blank
Date		CCME [a]	9-Jul-08	8-Jul-08	8-Jul-08	9-Jul-08	9-Jul-08	9-Jul-08	9-Jul-08	9-Jul-08	9-Jul-08	9-Jul-08	5-Jul-08
Dissolved Metals													
Aluminum	0.0002		0.0254	12.2	0.0569	0.0110	0.0307	0.0329	0.0927	0.0845	0.101	0.0031	0.0024
Antimony	0.00002		0.00329	0.00013	0.00009	0.00023	0.00015	0.00014	0.00008	0.00009	0.00009	<0.00002	<0.00002
Arsenic	0.00002		0.00029	0.00031	0.00018	0.00178	0.00056	0.00040	0.00033	0.00034	0.00050	<0.00002	<0.00002
Barium	0.00002		0.0496	0.0103	0.0525	0.0884	0.0619	0.0555	0.0350	0.0385	0.0392	<0.00002	0.00006
Beryllium	0.00001		<0.00001	0.00059	<0.00001	<0.00001	<0.00001	<0.00001	0.00002	0.00001	0.00001	<0.00001	<0.00001
Bismuth	0.000005		<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Boron	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Calcium	0.05		30.9	122	38.1	41.6	38.6	29.2	12.9	14.7	16.3	<0.05	<0.05
Cadmium	0.000005		0.0531	0.00323	0.000220	0.000023	0.000043	0.000014	0.000011	0.000007	0.000011	0.000008	<0.000005
Chromium	0.0001		<0.0001	0.0008	0.0001	<0.0001	0.0001	0.0002	0.0003	0.0003	0.0004	<0.0001	<0.0001
Cobalt	0.000005		0.000161	0.0509	0.00218	0.000010	0.000040	0.000031	0.000052	0.000051	0.000133	<0.000005	<0.000005
Copper	0.00005		0.0534	1.12	0.0313	0.00056	0.00713	0.00356	0.00159	0.00179	0.00249	0.00010	<0.00005
Iron	0.001		0.007	35.1	0.423	0.011	0.045	0.043	0.114	0.105	0.238	<0.001	0.002
Lead	0.000005		0.00218	0.00113	0.000099	0.000029	0.000015	0.000009	0.000062	0.000052	0.000025	<0.000005	0.000043
Lithium	0.0005		0.0024	0.0064	0.0009	0.0020	0.0013	0.0011	0.0019	0.0018	0.0012	<0.0005	<0.0005
Magnesium	0.05		8.33	25.4	7.98	13.1	11.6	9.31	4.35	4.93	6.77	<0.05	<0.05
Manganese	0.00005		0.258	1.39	0.0683	0.00248	0.0136	0.00386	0.00674	0.00681	0.0174	<0.00005	<0.00005
Mercury	0.00001		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Molybdenum	0.00005		<0.00005	0.00012	0.00024	0.00085	0.00093	0.00127	0.00052	0.00061	0.00056	<0.00005	<0.00005
Nickel	0.00002		0.00053	0.00789	0.00079	0.00022	0.00029	0.00034	0.00057	0.00058	0.00116	0.00002	<0.00002
Phosphorous	0.002		<0.002	0.003	<0.002	<0.002	<0.002	0.002	0.005	0.004	0.005	<0.002	<0.002
Potassium	0.05		1.36	2.17	0.88	1.20	0.98	1.03	0.50	0.55	0.60	<0.05	<0.05
Selenium	0.00004		<0.00004	0.00029	0.00005	0.00006	0.00011	0.00007	0.00006	0.00006	0.00008	<0.00004	<0.00004
Silicon	0.1		5.9	10.6	5.8	5.4	5.2	5.3	4.2	4.3	4.3	<0.1	<0.1
Silver	0.000005		0.000035	0.000021	<0.000005	<0.000005	0.000006	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Sodium	0.05		3.45	7.78	4.03	5.22	4.15	4.35	2.48	2.70	2.84	0.07	<0.05
Strontium	0.00005		0.271	0.307	0.246	0.269	0.246	0.182	0.105	0.116	0.111	<0.00005	0.00008
Thallium	0.000002		0.000025	0.000095	0.000006	<0.000002	0.000003	0.000002	0.000003	0.000002	0.000002	<0.000002	<0.000002
Tin	0.00001		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Titanium	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0012	0.0013	0.0017	<0.0005	<0.0005
Uranium	0.000002		0.00134	0.0145	0.00135	0.0177	0.00898	0.00570	0.00194	0.00238	0.00162	0.000006	0.000004
Vanadium	0.0002		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0003	0.0004	0.0004	0.0006	<0.0002	<0.0002
Zinc	0.0001		2.93	0.241	0.0182	0.0066	0.0051	0.0052	0.0054	0.0047	0.0039	0.0042	0.0007
Zirconium	0.0001		<0.0001	0.0001	<0.0001	<0.0001	0.0001	0.0002	0.0003	0.0003	0.0004	<0.0001	<0.0001

Notes:

All units mg/l unless otherwise noted.

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007.

b) 0.005 mg/L at pH <6.5, [Ca2+] <4 mg/L, DOC <2 mg/L: 0.1 mg/L at pH ≥6.5, [Ca2+] ≥4 mg/L, DOC ≥2 mg/L.

c) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] = 120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180 mg/L.

d) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] = 60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180 mg/L; 0.007 mg/L at [CaCO3] >180 mg/L.

e) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] = 60 - 120 mg 0.110 mg/L at [CaCO3] =120 - 180 mg/L; 0.150 mg/L at [CaCO3] >180 mg/L.

Italic *Results exceed CCME Aquatic Life*

B4. Surface Water Quality Data, Casino Project, September 2008

Appendix B4. Surface Water Quality Data, Casino Project, September 2008

AECOM

Station	Detection Limits	Water Quality Guidelines	W7 - Upper Canadian Creek	W3 - Canadian Creek us of Confluence with Britannia Creek	W14 - Mouth of Britannia Creek	W2 - Canadian Creek Downstream of Confluence with Britannia Creek	W2 - Replicate	W1 - Mouth of Canadian Creek	W6b - Yukon River Upstream of Canadian Creek	W6a - Yukon River Downstream of Canadian Creek	W15 - Yukon River Far Field Site	W17 - Sunshine Creek	W43 - Adit Discharge Pipe at Lower Camp
Date		**CCME [a]**	**10-Sep-08**	**10-Sep-08**	**10-Sep-08**	**10-Sep-08**	**10-Sep-08**	**10-Sep-08**	**9-Sep-08**	**9-Sep-08**	**9-Sep-08**	**9-Sep-08**	**9-Sep-08**
Physical Tests													
Temperature C	-		2.7	4.5	3	4.1	4.1	4.6	9.6	10.0	9.9	4.1	4.2
Conductivity (Field) µS/cm	-		117	175	188	179	179	201	220	174	216	179	347
pH (Field)	-		6.8	7.7	8.0	7.6	7.6	7.8	8.2	8.1	8.1	7.5	7.4
Hardness $CaCO_3$	0.5		41.0	83.7	90.0	83.0	81.7	89.7	107	83.9	107	83.9	94.4
Conductivity µS/cm	1		120	180	190	180	180	200	220	180	220	180	220
pH	-	6.5-9.0	6.8	7.8	7.8	7.9	7.9	7.9	8.1	8.1	8.1	7.9	7.5
Total Suspended Solids	1		1	3	2	3	3	3	14	12	32	1	<1
Total Dissolved Solids	1		100	74	150	120	120	140	180	140	140	96	120
Turbidity NTU	0.1		0.3	0.7	0.4	0.6	0.5	0.7	8.2	3.7	4.9	0.2	0.8
Dissolved Anions & Nutrients													
Ammonia as N	0.01		<0.01	<0.01	<0.01	<0.01	<0.01	0.03	0.04	<0.01	<0.01	<0.01	<0.01
Alkalinity, Total (as $CaCO_3$)	0.5		4.8	45	59	50	50	55	81	72	80	63	67
Acidity (pH 8.3) as $CaCO_3$	0.5		-	-	-	-	-	-	-	-	-	-	13.2
Chloride (Cl)	0.5		<0.5	0.6	0.7	0.6	<0.5	0.8	0.6	0.5	<0.5	0.6	<0.5
Sulfate (SO_4)	0.5		43	40	30	38	40	44	32	18	31	26	39
Nitrate (as N)	0.002	13	<0.002	0.173	0.255	0.197	0.197	0.202	0.014	0.015	0.011	0.206	0.443
Nitrite (as N)	0.002	0.06	<0.002	0.003	0.002	0.003	0.003	0.002	0.003	0.002	0.004	0.002	<0.002
Total Kjeldahl Nitrogen	0.02		0.12	0.21	0.26	0.21	0.25	0.23	0.09	0.11	0.08	0.20	0.04
Ortho Phosphate as P	0.001		0.002	<0.001	<0.001	<0.001	0.001	0.001	0.006	0.003	0.006	<0.001	0.002
Cyanide, Weak Acid Diss	0.0005		<0.0005	0.0007	0.0008	0.0007	0.0006	0.0008	<0.0005	<0.0005	<0.0005	0.0006	<0.0005
Total Cyanide	0.0005	0.005	0.0006	0.0010	0.0017	0.0012	0.0012	0.0012	<0.0005	0.0008	<0.0005	0.0013	<0.0005
Total Metals													
Aluminum	0.0002	0.005-0.1 [b]	*0.112*	*0.219*	*0.271*	*0.105*	0.0866	0.0883	*0.124*	0.0954	*0.137*	0.0600	0.0235
Antimony	0.00002		0.00007	0.00045	0.00033	0.00039	0.00038	0.00034	0.00013	0.00010	0.00015	0.00027	0.00264
Arsenic	0.00002	0.005	0.00026	0.00111	0.00103	0.00082	0.00076	0.00070	0.00060	0.00054	0.00064	0.00062	0.00079
Barium	0.00002		0.0471	0.0438	0.0699	0.0450	0.0431	0.0449	0.0561	0.0421	0.0597	0.0588	0.0658
Beryllium	0.00001		0.00002	0.00003	0.00002	0.00001	0.00001	0.00001	0.00001	0.00001	0.00002	<0.00001	<0.00001
Bismuth	0.000005		0.000040	0.000013	0.000018	0.000005	<0.000005	<0.000005	<0.000005	0.000012	<0.000005	<0.000005	<0.000005
Boron	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	0.000005	0.000017	*0.000238*	*0.000068*	*0.000031*	*0.000023*	*0.000019*	0.000015	*0.000080*	*0.000041*	*0.000088*	*0.000018*	*0.0425*
Calcium	0.05		12.2	22.0	21.8	20.9	20.6	22.7	28.8	23.2	28.7	20.8	26.2
Chromium	0.0001	0.001	0.0002	0.0005	0.0007	0.0003	0.0003	0.0003	0.0002	0.0002	0.0002	0.0003	<0.0001
Cobalt	0.000005		0.000144	0.000352	0.000219	0.000108	0.000083	0.000079	0.000181	0.000125	0.000199	0.000062	0.000320
Copper	0.00005	0.002-0.004 [c]	*0.00282*	*0.00521*	*0.00423*	*0.00339*	*0.00303*	*0.00279*	0.00139	0.00114	0.00143	0.00175	*0.0748*
Iron	0.001	0.3	0.100	0.208	*0.370*	0.107	0.084	0.085	0.193	0.152	0.225	0.058	0.047
Lead	0.000005	0.001-0.007 [d]	0.000154	0.00147	0.00150	0.000393	0.000059	0.000064	0.000253	0.000169	0.000270	0.000145	*0.0120*
Lithium	0.0005		0.0007	<0.0005	0.0007	<0.0005	<0.0005	0.0006	0.0022	0.0014	0.0022	0.0008	0.0020
Magnesium	0.05		2.56	6.95	8.63	7.48	7.37	8.04	8.52	6.29	8.50	7.76	7.02
Manganese	0.00005		0.0105	0.0342	0.0138	0.00687	0.00494	0.00404	0.0236	0.0156	0.0243	0.00435	0.524
Mercury	0.00001	0.000026	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Molybdenum	0.00005	0.073	0.00020	0.00063	0.00048	0.00057	0.00055	0.00059	0.00100	0.00101	0.00102	0.00041	<0.00005
Nickel	0.00002	0.025-0.15 [e]	0.00100	0.00122	0.00083	0.00087	0.00080	0.00076	0.00221	0.00117	0.00219	0.00057	0.00049
Phosphorous	0.002		0.006	0.012	0.017	0.006	0.006	0.005	0.021	0.015	0.021	0.005	0.003
Potassium	0.05		0.41	1.29	1.26	1.20	1.16	1.33	0.72	0.71	0.73	1.01	1.35
Selenium	0.00004	0.001	<0.00004	<0.00004	0.00006	<0.00004	0.00004	0.00006	0.00053	0.00028	0.00053	0.00006	<0.00004
Silicon	0.1		6.9	4.6	4.2	4.6	4.5	4.9	3.0	3.1	3.5	4.4	5.8
Silver	0.000005	0.0001	<0.000005	0.000005	0.000011	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	0.000007	<0.000005	*0.000105*
Sodium	0.05		3.38	3.20	3.00	2.77	2.75	2.77	1.86	1.85	1.91	3.03	3.09
Strontium	0.00005		0.0793	0.127	0.171	0.140	0.136	0.148	0.129	0.105	0.131	0.139	0.220
Thallium	0.000002	0.0008	0.000004	0.000005	0.000007	0.000004	0.000004	0.000004	0.000004	0.000004	0.000005	0.000003	0.000025
Tin	0.00001		<0.00001	<0.00001	0.00006	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	<0.00001
Titanium	0.0005		0.0015	0.0050	0.0093	0.0025	0.0021	0.0016	0.0023	0.0024	0.0024	0.0011	<0.0005
Uranium	0.000002		0.000095	0.00434	0.00349	0.00466	0.00465	0.00464	0.000929	0.000916	0.00104	0.00126	0.00126
Vanadium	0.0002		0.0002	0.0006	0.0010	0.0003	0.0002	0.0003	0.0004	0.0004	0.0004	0.0003	<0.0002
Zinc	0.0001	0.03	0.0195	0.0133	0.0033	0.0016	0.0011	0.0008	0.0062	0.0028	0.0065	0.0014	*2.35*
Zirconium	0.0001		0.0002	0.0004	0.0007	0.0004	0.0004	0.0003	0.0001	<0.0001	0.0001	0.0003	<0.0001

Station	Detection Limits	Water Quality Guidelines	W7 - Upper Canadian Creek	W3 - Canadian Creek us of Confluence with Britannia Creek	W14 - Mouth of Britannia Creek	W2 - Canadian Creek Downstream of Confluence with Britannia Creek	W2 - Replicate	W1 - Mouth of Canadian Creek	W6b - Yukon River Upstream of Canadian Creek	W6a - Yukon River Downstream of Canadian Creek	W15 - Yukon River Far Field Site	W17 - Sunshine Creek	W43 - Adit Discharge Pipe at Lower Camp
Date		CCME [a]	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	9-Sep-08	9-Sep-08	9-Sep-08	9-Sep-08	9-Sep-08
Dissolved Metals													
Aluminum	0.0002		0.0793	-	0.178	0.0782	0.0707	0.0752	0.0234	0.0194	0.0244	0.0672	0.0014
Antimony	0.00002		0.00006	-	0.00032	0.00038	0.00039	0.00036	0.00013	0.00010	0.00013	0.00027	0.00257
Arsenic	0.00002		0.00020	-	0.00078	0.00076	0.00074	0.00074	0.00044	0.00044	0.00045	0.00062	0.00047
Barium	0.00002		0.0456	-	0.0637	0.0442	0.0445	0.0454	0.0469	0.0378	0.0459	0.0594	0.0631
Beryllium	0.00001		0.00002	-	0.00002	0.00001	0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Bismuth	0.000005		<0.000005	-	0.000006	<0.000005	<0.000005	0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Boron	0.05		<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	0.000005		0.000224	-	0.000021	0.000019	0.000020	0.000017	0.000033	0.000017	0.000035	0.000018	0.0414
Calcium	0.05		12.5	-	22.1	21.3	21.3	23.8	28.7	23.7	29.1	21.5	26.8
Chromium	0.0001		0.0002	-	0.0005	0.0003	0.0003	0.0003	<0.0001	0.0001	0.0001	0.0002	<0.0001
Cobalt	0.000005		0.000112	-	0.000140	0.000075	0.000070	0.000075	0.000024	0.000023	0.000025	0.000055	0.000316
Copper	0.00005		0.00270	-	0.00317	0.00331	0.00321	0.00315	0.00098	0.00133	0.00102	0.00245	0.0709
Iron	0.001		0.047	-	0.174	0.077	0.059	0.092	0.024	0.024	0.025	0.066	0.010
Lead	0.000005		0.000022	-	0.000786	0.000577	0.000099	0.000262	0.000031	0.000045	0.000106	0.000103	0.00666
Lithium	0.0005		0.0007	-	0.0007	0.0005	0.0005	0.0006	0.0021	0.0013	0.0021	0.0008	0.0020
Magnesium	0.05		2.57	-	8.52	7.49	7.49	8.44	8.32	6.31	8.37	7.75	7.03
Manganese	0.00005		0.00729	-	0.00834	0.00411	0.00423	0.00308	0.00395	0.00260	0.00195	0.00333	0.537
Mercury	0.00001		<0.00001	-	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Molybdenum	0.00005		0.00019	-	0.00043	0.00057	0.00057	0.00062	0.00105	0.00105	0.00107	0.00040	<0.00005
Nickel	0.00002		0.00105	-	0.00077	0.00084	0.00084	0.00083	0.00154	0.00094	0.00157	0.00069	0.00047
Phosphorous	0.002		0.003	-	0.010	0.004	0.003	0.005	0.002	0.002	0.003	0.004	0.002
Potassium	0.05		0.42	-	1.27	1.21	1.20	1.41	0.71	0.73	0.72	1.04	1.39
Selenium	0.00004		0.00007	-	0.00008	0.00008	0.00008	0.00007	0.00057	0.00029	0.00056	0.00008	<0.00004
Silicon	0.1		7.9	-	4.6	5.0	5.0	4.7	3.3	3.1	3.2	4.2	5.6
Silver	0.000005		<0.000005	-	0.000008	0.000008	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	0.000023
Sodium	0.05		3.42	-	2.95	2.81	2.82	2.93	1.83	1.86	1.84	3.05	2.99
Strontium	0.00005		0.0801	-	0.174	0.143	0.142	0.151	0.133	0.110	0.131	0.141	0.226
Thallium	0.000002		0.000002	-	0.000006	0.000004	0.000003	0.000004	0.000003	0.000002	0.000003	0.000002	0.000025
Tin	0.00001		<0.00001	-	0.00002	0.00001	<0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Titanium	0.0005		0.0006	-	0.0041	0.0016	0.0010	0.0024	<0.0005	0.0009	0.0007	0.0009	<0.0005
Uranium	0.000002		0.000078	-	0.00359	0.00480	0.00486	0.00477	0.000941	0.000926	0.00102	0.00131	0.00126
Vanadium	0.0002		<0.0002	-	0.0005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Zinc	0.0001		0.0195	-	0.0029	0.0016	0.0013	0.0012	0.0018	0.0016	0.0023	0.0023	2.28
Zirconium	0.0001		0.0001	-	0.0007	0.0004	0.0004	0.0003	<0.0001	<0.0001	<0.0001	0.0003	<0.0001

Notes:

All units mg/l unless otherwise noted.

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007.

b) 0.005 mg/L at pH <6.5, [Ca2+] <4 mg/L, DOC <2 mg/L: 0.1 mg/L at pH ≥6.5, [Ca2+] ≥4 mg/L, DOC ≥2 mg/L.

c) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] = 120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180 mg/L.

d) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] = 60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180 mg/L; 0.007 mg/L at [CaCO3] >180 mg/L.

e) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] = 60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 - 180 mg/L; 0.150 mg/L at [CaCO3] >180 mg/L.

Italic *Results exceed CCME Aquatic Life uidelines.*

Appendix B4. Surface Water Quality Data, Casino Project, September 2008

Station	Detection Limits	Water Quality Guidelines	W43 - Replicate taken as W43B	W12 - Proctor Gulch before Confluence with Casino Creek	W8 - Upper Casino Creek	W13 - Meloy Creek	W11 - Casino Creek (proposed dam outflow)	H18 - Casino Creek (downstream of Brynelsen Creek)	W4 - Mouth of Casino Creek	W9 - Dip Creek us of Confluence with Casino Creek	W5 - Dip Creek ds Casino Confluence	W16 - Dip Creek far field	Maxxam Travel Blank
Date		CCME [a]	9-Sep-08	10-Sep-08	10-Sep-08	9-Sep-08	9-Sep-08	9-Sep-08	9-Sep-08	9-Sep-08	9-Sep-08	9-Sep-08	9-Sep-08
Physical Tests													
Temperature C	-		4.2	0.7	3.5	1.9	2.5	3.1	2.3	2.5	-	3.9	-
Conductivity (Field) µS/cm	-		347	690	211	195	207	113	162	129	-	119	-
pH (Field)	-		7.4	3.5	7.7	7.5	7.7	7.6	7.8	7.6	-	7.6	-
Hardness $CaCO_3$	0.5		94.9	235	91.7	93.9	93.4	64.5	78.0	62.7	67.2	68.9	<0.5
Conductivity µS/cm	1		220	740	210	200	210	140	160	130	140	150	1
pH	-	6.5-9.0	7.7	*3.4*	7.7	8.1	7.9	7.8	7.9	7.9	7.9	7.9	6.2
Total Suspended Solids	1		<1	11	14	3	3	2	12	17	25	18	<1
Total Dissolved Solids	1		130	470	150	94	100	70	92	56	76	92	<1
Turbidity NTU	0.1		0.9	18.0	3.4	0.3	1.1	0.5	1.6	4.0	1.7	2.8	<0.1
Dissolved Anions & Nutrients													
Ammonia as N	0.01		<0.01	0.03	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	0.01	0.02	0.01
Alkalinity, Total (as $CaCO_3$)	0.5		67	<0.5	35	82	59	45	55	54	55	56	<0.5
Acidity (pH 8.3) as $CaCO_3$	0.5		9.0	82.1	-	-	-	-	-	-	-	-	-
Chloride (Cl)	0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	0.6	<0.5
Sulfate (SO_4)	0.5		39	240	62	18	43	21	25	9.9	15	18	0.5
Nitrate (as N)	0.002	13	0.454	0.081	0.123	0.361	0.189	0.197	0.169	0.130	0.143	0.109	0.004
Nitrite (as N)	0.002	0.06	<0.002	0.003	0.002	<0.002	0.002	0.002	0.002	0.003	0.002	0.002	<0.002
Total Kjeldahl Nitrogen	0.02		0.02	0.13	0.11	0.14	0.15	0.15	0.17	0.15	0.22	0.19	<0.02
Ortho Phosphate as P	0.001		0.002	0.002	0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001	0.002	<0.001
Cyanide, Weak Acid Diss	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	0.0005	0.0008	0.0005	<0.0005	<0.0005	0.0007	<0.0005
Total Cyanide	0.0005	0.005	<0.0005	<0.0005	0.0006	0.0007	0.0008	0.0013	0.0010	0.0010	0.0010	0.0010	<0.0005
Total Metals													
Aluminum	0.0002	0.005-0.1 [b]	0.0224	*6.35*	*0.592*	0.0452	*0.195*	*0.157*	*0.192*	*0.157*	*0.354*	*0.203*	0.0008
Antimony	0.00002		0.00263	0.00015	0.00014	0.00024	0.00015	0.00013	0.00013	0.00008	0.00010	0.00010	<0.00002
Arsenic	0.00002	0.005	0.00077	0.00028	0.00055	0.00089	0.00060	0.00043	0.00050	0.00046	0.00066	0.00063	<0.00002
Barium	0.00002		0.0649	0.0285	0.0524	0.0718	0.0493	0.0379	0.0447	0.0457	0.0539	0.0466	<0.00002
Beryllium	0.00001		<0.00001	0.00037	0.00005	<0.00001	0.00002	0.00001	0.00002	0.00002	0.00003	0.00002	<0.00001
Bismuth	0.000005		<0.000005	0.000005	0.000009	<0.000005	<0.000005	<0.000005	<0.000005	0.000007	0.000008	<0.000005	0.000021
Boron	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	0.000005	0.000017	*0.0427*	*0.00176*	*0.000260*	*0.000041*	*0.000083*	*0.000032*	*0.000034*	0.000015	*0.000035*	*0.000021*	<0.000005
Calcium	0.05		26.3	71.3	27.7	26.1	26.1	17.9	21.0	16.5	17.7	17.7	<0.05
Chromium	0.0001	0.001	<0.0001	0.0005	0.0004	0.0002	0.0002	0.0003	0.0003	0.0004	0.0005	0.0005	<0.0001
Cobalt	0.000005		0.000313	0.0249	0.00235	0.000031	0.000511	0.000180	0.000233	0.000158	0.000393	0.000228	<0.000005
Copper	0.00005	0.002-0.004 [c]	*0.0743*	*0.650*	*0.0615*	0.00098	*0.0206*	*0.00746*	*0.00866*	0.00163	*0.00454*	*0.00362*	<0.00005
Iron	0.001	0.3	0.048	*14.2*	*0.873*	0.060	0.274	0.156	0.273	0.259	*0.567*	*0.384*	<0.001
Lead	0.000005	0.001-0.007 [d]	*0.0120*	0.000962	0.00137	0.000662	0.000165	0.000090	0.000214	0.000305	0.000732	0.000334	0.000009
Lithium	0.0005		0.0020	0.0042	0.0010	0.0010	0.0009	0.0007	0.0009	0.0020	0.0018	0.0013	<0.0005
Magnesium	0.05		7.07	13.9	5.47	7.00	6.86	4.82	6.19	5.25	5.56	5.99	<0.05
Manganese	0.00005		0.526	0.741	0.0717	0.00758	0.0275	0.0103	0.0166	0.0200	0.0419	0.0297	<0.00005
Mercury	0.00001	0.000026	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Molybdenum	0.00005	0.073	<0.00005	0.00015	0.00025	0.00053	0.00054	0.00072	0.00085	0.00059	0.00061	0.00067	<0.00005
Nickel	0.00002	0.025-0.15 [e]	0.00043	0.00438	0.00126	0.00030	0.00065	0.00045	0.00055	0.00060	0.00083	0.00087	<0.00002
Phosphorous	0.002		0.003	0.007	0.031	0.004	0.004	0.005	0.011	0.014	0.049	0.018	<0.002
Potassium	0.05		1.35	1.49	0.88	0.95	0.74	0.74	0.81	0.57	0.64	0.69	<0.05
Selenium	0.00004	0.001	<0.00004	0.00015	0.00004	<0.00004	0.00005	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004
Silicon	0.1		6.2	8.1	5.8	5.0	4.9	5.1	5.2	4.5	4.7	4.7	<0.1
Silver	0.000005	0.0001	*0.000116*	0.000016	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Sodium	0.05		3.07	4.51	3.10	3.11	2.89	2.66	3.08	2.74	2.79	2.89	<0.05
Strontium	0.00005		0.220	0.195	0.180	0.161	0.162	0.101	0.125	0.127	0.125	0.118	<0.00005
Thallium	0.000002	0.0008	0.000026	0.000057	0.000010	0.000002	0.000004	0.000004	0.000004	0.000003	0.000007	0.000003	<0.000002
Tin	0.00001		<0.00001	<0.00001	0.00003	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Titanium	0.0005		<0.0005	<0.0005	0.0058	0.0011	0.0013	0.0018	0.0051	0.0067	0.0196	0.0070	<0.0005
Uranium	0.000002		0.00126	0.00838	0.00164	0.00637	0.00400	0.00229	0.00294	0.00323	0.00338	0.00254	<0.000002
Vanadium	0.0002		<0.0002	<0.0002	0.0004	<0.0002	0.0002	0.0004	0.0008	0.0009	0.0017	0.0012	<0.0002
Zinc	0.0001	0.03	*2.38*	*0.127*	0.0214	0.0025	0.0056	0.0022	0.0024	0.0019	0.0035	0.0029	<0.0001
Zirconium	0.0001		<0.0001	0.0002	0.0002	0.0001	0.0002	0.0003	0.0004	0.0004	0.0004	0.0005	<0.0001

Appendix B4. Surface Water Quality Data, Casino Project, September 2008

Station	Detection Limits	Water Quality Guidelines	W43 - Replicate taken as W43B	W12 - Proctor Gulch before Confluence with Casino Creek	W8 - Upper Casino Creek	W13 - Meloy Creek	W11 - Casino Creek (proposed dam outflow)	H18 - Casino Creek (downstream of Brynelsen Creek)	W4 - Mouth of Casino Creek	W9 - Dip Creek us of Confluence with Casino Creek	W5 - Dip Creek ds Casino Confluence	W16 - Dip Creek far field	Maxxam Travel Blank
Date		**CCME [a]**	**9-Sep-08**	**10-Sep-08**	**10-Sep-08**	**9-Sep-08**	**9-Sep-08**	**9-Sep-08**	**9-Sep-08**	**9-Sep-08**	**9-Sep-08**	**9-Sep-08**	**9-Sep-08**
Dissolved Metals													
Aluminum	0.0002		0.0014	6.40	0.0604	0.0228	0.0574	0.104	0.0771	0.0588	0.0673	0.0597	0.0007
Antimony	0.00002		0.00252	0.00014	0.00011	0.00024	0.00016	0.00013	0.00013	0.00008	0.00010	0.00009	<0.00002
Arsenic	0.00002		0.00046	0.00030	0.00022	0.00083	0.00049	0.00037	0.00038	0.00033	0.00037	0.00045	<0.00002
Barium	0.00002		0.0620	0.0291	0.0467	0.0704	0.0500	0.0372	0.0407	0.0406	0.0410	0.0420	<0.00002
Beryllium	0.00001		<0.00001	0.00037	0.00001	<0.00001	0.00001	<0.00001	<0.00001	<0.00001	0.00001	0.00001	<0.00001
Bismuth	0.000005		<0.000005	0.000008	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	0.000007
Boron	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	0.000005		0.0418	0.00179	0.000190	0.000033	0.000071	0.000025	0.000021	0.000007	0.000012	0.000008	<0.000005
Calcium	0.05		26.7	74.0	27.6	26.0	26.7	16.9	20.2	16.2	17.6	18.2	<0.05
Chromium	0.0001		<0.0001	0.0005	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003	<0.0001
Cobalt	0.000005		0.000312	0.0262	0.00227	0.000020	0.000464	0.000131	0.000125	0.000063	0.000090	0.000091	<0.000005
Copper	0.00005		0.0703	0.681	0.0323	0.00098	0.0164	0.00544	0.00706	0.00130	0.00323	0.00277	<0.00005
Iron	0.001		0.010	15.1	0.264	0.021	0.136	0.083	0.092	0.097	0.105	0.141	0.001
Lead	0.000005		0.00680	0.00124	0.000105	0.000080	0.000117	0.000029	0.000043	0.000073	0.000042	0.000054	0.000017
Lithium	0.0005		0.0020	0.0043	0.0010	0.0009	0.0009	0.0006	0.0008	0.0019	0.0015	0.0013	<0.0005
Magnesium	0.05		7.00	14.3	5.54	6.81	6.86	4.50	5.84	5.10	5.37	6.11	<0.05
Manganese	0.00005		0.543	0.757	0.0624	0.00359	0.0260	0.00712	0.00787	0.00899	0.0123	0.0140	0.00006
Mercury	0.00001		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Molybdenum	0.00005		<0.00005	0.00014	0.00020	0.00052	0.00055	0.00076	0.00091	0.00064	0.00072	0.00076	<0.00005
Nickel	0.00002		0.00064	0.00467	0.00095	0.00029	0.00056	0.00045	0.00044	0.00070	0.00044	0.00064	<0.00002
Phosphorous	0.002		0.002	0.005	0.002	<0.002	0.003	0.003	0.003	0.005	0.005	0.005	<0.002
Potassium	0.05		1.38	1.53	0.77	0.94	0.77	0.75	0.78	0.56	0.63	0.71	<0.05
Selenium	0.00004		<0.00004	0.00018	0.00007	<0.00004	0.00008	0.00004	0.00004	0.00004	0.00005	0.00006	<0.00004
Silicon	0.1		5.8	8.9	6.3	4.7	5.4	4.8	4.9	4.8	4.9	4.8	<0.1
Silver	0.000005		0.000022	0.000022	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Sodium	0.05		2.96	4.64	3.07	3.02	2.91	2.51	2.91	2.68	2.75	2.96	<0.05
Strontium	0.00005		0.224	0.202	0.178	0.162	0.168	0.0970	0.124	0.125	0.124	0.124	<0.00005
Thallium	0.000002		0.000025	0.000060	0.000007	<0.000002	0.000004	0.000003	0.000003	<0.000002	<0.000002	<0.000002	<0.000002
Tin	0.00001		<0.00001	0.00002	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Titanium	0.0005		<0.0005	0.0023	0.0010	<0.0005	0.0007	0.0011	0.0010	0.0014	0.0022	0.0011	<0.0005
Uranium	0.000002		0.00125	0.00871	0.00108	0.00634	0.00405	0.00213	0.00281	0.00308	0.00293	0.00253	<0.000002
Vanadium	0.0002		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0003	0.0003	0.0004	<0.0002
Zinc	0.0001		2.28	0.133	0.0125	0.0021	0.0057	0.0017	0.0020	0.0038	0.0010	0.0012	<0.0001
Zirconium	0.0001		<0.0001	0.0002	0.0001	0.0001	0.0002	0.0003	0.0003	0.0003	0.0003	0.0004	<0.0001

Notes:

All units mg/l unless otherwise noted.

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007.

b) 0.005 mg/L at pH <6.5, [Ca2+] <4 mg/L, DOC <2 mg/L: 0.1 mg/L at pH ≥6.5, [Ca2+] ≥4 mg/L, DOC ≥2 mg/L.

c) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] = 120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180 mg/L.

d) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] = 60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180 mg/L; 0.007 mg/L at [CaCO3] >180 mg/L.

e) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] = 60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 - 180 mg/L; 0.150 mg/L at [CaCO3] >180 mg/L.

Italic *Results exceed CCME Aquatic Life u*

B5. Surface Water Quality Data, Casino Project, October 2008

Appendix B5. Surface Water Quality Data, Casino Project, October 2008

AECOM

Station	Detection Limits	Water Quality Guidelines	W7 - Upper Canadian Creek	W3 - Canadian Creek us of Confluence with Britannia Creek	W14 - Mouth of Britannia Creek	W1 - Mouth of Canadian Creek	W6b - Yukon River Upstream of Canadian Creek	W6a - Yukon River Downstream of Canadian Creek	W43 - Adit Discharge Pipe at Lower Camp	W12 - Proctor Gulch before Confluence with Casino Creek
Date		CCME [a]	10-Oct-08	11-Oct-08	10-Oct-08	10-Oct-08	10-Oct-08	10-Oct-08	11-Oct-08	11-Oct-08
Physical Tests										
Temperature C	-		0.0	1.8	0.3	1.9	4.3	3.6	1.5	0.4
Conductivity (Field) µS/cm	-		136	265	294	298	183	225	228	1026
pH (Field)	-		6.9	8.0	7.6	7.8	8.0	8.0	6.8	*3.5*
Hardness $CaCO_3$	0.5		44.7	119	139	138	109	84.2	99.1	335
Conductivity µS/cm	1		130	260	300	300	220	180	220	1000
pH	-	6.5-9.0	7.1	8.0	8.1	8.1	8.1	8.1	7.6	*3.3*
Total Suspended Solids	1		1	<1	<1	<1	14	12	4	2
Total Dissolved Solids	1		110	210	230	240	180	130	170	1000
Turbidity NTU	0.1		0.3	0.2	0.3	0.2	11.0	3.6	0.9	10.0
Dissolved Anions & Nutrients										
Ammonia as N	0.01		<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.05
Alkalinity, Total (as $CaCO_3$)	0.5		7.3	72	91	82	81	73	67	<0.5
Acidity (pH 8.3) as $CaCO_3$	0.5		-	-	-	-	-	-	13.7	131
Chloride (Cl)	0.5		0.6	1.2	1.5	1.5	0.8	0.8	5.0	1.0
Sulfate (SO_4)	0.5		47	50	52	42	33	19	49	450
Nitrate (as N)	0.002	13	0.004	0.236	0.304	0.249	0.015	0.014	0.296	0.032
Nitrite (as N)	0.002	0.06	<0.002	0.002	0.002	0.004	<0.002	0.002	0.002	0.005
Total Kjeldahl Nitrogen	0.02		0.11	0.20	0.28	0.39	0.09	0.09	0.07	0.16
Ortho Phosphate as P	0.001		0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.003
Cyanide, Weak Acid Diss	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0038
Total Cyanide	0.0005	0.005	<0.0005	0.0007	0.0010	0.0008	<0.0005	<0.0005	<0.0005	*0.0101*
Total Organic Carbon	0.5		2.8	8.0	11.5	8.6	3.9	3.6	1.4	3.0
Total Metals										
Aluminum	0.0002	0.005-0.1[b]	0.0253	0.0159	0.0494	0.0222	*0.208*	*0.107*	0.0139	*10.3*
Antimony	0.00002		0.00005	0.00035	0.00023	0.00027	0.00013	0.00010	0.00272	0.00016
Arsenic	0.00002	0.005	0.00016	0.00057	0.00050	0.00050	0.00059	0.00051	0.00072	0.00027
Barium	0.00002		0.0472	0.0528	0.0782	0.0597	0.0579	0.0427	0.0652	0.0108
Beryllium	0.00001		0.00001	<0.00001	0.00001	<0.00001	0.00002	0.00001	<0.00001	0.00053
Bismuth	0.000005		<0.000005	<0.000005	<0.000005	<0.000005	0.000005	<0.000005	0.000010	<0.000005
Boron	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	0.000005	0.000017	*0.000135*	0.000014	0.000007	0.000011	*0.000097*	*0.000061*	*0.0473*	*0.00244*
Calcium	0.05		13.2	30.4	32.7	34.2	28.7	23.0	27.3	99.1
Chromium	0.0001	0.001	<0.0001	<0.0001		<0.0001	0.0003	0.0002	<0.0001	0.0006
Cobalt	0.000005		0.000033	0.000044	0.000050	0.000042	0.000219	0.000138	0.000366	0.0409
Copper	0.00005	0.002-0.004[c]	0.00139	*0.00217*	0.00158	0.00194	0.00159	0.00121	*0.0686*	*0.92*
Iron	0.001	0.3	0.019	0.016	0.037	0.017	*0.368*	0.169	0.063	*26.2*
Lead	0.000005	0.001-0.007[d]	0.000031	0.000010	0.000072	0.000030	0.000224	0.000275	*0.0181*	0.000661
Lithium	0.0005		0.0007	<0.0005	0.0009	0.0007	0.0023	0.0015	0.0022	0.0059
Magnesium	0.05		2.83	10.5	14.0	12.7	9.01	6.52	7.51	21.2
Manganese	0.00005		0.00127	0.00675	0.00294	0.00171	0.0220	0.0152	0.472	1.04
Mercury	0.00001	0.000026	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Molybdenum	0.00005	0.073	0.00027	0.00088	0.00055	0.00077	0.00096	0.00100	<0.00005	0.00021
Nickel	0.00002	0.025-0.15[e]	0.00063	0.00066	0.00050	0.00060	0.00314	0.00160	0.00055	0.00642
Phosphorous	0.002		<0.002	<0.002	0.004	<0.002	0.017	0.015	0.003	0.004
Potassium	0.05		0.47	1.63	1.65	1.81	0.70	0.70	1.27	1.80
Selenium	0.00004	0.001	0.00006	0.00006	0.00007	0.00010	0.00068	0.00033	<0.00004	0.00024
Silicon	0.1		9.9	5.3	4.6	5.1	3.8	3.1	4.6	6.8
Silver	0.000005	0.0001	<0.000005	<0.000005	<0.000005	<0.000005	0.000007	<0.000005	*0.000146*	0.000021
Sodium	0.05		4.40	3.89	4.44	4.12	1.91	1.92	3.38	6.26
Strontium	0.00005		0.0908	0.198	0.286	0.223	0.135	0.107	0.245	0.287
Thallium	0.000002	0.0008	0.000002	0.000002	0.000003	0.000003	0.000005	0.000003	0.000027	0.000082
Tin	0.00001		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Titanium	0.0005		<0.0005	<0.0005	0.0010	0.0006	0.0045	0.0022	<0.0005	<0.0005
Uranium	0.000002		0.000043	0.0101	0.00833	0.0102	0.00102	0.000968	0.00128	0.0125
Vanadium	0.0002		0.0002	<0.0002	0.0002	<0.0002	0.0006	0.0003	<0.0002	<0.0002
Zinc	0.0001	0.03	0.0126	0.0006	0.0006	0.0003	0.0093	0.0074	*2.64*	*0.189*
Zirconium	0.0001		<0.0001	0.0002	0.0004	0.0002	0.0001	<0.0001	<0.0001	<0.0001

Appendix B5. Surface Water Quality Data, Casino Project, October 2008

AECOM

Station	Detection Limits	Water Quality Guidelines	W7 - Upper Canadian Creek	W3 - Canadian Creek us of Confluence with Britannia Creek	W14 - Mouth of Britannia Creek	W1 - Mouth of Canadian Creek	W6b - Yukon River Upstream of Canadian Creek	W6a - Yukon River Downstream of Canadian Creek	W43 - Adit Discharge Pipe at Lower Camp	W12 - Proctor Gulch before Confluence with Casino Creek
Date		**CCME [a]**	**10-Oct-08**	**11-Oct-08**	**10-Oct-08**	**10-Oct-08**	**10-Oct-08**	**10-Oct-08**	**11-Oct-08**	**11-Oct-08**
Dissolved Metals										
Aluminum	0.0002	0.005-0.1[b]	0.0176	0.0142	0.0404	0.0179	0.0241	0.0224	0.0013	2.58
Antimony	0.00002		0.00005	0.00034	0.00023	0.00024	0.00012	0.00009	0.00243	<0.0001
Arsenic	0.00002	0.005	0.00012	0.00053	0.00045	0.00045	0.00036	0.00036	0.00029	0.0001
Barium	0.00002		0.0427	0.0505	0.0732	0.0525	0.0433	0.0361	0.0590	0.0089
Beryllium	0.00001		<0.00001	<0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00005
Bismuth	0.000005		<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.00003
Boron	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.3
Cadmium	0.000005	0.000017	0.000120	0.000019	<0.000005	0.000010	0.000038	0.000037	0.0438	0.00005
Calcium	0.05		12.5	29.0	30.0	32.6	26.8	22.5	25.4	83.7
Chromium	0.0001	0.001	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0005
Cobalt	0.000005		0.000024	0.000042	0.000044	0.000042	0.000025	0.000027	0.000332	0.00063
Copper	0.00005	0.002-0.004[c]	0.00131	0.00212	0.00149	0.00189	0.00099	0.00084	0.0623	0.0162
Iron	0.001	0.3	0.007	0.015	0.031	0.014	0.028	0.025	0.011	0.355
Lead	0.000005	0.001-0.007[d]	0.000010	0.000065	0.000086	0.000014	0.000065	0.000185	0.00626	0.00005
Lithium	0.0005		0.0006	<0.0005	0.0008	0.0007	0.0021	0.0014	0.0021	0.006
Magnesium	0.05		2.72	10.1	13.0	12.4	8.36	6.38	6.93	0.34
Manganese	0.00005		0.00074	0.00663	0.00220	0.00137	0.00238	0.00427	0.430	0.0154
Mercury	0.00001	0.000026	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00005
Molybdenum	0.00005	0.073	0.00025	0.00084	0.00051	0.00070	0.00096	0.00098	<0.00005	<0.0003
Nickel	0.00002	0.025-0.15[e]	0.00062	0.00064	0.00046	0.00056	0.00216	0.00111	0.00048	0.0002
Phosphorous	0.002		<0.002	<0.002	0.003	<0.002	<0.002	0.003	<0.002	<0.01
Potassium	0.05		0.44	1.54	1.53	1.72	0.64	0.67	1.18	2.28
Selenium	0.00004	0.001	0.00005	0.00007	0.00008	0.00011	0.00062	0.00031	<0.00004	<0.0002
Silicon	0.1		8.8	4.9	4.3	5.0	3.0	2.8	5.2	4.0
Silver	0.000005	0.0001	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	0.000023	<0.00003
Sodium	0.05		4.13	3.68	4.11	3.93	1.77	1.85	3.05	1430
Strontium	0.00005		0.0852	0.189	0.258	0.195	0.125	0.105	0.226	0.281
Thallium	0.000002	0.0008	<0.000002	<0.000002	0.000003	0.000002	0.000003	0.000002	0.000024	0.00007
Tin	0.00001		<0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00005
Titanium	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.003
Uranium	0.000002		0.000039	0.00954	0.00767	0.00915	0.000906	0.000942	0.00116	0.00033
Vanadium	0.0002		0.0003	<0.0002	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.001
Zinc	0.0001	0.03	0.0114	0.0009	0.0007	0.0004	0.0023	0.0051	2.47	0.0034
Zirconium	0.0001		<0.0001	0.0001	0.0004	0.0002	<0.0001	<0.0001	<0.0001	<0.0005

Notes:

All units mg/l unless otherwise noted.

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007.

b) 0.005 mg/L at pH <6.5, [Ca2+] <4 mg/L, DOC <2 mg/L: 0.1 mg/L at pH ≥6.5, [Ca2+] ≥4 mg/L, DOC ≥2 mg/L.

c) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] = 120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180 mg/L.

d) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] = 60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180 mg/L; 0.007 mg/L at [CaCO3] >180 mg/L.

e) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] = 60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 - 180 mg/L; 0.150 mg/L at [CaCO3] >180 mg/L.

Italic *Results exceed CCME Aquatic Life uidelines.*

Appendix B5. Surface Water Quality Data, Casino Project, October 2008

Station	Detection Limits	Water Quality Guidelines	W11 - Casino Creek (proposed dam outflow)	W18 - Brynelsen Creek	W4 - Mouth of Casino Creek	W9 - Dip Creek us of Confluence with Casino Creek	W5 - Dip Creek ds Casino Confluence
Date		**CCME [a]**	**11-Oct-08**	**11-Oct-08**	**10-Oct-08**	**10-Oct-08**	**10-Oct-08**
Physical Tests							
Temperature C	-		0.0	0.0	0.0	0.1	0.4
Conductivity (Field) µS/cm	-		278	165	240	172	198
pH (Field)	-		6.9	7.6	7.7	7.5	7.6
Hardness $CaCO_3$	0.5		125	70.3	110	79.7	88.2
Conductivity µS/cm	1		270	160	240	170	190
pH	-	6.5-9.0	8.1	8.0	8.0	8.0	8.0
Total Suspended Solids	1		1	1	2	3	2
Total Dissolved Solids	1		220	110	190	130	150
Turbidity NTU	0.1		1.0	0.3	0.7	0.4	0.5
Dissolved Anions & Nutrients							
Ammonia as N	0.01		<0.01	<0.01	<0.01	<0.01	<0.01
Alkalinity, Total (as $CaCO_3$)	0.5		80	60	80	74	75
Acidity (pH 8.3) as $CaCO_3$	0.5		-	-			
Chloride (Cl)	0.5		0.6	0.6	1.0	1.4	2.5
Sulfate (SO_4)	0.5		50	25	40	15	25
Nitrate (as N)	0.002	13	0.245	0.236	0.203	0.191	0.189
Nitrite (as N)	0.002	0.06	0.003	0.003	0.003	0.003	<0.002
Total Kjeldahl Nitrogen	0.02		0.13	0.10	0.08	0.13	0.12
Ortho Phosphate as P	0.001		0.002	0.003	0.002	0.005	0.002
Cyanide, Weak Acid Diss	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Total Cyanide	0.0005	0.005	<0.0005	0.0005	0.0005	0.0009	<0.0005
Total Organic Carbon	0.5		2.9	4.7	5.1	6.6	5.8
Total Metals							
Aluminum	0.0002	0.005-0.1 [b]	0.0889	0.0325	0.0519	0.0354	0.0307
Antimony	0.00002		0.00015	0.00014	0.00013	0.00009	0.00010
Arsenic	0.00002	0.005	0.00054	0.00034	0.00038	0.00028	0.00034
Barium	0.00002		0.0623	0.0404	0.0550	0.0515	0.0498
Beryllium	0.00001		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Bismuth	0.000005		<0.000005	<0.000005	<0.000005	0.000011	<0.000005
Boron	0.05		<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	0.000005	0.000017	*0.000064*	0.000008	*0.000028*	<0.000005	0.000015
Calcium	0.05		34.0	19.0	29.2	20.6	22.9
Chromium	0.0001	0.001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001
Cobalt	0.000005		0.000245	0.000027	0.000074	0.000050	0.000047
Copper	0.00005	0.002-0.004 [c]	*0.0118*	0.00079	*0.00528*	0.00091	*0.00226*
Iron	0.001	0.3	0.198	0.025	0.094	0.072	0.058
Lead	0.000005	0.001-0.007 [d]	0.000100	0.000018	0.000074	0.000073	0.000065
Lithium	0.0005		0.0012	0.0006	0.0011	0.0023	0.0018
Magnesium	0.05		9.84	5.53	8.95	6.87	7.52
Manganese	0.00005		0.0264	0.00263	0.00964	0.0127	0.0104
Mercury	0.00001	0.000026	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Molybdenum	0.00005	0.073	0.00071	0.00123	0.00112	0.00070	0.00082
Nickel	0.00002	0.025-0.15 [e]	0.00036	0.00019	0.00027	0.00032	0.00031
Phosphorous	0.002		<0.002	<0.002	0.003	0.005	0.002
Potassium	0.05		0.87	0.89	0.94	0.64	0.74
Selenium	0.00004	0.001	0.00013	<0.00004	0.00005	<0.00004	<0.00004
Silicon	0.1		6.5	5.6	5.6	5.2	5.4
Silver	0.000005	0.0001	<0.000005	<0.000005	<0.000005	<0.000005	0.000007
Sodium	0.05		3.76	3.30	4.20	3.64	3.81
Strontium	0.00005		0.220	0.104	0.180	0.169	0.165
Thallium	0.000002	0.0008	0.000003	0.000002	<0.000002	0.000003	<0.000002
Tin	0.00001		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Titanium	0.0005		<0.0005	0.0006	0.0009	0.0015	0.0006
Uranium	0.000002		0.00820	0.00300	0.00627	0.00583	0.00558
Vanadium	0.0002		<0.0002	<0.0002	<0.0002	0.0003	0.0002
Zinc	0.0001	0.03	0.0040	0.0005	0.0017	0.0007	0.0010
Zirconium	0.0001		<0.0001	0.0001	0.0001	0.0002	0.0002

Appendix B5. Surface Water Quality Data, Casino Project, October 2008

Station	Detection Limits	Water Quality Guidelines	W11 - Casino Creek (proposed dam outflow)	W18 - Brynelsen Creek	W4 - Mouth of Casino Creek	W9 - Dip Creek us of Confluence with Casino Creek	W5 - Dip Creek ds Casino Confluence
Date		CCME [a]	11-Oct-08	11-Oct-08	10-Oct-08	10-Oct-08	10-Oct-08
Dissolved Metals							
Aluminum	0.0002	0.005-0.1[b]	0.0207	0.0250	0.0210	0.0219	0.0187
Antimony	0.00002		0.00013	0.00013	0.00012	0.00007	0.00009
Arsenic	0.00002	0.005	0.00042	0.00030	0.00032	0.00026	0.00028
Barium	0.00002		0.0584	0.0386	0.0528	0.0478	0.0489
Beryllium	0.00001		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Bismuth	0.000005		<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Boron	0.05		<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	0.000005	0.000017	0.000052	0.000006	0.000018	<0.000005	0.000010
Calcium	0.05		32.5	18.6	27.4	19.5	21.7
Chromium	0.0001	0.001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt	0.000005		0.000229	0.000020	0.000058	0.000055	0.000039
Copper	0.00005	0.002-0.004[c]	0.00704	0.00077	0.00363	0.00086	0.00182
Iron	0.001	0.3	0.036	0.014	0.030	0.042	0.035
Lead	0.000005	0.001-0.007[d]	0.000025	0.000022	0.000020	0.000040	0.000010
Lithium	0.0005		0.0011	<0.0005	0.0010	0.0023	0.0018
Magnesium	0.05		9.42	5.40	8.41	6.64	7.09
Manganese	0.00005		0.0242	0.00184	0.00684	0.0104	0.00963
Mercury	0.00001	0.000026	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Molybdenum	0.00005	0.073	0.00065	0.00115	0.00105	0.00070	0.00078
Nickel	0.00002	0.025-0.15[e]	0.00033	0.00018	0.00024	0.00028	0.00028
Phosphorous	0.002		<0.002	<0.002	<0.002	0.003	<0.002
Potassium	0.05		0.84	0.88	0.88	0.62	0.71
Selenium	0.00004	0.001	0.00009	<0.00004	0.00004	<0.00004	<0.00004
Silicon	0.1		5.2	4.8	5.1	4.5	5.1
Silver	0.000005	0.0001	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Sodium	0.05		3.55	3.21	3.82	3.41	3.50
Strontium	0.00005		0.212	0.0996	0.176	0.160	0.169
Thallium	0.000002	0.0008	0.000003	0.000003	<0.000002	<0.000002	0.000002
Tin	0.00001		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Titanium	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Uranium	0.000002		0.00762	0.00287	0.00590	0.00543	0.00539
Vanadium	0.0002		<0.0002	0.0002	<0.0002	0.0002	<0.0002
Zinc	0.0001	0.03	0.0031	0.0005	0.0012	0.0005	0.0007
Zirconium	0.0001		<0.0001	0.0001	0.0001	0.0002	0.0001

Notes:

All units mg/l unless otherwise noted.

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2007.

b) 0.005 mg/L at pH <6.5, [Ca2+] <4 mg/L, DOC <2 mg/L: 0.1 mg/L at pH ≥6.5, [Ca2+] ≥4 mg/L, DOC ≥2 mg/L.

c) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] = 120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180 mg/L.

d) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] = 60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180 mg/L; 0.007 mg/L at [CaCO3] >180 mg/L.

e) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] = 60 - 120 mg/L 0.110 mg/L at [CaCO3] =120 - 180 mg/L; 0.150 mg/L at [CaCO3] >180 mg/L.

Italic *Results exceed CCME Aquatic Life u*

B6. Surface Water Quality Replicate Data, Casino Project, 2008

Appendix B6. Surface Water Quality Replicate Data, Casino Project, May 2008

Station	W1	W1-R (W42)	RPD	Station	W1	W1-R (W42)	RPD
Date	5/22/2008	5/22/2008	%	Date	5/22/2008	5/22/2008	%
Physical Tests				**Dissolved Anions & Nutrients**			
Conductivity (us/cm)	92	92	0%	Alkalinity-Total	21	21	0%
Dissolved Hardness	48.9	48.6	1%	Alkalinity (PP as CaCO3)	<0.5	<0.5	n/c
pH	7.2	7.2	0%	Ammonia Nitrogen	0.011	0.009	20%
Total Suspended Solids	190	150	24%	Bicarbonate (HCO3)	26	25	4%
Total Dissolved Solids	92	92	0%	Carbonate (CO3)	<0.5	<0.5	n/c
Tubidity (NTU)	3.6	2.4	**40%**	Chloride Cl	1.2	1.2	0%
Cyanide + Thiocyanate	0.0013	0.0012	8%	Hydroxide (OH)	<0.5	<0.5	n/c
Total Hardness	49.6	48.9	1%	Nitrate Nitrogen	0.05	0.048	4%
Weak Acid Dissoc. Cyanide	0.001	0.0009	11%	Nitrite Nitrogen	0.003	0.003	0%
				Nitrate plus Nitrite	0.053	0.051	4%
				Ortho Phosphate as P	<0.001	<0.001	n/c
				Sulphate	17	13	**27%**
				Total Kjeldahl Nitrogen	0.41	0.32	25%
				Total Nitrogen	0.46	0.37	22%
Total Metals				**Dissolved Metals**			
Aluminum	0.723	0.579	22%	Aluminum	0.289	0.29	0%
Antimony	0.00019	0.00018	5%	Antimony	0.00018	0.00017	6%
Arsenic	0.00162	0.00134	19%	Arsenic	0.0007	0.0007	0%
Barium	0.059	0.0552	7%	Barium	0.0368	0.0365	1%
Beryllium	0.00006	0.00005	18%	Beryllium	0.00002	0.00003	**40%**
Bismuth	0.000009	0.000015	**50%**	Bismuth	<0.000005	<0.000005	n/c
Boron	<0.05	<0.05	n/c	Boron	<0.05	<0.05	n/c
Cadmium	0.00008	0.000084	5%	Cadmium	0.000039	0.000037	5%
Calcium	12.4	12.3	1%	Calcium	12.3	12.2	1%
Chromium	0.0011	0.0009	20%	Chromium	0.0004	0.0004	0%
Cobalt	0.000848	0.00066	25%	Cobalt	0.000204	0.000208	2%
Copper	0.00663	0.00634	4%	Copper	0.00508	0.00508	0%
Iron	1.00	0.709	**34%**	Iron	0.236	0.24	2%
Lead	0.000866	0.000625	**32%**	Lead	0.000064	0.000061	5%
Lithium	0.0007	0.0006	15%	Lithium	<0.0005	<0.0005	n/c
Magnesium	4.54	4.41	3%	Magnesium	4.44	4.39	1%
Manganese	0.0689	0.0612	12%	Manganese	0.016	0.0161	1%
Mercury	0.00001	0.00001	0%	Mercury	<0.00001	<0.00001	n/c
Molybdenum	0.0003	0.0003	0%	Molybdenum	0.00033	0.0003	10%
Nickel	0.00227	0.00208	9%	Nickel	0.00135	0.00134	1%
Phosphorus	0.084	0.062	**30%**	Phosphorus	0.013	0.014	7%
Potassium	1.3	1.27	2%	Potassium	1.25	1.24	1%
Selenium	<0.00004	<0.00004	n/c	Selenium	0.00006	0.00006	0%
Silicon	2.6	2.4	8%	Silicon	2.2	2.2	0%
Silver	0.00001	0.000008	22%	Silver	<0.000005	0.000005	n/c
Sodium	1.39	1.38	1%	Sodium	1.5	1.5	0%
Strontium	0.0809	0.0798	1%	Strontium	0.0786	0.0792	1%
Sulfur	6	6	0%	Sulfur	7	6	15%
Tellurium	<0.00002	<0.00002	n/c	Tellurium	<0.00002	<0.00002	n/c
Thallium	0.000011	0.000011	0%	Thallium	0.000005	0.000005	0%
Thorium	0.000275	0.000251	9%	Thorium	0.000227	0.000231	2%
Tin	<0.00001	<0.00001	n/c	Tin	<0.00001	<0.00001	n/c
Titanium	0.0254	0.0165	**42%**	Titanium	0.0029	0.0031	7%
Tungsten	0.00002	0.00002	0%	Tungsten	<0.00001	<0.00001	n/c
Uranium	0.00361	0.00343	5%	Uranium	0.00304	0.00302	1%
Vanadium	0.002	0.0015	**29%**	Vanadium	0.0003	0.0003	0%
Zinc	0.0062	0.0051	19%	Zinc	0.0069	0.0072	4%
Zirconium	0.0005	0.0005	0%	Zirconium	0.0004	0.0003	**29%**

Bold	*Exceedes Data Quality objective of 25%.*
Bold	*Exceedes Data Quality objective of 25%, but does not meet Pratical Quantitation Limit.*
RPD	*Relative Percent Difference.*
"-"	*Not Analyzed.*
"n/c"	*Not able to be calculated, because one or both values not precisely known, or within 3x the DL.*
"<"	*Less than detection limit.*

Appendix B6. Surface Water Quality Replicate Data, Casino Project, May 2008 (cont'd)

Station	W5	W5-R (W40)	RPD	Station	W5	W5-R (W40)	RPD
Date	5/22/2008	5/22/2008	%	Date	5/22/2008	5/22/2008	%
Physical Tests				**Dissolved Anions & Nutrients**			
Conductivity (us/cm)	74	74	0%	Alkalinity-Total	24	24	0%
Dissolved Hardness	40.3	39.8	1%	Alkalinity (PP as CaCO3)	<0.5	<0.5	n/c
pH	7.3	7.3	0%	Ammonia Nitrogen	<0.005	0.022	n/c
Total Suspended Solids	58	24	**83%**	Bicarbonate	29	30	3%
Total Dissolved Solids	74	76	3%	Carbonate	<0.5	<0.5	n/c
Tubidity (NTU)	4.2	2.5	**51%**	Chloride	1.2	1.2	0%
Cyanide + Thiocyanate	0.0008	0.0008	0%	Hydroxide	<0.5	<0.5	n/c
Total Hardness	41.4	40.4	2%	Nitrate Nitrogen	0.024	0.026	8%
Weak Acid Dissoc. Cyanide	0.0007	0.0008	13%	Nitrite Nitrogen	0.004	0.003	**29%**
				Nitrate plus Nitrite	0.028	0.029	4%
				Ortho Phosphate as P	<0.001	<0.001	n/c
				Sulphate	<0.5	<0.5	n/c
				Total Kjeldahl Nitrogen	0.42	0.46	9%
				Total Nitrogen	0.45	0.49	9%
Total Metals				**Dissolved Metals**			
Aluminum	0.489	0.476	3%	Aluminum	0.197	0.201	2%
Antimony	0.00009	0.00008	12%	Antimony	0.00007	0.00007	0%
Arsenic	0.00077	0.00077	0%	Arsenic	0.00037	0.00036	3%
Barium	0.0467	0.0455	3%	Barium	0.0314	0.0295	6%
Beryllium	0.00005	0.00005	0%	Beryllium	0.00002	0.00002	0%
Bismuth	0.000006	0.000008	n/c	Bismuth	<0.000005	<0.000005	n/c
Boron	<0.05	<0.05	n/c	Boron	<0.05	<0.05	n/c
Cadmium	0.000054	0.000047	14%	Cadmium	0.000016	0.000024	n/c
Calcium	10.9	10.7	2%	Calcium	10.6	10.6	0%
Chromium	0.0006	0.0005	18%	Chromium	0.0003	0.0003	0%
Cobalt	0.00041	0.000402	2%	Cobalt	0.000086	0.000084	2%
Copper	0.00669	0.00653	2%	Copper	0.00523	0.00483	8%
Iron	0.724	0.714	1%	Iron	0.197	0.2	2%
Lead	0.00152	0.00146	4%	Lead	0.000157	0.000153	3%
Lithium	0.0014	0.0014	0%	Lithium	0.0012	0.0012	0%
Magnesium	3.42	3.32	3%	Magnesium	3.38	3.26	4%
Manganese	0.0785	0.0741	6%	Manganese	0.0106	0.0103	3%
Mercury	0.00001	0.00001	0%	Mercury	<0.00001	0.00001	n/c
Molybdenum	0.0004	0.00037	8%	Molybdenum	0.00044	0.00039	12%
Nickel	0.0011	0.00103	7%	Nickel	0.00069	0.00064	8%
Phosphorus	0.052	0.047	10%	Phosphorus	0.013	0.011	17%
Potassium	0.71	0.69	3%	Potassium	0.69	0.69	0%
Selenium	0.00005	0.00005	0%	Selenium	0.00004	0.00006	n/c
Silicon	3	2.8	7%	Silicon	2.6	2.7	4%
Silver	0.00001	0.000011	10%	Silver	<0.000005	<0.000005	n/c
Sodium	1.61	1.57	3%	Sodium	1.73	1.61	7%
Strontium	0.0806	0.08	1%	Strontium	0.0803	0.0768	4%
Sulfur	<3	<3	n/c	Sulfur	<3	<3	n/c
Tellurium	<0.00002	<0.00002	n/c	Tellurium	<0.00002	<0.00002	n/c
Thallium	0.000007	0.000007	0%	Thallium	<0.000002	0.000003	n/c
Thorium	0.000192	0.000214	11%	Thorium	0.000157	0.000114	**32%**
Tin	<0.00001	<0.00001	n/c	Tin	0.00001	<0.00001	n/c
Titanium	0.0138	0.0152	10%	Titanium	0.0021	0.0021	0%
Tungsten	0.00003	0.00003	0%	Tungsten	<0.00001	0.00002	n/c
Uranium	0.003	0.00296	1%	Uranium	0.00223	0.00212	5%
Vanadium	0.0017	0.0017	0%	Vanadium	0.0004	0.0003	**29%**
Zinc	0.0042	0.0036	15%	Zinc	0.0053	0.0049	8%
Zirconium	0.0004	0.0005	22%	Zirconium	0.0003	0.0002	**40%**

Bold	*Exceedes Data Quality objective of 25%.*
Bold	*Exceedes Data Quality objective of 25%, but does not meet Pratical Quantitation Limit.*
RPD	*Relative Percent Difference.*
"-"	*Not Analyzed.*
"n/c"	*Not able to be calculated, because one or both values not precisely known, or within 3x the DL.*
"<"	*Less than detection limit.*

Appendix B6. Surface Water Quality Replicate Data, Casino Project, July 2008

Station	W1	W1-R (W101)	RPD	Station	W1	W1-R (W101)	RPD
Date	7/8/2008	7/8/2008	%	Date	7/8/2008	7/8/2008	%
Physical Tests				**Dissolved Anions & Nutrients**			
Conductivity (us/cm)	280	280	0%	Alkalinity-Total	81	82	1%
Dissolved Hardness	133	135	1%	Alkalinity (PP as CaCO3)	<0.5	<0.5	n/c
pH	8.1	8.1	0%	Ammonia Nitrogen	0.013	0.015	14%
Total Suspended Solids	4	4	0%	Bicarbonate (HCO3)	99	100	1%
Total Dissolved Solids	200	200	0%	Carbonate (CO3)	<0.5	<0.5	n/c
Tubidity (NTU)	0.5	0.3	**50%**	Chloride Cl	2.5	5.3	**72%**
Cyanide + Thiocyanate	0.0008	0.0008	0%	Hydroxide (OH)	<0.5	<0.5	n/c
Total Hardness	143	144	1%	Nitrate Nitrogen	0.169	0.164	3%
Weak Acid Dissoc. Cyanide	0.0005	<0.0005	n/c	Nitrite Nitrogen	<0.002	<0.002	n/c
				Nitrate plus Nitrite	0.169	0.164	3%
				Ortho Phosphate as P	0.001	<0.001	n/c
				Sulphate	63	59	7%
				Total Kjeldahl Nitrogen	0.24	0.19	23%
				Total Nitrogen	0.41	0.35	16%
Total Metals				**Dissolved Metals**			
Aluminum	0.0821	0.0752	9%	Aluminum	0.0438	0.0429	2%
Antimony	0.00028	0.00027	4%	Antimony	0.00027	.00030	11%
Arsenic	0.00057	0.00059	3%	Arsenic	0.00056	0.00054	4%
Barium	0.0627	0.0598	5%	Barium	0.0591	0.0608	3%
Beryllium	0.00001	0.00001	0%	Beryllium	0.00001	0.00001	0%
Bismuth	<0.000005	<0.000005	n/c	Bismuth	<0.000005	<0.000005	n/c
Boron	<0.05	<0.05	n/c	Boron	<0.05	<0.05	n/c
Cadmium	0.000014	0.000011	24%	Cadmium	0.000008	0.000008	0%
Calcium	35.8	36.1	1%	Calcium	33.3	33.5	1%
Chromium	0.0003	0.0003	0%	Chromium	0.0003	0.0002	**40%**
Cobalt	0.000099	0.000088	12%	Cobalt	0.000051	0.000042	19%
Copper	0.00243	0.00240	1%	Copper	0.00205	0.00211	3%
Iron	0.104	0.099	5%	Iron	0.044	0.045	2%
Lead	0.000059	0.000051	15%	Lead	<0.000005	<0.000005	n/c
Lithium	0.0009	0.0009	0%	Lithium	0.0008	0.0008	0%
Magnesium	13.0	13.0	0%	Magnesium	12.1	12.4	2%
Manganese	0.00454	0.00465	2%	Manganese	0.00131	0.00128	2%
Mercury	<0.00001	<0.00001	n/c	Mercury	0.00001	0.00001	0%
Molybdenum	0.00077	0.00075	3%	Molybdenum	0.00073	0.00078	7%
Nickel	0.00077	0.00082	6%	Nickel	0.00075	0.00068	10%
Phosphorus	0.005	0.005	0%	Phosphorus	<0.002	<0.002	n/c
Potassium	2.08	2.08	0%	Potassium	1.94	1.95	1%
Selenium	0.00011	0.00011	0%	Selenium	0.00012	.00010	18%
Silicon	4.5	4.8	6%	Silicon	3.8	4.1	8%
Silver	<0.000005	<0.000005	n/c	Silver	<0.000005	<0.000005	n/c
Sodium	4.39	4.40	0%	Sodium	4.20	4.20	0%
Strontium	0.236	0.234	1%	Strontium	0.214	0.217	1%
Sulfur	23	22	4%	Sulfur	21	21	0%
Thallium	0.000004	0.000003	**29%**	Thallium	0.000004	0.000004	0%
Tin	<0.00001	<0.00001	n/c	Tin	<0.00001	<0.00001	n/c
Titanium	0.0031	0.0027	14%	Titanium	0.0006	<0.0005	n/c
Uranium	0.00928	0.00907	2%	Uranium	0.00864	.00890	3%
Vanadium	0.0004	0.0004	0%	Vanadium	0.0003	0.0003	0%
Zinc	0.0008	0.0008	0%	Zinc	0.0045	0.0042	7%
Zirconium	0.0002	0.0002	0%	Zirconium	0.0002	0.0002	0%

Bold	*Exceedes Data Quality objective of 25%.*
Bold	*Exceedes Data Quality objective of 25%, but does not meet Pratical Quantitation Limit.*
RPD	*Relative Percent Difference.*
"-"	*Not Analyzed.*
"n/c"	*Not able to be calculated, because one or both values not precisely known, or within 3x the DL.*
"<"	*Less than detection limit.*

Appendix B6. Surface Water Quality Replicate Data, Casino Project, July 2008 (cont'd)

Station	W43	W43-R (W102)	RPD	Station	W43	W43-R (W102)	RPD
Date	7/8/2008	7/8/2008	%	Date	7/8/2008	7/8/2008	%
Physical Tests				**Dissolved Anions & Nutrients**			
Conductivity (us/cm)	240	240	0%	Alkalinity-Total	83	80	4%
Dissolved Hardness	109	112	3%	Alkalinity (PP as CaCO3)	<0.5	<0.5	n/c
pH	7.5	7.3	3%	Ammonia Nitrogen	0.016	<0.005	n/c
Total Suspended Solids	<1	<1	n/c	Bicarbonate (HCO3)	100	98	2%
Total Dissolved Solids	170	160	6%	Carbonate (CO3)	<0.5	<0.5	n/c
Tubidity (NTU)	0.2	0.3	**40%**	Chloride Cl	0.8	0.9	12%
Cyanide + Thiocyanate	<0.0005	<0.0005	n/c	Hydroxide (OH)	<0.5	<0.5	n/c
Total Hardness	116	117	1%	Nitrate Nitrogen	0.214	0.216	1%
Weak Acid Dissoc. Cyanide	<0.0005	<0.0005	n/c	Nitrite Nitrogen	<0.002	<0.002	n/c
				Nitrate plus Nitrite	0.214	0.216	1%
				Ortho Phosphate as P	<0.001	<0.001	n/c
				Sulphate	44	45	2%
				Total Kjeldahl Nitrogen	0.07	0.10	**35%**
				Total Nitrogen	0.28	0.31	10%
Total Metals				**Dissolved Metals**			
Aluminum	0.0036	0.0030	18%	Aluminum	0.0056	0.0254	**128%**
Antimony	0.00342	0.00342	0%	Antimony	0.00335	0.00329	2%
Arsenic	0.00049	0.00048	2%	Arsenic	0.00028	0.00029	4%
Barium	0.0517	0.0496	4%	Barium	0.0495	0.0496	0%
Beryllium	<0.00001	<0.00001	n/c	Beryllium	<0.00001	<0.00001	n/c
Bismuth	<0.000005	<0.000005	n/c	Bismuth	<0.000005	<0.000005	n/c
Boron	<0.05	<0.05	n/c	Boron	<0.05	<0.05	n/c
Cadmium	0.0553	0.0550	1%	Cadmium	0.0515	0.0531	3%
Calcium	32.3	32.7	1%	Calcium	30.1	30.9	3%
Chromium	<0.0001	<0.0001	n/c	Chromium	<0.0001	<0.0001	n/c
Cobalt	0.000164	0.000161	2%	Cobalt	0.000157	0.000161	3%
Copper	0.0608	0.0604	1%	Copper	0.0510	0.0534	5%
Iron	0.025	0.023	8%	Iron	0.007	0.007	0%
Lead	0.00587	0.00567	3%	Lead	0.00205	0.00218	6%
Lithium	0.0024	0.0025	4%	Lithium	0.0024	0.0024	0%
Magnesium	8.58	8.66	1%	Magnesium	8.13	8.33	2%
Manganese	0.266	0.268	1%	Manganese	0.252	0.258	2%
Mercury	<0.00001	<0.00001	n/c	Mercury	<0.00001	<0.00001	n/c
Molybdenum	<0.00005	<0.00005	n/c	Molybdenum	<0.00005	<0.00005	n/c
Nickel	.00050	0.00042	17%	Nickel	0.00045	0.00053	16%
Phosphorus	0.002	0.002	0%	Phosphorus	<0.002	<0.002	n/c
Potassium	1.43	1.41	1%	Potassium	1.33	1.36	2%
Selenium	<0.00004	<0.00004	n/c	Selenium	<0.00004	<0.00004	n/c
Silicon	5.8	6.1	5%	Silicon	6.0	5.9	2%
Silver	0.000090	0.000088	2%	Silver	0.000026	0.000035	**30%**
Sodium	3.52	3.52	0%	Sodium	3.44	3.45	0%
Strontium	0.280	0.281	0%	Strontium	0.265	0.271	2%
Sulfur	14	15	7%	Sulfur	15	16	6%
Thallium	0.000023	0.000023	0%	Thallium	0.000022	0.000025	13%
Tin	<0.00001	<0.00001	n/c	Tin	<0.00001	<0.00001	n/c
Titanium	<0.0005	<0.0005	n/c	Titanium	<0.0005	<0.0005	n/c
Uranium	0.00149	0.00154	3%	Uranium	0.00128	0.00134	5%
Vanadium	<0.0002	<0.0002	n/c	Vanadium	<0.0002	<0.0002	n/c
Zinc	3.06	2.99	2%	Zinc	2.84	2.93	3%
Zirconium	<0.0001	<0.0001	n/c	Zirconium	<0.0001	<0.0001	n/c

Bold	*Exceedes Data Quality objective of 25%.*
Bold	*Exceedes Data Quality objective of 25%, but does not meet Pratical Quantitation Limit.*
RPD	*Relative Percent Difference.*
"-"	*Not Analyzed.*
"n/c"	*Not able to be calculated, because one or both values not precisely known, or within 3x the DL.*
"<"	*Less than detection limit.*

Appendix B6. Surface Water Quality Replicate Data, Casino Project, September 2008

Station	W43	W43-R (W43-B)	RPD	Station	W43	W43-R (W43-B)	RPD
Date	9/9/2008	9/9/2008	%	Date	9/9/2008	9/9/2008	%
Physical Tests				**Dissolved Anions & Nutrients**			
Conductivity (us/cm)	220	220	0%	Alkalinity-Total	67	67	0%
Dissolved Hardness	95.8	95.4	0%	Ammonia Nitrogen	<0.01	<0.01	n/c
pH	7.5	7.7	3%	Chloride Cl	<0.5	<0.5	n/c
Total Suspended Solids	<1	<1	n/c	Nitrate Nitrogen	0.443	0.454	2%
Total Dissolved Solids	120	130	8%	Nitrite Nitrogen	<0.002	<0.002	n/c
Tubidity (NTU)	0.8	0.9	12%	Nitrate plus Nitrite	0.443	0.454	2%
Cyanide + Thiocyanate	<0.0005	<0.0005	n/c	Ortho Phosphate as P	0.002	0.002	0%
Total Hardness	94.4	94.9	1%	Sulphate	39	39	0%
Weak Acid Dissoc. Cyanide	<0.0005	<0.0005	n/c	Total Kjeldahl Nitrogen	0.04	0.02	**67%**
				Total Nitrogen	0.48	0.47	2%
Total Metals				**Dissolved Metals**			
Aluminum	0.0235	0.0224	5%	Aluminum	0.0014	0.0014	0%
Antimony	0.00264	0.00263	0%	Antimony	0.00257	0.00252	2%
Arsenic	0.00079	0.00077	3%	Arsenic	0.00047	0.00046	2%
Barium	0.0658	0.0649	1%	Barium	0.0631	0.0620	2%
Beryllium	<0.00001	<0.00001	n/c	Beryllium	<0.00001	<0.00001	n/c
Bismuth	<0.000005	<0.000005	n/c	Bismuth	<0.000005	<0.000005	n/c
Boron	<0.05	<0.05	n/c	Boron	<0.05	<0.05	n/c
Cadmium	0.0425	0.0427	0%	Cadmium	0.0414	0.0418	1%
Calcium	26.2	26.3	0%	Calcium	26.8	26.7	0%
Chromium	<0.0001	<0.0001	n/c	Chromium	<0.0001	<0.0001	n/c
Cobalt	0.000320	0.000313	2%	Cobalt	0.000316	0.000312	1%
Copper	0.0748	0.0743	1%	Copper	0.0709	0.0703	1%
Iron	0.047	0.048	2%	Iron	0.010	0.010	0%
Lead	0.0120	0.0120	0%	Lead	0.00666	0.00680	2%
Lithium	0.0020	0.0020	0%	Lithium	0.0020	0.0020	0%
Magnesium	7.02	7.07	1%	Magnesium	7.03	7.00	0%
Manganese	0.524	0.526	0%	Manganese	0.537	0.543	1%
Mercury	<0.00001	<0.00001	n/c	Mercury	<0.00001	<0.00001	n/c
Molybdenum	<0.00005	<0.00005	n/c	Molybdenum	<0.00005	<0.00005	n/c
Nickel	0.00049	0.00043	13%	Nickel	0.00047	0.00064	**31%**
Phosphorus	0.003	0.003	0%	Phosphorus	0.002	0.002	0%
Potassium	1.35	1.35	0%	Potassium	1.39	1.38	1%
Selenium	<0.00004	<0.00004	n/c	Selenium	<0.00004	<0.00004	n/c
Silicon	5.8	6.2	7%	Silicon	5.6	5.8	4%
Silver	0.000105	0.000116	10%	Silver	0.000023	0.000022	4%
Sodium	3.09	3.07	1%	Sodium	2.99	2.96	1%
Strontium	0.220	0.220	0%	Strontium	0.226	0.224	1%
Sulfur	14	14	0%	Sulfur	14	13	7%
Thallium	0.000025	0.000026	4%	Thallium	0.000025	0.000025	0%
Tin	<0.00001	<0.00001	n/c	Tin	<0.00001	<0.00001	n/c
Titanium	<0.0005	<0.0005	n/c	Titanium	<0.0005	<0.0005	n/c
Uranium	0.00126	0.00126	0%	Uranium	0.00126	0.00125	1%
Vanadium	<0.0002	<0.0002	n/c	Vanadium	<0.0002	<0.0002	n/c
Zinc	2.35	2.38	1%	Zinc	2.28	2.28	0%
Zirconium	<0.0001	<0.0001	n/c	Zirconium	<0.0001	<0.0001	n/c

Bold	*Exceedes Data Quality objective of 25%*
Bold	*Exceedes Data Quality objective of 25%, but does not meet Pratical Quantitation Limit*
RPD	*Relative Percent Difference*
"-"	*Not Analyzed*
"n/c"	*Not able to be calculated, because one or both values not precisely known, or within 3x the DL*
"<"	*Less than detection limit*

B7. Sediment Quality Data, Casino Project, September 2008

Appendix B7. Sediment Quality Data, Casino Project, September 2008

Station	Detection Limits	CCME Sediement Quality Guidelines for the Protection of Aquatic Life[a]		W7 - Upper Canadian Creek	W3 - Canadian Creek us of Confluence with Britannia Creek	W14 - Mouth of Britannia Creek	W2 - Canadian Creek Downstream of Confluence with Britannia Creek	W1 - Mouth of Canadian Creek	W12 - Proctor Gulch before Confluence with Casino Creek	W8 - Upper Casino Creek	W13 - Meloy Creek	W11 - Casino Creek (proposed dam outflow)	W4 - Mouth of Casino Creek	W9 - Dip Creek us of Confluence with Casino Creek	W5 - Dip Creek ds Casino Confluence
Date		**ISQG[b]**	**PEL[c]**	**10-Sep-08**	**10-Sep-08**	**10-Sep-08**	**10-Sep-08**	**10-Sep-08**	**10-Sep-08**	**10-Sep-08**	**9-Sep-08**	**9-Sep-08**	**9-Sep-08**	**9-Sep-08**	**9-Sep-08**
Physical Tests															
Moisture %	0.3			20	20	23	21	23	35	23	25	29	37	30	31
pH	0.01			6.45	7.27	7.37	7.38	7.45	3.28	7.16	7.41	7.29	6.66	6.92	6.59
Total Metals															
Aluminum	100			6810	6160	6690	5940	6900	11100	8010	10800	11200	11800	12000	13200
Antimony	0.1			0.8	1.0	0.8	0.9	0.9	2.4	1.2	2.3	2.6	0.8	0.6	0.7
Arsenic	0.2	5.9	17	*13.1*	***18.5***	*12.2*	***18.4***	*15.5*	***46.0***	***24.5***	***25.8***	***27.5***	*13.0*	*6.4*	*10.0*
Barium	0.1			144	98.9	159	96.8	96.7	188	140	272	217	156	169	206
Beryllium	0.1			0.2	0.2	0.1	0.2	0.2	0.3	0.4	0.4	0.4	0.2	0.4	0.4
Bismuth	0.1			0.5	0.1	<0.1	0.2	0.1	0.9	0.3	0.2	0.3	0.1	0.2	0.2
Cadmium	0.05	0.6	3.5	*0.68*	0.21	0.08	0.19	0.15	0.35	*1.80*	*1.55*	*1.78*	0.35	0.19	0.26
Calcium	100			1200	1860	2250	1850	2300	1170	2030	3780	3920	3590	5440	5090
Chromium	1	37.3	90	6	15	9	12	17	13	5	12	9	14	18	15
Cobalt	0.3			8.3	7.3	6.6	6.9	8.0	10.1	29.1	10.4	23.2	11.1	8.5	10.5
Copper	0.5	35.7	197	*57.0*	18.0	6.4	15.8	20.3	***223***	***292***	15.0	*191*	33.4	12.6	19.8
Iron	100			16500	13900	16700	13800	16000	83500	36600	27300	34900	29100	25700	27500
Lead	0.1	35	91.3	11.4	10.5	4.4	7.8	9.6	*73.9*	*42.9*	***192***	***111***	24.9	11.8	14.3
Magnesium	100			3560	4840	3890	4800	4890	3460	2880	4970	4440	6040	5370	5590
Manganese	0.2			450	343	355	354	336	407	1200	1400	1390	500	514	709
Mercury	0.05	0.17	0.486	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Molybdenum	0.1			5.5	2.5	0.4	2.7	2.4	5.0	2.9	1.2	2.4	1.5	1.1	1.1
Nickel	0.8			5.1	13.8	6.0	13.3	13.0	7.5	6.4	9.4	9.9	8.2	12.2	12.5
Phosphorous	10			337	374	431	428	405	577	434	498	444	584	965	703
Potassium	100			1310	1360	1280	1190	1480	880	665	2120	1300	2170	1080	1480
Selenium	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Silver	0.05			0.12	0.05	<0.05	0.06	0.18	0.62	0.12	0.38	0.29	0.08	0.10	0.11
Sodium	100			<100	<100	107	<100	<100	<100	<100	<100	<100	176	197	156
Strontium	0.1			9.7	11.6	14.6	12.4	13.5	9.2	14.8	25.4	28.1	17.6	33.2	36.3
Thallium	0.05			0.17	0.12	0.12	0.12	0.12	0.17	0.13	0.32	0.22	0.25	0.15	0.22
Tin	0.1			0.3	0.2	0.3	0.2	0.2	0.5	0.2	0.7	0.5	0.5	0.5	0.5
Titanium	1			443	292	568	254	365	471	342	859	722	974	748	888
Vanadium	2			30	23	36	23	27	46	31	50	45	70	54	53
Zinc	1	123	315	65	40	34	41	43	*169*	*180*	*226*	*192*	94	64	76
Zirconium	0.5			1.1	0.7	0.6	0.7	0.8	0.8	0.9	1.0	0.9	0.9	1.3	1.5

Notes:

All units mg/kg dry weight unless otherwise noted.

a) Canadian Sediment quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2008.

b) ISQG: Interim Freshwater Sediment Quality Guidelines.

c) PEL: Probable Effects Levels.

Italic	*Results exceed ISQG.*
Italic	*Results exceed ISQG & PEL.*

B8. Periphyton Taxonomy, Casino Project, September 2008

Appendix B8. Periphyton Taxonomy, Casino Project, September 2009

FES Sample Number			080476	080477	080478	080479	080480	080481	080482	080483	080484	080485	0804
Sample Site			P1-1	P1-2	P1-3	P1-4	P1-5	P2-1	P2-2	P2-3	P2-4	P2-5	P3-
Sampling Date			11-Sep-08	11-Sep-08	11-Sep-08	11-Sep-08	11-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep
Area Sampled (cm^2)			214.58	199.16	220.90	322.84	240.39	102.71	243.87	217.29	246.39	313.23	214.8
Phylum	**Order**	**Genera and Species**											
		Cyclotella sp.											
		Melosira sp.											
	Pennales	*Achnanthes flexella*						<3.1	<1.0	<1.5			<1.2
		Achnanthes lanceolata											
		Achnanthes minutissima	12.8	33.6	<1.3	33.6	53.6	37.2	12.0	9.0	6.4	4.2	1.2
		Achnanthes spp.	9.6	2.8	7.8	16.8	26.8	6.2	8.0	12.0	16.0	4.2	4.8
		Amphipleura pellucida					<1.7						
		Amphora spp.											
		Caloneis spp.		<1.4									
		Caloneis sp.?											
		Ceratoneis arcus	120.0	14.0	15.6	15.4	78.2	117.8	6.0	9.0	38.4	14.0	26.4
		Cocconeis placentula								<1.5	<1.6		
		Cymbella cf. cestaii	<1.6					3.1	<1.0			<0.7	<1.2
		Cymbella cistula	<1.6					<3.1		<1.5	<1.6	<0.7	<1.2
		Cymbella minuta	16.0	2.8	<1.3	6.6	20.4	6.2	2.0	3.0	9.6	1.4	
		Cymbella sinuata	<1.6	<1.4	2.6	2.2	<1.7	9.3	1.0	15.0	6.4	0.7	1.2
		Cymbella spp.	<1.6			<1.1		<3.1	<1.0		<1.6	<0.7	
		Denticula sp.	<1.6				<1.7	<3.1	<1.0		<1.6	<0.7	
		Diatoma elongatum	1,108.8	67.2	117.6	268.8	415.4	3,642.6	144.0	471.5	430.5	270.4	211.
		Diatoma mesodon	<1.6	<1.4	<1.3	<1.1	1.7	<3.1		<1.5		<0.7	<1.2
		Diatomella sp.											
		Didymosphenia geminata											
		Diploneis spp.											
		Epithemia spp.											
		Eunotia spp.						<3.1			<1.6		
		Fragilaria capucina	<1.6										
		Fragilaria construens									<1.6		
		Fragilaria crotonensis											
		Fragilaria vaucheriae	216.0	2.8	18.2	117.6	241.2	62.0		9.0	16.0	1.4	2.4
		Fragilaria spp.	9.6	11.2	10.4	33.6	174.2	62.0	4.0	27.0	22.4	7.0	4.8
		Frustulia sp.											
		Gomphonema acuminatum / parvulum	19.2	25.2	7.8	50.4	40.8	99.2	2.0	6.0	9.6	<0.7	<1.2
		Gomphonema spp.	6.4	<1.4	<1.3		6.8	74.4	<1.0	9.0	3.2	<0.7	1.2
		Hanitzschia sp.											
		Meridion circulare	180.0	25.2	28.6	109.2	160.8	3.1	<1.0	9.0	6.4	<0.7	<1.2
		Navicula radiosa					<1.7	<3.1	<1.0	<1.5	1.6		
		Navicula spp.	1.6			6.6	6.8	12.4	<1.0	<1.5	1.6	<0.7	<1.2
		Neidium spp.											
		Nitzschia spp.	36.0	19.6	2.6	8.8	6.8	6.2	1.0	6.0	6.4	2.8	<1.2
		Pinnularia spp.	<1.6	<1.4	<1.3	1.1	<1.7	6.2	<1.0	<1.5	3.2	0.7	<1.2
		Rhopalodia sp.											
		Stauroneis spp.											
		Surirella spp.											
		Synedra ulna	1.6	<1.4		<1.1	<1.7	37.2	<1.0	1.5	9.6	<0.7	4.8
		Synedra spp.	6.4	5.6	9.8	11.0	13.6	12.4	1.0	9.0	6.4	2.8	<1.2
		Tabellaria fenestrata											
		Tabellaria flocculosa	<1.6										
		UID girdle view			<1.3					<1.5	<1.6		9.6
Chlorophyta	Chaetophorales	*Stigeoclonium sp.*											
		UID Chaetophorales											
	Chlorococcales	*Oocystis spp.*	<1.6										

Appendix B8. Periphyton Taxonomy, Casino Project, September 2009

FES Sample Number			080476	080477	080478	080479	080480	080481	080482	080483	080484	080485	0804
Sample Site			P1-1	P1-2	P1-3	P1-4	P1-5	P2-1	P2-2	P2-3	P2-4	P2-5	P3-
Sampling Date			11-Sep-08	11-Sep-08	11-Sep-08	11-Sep-08	11-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep
Area Sampled (cm^2)			214.58	199.16	220.90	322.84	240.39	102.71	243.87	217.29	246.39	313.23	214.8
	Oedogoniales	*Oedogonium spp.*											
	Ulothricales	*Hormidium sp.?*											<1.2
		Microspora sp.											
		Ulothrix spp.	<1.6			<1.1							
		UID Ulothricales											
	Zygnematales	*Closterium spp.*											
		Cosmarium spp.	<1.6										
		Cylindrocystis spp.											
		Mougeotia spp.											
		Roya sp.											
Chlorophyta		UID Chlorophyta colonial		11.2									
		UID Chlorophyta filamentous										<0.7	16.8
		UID Chlorophyta unicellular		2.8									1.2
Chrysophyta	Chromulinales	*Chromulina sp.*	1,663.2		205.8	1,328.4	930.6	840.6	800.8	207.0	172.2	2,772.0	28.8
		Hudrurus sp.									<1.6	<0.7	
	Tribonematales	*Tribonema spp.*	<1.6										
Chrysophyta		UID Chrysophyte colonial	22.4	11.2	7.8	81.4	80.4			24.0	73.8	20.8	
		UID Chrysophyte cyst			<1.3						12.3	1.4	<1.2
		UID Chrysophyte flagellate											
		UID Chrysophyte unicellular	12.0	2.8	2.6								
Cyanophyta	Chamaesiphonale	*Chamaesiphon spp.*											
		Clastidium setigerum											
	Chroococcales	*Aphanocapsa spp.*											
		UID Chrooccocales						24.3	8.0		110.7	20.8	57.6
	Nostocales	*Anabaena sp. ?*					<1.7						
		Calothrix sp. ?											
		Nostoc sp. / Anabaena sp.										<0.7	
		Nostoc sp.											
		Tolypothrix sp.											13.2
		UID Nostocales				<1.1		<3.1					
	Oscillatoriales	*Lyngbya spp.*							<1.0		<1.6	<0.7	
		Homoeothrix varians										<0.7	
		Microcoleus sp.											
		Oscillatoria cf. agardhii											
		Oscillatoria spp.											
		Phormidium sp.?											
		Pseudoanabaena spp.	<1.6		<1.3	<1.1				<1.5	16.0	<0.7	<1.2
		UID Oscillatoriales	<1.6	<1.4	<1.3		<1.7		<1.0	<1.5	<1.6	<0.7	<1.2
Rhodophyta	Nemalionales	*Audouinella sp.*											
		Batrachospermum sp.											
		UID flagellate	12.0			8.4							
		UID colonial											<1.2
		UID filamentous							<1.0	<1.5			<1.2
		UID unicellular	138.6	44.8	39.2	97.2	51.7	93.4	8.0	11.5	236.5	26.0	38.4

Appendix B8. Periphyton Taxonomy, Casino Project, September 2009

FES Sample Number			080490	080491	080492	080493	080494	080495	080496	080497	080498	080499	080500	080501	080502	080503
Sample Site			P3-5	P4-1	P4-2	P4-3	P4-4	P4-5	P5-1	P5-2	P5-3	P5-4	P5-5	P7-1	P7-2	P7-3
Sampling Date			10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08
Area Sampled (cm^2)			134.26	225.42	238.90	227.48	283.93	128.71	122.45	103.48	142.45	73.16	176.26	155.61	199.81	304.84
Phylum	**Order**	**Genera and Species**														
		Cyclotella sp.														
		Melosira sp.										<1.9				
	Pennales	*Achnanthes flexella*			<2.7		<1.3	<2.6		<1.8						<1.4
		Achnanthes lanceolata		<1.3	2.7		<1.3						<1.3	5.8	<5.8	<1.4
		Achnanthes minutissima	16.0	30.0	208.0	3,393.6	147.0	102.5	13.0	10.8	16.0	3.8	2.6	113.0	267.6	99.0
		Achnanthes spp.	19.2	60.0	187.2	2,181.6	52.5	123.0	10.4	7.2	24.0	11.4	7.8	203.4	490.6	66.0
		Amphipleura pellucida														
		Amphora spp.		<1.3			<1.3	<2.6						<2.9	<5.8	<1.4
		Caloneis spp.				<2.0	2.6				<1.0	<1.9	<1.3		5.8	2.8
		Caloneis sp.?		<1.3												
		Ceratoneis arcus	38.4	180.0	2,723.4	2,908.8	683.4	1,260.8	58.8	126.9	118.4	22.8	41.6	90.4	81.2	36.8
		Cocconeis placentula		1.3	5.4	<2.0	<1.3	<2.6	<1.3			<1.9	<1.3		<5.8	
		Cymbella cf. cestaii	<1.6	<1.3		<2.0	<1.3	<2.6		<1.8						
		Cymbella cistula	<1.6		2.7	8.0	5.2	<2.6			<1.0			<2.9		<1.4
		Cymbella minuta	3.2	13.0	166.4	666.6	63.0	164.0	10.4	1.8	8.0	<1.9	<1.3	23.2	23.2	8.4
		Cymbella sinuata	22.4	5.2	41.6	31.6	2.6		7.8	10.8	4.0			11.6	34.8	<1.4
		Cymbella spp.	<1.6	<1.3		<2.0		<2.6	<1.3		<1.0			<2.9	<5.8	<1.4
		Denticula sp.														
		Diatoma elongatum	1,047.2	90.0	1,201.5	8,847.6	442.2	1,260.8	10.4	14.4	12.0	11.4	5.2			
		Diatoma mesodon		<1.3	<2.7	2.0	2.6	<2.6		<1.8		<1.9	<1.3	2.9	<5.8	
		Diatomella sp.												<2.9		
		Didymosphenia geminata			<2.7	<2.0	31.2	109.2	<1.3					<2.9		
		Diploneis spp.		<1.3	<2.7		<1.3	<2.6	<1.3							
		Epithemia spp.														
		Eunotia spp.		<1.3	<2.7					<1.8			<1.3	<2.9		<1.4
		Fragilaria capucina		<1.3	10.8	12.0	<1.3	31.2		5.4	4.0	<1.9	<1.3	<2.9	<5.8	4.2
		Fragilaria construens		<1.3										5.8		<1.4
		Fragilaria crotonensis					<1.3									
		Fragilaria vaucheriae	19.2	190.0	2,242.8	3,030.0	884.4	2,364.0	15.6	25.2	32.0	30.4	7.8	316.4	401.4	77.0
		Fragilaria spp.	19.2	130.0	801.0	848.4	361.8	472.4	2.6	14.4	8.0	11.4	7.8	22.6	11.6	8.4
		Frustulia sp.			<2.7			<2.6								
		Gomphonema acuminatum / parvulum	6.4	13.0	270.4	11,756.4	21.0	41.0	7.8	14.4	12.0	22.8	3.9	67.8	58.0	11.2
		Gomphonema spp.	22.4	10.4	145.6	13,938.0	63.0	61.5	5.2	7.2	36.0	3.8	2.6	11.6	23.2	8.4
		Hanitzschia sp.														<1.4
		Meridion circulare	<1.6	7.8	75.6	158.0	49.4	246.0	15.6	10.8	10.0	7.6	3.9	29.0	46.4	5.6
		Navicula radiosa	<1.6	<1.3	<2.7	2.0	1.3	2.6	<1.3	<1.8	<1.0	<1.9				
		Navicula spp.		2.6	<2.7	<2.0	13.0	10.4		21.6	20.0	11.4		<2.9	<5.8	
		Neidium spp.		<1.3										<2.9	<5.8	
		Nitzschia spp.	9.6	50.0	83.2	363.6	105.0	184.5	18.2	25.2	96.0	15.4	5.2	17.4	58.0	22.4
		Pinnularia spp.	1.6	5.2	5.4	<2.0	13.0	15.6	<1.3	1.8	2.0	<1.9	<1.3	11.6	46.4	8.4
		Rhopalodia sp.						<2.6								
		Stauroneis spp.	<1.6	<1.3	<2.7	<2.0	<1.3	<2.6			<1.0					<1.4
		Surirella spp.			<2.7	<2.0	<1.3				<1.0					
		Synedra ulna	19.2	1.3	27.0	<2.0	2.6	10.4		<1.8	<1.0	<1.9	<1.3			
		Synedra spp.	3.2	50.0	640.8	3,999.6	361.8	1,182.0	7.8	3.6	16.0	11.4	7.8	5.8	11.6	1.4
		Tabellaria fenestrata	<1.6		2.7	<2.0		5.2						<2.9		
		Tabellaria flocculosa		<1.3	2.7	<2.0	<1.3	<2.6			<1.0			<2.9	<5.8	<1.4
		UID girdle view		2.6		63.2	2.6			<1.8	6.0	<1.9		5.8	<5.8	2.8
Chlorophyta	Chaetophorales	*Stigeoclonium sp.*														
		UID Chaetophorales													<5.8	
	Chlorococcales	*Oocystis spp.*														

Appendix B8. Periphyton Taxonomy, Casino Project, September 2009

FES Sample Number			080490	080491	080492	080493	080494	080495	080496	080497	080498	080499	080500	080501	080502	080503
Sample Site			P3-5	P4-1	P4-2	P4-3	P4-4	P4-5	P5-1	P5-2	P5-3	P5-4	P5-5	P7-1	P7-2	P7-3
Sampling Date			10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08
Area Sampled (cm^2)			134.26	225.42	238.90	227.48	283.93	128.71	122.45	103.48	142.45	73.16	176.26	155.61	199.81	304.84
	Oedogoniales	*Oedogonium spp.*									<1.0					<1.4
	Ulothricales	*Hormidium sp.?*	<1.6													
		Microspora sp.														
		Ulothrix spp.				<2.0	<1.3									
		UID Ulothricales														
	Zygnematales	*Closterium spp.*				<2.0		<2.6		<1.8						
		Cosmarium spp.	<1.6		<2.7							<1.9	<1.3			
		Cylindrocystis spp.												<2.9		<1.4
		Mougeotia spp.								<1.8				<2.9		
		Roya sp.														
Chlorophyta		UID Chlorophyta colonial														
		UID Chlorophyta filamentous					<1.3					<1.9				
		UID Chlorophyta unicellular	3.2	<1.3										<2.9		
Chrysophyta	Chromulinales	*Chromulina sp.*	618.8	80.0	41.6	909.0	160.8	41.0	39.2	56.4	333.0	88.8	453.2	45.2		2.8
		Hudrurus sp.														
	Tribonematales	*Tribonema spp.*			<2.7											
Chrysophyta		UID Chrysophyte colonial												<2.9		
		UID Chrysophyte cyst		2.6	<2.7	<2.0		<2.6			2.0			17.4	23.2	5.6
		UID Chrysophyte flagellate								<1.8		3.8				
		UID Chrysophyte unicellular														
Cyanophyta	Chamaesiphonale	*Chamaesiphon spp.*		490.0	665.6	4,908.6	5,185.8	6,146.4						8,246.0	267.6	1,941.2
		Clastidium setigerum				47.4	10.5	61.5						4,774.0	579.8	1,139.4
	Chroococcales	*Aphanocapsa spp.*	<1.6													
		UID Chrooccocales	19.2	770.0	41.6	303.0	402.0	394.0		<1.8		<1.9		607.6	401.4	295.4
	Nostocales	*Anabaena sp. ?*														
		Calothrix sp. ?														
		Nostoc sp. / Anabaena sp.		31.2												<1.4
		Nostoc sp.	<1.6	<1.3		<2.0	<1.3	<2.6							<5.8	<1.4
		Tolypothrix sp.	<1.6													<1.4
		UID Nostocales											<1.3			
	Oscillatoriales	*Lyngbya spp.*												<2.9		25.2
		Homoeothrix varians		660.0	47,739.6	6,120.6	5,668.2	19,069.6			30.0	22.8	39.0	110,583.2	2,988.2	803.0
		Microcoleus sp.														
		Oscillatoria cf. agardhii	<1.6	26.0	48.6	32,239.2	7,477.2	92,038.4						<2.9		
		Oscillatoria spp.														
		Phormidium sp.?								<1.8						
		Pseudoanabaena spp.	<1.6			94.8	168.0		<1.3	<1.8	8.0				174.0	42.0
		UID Oscillatoriales	25.6	220.0	124.8				<1.3	14.4	<1.0	<1.9	<1.3	156.6	356.8	56.0
Rhodophyta	Nemalionales	*Audouinella sp.*		13.0	232.2		1,900.5	512.5								
		Batrachospermum sp.		249.6	11,169.6		33.8									
		UID flagellate		385.0	5,286.6											
		UID colonial				47.4					26.0				<5.8	
		UID filamentous							<1.3							
		UID unicellular	95.2	77.0	400.5	1,212.0	120.6	157.6	39.2	14.1	22.2	29.6	20.6	434.0	515.4	126.6

Appendix B8. Periphyton Taxonomy, Casino Project, September 2009

FES Sample Number			080504	080505	080506	080507	080508	080509	080510
Sample Site			P7-4	P7-5	P8-1	P8-2	P8-3	P8-4	P8-5
Sampling Date			10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08
Area Sampled (cm^2)			117.23	114.00	168.77	154.97	185.16	192.39	275.81
Phylum	**Order**	**Genera and Species**							
		Cyclotella sp.							
		Melosira sp.	<4.9						
	Pennales	*Achnanthes flexella*	<4.9						
		Achnanthes lanceolata	19.6	50.4	500.5	4.0	15.9	60.4	2.6
		Achnanthes minutissima	414.7	1,490.4	214.5				
		Achnanthes spp.	377.0	1,555.2	357.5	2.0	21.2	90.6	7.8
		Amphipleura pellucida							
		Amphora spp.	<4.9						
		Caloneis spp.	19.6	8.4	18.6		<0.7	3.9	<1.3
		Caloneis sp.?							
		Ceratoneis arcus	127.4	235.2	26,979.4	347.8	1,359.6	5,224.5	135.2
		Cocconeis placentula							
		Cymbella cf. cestaii	<4.9						
		Cymbella cistula	<4.9	<8.4					
		Cymbella minuta	39.2	67.2				<3.9	<1.3
		Cymbella sinuata	<4.9	16.8	9.3	1.0		7.8	<1.3
		Cymbella spp.		<8.4	<9.3		<0.7	<3.9	<1.3
		Denticula sp.							
		Diatoma elongatum							
		Diatoma mesodon	49.0	67.2	99,108.0	400.4	3,296.0	15,441.3	343.2
		Diatomella sp.		<8.4					
		Didymosphenia geminata	<4.9	<8.4					
		Diploneis spp.							
		Epithemia spp.	<4.9						
		Eunotia spp.	9.8	8.4	55.8	4.0	2.8	31.2	2.6
		Fragilaria capucina	<4.9	<8.4	18.6	<1.0	4.2	<3.9	
		Fragilaria construens		<8.4				<3.9	
		Fragilaria crotonensis						<3.9	
		Fragilaria vaucheriae	263.9	1,620.0	2,477.7	74.0	247.2	928.8	31.2
		Fragilaria spp.	37.7	324.0	24,226.4	118.4	576.8	5,688.9	166.4
		Frustulia sp.							
		Gomphonema acuminatum / parvulum	58.8	33.6	286.0	<1.0	5.3	30.2	<1.3
		Gomphonema spp.	58.8	84.0	214.5	4.0	21.2	120.8	
		Hanitzschia sp.				<1.0	<0.7	<3.9	
		Meridion circulare	19.6	67.2	4,404.8	6.0	247.2	906.0	7.8
		Navicula radiosa							
		Navicula spp.							
		Neidium spp.		<8.4			<0.7	<3.9	
		Nitzschia spp.	58.8	33.6	143.0	6.0	<0.7	7.8	5.2
		Pinnularia spp.	29.4	33.6	55.8	12.0	18.2	3.9	10.4
		Rhopalodia sp.							
		Stauroneis spp.							
		Surirella spp.				<1.0			
		Synedra ulna							
		Synedra spp.	9.8	33.6	1,651.8	14.8	21.1	181.2	41.6
		Tabellaria fenestrata	<4.9		223.2	<1.0	8.4	39.0	<1.3
		Tabellaria flocculosa	<4.9		241,8	<1.0	9.8	140.4	5.2
		UID girdle view			9.3	2.0		<3.9	1.3
Chlorophyta	Chaetophorales	*Stigeoclonium sp.*			55.8		4.2	46.8	
		UID Chaetophorales			<9.3	10.0			
	Chlorococcales	*Oocystis spp.*			<9.3				

Appendix B8. Periphyton Taxonomy, Casino Project, September 2009

FES Sample Number			080504	080505	080506	080507	080508	080509	080510
Sample Site			P7-4	P7-5	P8-1	P8-2	P8-3	P8-4	P8-5
Sampling Date			10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08	10-Sep-08
Area Sampled (cm^2)			117.23	114.00	168.77	154.97	185.16	192.39	275.81
	Oedogoniales	*Oedogonium spp.*							
	Ulothricales	*Hormidium sp.?*							
		Microspora sp.		<8.4	130.2	<1.0	21.0	109.2	
		Ulothrix spp.							
		UID Ulothricales	<4.9				<0.7		
	Zygnematales	*Closterium spp.*			<9.3		<0.7	3.9	
		Cosmarium spp.			9.3		<0.7		
		Cylindrocystis spp.			55.8		2.8	15.6	
		Mougeotia spp.					<0.7	<3.9	<1.3
		Roya sp.			<9.3		<0.7		
Chlorophyta		UID Chlorophyta colonial							
		UID Chlorophyta filamentous			<9.3				<1.3
		UID Chlorophyta unicellular		<8.4	214.5	4.0	10.6	60.4	20.8
Chrysophyta	Chromulinales	*Chromulina sp.*	19.6	50.4	56,711.8	11,554.4	8,981.6	13,235.4	2,406.0
		Hudrurus sp.							
	Tribonematales	*Tribonema spp.*			930.0	<1.0	2.8	148.2	
Chrysophyta		UID Chrysophyte colonial			<9.3	8.0			31.2
		UID Chrysophyte cyst	9.8	33.6	143.0		5.3	30.2	2.6
		UID Chrysophyte flagellate					10.6	60.4	
		UID Chrysophyte unicellular			14,866.2	514.8	1,112.4	5,572.8	401.0
Cyanophyta	Chamaesiphonale	*Chamaesiphon spp.*	1,583.4	2,916.0	22,574.6	1,258.4	1,277.2	24,845.4	13,643.0
		Clastidium setigerum	263.9	2,656.8	825.9	143.0			1,443.6
	Chroococcales	*Aphanocapsa spp.*							
		UID Chrooccocales	453.3	1,993.6	12,113.2	1,172.6	618.0	5,108.4	5,373.4
	Nostocales	*Anabaena sp. ?*							
		Calothrix sp. ?							
		Nostoc sp. / Anabaena sp.			<9.3	<1.0	<0.7		
		Nostoc sp.	78.8			<1.0	<0.7	<3.9	
		Tolypothrix sp.	<4.9	<8.4					
		UID Nostocales							
	Oscillatoriales	*Lyngbya spp.*	<4.9	<8.4					
		Homoeothrix varians	6,371.3	125,596.8	256,579.6	5,548.4	3,357.8	87,075.0	17,563.8
		Microcoleus sp.				40.0			
		Oscillatoria cf. agardhii			3,360.5	1,235.8	114.8	5,828.6	4,090.2
		Oscillatoria spp.					65.8	234.0	<1.3
		Phormidium sp.?							
		Pseudoanabaena spp.	274.4	470.4	1,358.5		16.8	156.0	
		UID Oscillatoriales	117.6	252.0	2,073.5		95.4	<3.9	
Rhodophyta	Nemalionales	*Audouinella sp.*			<9.3			<3.9	83.2
		Batrachospermum sp.							
		UID flagellate			275.3	7.4			20.8
		UID colonial							
		UID filamentous				<1.0	<0.7		
		UID unicellular	580.4	996.8	9,360.2	143.0	1,359.6	1,625.4	120.3

B9. Benthic Invertebrate Taxonomy, Casino Project, September 2008

Appendix B9. Benthic Invertebrate Taxonomy, Casino Project, September 2008

	Sample ID:	B1-1	B1-2	B1-3	B1-4	B1-5	B2-1	B2-2	B2-3	B2-4	B2-5	B3-1	B3-2	B3-3	B3-4	B3-5	B4-1	B4-2	B4-3	B4-4	B4-5	B5-1	B5-2	B5-3
	CC#:	080450	080451	080452	080453	080454	080455	080456	080457	080458	080459	080460	080461	080462	080463	080464	080465	080466	080467	080468	080469	080470	080471	080472
Order: Ephemeroptera	adult			1		4	3	3	1	1	1				1		1	1						
Order: Ephemeroptera	nymph (dam./juv.)	1				1			1															
Family: Ameletidae																								
Ameletus sp.	nymph	1	1	1		6	2		1	2	2	4	2	1	1					1	1	4		1
Family: Baetidae	nymph (dam./juv.)					1	3	4		8		3	1		1			1						
Baetis sp.	nymph	4	1	2		2		3	12	4	18	14	1	7		8						6		3
Baetis bicaudatus	nymph	2		2	1		1	2	3	5	5			2		2				1	1	7		2
Baetis tricaudatus	nymph					1																		
Acentrella sp.	nymph			1		1																		
Family: Heptageniidae	nymph		1	2	1	2	7	4	25	8	12	17	2	7	5	8	1	2		3	2	13	1	
Cinygmula sp.	nymph	3				1		1		1						1		3				8	4	4
Epeorus sp.	nymph						1		3		2	6		1		1	1			1		13	3	5
Family: Ephemerellidae	nymph		1			1	1		3	1	1	1										2		1
Serratella sp.	nymph			1		1																		
Ephemerella sp.	nymph															1								
Drunella sp.	nymph																							1
Drunella doddsi	nymph	2		4		2	3	3	10	8	11	12	6	14	4	5			1	1		5	1	1
Drunella coloradensis	nymph			1						1				1		1								
Order: Plecoptera	adult									2														
Order: Plecoptera	nymph (dam./juv.)	1	1				7	1	2	8	3	3								1		2		
Family: Chloroperlidae	nympg (dam./juv.)					1			1								2							
Suwallia sp.	nymph		1	2		1	1		4	3	6				1	1			1	6	2	8	1	2
Family: Perlodidae	nymph (dam./juv.)	17	5	4	3	9	2	1	2	4				4		3		1				5	2	6
Skwala sp.	nymph			1															1					
Isoperla sp.	nymph										3													
Megarcys sp.	nymph																							
Family: Nemouridae	nymph (dam./juv.)																							
Podmosta sp.	nymph						1	28	11	6	13													
Ostrocerca sp.	nymph										1													
Zapada oregonensis/haysi	nymph							1				1					1					2		
Family: Taeniopterygidae																								
Taenionema sp.	nymph			1				1		2		1												
Family: Capniidae	nymph (dam./juv.)	4	3	6	1	8	3	19	6	15	5	7	1	5	3	5	2	1	1	1		2		1
Capnia sp.	nymph																							
Order: Trichoptera	larvae (dam./juv.)					2																		
Family: Apataniidae																								
Apatania sp.	larvae																				1			
Family: Glossosomatidae																								
Glossosoma sp.	larvae			1				1						1										
Family: Limnephilidae	larvae (dam./juv.)	6	1	1				1							1			1	3	2		4		
Ecclisomyia sp.	larvae			1		3					1	1		5			3	2	1		1		2	
Hydratophylax/Pycnopsyche sp.	larvae																					1		
Family: Rhyacophilidae																								
Rhyacophila sp.	larvae																	1						
Order: Diptera UID	larvae	1	1	1	1	3		3	2		2		9	4	2	3	2	2		4	3	4	3	3
Order: Diptera UID	pupae	3	2			3	1		3															
Family: Muscidae	larvae (juv./dam.)									1												1		
Family: Ceratopogonidae																								
Bezzia/Metachela sp.	larvae																							
Family: Tipulidae	larvae (juv./dam.)			1					1			1												1
Tipula sp.	larvae	1	2					1											1				1	
Limonia sp.	larvae		1																					
Dicranota sp.	larvae							1												1		1		
Family: Psychodidae UID	larvae													2										
Pericoma sp.	larvae	1		2		1												1	2		1		1	2
Family: Empididae	larvae (juv.)	1																				1		
Chelifera/Metachela sp.	larvae	1	1				1	1						1			4	2		1			3	1
Clinocera sp.	larvae																							
Family: Simuliidae	pupae					2	2	3		1		1	1	2	2							1	1	
Simulium sp.	larvae																							

Appendix B9. Benthic Invertebrate Taxonomy, Casino Project, September 2008

	Sample ID:	B1-1	B1-2	B1-3	B1-4	B1-5	B2-1	B2-2	B2-3	B2-4	B2-5	B3-1	B3-2	B3-3	B3-4	B3-5	B4-1	B4-2	B4-3	B4-4	B4-5	B5-1	B5-2	B5-3
	CC#:	080450	080451	080452	080453	080454	080455	080456	080457	080458	080459	080460	080461	080462	080463	080464	080465	080466	080467	080468	080469	080470	080471	080472
Prosimulium sp.	larvae						2	3	1	3	1	2		3						1				1
Family: Chironomidae	larvae																							
Family: Chironomidae	pupae		2	3		4	5	2		1			6	13	12	5	2	4					2	2
Subfamily : Orthocladiinae	larvae											1	1											
Cricotopus/Orthocladius sp.	larvae	2	1				1		2		2			4	2							3		4
Eukiefferiella sp.	larvae			8	2	5	11	4		11	7			6	6		3					11	2	2
Hydrobaenus sp.	larvae																							
Parasmittia sp.	larvae											3												
Metriocnemus sp.	larvae																							
Tvetenia sp.	larvae			2	1	2	2	6	3	5	4				2									
Subfamily : Diamesinae	larvae																							
Diamesa sp.	larvae	14	5	40	4	7	25	65	36	53	46	32	21	11	10	24	4	4			2	15	3	
Pseudodiamesa sp.	larvae					1				1								1						
Pagastia sp.	larvae	2	2	8		4	4	3	8	3	1	5	2	15	4	4				3		6	3	
Potthastia sp.	larvae																							
Subfamily : Chironominae	larvae																							
Tribelos sp.	larvae												1											
Subfamily : Tanypodinae	larvae													1										
Subfamily : Podonominae	larvae																							
Trichotanypus sp.	larvae																						1	
Order: Coleoptera																								
Family: Dytiscidae	larvae (juv./dam.)															1								1
Family: Curculionidae	adult																					1		
Order: Lepidoptera	larvae								1		1		1					1						
Order: Collembola	larvae	3	1				2	1	1	2		3	4	3	3					1		1		1
Class: Crustacea																								
Order: Ostracoda			1				1		1			1	1		1							2	1	1
Order: Copepoda				3						2			2	1			1	1		1		5		2
Order: Cladocera								1					2		1							1		
Order: Bivalvia													1											
Order: Gastropoda																								
Family: Hydrobiidae								1																
Phylum: Annelida																								
Class: Oligochaeta				3					1			1		1	1			7					1	1
Family: Lumbriculidae			20		2	6		1					3				13	2		3	2	9		
Phylum: Nematoda			1	3		3							1				1	1				3		
Order: Prostigmata UID	adult																1					1	1	2
Order: Prostigmata	deutonymph		1												1		1							
Family: Hydrozetidae	adult	1		2	1	2	3	2	3			1	2	2			1	1	1	2	1	5	1	3
Family: Aturidae																								
Aturus	adult																					2		
Family: Hygrobatidae																								
Hygrobates	adult																2	1		1		4	1	1
Family: Limnesiidae																								
Limnesia	adult																							
Family: Sperchontidae																								
Sperchon	adult									1													1	
Family: Lebertiidae																								
Lebertia	adult							1				1		1	1						1			1
Family: Feltridae																								
Feltria	adult			1					2	2		1									1			1
TOTAL NUMBER		**71**	**56**	**108**	**17**	**86**	**92**	**169**	**149**	**164**	**147**	**123**	**71**	**118**	**64**	**73**	**45**	**40**	**12**	**35**	**19**	**159**	**40**	**57**
DENSITY (no. org./m^2)		**763**	**602**	**1,161**	**183**	**925**	**989**	**1,817**	**1,602**	**1,763**	**1,581**	**1,323**	**763**	**1,269**	**688**	**785**	**484**	**430**	**129**	**376**	**204**	**1,710**	**430**	**613**

Notes:

juv. = juvenile, dam. = damaged

Appendix B9. Benthic Invertebrate T

	Sample ID:	B5-4	B5-5	B7-1	B7-2	B7-3	B7-4	B7-5	B8-1	B8-2	B8-3	B8-4	B8-5
	CC#:	080473	080474	080475	080476	080477	080478	080479	080480	080481	080482	080483	080484
Order: Ephemeroptera	adult								1				
Order: Ephemeroptera	nymph (dam./juv.)	2	1										
Family: Ameletidae													
Ameletus sp.	nymph								3	2	1	2	3
Family: Baetidae	nymph (dam./juv.)		1										
Baetis sp.	nymph	2	3										
Baetis bicaudatus	nymph	1	8									2	
Baetis tricaudatus	nymph												
Acentrella sp.	nymph	2											
Family: Heptageniidae	nymph	2	4		1		1	1	106	21	85	46	29
Cinygmula sp.	nymph	1	3						4	1	2	1	2
Epeorus sp.	nymph	6	5										
Family: Ephemerellidae	nymph	1	1										
Serratella sp.	nymph												
Ephemerella sp.	nymph												
Drunella sp.	nymph												
Drunella doddsi	nymph		1										
Drunella coloradensis	nymph												
Order: Plecoptera	adult												
Order: Plecoptera	nymph (dam./juv.)	1	1	1				7	9	5	11	9	3
Family: Chloroperlidae	nympg (dam./juv.)			3			3	7					
Suwallia sp.	nymph	3	3	2		1		1					
Family: Perlodidae	nymph (dam./juv.)	3	3	6	4	1	3	1					
Skwala sp.	nymph							1	1			1	2
Isoperla sp.	nymph												
Megarcys sp.	nymph										5	2	
Family: Nemouridae	nymph (dam./juv.)							1	4	6	19	8	7
Podmosta sp.	nymph								9	15	13	20	15
Ostrocerca sp.	nymph										4	3	
Zapada oregonensis/haysi	nymph	2											
Family: Taeniopterygidae													
Taenionema sp.	nymph												
Family: Capniidae	nymph (dam./juv.)	1	2			1		2	48	37	53	36	42
Capnia sp.	nymph											1	
Order: Trichoptera	larvae (dam./juv.)												
Family: Apataniidae													
Apatania sp.	larvae												
Family: Glossosomatidae													
Glossosoma sp.	larvae												
Family: Limnephilidae	larvae (dam./juv.)	2											
Ecclisomyia sp.	larvae		4									2	1
Hydratophylax/Pycnopsyche sp.	larvae												
Family: Rhyacophilidae													
Rhyacophila sp.	larvae												
Order: Diptera UID	larvae	6	5	1				2			1		
Order: Diptera UID	pupae	1											
Family: Muscidae	larvae (juv./dam.)												
Family: Ceratopogonidae													
Bezzia/Metachela sp.	larvae				2		2						
Family: Tipulidae	larvae (juv./dam.)												
Tipula sp.	larvae								3			1	2
Limonia sp.	larvae												
Dicranota sp.	larvae								1			1	
Family: Psychodidae UID	larvae												
Pericoma sp.	larvae	1											
Family: Empididae	larvae (juv.)									1			
Chelifera/Metachela sp.	larvae										1	2	3
Clinocera sp.	larvae	1							2	1	1	5	1
Family: Simuliidae	pupae	1			1				1	1	1	3	
Simulium sp.	larvae										1		

Appendix B9. Benthic Invertebrate T

	Sample ID:	B5-4	B5-5	B7-1	B7-2	B7-3	B7-4	B7-5	B8-1	B8-2	B8-3	B8-4	B8-5
	CC#:	080473	080474	080475	080476	080477	080478	080479	080480	080481	080482	080483	080484
Prosimulium sp.	larvae	1	1					1	1		3	1	1
Family: Chironomidae	larvae												
Family: Chironomidae	pupae		3			1				3	12	11	5
Subfamily : Orthocladiinae	larvae												
Cricotopus/Orthocladius sp.	larvae	5	5						27	2			
Eukiefferiella sp.	larvae	3							16	12	87	23	45
Hydrobaenus sp.	larvae								1				
Parasmittia sp.	larvae												
Metriocnemus sp.	larvae	1											
Tvetenia sp.	larvae												
Subfamily : Diamesinae	larvae												
Diamesa sp.	larvae			16	10	2	6	13	17		125	66	67
Pseudodiamesa sp.	larvae												
Pagastia sp.	larvae	9	6						6				
Potthastia sp.	larvae		1										
Subfamily : Chironominae	larvae												
Tribelos sp.	larvae												
Subfamily : Tanypodinae	larvae												
Subfamily : Podonominae	larvae												
Trichotanypus sp.	larvae								1				
Order: Coleoptera													
Family: Dytiscidae	larvae (juv./dam.)												
Family: Curculionidae	adult												
Order: Lepidoptera	larvae	1						1					
Order: Collembola	larvae	1		2	3	10	11	2	4	4	23	3	5
Class: Crustacea													
Order: Ostracoda		1							2	2	1		
Order: Copepoda		1	1									1	
Order: Cladocera													
Order: Bivalvia													
Order: Gastropoda													
Family: Hydrobiidae													
Phylum: Annelida													
Class: Oligochaeta					1								
Family: Lumbriculidae							2	1	139	34	60	151	78
Phylum: Nematoda			1				6	2	3		1	1	2
Order: Prostigmata UID	adult			1									
Order: Prostigmata	deutonymph				1								
Family: Hydrozetidae	adult	3	3		3	1	1	1	1		2	2	1
Family: Aturidae													
Aturus	adult												
Family: Hygrobatidae													
Hygrobates	adult	4	1										
Family: Limnesiidae													
Limnesia	adult								1				
Family: Sperchontidae													
Sperchon	adult												
Family: Lebertiidae													
Lebertia	adult	1											
Family: Feltridae													
Feltria	adult				1						4		
TOTAL NUMBER		**70**	**67**	**32**	**27**	**17**	**35**	**44**	**410**	**147**	**516**	**404**	**314**
DENSITY (no. org./m^2)		**753**	**720**	**344**	**290**	**183**	**376**	**473**	**4,409**	**1,581**	**5,548**	**4,344**	**3,376**

Notes:

juv. = juvenile, dam. = damaged

B10. FISS Reports for Watersheds of the Aquatic Regional Study Area of the Casino Project

FISS Search Results

Fisheries and Oceans Canada | Pêches et Océans Canada

REFERENCE INFORMATION			
Waterbody Names			
Gazetteer Name:	BRITANNIA CREEK	Alias1:	
		Alias2:	
Waterbody Codes			
Watershed code:	800787800000000000000000000000000000		
SISS/RAB code:	603769000000000000	Lake Seq. No.:	0
Confluence Information			
Map No:		Confluence ID:	
	Zone:	7	
Easting:	6179	Northing:	69735
Comments			
FLOWS NE AND N INTO YUKON R., YUKON TERRITORY. DRAINAGE BASIN AREA =115KM SQUARE.			

STREAM INFORMATION				
MapNo	**ID**	**Station**	**Reference**	**Mean Annual Runoff**

PROVINCIAL FISHERIES MANAGEMENT OBJECTIVES		
Habitat Type	Mgmt Obj.1	Mgmt Obj.2

ENHANCEMENT AND MANAGEMENT ACTIVITIES								
MapNo	**ID**	**Type**	**Activity**	**Project**	**Start**	**Finish**	**Species**	**Reference**

		W	M				SA			800001
			THE LOWER SECTION OF THIS CREEK IS CLASSIFIED AS TYPE II - SALMONID REARING STREAM, BY THE YUKON PLACER AUTHORIZATION. THE REST OF THE WATERSHED IS CLASSIFIED AS TYPE IV							
115J15	5	U	MA		93		SA			800001
			YPA TYPE II							
115J15	6	U	MA		93					800001
115J15	5	D	YPA TYPE IV							
115J15	17	P	MSB	94	94					110121
			TEMPERATURE AND TDS DATA. NO FISH CAPTURED. NOTICEABLY NAIVE ARTIC GRAYLING AND ROUND WHITEFISH OBSERVED							
115J15	18	P	MSB	94	94					110121
			TEMPERATURE AND TDS DATA. NO FISH CAPTURED. ARCTIC GRAYLING OBSERVED DOWNSTREAM OF STATION							
		W	MSS	93	93	GR	WF	CH		110121
			FISH SCALE AGING RESULTS FOR THE CASINO PROJECT - FISHERIES ASSESSMENT PART 1. JUNE 1993							
		W	MSS							80092
			CASINO PROJECT ENVIRONMENTAL MONITORING PROGRAM - ELECTROFISHING AND MINNOW TRAPS. JUNE, AUGUST, AND SEPTEMBER 1993							830006
		W	MSB	00	00	CH				110121
			AERIAL SURVEY-1 ADULT CHINOOK CARCASS FOUND (AUGUST-2000)							
		W	MSS	00	00	CH				110121
			MINNOW TRAPPING- JUVENILE CHINOOK CAPTURED (JULY 2000							
		W	MSS	93	93	GR	CH	WF		110121
			CASINO PROJECT SAMPLING DATA-AGE/ SPECIES							

RESOURCE USE INFORMATION										
MapNo	ID	Type	Code	Catch Mean	High	Low	Effort Mean	High	Low	Reference

FISHERIES POTENTIAL AND CONSTRAINTS							
MapNo	ID	Type	Activity	P	L	Species	Reference
		W	WC	G			110121
			PHOTOGRAPH SHOWING WATER COLOUR AND TURBIDITY RESULTS OF MINING				
115J15	2004	P	W	G			80092
			CASINO PROJECT ENVIRONMENTAL MONITORING PROGRAM INITIATED SAMPLING HERE IN JUNE 1993				
115J15	19	P	W	G			80092
			CASINO PROJECT ENVIRONMENTAL MONITORING PROGRAM INITATED SAMPLING HERE IN JUNE 1993				
		W	W	G			830006
			AERIAL PHOTGRAPHS OF CREEK				
115J15	25	U	WDP	C		SA	110121
			AUGUST 2000. A PLACER OPERATION ON CANADIAN CREEK WAS DISCHARGING UNSETTLED, TURBID EFFLUENT INTO BRITTANIA CREEK, DETRIMENTAL TO HATCHED SALMON FRY.				
		W	HS	P		CH	110121
			AUGUST 17, 2000. SINGLE DEAD SALMON CARCASS OBSERVED AT CREEK OUTLET. NUMEROUS JUVENILE CHINOOK WERE CAPTURED IN JULY 2000 MINNOW TRAPS. ADULT CHINOOK SALMON ARE UTILIZING THE CREEK AS A SPAWNING AREA.				

OBSTRUCTIONS							

MapNo	ID	Type	OBS	Height	Length	Species Blocked	Reference

LAND USE

MapNo	ID	Type	Land Use	Start Date	Reference
		W	MI		11057
			UPPER WATERSHED EXTENSIVELY PLACER MINED. EXTENSIVE QUARTZ MINING EXPLORATION IN THE UPPER WATERSHED		
		W	PM		110121
			PHOTOGRAPH SHOWING RESLTS OF MINING		
		W	RD		830006
			1994 - ACCESS ROAD TO CASINO MINE SITE RUNS ALONG BRITANNIA CREEK FROM THE YUKON RIVER		

VALUE COMMENTS

MapNo	ID	Type	Value Code	Reference

SENSITIVITY COMMENTS

MapNo	ID	Type	Sensitivity Code	Reference

SPECIES / STOCK IDENTIFICATION

Species	Char	Stock	Stock Type	Mgmt Class
CH				
GR				
RW				
SA				

FISH DISTRIBUTION

MapNo	ID	Species	Type	Activity	Reference
		CH	W	REA	110121
				FRY REARING IN THIS STREAM	
		GR	W	OBL	110121
				PRESENCE NOTED	
115J15	18	RW	P	OBL	110121
				FISH NOTICEABLY NAIVE; ALLOWED APPROACH TO WITHIN 2 - 0.5 M. THIS IS NOT NORMAL	
115J15	5	SA	U	REA	800001
115J15	17	GR	P	OBL	110121
				LARGE CONGREGATION OF GRAYLING OBSERVED. FISH NOTICEABLY NAIVE; ALLOWED APPROACH TO WITHIN 2 - .5 M	
115J15	20	GR	P	OBL	830006
				PRELIMINARY ASSESSMENT OF FISHERIES - ELECTROFISHING DATA: LENGTH, WEIGHT AND AGE OF CAPTURED FISH (CASINO MINE PROJECT)	
115J15	21	GR	P	OBL	830006
				PRELIMINARY ASSESSMENT OF FISHEREIES - ELECTROFISHING DATA: LENGTH, WEIGHT AND AGE OF CAPTURED FISH (CASINO MINE PROJECT)	
115J15	2004	CH	P	OBL	110121
				1 ADULT CHINOOK CARCASS OBSERVED (AUGUST 2000)	
		CH	W	OBL	110121
				NUMEROUS JUVENILE CHINOOK SALMON CAPTURED (JULY 2000)	

FISS Search Results

Fisheries and Oceans Canada | Pêches et Océans Canada

REFERENCE INFORMATION			
Waterbody Names			
Gazetteer Name:	CANADIAN CREEK	Alias1:	
		Alias2:	
Waterbody Codes			
Watershed code:	800787850000000000000000000000000000		
SISS/RAB code:		Lake Seq. No.:	0
Confluence Information			
Map No:		Confluence ID:	
	Zone:		
Easting:		Northing:	
Comments			
TRIBUTARY TO BRITTANICA			

STREAM INFORMATION				
MapNo	**ID**	**Station**	**Reference**	**Mean Annual Runoff**

PROVINCIAL FISHERIES MANAGEMENT OBJECTIVES		
Habitat Type	Mgmt Obj.1	Mgmt Obj.2

ENHANCEMENT AND MANAGEMENT ACTIVITIES								
MapNo	**ID**	**Type**	**Activity**	**Project**	**Start**	**Finish**	**Species**	**Reference**

W	MA		93			800001
	YPA TYPE IV					
W	MSS	93	93	GR		110121
	FISH SCALE AGING RESULTS FOR THE CASINO PROJECT - FISHERIES ASSESSMENT PART 1. JUNE 1993					
W	MSS	93	93			80092
	CASINO PROJECT ENVIRONMENTAL MONITORING PROGRAM - ELECTROFISHING AND MINNOW TRAPS: JUNE, AUG. AND SEPT. 1993					830006

RESOURCE USE INFORMATION

MapNo	ID	Type	Code	Catch Mean	High	Low	Effort Mean	High	Low	Reference

FISHERIES POTENTIAL AND CONSTRAINTS

MapNo	ID	Type	Activity	P	L	Species	Reference
115J15	13	P	W	G			80092
			CASINO PROJECT ENVIRONMENTAL MONITORING PROGRAM INITIATED WATER SAMPLING HERE IN JUNE 1993				
115J15	14	P	W	G			80092
			CASINO PROJECT ENVIRONMENTAL MONITORING PROGRAM INITIATED WATER SAMPLING HERE IN JUNE 1993				
		W	H	G			830006
			AERIAL PHOTOGRAPHS OF CREEK				

OBSTRUCTIONS

MapNo	ID	Type	OBS	Height	Length	Species Blocked	Reference

LAND USE

MapNo	ID	Type	Land Use	Start Date	Reference
		W	MI		830006
			1993 - HEADWATERS IN CASINO MINE EXPLORATION SITE		

VALUE COMMENTS

MapNo	ID	Type	Value Code	Reference

SENSITIVITY COMMENTS

MapNo	ID	Type	Sensitivity Code	Reference

SPECIES / STOCK IDENTIFICATION

Species	Char	Stock	Stock Type	Mgmt Class
GR				

FISH DISTRIBUTION

MapNo	ID	Species	Type	Activity	Reference
115J15	13	GR	P	OBL	830006
				PRELIMINARY ASSESSMENT OF FISHERIES - CASINO MINE PROJECT. ELCTROFISHING DATA: LENGTH, AGE, EFFORT	

Return to the search screen.

FISS Search Results

Fisheries and Oceans Canada | Pêches et Océans Canada

REFERENCE INFORMATION			
Waterbody Names			
Gazetteer Name:	CASINO CREEK	Alias1:	
		Alias2:	
Waterbody Codes			
Watershed code:	843102510971100000000000000000000000		
SISS/RAB code:		Lake Seq. No.:	0
Confluence Information			
Map No:		Confluence ID:	
	Zone:		
Easting:		Northing:	
Comments			
TRIBUTARY OF DIP CREEK WHICH DRAINS INTO KLOTTASIN, THEN DONJEK R. AND INTO WHITE RIVER			

STREAM INFORMATION				
MapNo	**ID**	**Station**	**Reference**	**Mean Annual Runoff**

PROVINCIAL FISHERIES MANAGEMENT OBJECTIVES		
Habitat Type	Mgmt Obj.1	Mgmt Obj.2

ENHANCEMENT AND MANAGEMENT ACTIVITIES								
MapNo	**ID**	**Type**	**Activity**	**Project**	**Start**	**Finish**	**Species**	**Reference**

115J10	6	P	MSS	93	93	GR	CCG	13085
			HABITAT CHARACTERISTICS; ELECTROFISHING; CALCULATED WATER FLOW; METAL ANALYSIS SAMPLES (GR). JUNE					
115J10	7	P	MSS	93	93	GR		13085
			HABITAT; ELECTROFISHING; STOP NETS; CALCULATED WATER FLOW. AGING, METAL ANALYSIS SAMPLES. JUNE					
115J10	9	P	MSS	93	93	NF		13085
			HABITAT; ELECTROFISHING. JUNE.					
115J10	6	P	MSS	93	93	GR	CCG	13086
			STOPNETS, ELECTROSHOCKING; MINNOW TRAPS (3). AUGUST.					
115J10	7	P	MSS	93	93	GR	CCG	13086
			STOPNETS; ELECTROSHOCKING; MINNOW TRAPS (3). AUGUST.					
115J10	8	P	MSS	93	93	NF		13086
			ELECTROSHOCKING; MINNOW TRAPS (3). AUGUST.					
115J16	6	P	MSS	93	93	GR	CCG	13087
			STOPNETS, ELECTROSHOCKING; MINNOW TRAPS (3); PHYSICAL CHARACTERISTICS. SEPTEMBER.					
115J10	8	P	MSS	93	93	NF		13087
			ELECTROFISHING; MINNOW TRAPS (3) PHYSICAL CHARACTGERISTICS. SEPTEMBER.					
115J10	7	P	MS	93	93	GR	CCG	13087
			STOPNETS, ELECTROSHOCKING; MINNOW TRAPS (3) PHYSICAL CHARACTERISTICS. SEPTEMBER.					
		W	MSS	93	93	GR		110121
			FISH SCALE AGING RESULTS FOR THE CASINO PROJECT - FISHERIES ASSESSMENT PART I. JUNE 1993.					
		W	MSS	93	93			80092
			CASINO PROJECT ENVIRONMENTAL MONITORING PROGRAM - ELECTROFISHING AND MINNOW TRAPS.					830006

JUNE, AUGUST AND SEPTEMBER 1993.

RESOURCE USE INFORMATION										
MapNo	ID	Type	Code	Catch Mean	High	Low	Effort Mean	High	Low	Reference

FISHERIES POTENTIAL AND CONSTRAINTS							
MapNo	ID	Type	Activity	P	L	Species	Reference
115J10	6	P	W	G			80092
			CASINO PROJECT ENVIRONMENTAL MONITORING PROGRAM WATER QUALITY SAMPLING INITIATED HERE JUNE 1993.				
115J10	14	P	W	G			80092
			CASINO PROJECT ENVIRONMENTAL MONITORING PROGRAM WATER QUALITY SAMPLING INITIATED HERE JUNE 1993.				
		W	H	G			830006
			AERIAL PHOTOGRAPHS OF CREEK				

OBSTRUCTIONS							
MapNo	ID	Type	OBS	Height	Length	Species Blocked	Reference

LAND USE					
MapNo	ID	Type	Land Use	Start Date	Reference
		W	MI	1993-01-01 00:00:00.0	830006
			HEADWATERS IN CASINO MINE EXPLORATION SITE.		

VALUE COMMENTS

MapNo	ID	Type	Value Code	Reference

SENSITIVITY COMMENTS

MapNo	ID	Type	Sensitivity Code	Reference

SPECIES / STOCK IDENTIFICATION

Species	Char	Stock	Stock Type	Mgmt Class
GR				
GR	RS			
CCG	RS			

FISH DISTRIBUTION

MapNo	ID	Species	Type	Activity	Reference
115J10	6	CCG	P	OBL	13085
					13086
115J10	7	CCG	P	OBL	13087
115J10	6	GR	P	OBL	830006
				PRELIMINARY ASSESSMENT OF FISHERIES - CASINO MINE PROJECT - ELECTROFISHING DATA: EFFORT, LENGTH, AGE, WEIGHT.	
115J10	7	GR	P	OBL	830006
				PRELIMINARY ASSESSMENT OF FISHERIES - CASINO MINE PROJECT. ELECTROFISHING DATA: EFFORT, LENGTH, AGE, WEIGHT.	
115J10	6	GR	P	OBL	13085
				METAL ANALYSIS SAMPLES TAKEN; SOME GR SHOWED EVIDENCE OF GILL LICE.	

115J10	7	GR	P	OBL	13085
				METAL ANALYSIS SAMPLES; AGING.	
115J10	6	GR	P	OBL	13086
				LENGTH/WEIGHT MEASUREMENTS; SCALES TAKEN FOR AGING; EVIDENCE OF GILL LICE.	13087
115J10	7	GR	P	OBL	13086
				LENGTH/WEIGHT MEASUREMENTS; SCALES TAKEN FOR AGING.	13087

Return to the search screen.

FISS Search Results

Fisheries and Oceans Canada

Pêches et Océans Canada

REFERENCE INFORMATION			
Waterbody Names			
Gazetteer Name:	DIP CREEK	Alias1:	
		Alias2:	
Waterbody Codes			
Watershed code:	843102510900000000000000000000000000		
SISS/RAB code:		Lake Seq. No.:	0
Confluence Information			
Map No:		Confluence ID:	
	Zone:		
Easting:		Northing:	
Comments			
TRIBUTARY TO KLOTASSIN R.			

STREAM INFORMATION				
MapNo	**ID**	**Station**	**Reference**	**Mean Annual Runoff**
115J11	1		DFO0011	

PROVINCIAL FISHERIES MANAGEMENT OBJECTIVES				
Habitat Type	AR	Mgmt Obj.1	PR	Mgmt Obj.2

ENHANCEMENT AND MANAGEMENT ACTIVITIES

MapNo	ID	Type	Activity	Project	Start	Finish	Species			Reference
		W	MS		94	94				110121
			HELICOPTER SURVEY - HABITAT. SET UP STATIONS.							
115J11	1	P	MSS		94	94	CH	CCG	BB	110121
115J11	2	P	MSS		94	94	CCG			110121
115J10	1	P	MSS		94	94	CCG			110121
115J10	5	P	MSS		93	93	CCG			13085
			HABITAT CHARACTERISTICS; ELECTROFISHING. JUNE.							
115J10	5	P	MSS		93	93	CCG	GR		13086
			ELECTROFISHING, MINNOW TRAPS. AUGUST.							
115J10	5	P	MSS		93	93	CCG			13087
			ELECTROSHOCKING; MINNOW TRAPS (3). SEPTEMBER.							
115J10	17	P	MSS		93	93				80092
			CASINO PROJECT ENVIRONMENTAL MONITORING PROGRAM - ELECTROFISHING AND MINNOW TRAPS: JUNE, AUGUST AND SEPTEMBER, 1993.							830006
115J10	18	P	MSB		93	93				830006
			CASINO PROJECT ENVIRONMENTAL MONITORING PROGRAM - JUNE, AUGUST AND SEPTEMBER 1993. WATER QUALITY AND HYDROLOGY STATION.							80092
115J10	19	P	MSS		93	93				830006
			CASINO PROJECT ENVIRONMENTAL MONITORING PROGRAM - JUNE AUGUST AND SEPTEMBER 1993. WATER QUALITY STATION.							80092
		W	MS	YRP	98	98	CH			DFO0011
			IDENTIFY AREAS UTILIZED BY CHINOOK, PILOT SURVEY FOR FUTURE ENHANCEMENT AND RESTORATION							
115J11	3	P	MSS	YRP	98	98	CH			DFO0011
			2 MINNOW TRAPS SET							

RESOURCE USE INFORMATION

MapNo	ID	Type	Code	Catch Mean	High	Low	Effort Mean	High	Low	Reference

FISHERIES POTENTIAL AND CONSTRAINTS

MapNo	ID	Type	Activity	P	L	Species	Reference
115J10	18	P	W	G			80092
			CASINO PROJECT ENVIRONMENTAL MONITORING PROGRAM WATE QUALITY SAMPLING INITIATED HERE JUNE 1993.				
115J10	19	P	W	G			80092
			CASINO PROJECT ENVIRONMENTAL MONITORING PROGRAM WATER QUALITY SAMPLING INITIATED HERE JUNE 1993.				
		W	NS	G			830006
			AERIAL PHOTOGRAPHY OF CREEK.				
		W	FAN	G		CH	DFO0011
			DIFFICULT TO REACH BY BOAT OR HELICOPTER				
		W	EHS	P	M	CH	DFO0011
			ALTHOUGH RESULTS OF TRAPPING INDICATED FEW JUVINILE CHINOOK, SCHOOLS WERE SEEN IN AREA BUT RELUCTANT TO ENTER TRAPS				

OBSTRUCTIONS

MapNo	ID	Type	OBS	Height	Length	Species Blocked	Reference

LAND USE

MapNo	ID	Type	Land Use	Start Date	Reference

115J11	0001	P	PM	800001
			STREAM CLASSIFICATION.	

VALUE COMMENTS

MapNo	ID	Type	Value Code	Reference

SENSITIVITY COMMENTS

MapNo	ID	Type	Sensitivity Code	Reference
115J11	0002	P	HAB	110121
			CH REARING.	

SPECIES / STOCK IDENTIFICATION

Species	Char	Stock	Stock Type	Mgmt Class
CH	AN			
GR				
BB	RS			
GR	RS			
CCG	RS			
RW				WI
BB				WI

FISH DISTRIBUTION

MapNo	ID	Species	Type	Activity	Reference
115J11	1	BB	P	OBL	110121
115J11	2	BB	P	OBL	110121

115J11	1	CCG	P	OBL	110121
115J10	5	CCG	P	OBL	13085
					13086
115J10	5	CCG	P	OBL	13087
115J11	2	CH	P	REA	110121
		CH	W	REA	110121
				NO CHINOOK SPAWNING IN 1993.	
115J10	17	GR	P	OBL	830006
				PRELIMINARY ASSESSMENT OF FISHERIES - CASINO MINE PROJECT, ELECTROFISHING DATA: LENGTH, WEIGHT, AGE, EFFORT.	
115J10	5	GR	P	OBL	13086
				WEIGHT, LENGTH MEASUREMENTS; SCALES TAKEN FOR AGING.	
115J11	3	CH	P	OBL	DFO0011
				2 MINNOW TRAPS SET (JULY 9, 1998) 1 JUVINILE CHINOOK CAUGHT	
115J11	3	RW	P	OBL	DFO0011
				2 MINNOW TRAPS SET (JULY 9, 1998) 24 FISH CAUGHT	
115J11	3	BB	P	OBL	DFO0011
				2 MINNOW TRAPS SET (JULY 9, 1998) 1 FISH CAUGHT	
115J11	6	CH	P	OBL	110121
				1 ADULT CHINOOK OBSERVED AND SAMPLED	
		CH	W	OBL	110121
				A PAIR OF ADULT CHINOOK OBSERVED	

FISS Search Results

Fisheries and Oceans Canada

Pêches et Océans Canada

REFERENCE INFORMATION			
Waterbody Names			
Gazetteer Name:	EXCELSIOR CREEK	Alias1:	
		Alias2:	
Waterbody Codes			
Watershed code:	800782700000000000000000000000000000		
SISS/RAB code:	603619000000000000000	Lake Seq. No.:	0
Confluence Information			
Map No:		Confluence ID:	
	Zone:	7	
Easting:	6040	Northing:	69742
Comments			
FLOWS NE INTO YUKON R., YUKON TERRITORY			

STREAM INFORMATION				
MapNo	**ID**	**Station**	**Reference**	**Mean Annual Runoff**

PROVINCIAL FISHERIES MANAGEMENT OBJECTIVES		
Habitat Type	Mgmt Obj.1	Mgmt Obj.2

ENHANCEMENT AND MANAGEMENT ACTIVITIES								
MapNo	**ID**	**Type**	**Activity**	**Project**	**Start**	**Finish**	**Species**	**Reference**

	W	M				SA		800001
		THE LOWER END OF THIS CREEK IS CLASSIFIED AS TYPE II - SALMONID REARING STREAM, BY THE YUKON PLACER AUTHORIZATION						
115J15	2	U	MA		93	SA		800001
		YPA TYPE II						

RESOURCE USE INFORMATION										
MapNo	ID	Type	Code	Catch Mean	High	Low	Effort Mean	High	Low	Reference

FISHERIES POTENTIAL AND CONSTRAINTS							
MapNo	ID	Type	Activity	P	L	Species	Reference

OBSTRUCTIONS							
MapNo	ID	Type	OBS	Height	Length	Species Blocked	Reference

LAND USE					
MapNo	ID	Type	Land Use	Start Date	Reference

VALUE COMMENTS				
MapNo	ID	Type	Value Code	Reference

SENSITIVITY COMMENTS				
MapNo	ID	Type	Sensitivity Code	Reference

SPECIES / STOCK IDENTIFICATION				
Species	**Char**	**Stock**	**Stock Type**	**Mgmt Class**
CH				
SA				

FISH DISTRIBUTION					
MapNo	**ID**	**Species**	**Type**	**Activity**	**Reference**
		CH	W	UNC	11057
				SUSPECTED REARING IN THIS STREAM	
115J15	2	SA	U	REA	800001

Return to the search screen.

B11. Minnow Trapping Catch, Effort and CPUE, Casino Project, 2008

Appendix B11. Minnow Trapping Catch, Effort and CPUE, Casino Project, 2008

			Catch			CPUE (number/trap-day)		
Date	Site	Trap	ARGR	SLSC	Total	ARGR	SLSC	Total
11-Jul	F07	A	0	0	0	0	0	0
11-Jul	F07	B	0	0	0	0	0	0
11-Jul	F07	C	0	0	0	0	0	0
11-Jul	F09	A	0	0	0	0	0	0
11-Jul	F09	B	0	0	0	0	0	0
11-Jul	F09	C	0	0	0	0	0	0
11-Jul	F05	A	0	0	0	0	0	0
11-Jul	F05	B	0	0	0	0	0	0
11-Jul	F05	C	0	0	0	0	0	0
11-Jul	F01	A	0	0	0	0	0	0
11-Jul	F01	B	0	0	0	0	0	0
11-Jul	F01	C	0	0	0	0	0	0
11-Jul	F14	A	0	0	0	0	0	0
11-Jul	F14	B	0	0	0	0	0	0
11-Jul	F14	C	0	0	0	0	0	0
12-Sep	F14	A	0	0	0	0	0	0
12-Sep	F14	B	0	0	0	0	0	0
12-Sep	F11	A	0	0	0	0	0	0
12-Sep	F11	B	0	0	0	0	0	0
12-Sep	F08	A	0	0	0	0	0	0
12-Sep	F08	B	0	0	0	0	0	0

Note:

ARGR = Arctic grayling, SLSC = slimy sculpin and CPUE = catch-per-unit-effort.

All traps were soaked for one day.

B12. Electrofishing Effort, Catch and CPUE, Casino Project, 2008

Appendix B12. Electrofishing Effort, Catch and CPUE, Casino Project, 2008

Date	Site	Section Length (m)	Pass	Voltage	Effort (sec)	Catch ARGR	Catch SLSC	Catch Total	CPUE (number/100 sec) ARGR	CPUE (number/100 sec) SLSC	CPUE (number/100 sec) Total	Comments
8-Jul	F03	75	1	600	1,190	1	0	1	0.08	0.00	0.08	-
8-Jul	F03	75	2	750	834	0	0	0	0.00	0.00	0.00	Saw 1 ARGR (~150 mm long)
8-Jul	F03	38	3	750	269	1	0	1	0.37	0.00	0.37	Only half of section electrofished.
	sum				2,293	2	0	2	0.09	0.00	0.09	
8-Jul	F04	200	1	600	754	4	0	4	0.53	0.00	0.53	-
9-Jul	F07	75	1	600	476	0	0	0	0.00	0.00	0.00	-
9-Jul	F07	75	2	600	437	0	0	0	0.00	0.00	0.00	-
9-Jul	F07	75	3	600	420	0	0	0	0.00	0.00	0.00	-
	sum				1,333	0	0	0	0.00	0.00	0.00	
9-Jul	F08	75	1	550	447	1	0	1	0.22	0.00	0.22	-
9-Jul	F08	75	2	550	512	0	0	0	0.00	0.00	0.00	-
9-Jul	F08	75	3	550	419	1	0	1	0.24	0.00	0.24	-
	sum				1,378	2	0	2	0.15	0.00	0.15	
9-Jul	F09	168	1	550	340	0	0	0	0.00	0.00	0.00	-
9-Jul	F10	168	1	530	709	2	0	2	0.28	0.00	0.28	Saw 3 ARGR (~300 mm long)
9-Jul	F05	226	1	550	577	0	0	0	0.00	0.00	0.00	-
10-Jul	F11	220	1	550	1,591	0	0	0	0.00	0.00	0.00	-
10-Jul	F12	200	1	500	353	0	0	0	0.00	0.00	0.00	Section length was approximate.
10-Jul	F13	75	1	600	787	0	11	11	0.00	1.40	1.40	-
10-Jul	F13	75	2	600	600	0	8	8	0.00	1.33	1.33	-
10-Jul	F13	75	3	600	438	1	1	2	0.23	0.23	0.46	-
		sum			1,825	1	20	21	0.05	1.10	1.15	
10-Jul	F01	100	1	650	707	1	0	1	0.14	0.00	0.14	-
11-Jul	F01	100	1	550	707	0	0	0	0.00	0.00	0.00	-
12-Sep	F14		1	300	922	0	6	6	0.00	0.65	0.65	-
12-Sep	F11		1	360	1,377	0	1	1	0.00	0.07	0.07	One SLSC seen, but it escaped.
12-Sep	F08		1	300	523	0	0	0	0.00	0.00	0.00	-

Note:

ARGR = Arctic grayling, SLSC = slimy sculpin and CPUE = catch-per-unit-effort.

Dashes indiacte no data were available or no comments.

B13. Angling Catch, Casino Project, 2008

Appendix B13. Angling Catch, Casino Project, 2008

Date	Site	Catch ARGR	Catch SLSC	Total	Comments
10-Jul	F08	0	0	0	Observed 1 ARGR (~150 mm)
10-Jul	F14	1	0	1	Fish was not measured (~200 mm)

Note:

ARGR = Arctic grayling, SLSC = slimy sculpin.

B14. Fish Biological Characteristics, Casino Project, 2008

Appendix B14. Fish Biological Characteristics, Casino Project, 2008

Date	Watershed	Site	Gear	Fish ID	Species	Length (mm)	Weight (g)	Scales?	Age (year)	Tissue?	Comments
8-Jul	Britannia	F03	EF	1	ARGR	280	200+	No	-	No	Too heavy for balance.
8-Jul	Britannia	F03	EF	2	ARGR	190	200+	No	-	No	Too heavy for balance.
8-Jul	Britannia	F04	EF	3	ARGR	280	220.0	Yes	5	No	-
8-Jul	Britannia	F04	EF	4	ARGR	285	260.0	Yes	6	No	-
8-Jul	Britannia	F04	EF	5	ARGR	290	230.0	Yes	6	No	-
8-Jul	Britannia	F04	EF	6	ARGR	280	250.0	Yes	5	No	-
9-Jul	Casino	F08	EF	7	ARGR	185	71.6	Yes	3	No	-
9-Jul	Casino	F08	EF	8	ARGR	173	44.5	Yes	2	No	-
9-Jul	Casino	F10	EF	9	ARGR	293	230.0	Yes	6	No	-
9-Jul	Casino	F10	EF	10	ARGR	300	260.0	Yes	6	No	-
10-Jul	Casino	F13	EF	11	SLSC	120	19.3	No	-	No	-
10-Jul	Casino	F13	EF	12	SLSC	72	3.7	No	-	No	-
10-Jul	Casino	F13	EF	13	SLSC	70	3.2	No	-	No	-
10-Jul	Casino	F13	EF	14	SLSC	71	2.9	No	-	No	-
10-Jul	Casino	F13	EF	15	SLSC	71	4.1	No	-	No	-
10-Jul	Casino	F13	EF	16	SLSC	61	2.2	No	-	No	-
10-Jul	Casino	F13	EF	17	SLSC	120	12.5	No	-	Yes	-
10-Jul	Casino	F13	EF	18	SLSC	98	8.4	No	-	Yes	-
10-Jul	Casino	F13	EF	19	SLSC	71	3.4	No	-	Yes	-
10-Jul	Casino	F13	EF	20	SLSC	65	2.3	No	-	Yes	-
10-Jul	Casino	F13	EF	21	SLSC	65	2.9	No	-	Yes	-
10-Jul	Casino	F13	EF	22	ARGR	294	240.0	Yes	-	No	-
10-Jul	Casino	F13	EF	23	SLSC	129	18.1	No	-	No	-
10-Jul	Casino	F13	EF	24	SLSC	55	1.8	No	-	No	-
10-Jul	Casino	F13	EF	25	SLSC	79	4.5	No	-	No	-
10-Jul	Casino	F13	EF	26	SLSC	65	1.6	No	-	No	-
10-Jul	Casino	F13	EF	27	SLSC	75	4.4	No	-	No	-
10-Jul	Casino	F13	EF	28	SLSC	54	1.3	No	-	No	-
10-Jul	Casino	F13	EF	29	SLSC	65	2.0	No	-	No	-
10-Jul	Casino	F13	EF	30	SLSC	65	3.0	No	-	No	-
10-Jul	Casino	F13	EF	31	ARGR	220	130.0	Yes	2	No	-
10-Jul	Britannia	F01	EF	32	ARGR	274	200.0	Yes	6	No	-
10-Jul	Dip	F14	AN	33	ARGR	~200	-	No	-	No	-
12-Sep	Dip	F14	EF	34	SLSC	70	4.0	No	-	Yes	-
12-Sep	Dip	F14	EF	35	SLSC	80	4.7	No	-	Yes	-
12-Sep	Dip	F14	EF	36	SLSC	63	2.7	No	-	Yes	-
12-Sep	Dip	F14	EF	37	SLSC	42	1.0	No	-	No	-
12-Sep	Dip	F14	EF	38	SLSC	29	0.5	No	-	No	-
12-Sep	Dip	F14	EF	39	SLSC	38	0.8	No	-	No	-
12-Sep	Casino	F11	EF	40	SLSC	89	8.7	No	-	Yes	-

Notes:

EF = electrofishing, AN = angling, ARGR = Arctic grayling and SLSC = slimy sculpin.

B15. Fish Tissue Metal Concentrations, Casino Project, 2008

Analysis Report

REPORT ON: Amended Report - Analysis of Tissue Samples

REPORTED TO: Gartner Lee Limited
490-6400 Roberts St
Burnaby, BC
V5G 4C9

Att'n: Genevieve Martin

CHAIN OF CUSTODY: 188716
PROJECT NAME: Casino
PROJECT NUMBER: 80049

NUMBER OF SAMPLES: 5

REPORT DATE: December 11, 2008

DATE SUBMITTED: July 15, 2008

GROUP NUMBER: 90716049

SAMPLE TYPE: Tissue

NOTE: Results contained in this report refer only to the testing of samples as submitted. Other information is available on request.

TEST METHODS:

Mercury in Tissue - samples were digested using a nitric acid-hydrogen peroxide digestion procedure based on EPA Method 200.3. Analysis was performed using Cold Vapour Atomic Absorption Spectrophotometry or Cold Vapour Atomic Fluorescence Spectrophotometry.

Metals in Tissue - samples were digested using a nitric acid-hydrogen peroxide digestion procedure based on EPA Method 200.3. Analysis was performed using Inductively Coupled Argon Plasma Spectroscopy (ICP), or ICP Mass Spectrometry (ICP/MS).

COMMENTS:

Amended Report - This report supercedes final hard copy sent on August 6, 2008 via mail. The tissue results are based on a wet weight basis - not dry weight as indicated in the footnotes of the report. cjw December 11, 2008

TEST RESULTS:

(See following pages)

CANTEST LTD.

Anna Becalska, PhD
Coordinator, Trace Metals

4606 Canada Way, Burnaby, BC V5G 1K5
Tel: 604 734 7276 Fax: 604 731 2386

REPORTED TO: Gartner Lee Limited

REPORT DATE: December 11, 2008

GROUP NUMBER: 90716049

CANTEST

Metals Analysis in Tissue

CLIENT SAMPLE IDENTIFICATION:		F13 CCG-7	F13 CCG-8	F13 CCG-9	F13 CCG-10	
DATE SAMPLED:		Jul 10/08	Jul 10/08	Jul 10/08	Jul 10/08	DETECTION LIMIT
CANTEST ID:		807160139	807160141	807160142	807160145	
Aluminum	Al	43.7	23.3	23	9.8	0.5
Antimony	Sb	<	<	<	<	0.1
Arsenic	As	0.2	0.1	0.1	0.1	0.1
Barium	Ba	9.8	3.9	3.1	3.1	0.1
Beryllium	Be	<	<	<	<	0.02
Boron	B	<	<	<	<	2
Cadmium	Cd	0.24	0.07	0.06	0.04	0.02
Calcium	Ca	37400	15100	11300	12800	1
Chromium	Cr	0.1	<	<	<	0.1
Cobalt	Co	0.1	<	0.1	<	0.1
Copper	Cu	2.1	1.1	1.1	1.1	0.1
Iron	Fe	161	70	63	49	5
Lead	Pb	0.1	<	<	<	0.1
Magnesium	Mg	900	450	427	437	0.5
Manganese	Mn	17.9	8.1	10.3	5.8	0.1
Mercury	Hg	0.09	0.07	0.03	0.02	0.01
Molybdenum	Mo	<	<	<	<	0.1
Nickel	Ni	0.1	<	<	<	0.1
Phosphorus	P	22900	10300	8500	9470	0.5
Potassium	K	5860	3060	3190	3710	1
Selenium	Se	0.9	0.4	0.7	0.7	0.2
Silicon	Si	66	22	35	31	10
Silver	Ag	0.01	<	<	<	0.01
Sodium	Na	3360	1450	1420	1300	1
Strontium	Sr	52.4	23	16.8	24.1	0.05
Tellurium	Te	<	<	<	<	0.1
Thallium	Tl	<	<	<	<	0.02
Tin	Sn	<	<	<	<	0.1
Titanium	Ti	13.1	5.6	4.9	4.9	0.3
Uranium	U	0.29	0.11	0.05	<	0.04
Vanadium	V	0.8	<	<	<	0.5
Zinc	Zn	57.4	30.2	21.7	22.4	0.5
Zirconium	Zr	<	<	<	<	3

Results expressed as micrograms per gram, dry basis (µg/g)
< = Less than detection limit

4606 Canada Way, Burnaby, BC V5G 1K5
Tel: 604 734 7276 Fax: 604 731 2386

REPORTED TO: Gartner Lee Limited

REPORT DATE: December 11, 2008

GROUP NUMBER: 90716049

CANTEST

Metals Analysis in Tissue

CLIENT SAMPLE IDENTIFICATION:		F13 CCG-11	
DATE SAMPLED:		Jul 10/08	DETECTION LIMIT
CANTEST ID:		807160146	
Aluminum	Al	46.1	0.5
Antimony	Sb	<	0.1
Arsenic	As	0.1	0.1
Barium	Ba	3.9	0.1
Beryllium	Be	<	0.02
Boron	B	<	2
Cadmium	Cd	0.1	0.02
Calcium	Ca	10700	1
Chromium	Cr	<	0.1
Cobalt	Co	<	0.1
Copper	Cu	1.9	0.1
Iron	Fe	81	5
Lead	Pb	<	0.1
Magnesium	Mg	412	0.5
Manganese	Mn	7.8	0.1
Mercury	Hg	0.02	0.01
Molybdenum	Mo	<	0.1
Nickel	Ni	<	0.1
Phosphorus	P	8380	0.5
Potassium	K	3380	1
Selenium	Se	0.7	0.2
Silicon	Si	45	10
Silver	Ag	<	0.01
Sodium	Na	1350	1
Strontium	Sr	15.1	0.05
Tellurium	Te	<	0.1
Thallium	Tl	<	0.02
Tin	Sn	<	0.1
Titanium	Ti	6.2	0.3
Uranium	U	0.2	0.04
Vanadium	V	0.5	0.5
Zinc	Zn	25.8	0.5
Zirconium	Zr	<	3

Results expressed as micrograms per gram, dry basis (µg/g)
< = Less than detection limit

4606 Canada Way, Burnaby, BC V5G 1K5
Tel: 604 734 7276 Fax: 604 731 2386

REPORTED TO: Gartner Lee Limited

REPORT DATE: December 11, 2008

GROUP NUMBER: 90716049

CANTEST

Batch Quality Control for Dissolved Metals Analysis in Tissue (QC# 111086)

Parameter		Blank (ug/g)	Blank Limits	Duplicate (R.P.D.) 807160241	Duplicate Limits	Duplicate (R.P.D.) 807170051	Duplicate Limits
Aluminum	Al	< 0.5	0.2	-	-	-	-
Antimony	Sb	< 0.1	0.001	-	-	-	-
Arsenic	As	< 0.1	0.002	NC	20	-	-
Barium	Ba	< 0.1	0.001	-	-	-	-
Beryllium	Be	< 0.02	0.001	-	-	-	-
Boron	B	< 2	0.02	-	-	-	-
Cadmium	Cd	< 0.02	0.0004	NC	20	5.1	20
Calcium	Ca	< 1	0.3	6.1	20	-	-
Chromium	Cr	< 0.1	0.001	-	-	-	-
Cobalt	Co	< 0.1	0.001	-	-	-	-
Copper	Cu	< 0.1	0.001	PASS	20	-	-
Iron	Fe	< 5	0.05	NC	20	-	-
Lead	Pb	< 0.1	0.002	NC	20	NC	20
Magnesium	Mg	< 0.5	0.2	PASS	20	-	-
Manganese	Mn	< 0.1	0.01	NC	20	-	-
Molybdenum	Mo	< 0.1	0.002	-	-	-	-
Nickel	Ni	< 0.1	0.003	-	-	-	-
Phosphorus	P	< 0.5	0.1	2.6	20	-	-
Potassium	K	< 1	0.3	0	20	-	-
Selenium	Se	< 0.2	0.004	-	-	-	-
Silver	Ag	< 0.01	0.001	-	-	-	-
Sodium	Na	< 1	0.5	2.3	20	-	-
Strontium	Sr	< 0.05	0.002	-	-	-	-
Tellurium	Te	< 0.1	0.002	-	-	-	-
Thallium	Tl	< 0.02	0.002	-	-	-	-
Tin	Sn	< 0.1	0.01	-	-	-	-
Titanium	Ti	< 0.3	0.01	-	-	-	-
Uranium	U	< 0.04	0.002	-	-	-	-
Vanadium	V	< 0.5	0.002	-	-	-	-
Zinc	Zn	< 0.5	0.04	NC	20	-	-
Zirconium	Zr	< 3	0.04	-	-	-	-

ug/g = micrograms per gram, dry basis
R.P.D. = Relative Percent Difference
PASS = Duplicate sample results were in the range of one to five times the detection limit. R.P.D. calculation is not applicable in this range. Acceptance criteria is a maximum difference between the duplicates equivalent to the value of the detection limit.
NC = Not Calculated. Duplicate sample results were less than the detection limit. Relative Percent Difference calculation is not defined for analyte levels of less than detection limit.

4606 Canada Way, Burnaby, BC V5G 1K5
Tel: 604 734 7276 Fax: 604 731 2386

Batch Quality Control for Dissolved Metals Analysis in Tissue (QC# 111086)

Parameter		Duplicate (R.P.D.) 807170062	Duplicate Limits	NRC TORT-2, "Lobster Tissue" (% Recovery)	NRC TORT-2, "Lobster Tissue" Limits
Arsenic	As	-	-	87	66 - 113
Cadmium	Cd	0	20	88	63 - 118
Chromium	Cr	-	-	65	60 - 120
Cobalt	Co	-	-	78	60 - 120
Copper	Cu	-	-	87	60 - 120
Iron	Fe	-	-	90	60 - 120
Lead	Pb	NC	20	86	39 - 150
Manganese	Mn	-	-	87	60 - 120
Mercury	Hg	-	-	93	78 - 122
Molybdenum	Mo	-	-	95	60 - 120
Nickel	Ni	-	-	80	50 - 122
Selenium	Se	-	-	89	67 - 118
Strontium	Sr	-	-	93	60 - 120
Vanadium	V	-	-	116	60 - 120
Zinc	Zn	-	-	83	53 - 125

ug/g = micrograms per gram, dry basis
R.P.D. = Relative Percent Difference
NC = Not Calculated. Duplicate sample results were less than the detection limit. Relative Percent Difference calculation is not defined for analyte levels of less than detection limit.

4606 Canada Way, Burnaby, BC V5G 1K5
Tel: 604 734 7276 Fax: 604 731 2386

Instrument Quality Control for the Mercury Monitor (QC# 216250)

QC Type: Calibration Verification

Parameter	% Recovery	Limits
Mercury Hg	93	90 - 110

4606 Canada Way, Burnaby, BC V5G 1K5
Tel: 604 734 7276 Fax: 604 731 2386

Batch Quality Control Frequency Summary

Metals Plant Tissue Digestion (Batch# 111086)

QC Type	No. Samples
NRC TORT-2, "Lobster Tissue"	1
Blank	2
Duplicate	3
Batch Size	21

4606 Canada Way, Burnaby, BC V5G 1K5
Tel: 604 734 7276 Fax: 604 731 2386

Analysis Report

REPORT ON: Amended Report - Analysis of Tissue Samples

REPORTED TO: Gartner Lee Limited
490-6400 Roberts St
Burnaby, BC
V5G 4C9

Att'n: Genevieve Martin

CHAIN OF CUSTODY: 2106142
PROJECT NAME: Casino
PROJECT NUMBER: 80049

NUMBER OF SAMPLES: 4

REPORT DATE: December 11, 2008

DATE SUBMITTED: September 16, 2008

GROUP NUMBER: 90917022

SAMPLE TYPE: Tissue

NOTE: Results contained in this report refer only to the testing of samples as submitted. Other information is available on request.

TEST METHODS:

Mercury in Tissue - samples were digested using a nitric acid-hydrogen peroxide digestion procedure based on EPA Method 200.3. Analysis was performed using Cold Vapour Atomic Absorption Spectrophotometry or Cold Vapour Atomic Fluorescence Spectrophotometry.

Metals in Tissue - samples were digested using a nitric acid-hydrogen peroxide digestion procedure based on EPA Method 200.3. Analysis was performed using Inductively Coupled Argon Plasma Spectroscopy (ICP), or ICP Mass Spectrometry (ICP/MS).

COMMENTS:

Amended Report - This report supercedes final hard copy sent on October 15, 2008 via mail. The tissue results are based on a wet weight basis - not dry weight as indicated in the footnotes of the report. cjw December 11, 2008

TEST RESULTS:

(See following pages)

CANTEST LTD.

per Anna Becalska, PhD
Coordinator, Trace Metals

4606 Canada Way, Burnaby, BC V5G 1K5
Tel: 604 734 7276 Fax: 604 731 2386

REPORTED TO: Gartner Lee Limited

REPORT DATE: December 11, 2008

GROUP NUMBER: 90917022

CANTEST

Metals Analysis in Tissue

CLIENT SAMPLE IDENTIFICATION:		F14-1	F14-2	F14-3	F11-1	
DATE SAMPLED:		Sep 12/08	Sep 12/08	Sep 12/08	Sep 12/08	DETECTION LIMIT
CANTEST ID:		809170067	809170068	809170069	809170070	
Aluminum	Al	19.5	294	16.2	35.6	0.5
Antimony	Sb	<	<	<	<	0.1
Arsenic	As	0.1	0.3	0.1	0.1	0.1
Barium	Ba	3.2	7.3	3.1	1.2	0.1
Beryllium	Be	<	<	<	<	0.02
Boron	B	<	<	<	<	2
Cadmium	Cd	0.03	0.04	<	0.03	0.02
Calcium	Ca	9630	10100	8210	3760	1
Chromium	Cr	<	0.3	<	0.1	0.1
Cobalt	Co	<	0.3	<	<	0.1
Copper	Cu	1	1.1	0.9	0.9	0.1
Iron	Fe	51	693	51	71	5
Lead	Pb	<	0.3	<	<	0.1
Magnesium	Mg	363	486	360	295	0.5
Manganese	Mn	8.2	25.4	8.8	3.1	0.1
Mercury	Hg	0.032	0.038	0.034	0.027	0.01
Molybdenum	Mo	<	<	<	<	0.1
Nickel	Ni	<	0.3	<	<	0.1
Phosphorus	P	7450	7660	6610	4590	0.5
Potassium	K	3320	2670	2510	3320	1
Selenium	Se	0.8	0.7	0.7	1.1	0.2
Silicon	Si	41	64	49	38	10
Silver	Ag	<	<	<	<	0.01
Sodium	Na	1250	1260	1250	1090	1
Strontium	Sr	17.4	17	17.5	4.89	0.05
Tellurium	Te	<	<	<	<	0.1
Thallium	Tl	<	<	<	<	0.02
Tin	Sn	<	<	<	<	0.1
Titanium	Ti	4.2	24.6	3.9	3.7	0.3
Uranium	U	0.05	0.13	<	<	0.04
Vanadium	V	<	1.5	<	<	0.5
Zinc	Zn	21.6	28	21.2	19.2	0.5
Zirconium	Zr	<	<	<	<	3

Results expressed as micrograms per gram, dry basis (µg/g)
< = Less than detection limit

4606 Canada Way, Burnaby, BC V5G 1K5
Tel: 604 734 7276 Fax: 604 731 2386

REPORTED TO: Gartner Lee Limited

REPORT DATE: December 11, 2008

GROUP NUMBER: 90917022

CANTEST

Batch Quality Control for Dissolved Metals Analysis in Tissue (QC# 113690)

Parameter		Blank (ug/g)	Blank Limits	Duplicate (R.P.D.) 809170495	Duplicate Limits	Duplicate (R.P.D.) 809170515	Duplicate Limits
Aluminum	Al	< 0.5	0.2	8.6	20	4.2	20
Antimony	Sb	< 0.1	0.001	NC	20	NC	20
Arsenic	As	< 0.1	0.002	NC	20	PASS	20
Barium	Ba	< 0.1	0.001	0.2	20	2.1	20
Beryllium	Be	< 0.02	0.001	NC	20	NC	20
Boron	B	< 2	0.02	PASS	20	5.7	20
Cadmium	Cd	< 0.02	0.0004	PASS	20	PASS	20
Calcium	Ca	< 1	0.3	2.3	20	3.5	20
Chromium	Cr	< 0.1	0.001	0	20	11.8	20
Cobalt	Co	< 0.1	0.001	PASS	20	PASS	20
Copper	Cu	< 0.1	0.001	6.7	20	2.2	20
Iron	Fe	< 5	0.05	5.6	20	5	20
Lead	Pb	< 0.1	0.002	NC	20	PASS	20
Magnesium	Mg	< 0.5	0.2	5.6	20	2.1	20
Manganese	Mn	< 0.1	0.01	8.5	20	1	20
Molybdenum	Mo	< 0.1	0.002	0	20	0	20
Nickel	Ni	< 0.1	0.003	3.3	20	0	20
Phosphorus	P	< 0.5	0.1	3.5	20	0.5	20
Potassium	K	< 1	0.3	2.2	20	0.9	20
Selenium	Se	< 0.2	0.004	NC	20	PASS	20
Silver	Ag	< 0.01	0.001	NC	20	NC	20
Sodium	Na	< 1	0.5	11.8	20	8.7	20
Strontium	Sr	< 0.05	0.002	2.6	20	6.4	20
Tellurium	Te	< 0.1	0.002	NC	20	NC	20
Thallium	Tl	< 0.02	0.002	PASS	20	NC	20
Tin	Sn	< 0.1	0.01	NC	20	NC	20
Titanium	Ti	< 0.3	0.01	6.1	20	0	20
Uranium	U	< 0.04	0.002	NC	20	NC	20
Vanadium	V	< 0.5	0.002	NC	20	NC	20
Zinc	Zn	< 0.5	0.04	3.6	20	4.3	20
Zirconium	Zr	< 3	0.04	NC	20	NC	20

ug/g = micrograms per gram, dry basis
R.P.D. = Relative Percent Difference
PASS = Duplicate sample results were in the range of one to five times the detection limit. R.P.D. calculation is not applicable in this range. Acceptance criteria is a maximum difference between the duplicates equivalent to the value of the detection limit.
NC = Not Calculated. Duplicate sample results were less than the detection limit. Relative Percent Difference calculation is not defined for analyte levels of less than detection limit.

4606 Canada Way, Burnaby, BC V5G 1K5
Tel: 604 734 7276 Fax: 604 731 2386

REPORTED TO: Gartner Lee Limited

REPORT DATE: December 11, 2008

GROUP NUMBER: 90917022

CANTEST

Batch Quality Control for Dissolved Metals Analysis in Tissue (QC# 113690)

Parameter		Duplicate (R.P.D.) 809180212	Duplicate Limits	NIST1573a Tomato Leaves (% Recovery)	NIST1573a Tomato Leaves Limits	NRC TORT-2, "Lobster Tissue" (% Recovery)	NRC TORT-2, "Lobster Tissue" Limits
Aluminum	Al	-	-	32	7 - 91	-	-
Arsenic	As	-	-	195	80 - 283	88	66 - 113
Boron	B	-	-	96	62 - 142	-	-
Cadmium	Cd	-	-	79	30 - 124	89	63 - 118
Calcium	Ca	3.4	20	97	60 - 120	-	-
Chromium	Cr	-	-	50	28 - 97	75	60 - 120
Cobalt	Co	-	-	97	50 - 150	95	60 - 120
Copper	Cu	5.3	20	85	59 - 125	89	60 - 120
Iron	Fe	0.3	20	87	52 - 167	87	60 - 120
Lead	Pb	-	-	-	-	87	39 - 150
Magnesium	Mg	6	20	-	-	-	-
Manganese	Mn	6.2	20	101	62 - 131	88	60 - 120
Mercury	Hg	-	-	(*)	88.24 - 111.8	119	78 - 122
Molybdenum	Mo	-	-	-	-	94	60 - 120
Nickel	Ni	-	-	63	28 - 143	80	50 - 122
Phosphorus	P	9.6	20	110	60 - 120	-	-
Potassium	K	2.8	20	105	60 - 120	-	-
Selenium	Se	-	-	-	-	89	67 - 118
Sodium	Na	6.5	20	84	60 - 120	-	-
Strontium	Sr	-	-	-	-	86	60 - 120
Vanadium	V	-	-	62	50 - 150	100	60 - 120
Zinc	Zn	4.7	20	87	49 - 109	92	53 - 125

ug/g = micrograms per gram, dry basis
R.P.D. = Relative Percent Difference
(*) = Quality Control results exceeded internally set limits; after review by Quality Assurance Unit, non-conformance overridden and batch sample analysis results released for reporting

4606 Canada Way, Burnaby, BC V5G 1K5
Tel: 604 734 7276 Fax: 604 731 2386

Instrument Quality Control for the Mercury Monitor (QC# 221756)

QC Type: Calibration Verification

Parameter	% Recovery	Limits
Mercury Hg	96	90 - 110

4606 Canada Way, Burnaby, BC V5G 1K5
Tel: 604 734 7276 Fax: 604 731 2386

Batch Quality Control Frequency Summary

Metals Plant Tissue Digestion (Batch# 113690)

QC Type	No. Samples
NIST1573a Tomato Leaves	1
NRC TORT-2, "Lobster Tissue"	1
Blank	2
Duplicate	3
Batch Size	25

4606 Canada Way, Burnaby, BC V5G 1K5
Tel: 604 734 7276 Fax: 604 731 2386

B16. Fish Habitat Data, Casino Project, July 2008

Appendix B16. Fish Habitat Data, Casino Project, July 2008

Site	Date	Distance Surveyed (m)	Stream Characteristics				Habitat Type (%)					Side Channel (%)	Bed Material (%)						
													Fines	Gravels		Larges			Bedrock
			Stage (H/M/L)	Gradient (%)	Wet Width (m)	Channel Width (m)	Pool	Run	Riffle	Cascade	Other			Small (2-16 mm)	Large (16-64 mm)	Small Cobble (64-128 mm)	Large Cobbles (128-256 mm)	Boulder (>256 mm)	
F08	9-Jul	75	Low	3.0	2.9	3.3	40	0	0	60	0	0	10	30	0	0	40	20	0
					4.5	5.8													
					2.2	5.6													
F07	9-Jul	75	Low	9.0	3.4	4.7	Cascade Pool					0	20	10	0	5	15	50	0
					4.4	6.2													
					5.4	8.1													
F03	8-Jul	75	Low	3.0	4.7	6.2	10	0	90	0	0	0	10	15	0	35	30	10	0
					7.0	7.0													
					4.5	9.5													
					3.7	10.3													
F04	8-Jul	200	Low	4.0	5.6	5.6	Cascade Pool					0-10	5	0	20	15	10	50	0
					5.0	8.8													
					5.0	5.1													

Appendix B16. Fish Habitat Data, Casino Project, July 2008

Site	Date	Distance Surveyed (m)	Cover Type (%)							Crown Closure (%)	Banks (F, G, L, R)	Confinement (EN, CO, FC, OC, UC, N/A)	Braided (Y or N)	pH	Water Temp (°C)	TDS (g/L)	Conductivity (25°C) (µs/cm)	DO (%)	DO (mg/L)	Comments
			Total Overall	Deep Pool	LOD	Boulder	Cutbank	Instream Veg	Overstream Veg											
F08	9-Jul	75	30	20	0	70	5	0	5	5	F, L	UC	N	7.39	5.93	0.173	264	86.8	10.81	Casino Creek, Cascade Pool habitat
F07	9-Jul	75	30	3	0	85	2	0	10	5	F, L	UC	N	6.9	3.4	0.181	278	92.9	12.36	Upper Reach of Casino Creek, Cascade Pool habitat
F03	8-Jul	75	45	0	40	5	15	0	40	7	F, L	UC	N	7.45	9	0.167	256	95.5	11.0	Upstream of Britannia Creek
F04	8-Jul	200	50	0	10	80	0	0	10	17	F, L	UC	Y	6.53	6.34	0.075	111	93.4	11.45	Upstream of F03, Cascade Pool habitat

B17. Fish Habitat Data, Casino Project, September 2008

Appendix B17. Fish Habitat Data, Casino Project, September 2008

Site ID	Date	Reach	Co-ordinates		Stream Characteristics					Habitat Type (%)				Side Channel %	Bed Material (%)							Co		
																Gravels		Larges						
			Easting	Northing	Stage (H/M/L)	Gradient (%)	Wet Width (m)	Channel Width (m)	Depth (m)	Pool	Run	Riffle	Other		Fines	Small (2-16 mm)	Large (16-64 mm)	Small Cobble (64-128 mm)	Large Cobbles (128-256 mm)	Boulder (>256 mm)	Bedrock	Total Overall	Deep Pool	LOD
Lower Reach of Britannia Creek	11-Sep	1	617,126	6,970,199	High	0.0	-	-	0.35	20	30	50	0	(only 1)	20	20	0	50	10	0	0	10	20	80
									0.20															
Upper Reach of Britannia Creek	11-Sep	2	616,279	6,966,540	High	1.0	4.2	4.2	0.21	10	20	70	0		0	30	30	0	20	20	0	10	0	70
							3.9	3.9	0.42															
									0.16															
									0.42															
									0.23															
Lower Reach of Canadian Creek	11-Sep	1	615,314	6,966,030	High	0.0	4.8	7.9	1.00	20	40	40	0		10	10	10	20	50	0	0	10	20	80
									0.26															
Cascade pools on Canadian Creek	11-Sep	2	609,160	690,684	High	15.0	8.0	8.0	0.43						5	0	5	0	0	90	0	50	0	0
Upper Reach of Canadian Creek	11-Sep	3	609,622	6,958,679	High	3.0	4.0	4.0	0.36	10	10	80	0		5	0	0	15	60	20	0	20	0	0
							1.95	1.95	0.16															
At site F14 on Dip Creek	12-Sep	1	609,367	6,947,025	High	0.0	11.0	11.0	1.25	30	30	40	0		50	10	0	30	10	0	0	25	50	50
							10.0	10.0																
Meloy Creek	12-Sep	1	611,661	6,954,143	High	2 to 3	1.8	1.8	0.40	20	50	30	0		80	5	0	5	0	10	0	70	20	0
							1.1	1.1	0.21															
							0.5	0.5																
Upper Reach of Casino Creek	12-Sep	2	613,087	6,954,573	High	3.0	6.1	6.1	0.34	50	10	40	0		10	0	10	20	20	40	0	30	0	0
							4.7	4.7	0.08															
									0.40															
Lower Reach of Casino Creek	12-Sep	1	610,515	6,950,136	High	2.0	5.8	5.8	1.50	30	40	30	0		30	5	5	20	40	0	0	30	70	30
							5.6	5.6	0.40															
									0.27															
									0.65															
Lower Reach of Brynelson Creek	12-Sep	1	610,209	6,952,288	High	2.0	6.1	6.1	0.12	20	20	60	0		30	0	20	20	20	10	0	10	0	0
							4.7	4.7	0.26															
									0.49															
									0.30															
Upper Reach of Brynelson Creek	12-Sep	2	609,448	6,953,393	High	2 to 3	4.1	4.1	0.40	30		70	0		0	0	0	10	20	70	0	20	0	20
									0.35															
									0.40															
Lower Reach of Austin Creek	12-Sep	1	610,157	6,949,620	High	0.0	1.9	1.9	0.54	70	30		0		100	0	0	0	0	0	0	100	0	0
							1.6	1.6	0.39															
Upper Reach of Austin Creek	12-Sep	2	608,816	6,951,236	High		1.08	1.08	0.56	70	20	10	0		90	0	0	0	0	10	0	90	10	0
								0.80	0.29															

Appendix B17. Fish Habitat Data, Casino Project, September 2008

Site ID	Cover Type (%)				Crown Closure (%)	Bars (%)	Confinement (EN, CO, FC, OC, UC, N/A)	Braided (Y or N)	YSI 556						Hanna Combo Pen		
	Boulder	Cutbank	Instream Veg	Overstream Veg					pH	Water Temperature (°C)	TDS (g/L)	Conductivity (25°C) (µs/cm)	DO %	DO (mg/L)	Water Temperature (°C)	Conductivity (25°C) (µs/cm)	pH
Lower Reach of Britannia Creek	0	0	0	0	10	20	OC	N	7.16	5.42	0.126	195	95.5	12.04	5.9	-	8.04
Upper Reach of Britannia Creek	0	20	0	10	20	10	UC		9.73	3.08	0.117	175	96	12.9	3	150	7.96
Lower Reach of Canadian Creek	0	0	0	0	10	0	UC	N	7.01	5.65	0.102	161	88.1	11.06	-	-	-
Cascade pools on Canadian Creek	100	0	0	0	0	0	FC	N	6.92	4.01	0.073	108	84.5	11.08	-	-	-
Upper Reach of Canadian Creek	100	0	0	0	0	0	UC	N	6.82	3.17	0.075	118	79.2	10.6	-	-	-
At site F14 on Dip Creek	0	0	0	0	10	0	UC	Y	6.91	2	0.1	152	85.2	11.79	-	-	-
Meloy Creek	0	0	0	80	10	0	UC	N	6.69	1.99	0.128	188	85	11.75	-	-	-
Upper Reach of Casino Creek	80	0	0	20	0	0	UC	N	7	3.39	0.133	202	87.7	11.66	-	-	-
Lower Reach of Casino Creek	0	0	0	0	20	0	UC	N	7	4.64	0.19	180	84.9	10.97	-	-	-
Lower Reach of Brynelson Creek	90	0	0	10	10	0	UC	Y	6.92	2.56	0.077		93.1	12.69	2.9	92	7.96
Upper Reach of Brynelson Creek	80	0	0	0	10	0	UC	N	6.78	3.01	0.067	105	90.1	12.12	-	-	-
Lower Reach of Austin Creek	0	0	0	100	0	0	UC	Y	7	2.85	0.135	208	87.2	11.75	-	-	-
Upper Reach of Austin Creek	0	0	0	90	0	0	UC	Y	5.82	1.94	0.068	110	90.1	12.43	-	-	-

AECOM

Appendix C

Terrestrial Environment

C1. Ecosystem Classification Data, Casino Project, July 2008

Appendix C1. Ecosystem Classification Data, Casino Project, July 2008.

Number of Ecosite Sampling Points				**13**				
Site Observations								
Plot ID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Plot Type	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground
Assessment Date	7/8/2008	7/8/2008	7/8/2008	7/8/2008	7/8/2008	7/9/2008	7/9/2008	7/9/2008
Location (UTM Co-ordinates)	7V 0615740 E 6966668 N	7V 0615899 E 6966475 N	7V 0608513 E 6957166 N	7V 0606672 E 6946763 N	7V 0610514 E 6963530 N	7V 0610965 E 6941982 N	7V 0610685 E 6940964 N	7V 0610206 E 6941620 N
Ecological Region								
Habitat Description	Aspen Forest	Riparian	Low Shrub	Dry Shrub	Tussock Sedge	Subalpine	Alpine	Subalpine
Parent Material	Collivial	Fluvial	Bedrock	Collivial	Organic	Collivial	Collivial	Collivial
Site Position (Macro)	Inclined	Flood Plain	Ridged	Inclined	Inclined	Inclined	Ridged	Inclined
Site Position (Meso)	Mid Slope	Level	Crest	Upper Slope	Lower Slope	Upper Slope	Crest	Mid Slope
Slope (%)	55	2	3	58	50	56	2	50
Aspect (degree)	153	40	335	195	10	272	360	70
Drainage	Well Drained (3)	Imperfectly Drained (5)	Poorly Drained (6)	Rapidly (2)	Poorly Drained (6)	Moderately Well Drained (4)	Moderately Well Drained (4)	Poorly Drained (6)
Site Photos								
Vegetation								
Main Canopy Descriptor	-	A16Sb10	-	-	-	A05Bw8Sb2	-	-
Sub Canopy Descriptor	D4Aw10	-	-	-	-	-	-	-
Structural Stage	Pole/Sapling	Mature Forest	Low Shrub	Dwarf Shrub	Dwarf-shrub Dominated	Tall Shrub/Woodland	Bryoid	Tall Shrub/Woodland
Dominant Shrub Species (% cover)	*Rosa acicularis (15)*	*Alnus incana (20)*	*Betula glandulosa (45)*	*Arctostaphylos uva-ursi (15)*	*Ledum decumbens (35)*	*Betula grandulosa (50)*	*Betula grandulosa (15)*	*Ledum decumbens (35)*
Sub-dominant Shrub Species (% cover)	*Shepherdia canadensis (5)*	*Vaccinium vitis-idaea (15)*	*Salix glauca. (25)*	*Rosa acicularis (5)*	*Andromeda polifolia (15) and Betula glandulosa (15)*	*Salix glauca (20)*	*Arctostaphylos alpina (10)*	*Oxycoccus microcarpus (15)*
Dominant Herb/Forb Species (% cover)	*Epilobium angustifolium (4)*	*Equisetum arvense (4)*	*Petasites spp. (3)*	*Artemisia frigida (15)*	*Equisetum sylvaticum (6)*	*Mertensia paniculata (3)*	*Dryas spp. (45)*	*Polygonum vivparum (2) and Petasites spp. (2)*
Sub-dominant Herb/Forb Species (% cover)	*Galium boreale (2) and Achillea millefolium (2)*	*Equisetum scirpoides (2)*	*Jacobs Ladder (2)*	*Fragaria virginiana (6) and Solidago simplex (6)*	*Polygonum vivparum (5) and Lycopodium annotinum (5)*	*Epilobium angustifolium (2) and Saxifraga bronchialis (2)*	*Saxifraga bronchialis (4)*	-
Dominant Graminoid Species (% cover)	-	-	*Carex spp. (20)*	*Poa spp. (8)*	-		-	*Carex spp. (15)*
Sub-dominant Graminoid Species (% cover)	-	-	-	-	-	-	-	-
Dominant Mosses, Liverwort, Lichen Species (% cover)	-	*Hylocomium splendens (20)*	*Hylocomium splendens (45)*	-	*Sphagnum spp. (65)*	*Hylocomium splendens (20)*	*Cladina spp (8)*	*Pleurozium schreberi (65)*
Sub-dominant Mosses, Liverwort, Lichen Species (% cover)	-	-	*Sphagnum spp. (15)*	-	-	*Cladina spp (5) and Polytrichum spp (5)*	-	*Sphagnum spp. (15)*
Moisture Regime	Submesic (4)	Subhygric (6)	Hygric (7)	Submesic (4)	Subhydric (8)	Mesic (5)	Mesic (5)	Subhygric (6)
Nutrient Regime	Medium (C)	Medium (C)	Poor (B)	Medium (C)	Poor (B)	Poor (B)	Poor (B)	Poor (B)
Ecosite Classification								
Soils Characteristics								
Organic Layer								
Organic Thickness (cm)	-	10 (buried organic within profile)	-	-	0-31	-	-	30
LFH Thickness (cm)	1	2	5	0	-	2	3	-
Humus Form	Moder	Raw Moder	Mor	-	-	Mor	Mor	-
Mineral Soil (Topsoil)								
Topsoil Thickness (cm)	0-7	-	0-9	0-11	-	0-4	0-3	-
Topsoil Texture	L	-	L	L	-	L	L	-
Topsoil Color	10YR 4/4	-	7.5 YR 3/4	10YR 2/2	-	10YR 3/2	10YR 3/2	-
Coarse Fragment Class	Gravel	-	-	-	-	Cobble / Sand	-	-
Coarse Fragment (%)	<15	0	0	-	-	< 15	-	-

Appendix C1. Ecosystem Classification Data, Casino Project, July 2008.

Number of Ecosite Sampling Points				**13**				
Site Observations								
Plot ID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Mineral Soil (Subsoil)								
Subsoil Thickness (cm)	7-45	10-50	9-60	11-29 / 29-55	-	4-35	3-35	-
Subsoil Texture	LS	cS	fSCL	grL / grL	-	L	L	-
Subsoil Color	10YR 4/4	10YR 4/4	Gley 1 4/10Y	10YR 4/4 / 10YR 4/3	-	10YR 3/6	10YR 4/3	-
Coarse Fragment Class	Gravel / Cobble	-	-	Gravel	-	Cobble / Sand	Sand	-
Coarse Fragment (%)	<30	0	0	<50	-	< 80	< 50	-
Presence of/Depth to (cm):								
Carbonates	-	-	-	-	-	-	-	-
Mottles/ Gleying	-	15	10	-	-	-	-	-
Water Table	-	-	-	-	-	-	-	30
Bedrock	-	-	-	-	-	-	35	-
Root Restriction	-	-	-	-	31	-	-	30
Effective Rooting Depth	40	15	15	35	30	20	6	-
Effective Texture	7	10	-	11	-	20	20	-
Pit Depth	45	55	60	55	30	35	35	30
Permafrost Depth	-	-	-	-	30	-	-	30
Seepage	N	N	Y	N	Y	N	N	Y
Soil Classification								
Comments								
	Immature Trembling aspen stand with ~ 3 m height. Scattered standing aspen remnants throughout stand. Aspen trees have silver coloring from unknown insect infestation. Soils shallow with coarse frags and bare soil prevelant across site.	Buried organic horizons to 10 cm with mottles present. Alder, willow and birch dominate understory shurb layer.	Plot located at crest of long slope near area of exposed bedrock with willow, dwarf birch and mossess dominating site.	Plot located on steep graminoid/forb dominated sideslope immediately above Dip Creek.	Plot located on north facing, poorly drained, wet tundra slope.	Plot within shrubby slope transitiong into open alpine located at upper slope position.	Plot located at saddle of alpine area with large amounts of exposed bedrock.	Plot located on open tundra slope with scattered dwarf birch and willow with the site dominated by ericarious shrubs and feathermoss.

Appendix C1. Ecosystem Classification Data, Casino Project, July 2008.

Number of Ecosite Sampling Points									
Site Observations									
Plot ID	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Plot Type	Ground	Ground	Ground	Ground	Ground	Ground	Visual	Ground	Ground
Assessment Date	7/9/2008	7/9/2008	7/9/2008	7/10/2008	7/10/2008	7/10/2008	7/10/2008	7/10/2008	7/10/2008
Location (UTM Co-ordinates)	7V 0609812 E 6948824 N	7V 0609654 E 6949236 N	7V 614952 E 6966217 N	7V 0619197 E 6963646 N	7V 0618722 E 6963601 N	7V 0601196 E 6943376 N	7V 0601355 E 6943360 N	7V 0602780 E 6942145 N	7V 0602740 E 6942316 N
Ecological Region									
Habitat Description	Aspen Forest	Spruce/Birch Forest	Disturbance	Subalpine	Aspen Forest	Aspen Forest	Dry Shrub	Tussock Sedge	Treed Bog (sloped)
Parent Material	Morainal	Morainal	Morainal	Collivial	Morainal	Morainal	Collivial	Organic	Organic
Site Position (Macro)	Inclined	Inclined	Inclined	Inclined	Inclined	Inclined	Inclined	Inclined	Level
Site Position (Meso)	Mid Slope	Upper Slope	Mid Slope	Upper Slope	Upper Slope	Upper Slope	Upper Slope	Lower Slope	Level
Slope (%)	34	18	40	60	48	28	44	18	1
Aspect (degree)	196	40	105	340	215	225	180	10	10
Drainage	Well Drained (3)	Imperfectly Drained (5)	Moderately Well Drained (4)	Imperfectly Drained (5)	Well Drained (3)	Well Drained (3)	Rapidly Drained (2)	Imperfectly Drained (5)	Poorly Drained (6)
Site Photos									
Vegetation									
Main Canopy Descriptor	D12Aw9Sw1	B09Bw6Sb4	A10Aw7Sw2Bw1	-	C8Aw8Bw1Sw1	C9Aw9Sw1	-	C6Sb10	-
Sub Canopy Descriptor	-	A05Sb8Bw2	-	-	B4Aw10	B5Aw10	-	-	-
Structural Stage	Mature Forest	Mature Forest	Old Forest	Tall Shrub/Woodland	Mature Forest	Young Forest	Dwarf-shrub Dominated	Shrub/Woodland	Shrub/Woodland
Dominant Shrub Species (% cover)	*Vaccinium vitis-idaea (15)*	*Ledum decumbens (50)*	*Shepherdia canadensis (15) and Linnaea borealis (15)*	*Ledum decumbens (60)*	*Shepherdia canadensis (20)*	*Vaccinium vitis-idaea (45)*	*Arctostaphylos uva-ursi (65)*	*Ledum decumbens (20)*	*Ledum decumbens (35)*
Sub-dominant Shrub Species (% cover)	*Linnaea borealis (10)*	*Vaccinium vitis-idaea (30)*	*Viburnum edule (8)*	*Betula grandulosa (30)*	*Arctostaphylos uva-ursi (12)*	*Arctostaphylos uva-ursi (30)*	*Populus tremuloides (6)*	*Salix spp. (6)*	*Betula grandulosa (30)*
Dominant Herb/Forb Species (% cover)	*Epilobium angustifolium (5)*	*Lycopodium complanatum (3)*	*Epilobium angustifolium (6)*	*Epilobium latifolium (1) and Rumex arcticus (1)*	*Mertensia paniculata (4)*	*Pyrola asarifolia (2); Mertensia paniculata (2) and Delphinium glaucum (2)*	*Fragaria virginiana (5)*	*Petasites frigidus (3)*	*Rubus chamaemorus (8)*
Sub-dominant Herb/Forb Species (% cover)	*Mertensia paniculata (2); Pyrola asarifolia (2); Zigadenus elegans (2) and Delphinium glaucum (2)*		*Mertensia paniculata (4)*	-	*Epilobium angustifolium (3)*	*Anemone multifida (1)*	*Zygadenus elegans (4) and Vicia americana (4)*	*Equisetum arvense (2) and Equisetum pratense (2)*	-
Dominant Graminoid Species (% cover)	-	-	*Festuca altaica (10)*	*Poa artica (1)*	*Poa artica (6)*	*Poa spp. (6)*		-	*Eriophorum vaginatum (25)*
Sub-dominant Graminoid Species (% cover)	-	-	-	-	-	-	-	-	-
Dominant Mosses, Liverwort, Lichen Species (% cover)	-	*Hylocomium splendens (75)*	-	*Pleurozium schreberi (45)*	-	-	-	*Hylocomium splendens (45)*	*Sphagnum spp. (50)*
Sub-dominant Mosses, Liverwort, Lichen Species (% cover)	-	*Pleurozium schreberi (15)*	-	*Hylocomium splendens (35)*	-	-	-	*Pleurozium schreberi (25) and Cladina spp. (20)*	-
Moisture Regime	Mesic (5)	Subhydric (6)	Mesic (5)	Subhydric (6)	Mesic (5)	Submesic (4)	Submesic (4)	Subhygric (6)	Hygric (7)
Nutrient Regime	Medium (C)	Poor (B)	Medium (C)	Poor (B)	Medium (C)	Medium (C)	Medium (C)	Poor (B)	Poor (B)
Ecosite Classification									
Soils Characteristics									
Organic Layer									
Organic Thickness (cm)	-	-	-	-	-	-		15	18
LFH Thickness (cm)	4	3	-	16	4	2		-	-
Humus Form	Mor	Mor	-	Mor	Moder	Moder		Peaty Mor	-
Mineral Soil (Topsoil)									
Topsoil Thickness (cm)	0-11	0-6	0-11	0-25	0-9	0-13		0-18	-
Topsoil Texture	L	L	L	L	L	L		L	-
Topsoil Color	10YR 4/4	10YR 4/2	10YR 3/3	10YR 3/3	7.5YR 3/3	7.5YR 3/3		5Y 3/2	-
Coarse Fragment Class	-	Gravel	Gravel	Gravel/Cobble/Sand	Gravel/Cobble	Small Gravel		-	-
Coarse Fragment (%)	-	< 30	< 5	< 80	< 50	< 50		0	-

Appendix C1. Ecosystem Classification Data, Casino Project, July 2008.

Number of Ecosite Sampling Points									
Site Observations									
Plot ID	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Mineral Soil (Subsoil)									
Subsoil Thickness (cm)	11-42	6-45	11-45	-	9-43	13-50		18-27	-
Subsoil Texture	L-CL	L-CL	L	-	SL	L		SiCL	-
Subsoil Color	10YR 4/4	10YR 4/4	10YR 4/3	-	10YR 4/3	7.5YR 3/4		5Y 3/2	-
Coarse Fragment Class	Gravel	Gravel	Gravel	-	Cobble	Small Gravel		-	-
Coarse Fragment (%)	< 30	<30	<5	-	< 30	< 50		0	-
Presence of/Depth to (cm):									
Carbonates	-	-	-	-	-	-		-	-
Mottles/ Gleying	-	-	-	-	-	-		At Surface	-
Water Table	-	-	-	-	-	-		-	-
Bedrock	-	-	-	At surface	-	-		-	-
Root Restriction	-	-	-	-	-	-		27	18
Effective Rooting Depth	28	18	20	-	22	30		5	-
Effective Texture	11	6	11	-	9	13		20	-
Pit Depth	42	45	45	25	43	50		27	18
Permafrost Depth	-	-	-	-	-	-		18	18
Seepage	N	N	N	N	N	N		Y	Y
Soil Classification									
Comments									
	Dry south facing, immature aspen stand dominated by short shrubs.	Plot characteristic of similar topographic positions throughout local study area.	Numerous dead standing snags, remnants of previous burn with large amounts of blowdown across hillside.	Plot located near top of Black spruce/ dwarf birch/lab tea scrub slope. Open tundra slope to west. Coluvium or fractured bedrock immediately below moss layer with very little soil present.	Immature aspen stand on Southwest facing slope. Some birch and spruce scattered throughout.	Characteristic aspen stand on south or southwest facing well drained slope.	Open, dry south facing slope with vegetation primarily ground shrubs (bearberry).	Black spruce stand on North facing slope, characterized as a Sb treed bog on a slope. Surfacewater moving downslope over surface of permafrost.	Open shrubby bog with cottongrass and sphagnum hummocks throughtout caused by surface water held up from permafrost.

C2. Ecosystem Classification Data, Casino Project, September 2008

Appendix C2. Ecosystem Classification Data, Casino Project, September 2008

Site Observations					
Plot ID	**18**	**19**	**20**	**21**	**22**
Plot Type	Ground	Visual	Visual	Ground	Visual
Assessment Date	9/9/2008	9/9/2008	9/10/2008	9/10/2008	9/10/2008
Location (UTM Co-ordinates)	7V 0605681 E 6958060 N	7V 0604883 E 6960270 N		7V 0599985 E 6943470 N	7V 0600113 E 6943246 N
Ecological Region					
Habitat Description	Alpine	Felsenmeer		Aspen Forest	Treed Bog (sloped)
Parent Material	Collivial	Bedrock	Colluvial	Colluvial	Organic
Site Position (Macro)	Ridged	Ridged	Inclined	Inclined	Inclined
Site Position (Meso)	Crest	Upper Slope	Upper Slope	Mid Slope	Lower Slope
Slope (%)	-	12	20	30	-
Aspect (degree)	-	360	345	162	-
Drainage	Rapidly Drained (2)	Well Drained (3)	Poorly Drained (7)	Well Drained (3)	Poorly Drained (7)
Site Photos					
Vegetation					
Main Canopy Descriptor	-	-	-	-	-
Sub Canopy Descriptor	-	-	-	-	-
Structural Stage	Sparse/Bryoid	Sparse/Bryoid	Low Shrub	Mature Forest	Tall Shrub/Woodland
Dominant Shrub Species (% cover)	*Drya spp. (50)*	*Betula glandulosa*	*Ledum decumbens*	*Vaccinium vitis-idaea (35)*	
Sub-dominant Shrub Species (% cover)	*Vaccinium vitis-idaea (3)*	*Cassiope tetragona, Empetrum nigrum & Vaccinium membranaceum*	*Vaccinium vitis-idaea, Empetrum nigrum & Vaccinium membranaceum*	*Arctostaphylos uva-ursi (25)*	
Dominant Herb/Forb Species (% cover)	-	*Dryas spp.*	*Polygonum bistora*	*Galium boreale (2)*	
Sub-dominant Herb/Forb Species (% cover)	-	-	-	*Epilobium angustifolium (1)*	
Dominant Graminoid Species (% cover)	*Hierochloe alpina (10)*	-	*Luzula parviflora*	*Calamagrostis purpurascens (5)*	
Sub-dominant Graminoid Species (% cover)	*Luzula spp. (3)*	-	-	-	
Dominant Mosses, Liverwort, Lichen Species (% cover)	*Polytrichum juniperinum (3)*	-	*Hylocomium splendens*	*Cladina rangifernia (2)*	
Sub-dominant Mosses, Liverwort, Lichen Species (% cover)	-	-	-	*Lycopodium complanatum*	
Moisture Regime	Subxeric (3)	Subhygric (6)	Hygric (7)	Submesic (4)	
Nutrient Regime	Poor (B)	Poor (B)	Poor (B)	Poor (B)	

Appendix C2. Ecosystem Classification Data, Casino Project, September 2008

Site Observations					
Plot ID	**18**	**19**	**20**	**21**	**22**
Ecosite Classification					
Soils Characteristics					
Organic Layer					
Organic Thickness (cm)	2	-	20	-	-
LFH Thickness (cm)	-	-	-	7	-
Humus Form	Peaty Mor	-	Peaty Mor	Mor	-
Mineral Soil (Topsoil)					
Topsoil Thickness (cm)	0-3	-	0-23	0-8	-
Topsoil Texture	L	-	SCL	L	-
Topsoil Color	10YR 2/1	-		10YR 3/4	-
Coarse Fragment Class	-	-	-	-	-
Coarse Fragment (%)	-	-	-	-	-
Mineral Soil (Subsoil)					
Subsoil Thickness (cm)	3-29 / 29-42	-	-	8-40	-
Subsoil Texture	CL / CL	-	-	SL	-
Subsoil Color	2.5Y 4/4 / 2.5Y 4/3	-	-	2.5Y4/3	-
Coarse Fragment Class		-	-	-	-
Coarse Fragment (%)		-	-	-	-
Presence of/Depth to (cm):					
Carbonates	-	-	-	-	-
Mottles/ Gleying	-	-	-	-	-
Water Table	-	-	-	-	-
Bedrock	-	-	-	-	-
Root Restriction	-	-	-	-	-
Effective Rooting Depth	-	-	-	-	-
Effective Texture	-	-	-	-	-
Pit Depth	42	-	23	40	-
Permafrost Depth	-	-	-	-	-
Seepage	-	-	-	-	-
Soil Classification	-	-	-	-	-
Comments					
	Vegetation hardened of and done for the season. Crest and upper slope position easily typed the same.	Rocky Scree slope grades into birch shrub.	Surface and subsurface drainage channels into shallow gully with a high water table.	Aspen stand on dry, south facing slope, charactistic of these types observed thoughout study area.	South of site #108 where slope decrease and drainage is poor. Black spruce treed bog.

Appendix C2. Ecosystem Classification Data, Casino Project, September 2008

Site Observations						
Plot ID	**23**	**24**	**25**	**26**	**27**	**28**
Plot Type	Ground	Ground	Ground	Ground	Ground	Ground
Assessment Date	9/10/2008	9/10/2008	9/10/2008	9/10/2008	9/10/2008	9/10/2008
Location (UTM Co-ordinates)	7V 0600185 E 6942998 N	7V 620660 E 6951944 N	7V 620653 E 6951802 N	7V 608536 E 6946051 N	7V 611658 E 6973460 N	7V 613793 E 6973079 N
Ecological Region						
Habitat Description	Shrubby Bog (sloped)	Disturbance	Spruce Forest	Spruce/Birch Forest	Birch Forest	Birch Forest
Parent Material	Organic	Colluvial	Colluvial	Morainal	Alluvial	Alluvial
Site Position (Macro)	Level	Inclined	Inclined	Inclined	Floodplain	Floodplain
Site Position (Meso)	Level	Upper Slope	Mid Slope	Lower Slope	Level	Level
Slope (%)	-	22	42	24	-	-
Aspect (degree)	-	208	200	270	-	-
Drainage	Poorly Drained (7)	Moderately Well Drained (4)	Moderately Well Drained (4)	Well Drained (3)	Imperfectly Drained (6)	Imperfectly Drained (6)
Site Photos						
Vegetation						
Main Canopy Descriptor	-	-	-	-	-	-
Sub Canopy Descriptor	-	-	-	-	-	-
Structural Stage	Shrub/Woodland	Old Forest	Old Forest	Mature Forest	Mature Forest	Mature Forest
Dominant Shrub Species (% cover)	*Betula glandulosa (35)*	*Vaccinium vitis-idaea (45)*	*Vaccinium vitis-idaea (15)*	*Vaccinium vitis-idaea (15) and Ledum decumbens (15)*	*Rosa acicularis (20)*	*Rosa acicularis (35)*
Sub-dominant Shrub Species (% cover)	*Salix planifolia (20)*	*Ledum decumbens (30)*	*Empetrum nigrum (4)*	*Arctostaphylos uva-ursi (10)*	*Cornus stolonifera (15), Alnus tenuifolia (15)*	*Rubus idaeus (30)*
Dominant Herb/Forb Species (% cover)	*Rubus chamaemorus (3)*	-		*Mertensia paniculata (1)*	*Epilobium angustifolium (4)*	*Equisetum arvense (20)*
Sub-dominant Herb/Forb Species (% cover)	*Pedasites spp. (2)*	-	-	-	*Mertensia paniculata (3), Delphinium glancum (3)*	-
Dominant Graminoid Species (% cover)	*Eriophorum spp. (40)*	-	-		*Calamagrostis canadensis (5)*	*Calamagrostis canadensis (20)*
Sub-dominant Graminoid Species (% cover)	-	-	-	-	-	-
Dominant Mosses, Liverwort, Lichen Species (% cover)	*Sphagnum spp.*	*Hylocomium splendens (25)*	*Hylocomium splendens (85)*	*Hylocomium splendens (20)*	-	-
Sub-dominant Mosses, Liverwort, Lichen Species (% cover)	-	*Polytrichum juniperinum (2)*	-	*Pleurozium schreberi (5)*	-	-
Moisture Regime	Subhygric (6)	Mesic (5)	Mesic (5)	Submesic (4)	Subhygric (6)	Subhygric (6)
Nutrient Regime	Poor (B)	Poor (B)	Poor (B)	Poor (B)	Rich (D)	Rich (D)

Appendix C2. Ecosystem Classification Data, Casino Project, September 2008

Site Observations						
Plot ID	**23**	**24**	**25**	**26**	**27**	**28**
Ecosite Classification						
Soils Characteristics						
Organic Layer						
Organic Thickness (cm)	35	-	-	-	-	-
LFH Thickness (cm)	-	5	13	2	10	12
Humus Form		Mor	Mor	Mor	Moder	Mor
Mineral Soil (Topsoil)						
Topsoil Thickness (cm)	-	0-5	0-12	0-5	-	0-6
Topsoil Texture	-	L	L	L	-	fS
Topsoil Color	-	10YR 3/3	10YR 3/3	10YR 4/3	-	10YR 3/1
Coarse Fragment Class	-	-	-	-	-	-
Coarse Fragment (%)	-	-	-	-	-	-
Mineral Soil (Subsoil)						
Subsoil Thickness (cm)	35	5-43	12+	5-35 / 35-54	0-45	6-36
Subsoil Texture	-	gSL	gSL	L / N/A	S	fS
Subsoil Color	-	2.5Y 4/3	2.5Y4/3	10YR 4/3 / 7.5Y 3/4	5Y 3/2	2.5Y 3/1
Coarse Fragment Class	-	-	-	-	-	-
Coarse Fragment (%)	-	-	-	-	-	-
Presence of/Depth to (cm):						
Carbonates	-	-	-	-	-	-
Mottles/ Gleying	-	-	-	-	-	-
Water Table	-	-	-	-	-	-
Bedrock	-	-	-	-	-	-
Root Restriction	-	-	-	-	-	-
Effective Rooting Depth	-	-	-	-	-	-
Effective Texture	-	-	-	-	-	-
Pit Depth	35	43	12+	54	45	46
Permafrost Depth	35	-	-	-	-	-
Seepage	-	-	-	-	-	-
Soil Classification	-	-	-	-	-	-
Comments						
	Shrub layer generally <1 m. Extremely Hummocky ground with tussock sedge.	Site in proximity to historic placer mining activity, east of lod air strip. Area appears to be in historicly burned in early 90's.	Thick mor humus form with evidence of historic burn as seen thru charcoal within profile. Very gravelly Bm horizon.	C horizon contains high % gravel with mica flakes and limited soil present. High % of lichen cover observed on site. Site was a black spruce dominated stand on a northwest facing slope	Poorly developed soil horizons as a result of depostional characteristics and periodic flooding events. Island in middle of Yukon river, site is unlike any other within LSA, Poplar stand with rich shrub layer.	Large healthy stand of high quality white birch. Buried log at 36 cm with former Ah horizon below within the soil profile.

Appendix C2. Ecosystem Classification Data, Casino Project, September 2008

Site Observations					
Plot ID	**29**	**30**	**31**	**32**	**33**
Plot Type	Visual	Ground	Visual	Ground	Visual
Assessment Date	9/10/2008	9/10/2008	9/10/2008	9/10/2008	9/10/2008
Location (UTM Co-ordinates)	7V 613919 E 6973035 N	7V 635414 E 6957579 N	7V 634959 E 6957682 N	7V 611733 E 6959586 N	7V 611879 E 6959889 N
Ecological Region					
Habitat Description	Spruce (Sw) Forest	Spruce (Sw) Forest	Treed Bog (sloped)	Subalpine	Felsenmeer
Parent Material	Alluvial	Colluvial	organic/Colluvial	Collivial	Bedrock
Site Position (Macro)	Floodplain	Inclined	Inclined	Inclined	Ridged
Site Position (Meso)	Level	Upper Slope	Upper Slope	Mid Slope	Upper Slope
Slope (%)	-	23	-	22	-
Aspect (degree)	-	219	-	180	-
Drainage	Imperfectly Drained (6)	Imperfectly Drained (6)	Imperfectly Drained (6)	Poorly Drained (7)	Moderately Well Drained (4)
Site Photos					
Vegetation					
Main Canopy Descriptor	B30Sw10				
Sub Canopy Descriptor	B24Bw10				
Structural Stage	Mature Forest	Mature Forest	Young Forest	Tall Shrub/Woodland	Low Shrub
Dominant Shrub Species (% cover)		*Betula glandulosa (10), Empetrum nigrum (10)*		*Vaccinium uliginosum (40)*	*Betula glandulosa, Empetrum nigrum, Vaccinium vitis-idaea, Salix glauca*
Sub-dominant Shrub Species (% cover)		*Ledum decumbens (6)*		*Ledum decumbens (30)*	
Dominant Herb/Forb Species (% cover)		*Mertensia paniculata (2), Lupinus arcticus (2)*		-	*Lupinus arcticus, Cystopteris fragilis*
Sub-dominant Herb/Forb Species (% cover)		-		-	
Dominant Graminoid Species (% cover)		*Calamagrostis canadensis (15)*		-	
Sub-dominant Graminoid Species (% cover)		-		-	
Dominant Mosses, Liverwort, Lichen Species (% cover)		*Hylocomium splendens (65)*		*Hylocomium splendens (40)*	*Flavocetraria cucullata, Cladina mitis, Cladina stellaris, Tomenthypnum nitens*
Sub-dominant Mosses, Liverwort, Lichen Species (% cover)		-		*Pleurozium schreberi (25)*	
Moisture Regime		Subhygric (6)		Subhygric (6)	
Nutrient Regime		Rich (D)		Rich (D)	

Appendix C2. Ecosystem Classification Data, Casino Project, September 2008

Site Observations					
Plot ID	**29**	**30**	**31**	**32**	**33**
Ecosite Classification					
Soils Characteristics					
Organic Layer					
Organic Thickness (cm)	-	-	-	18	-
LFH Thickness (cm)	-	8	-	-	-
Humus Form	-	Mor	-	-	-
Mineral Soil (Topsoil)					
Topsoil Thickness (cm)	-	-	-	-	-
Topsoil Texture	-	-	-	-	-
Topsoil Color	-	-	-	-	-
Coarse Fragment Class	-	-	-	-	-
Coarse Fragment (%)	-	-	-	-	-
Mineral Soil (Subsoil)					
Subsoil Thickness (cm)	-	0-22	-	18-42 / 42+	-
Subsoil Texture	-	SiC	-	CL / CL	-
Subsoil Color	-	2.5Y 3/1	-	10YR 4/3 / 2.5Y 4/4	-
Coarse Fragment Class	-	-	-	-	-
Coarse Fragment (%)	-	-	-	-	-
Presence of/Depth to (cm):					
Carbonates	-	-	-	-	-
Mottles/ Gleying	-	-	-	-	-
Water Table	-	-	-	-	-
Bedrock	-	-	-	-	-
Root Restriction	-	-	-	-	-
Effective Rooting Depth	-	-	-	-	-
Effective Texture	-	-	-	-	-
Pit Depth		22		42+	
Permafrost Depth	-	-	-	-	-
Seepage	-	-	-	-	-
Soil Classification	-	-	-	-	-
Comments					
	East of pure Bw stand wich grades into mixedwood type. Very large white spruce stems (~30 m height and Diam 57.8 cm). Ground Vegetation and soils similar to that of site 115.	Very shallow soils. High % coarse fragments.	Scrubby black spruce treed bog with large patches of birch.	Rocky/Bouldery scree slope grades into birch and willow shrub slope on south facing site. Shallow soils with poor drainage. Seepage present within soil profile.	Shrubby scree slope.

C3. Wildlife Survey Data, Casino Project, 2008

Appendix C3. Wildlife Survey Data, Casino Project, 2008

Date	Time	Waypoint	Easting	Northing	Elevation (m)	Species	Comments
21-May	11:51	-	619,781	6,973,576	470	black bear	observed at W6b water quality site
7-Jul	11:50	466	610,594	6,959,232	1,334	grizzly bear	large blonde-coloured grizzly bear by tank farm
7-Jul	19:44	467	617,430	6,973,771	473	moose	moose on Yukon River
8-Jul	12:30	468	615,643	6,968,170	846	grizzly bear	blonde-coloured grizzly bear on Britannia Creek
8-Jul	12:36	469	614,545	6,972,795	452	moose	cow moose and calf on island in Yukon River; photos 1406-1408
8-Jul	16:20	470	609,718	6,959,554	1,388	wolf scat	wolf scat at Dip Creek; photos 1468-1470
8-Jul	16:25	471	607,837	6,957,167	1,560	beaver sign	beaver-chewed aspen trees on north side of Dip Creek; photo 1471
8-Jul	17:33	472	606,489	6,946,636	635	wolf scat	wolf scat at Dip Creek; photos 1488-1489
8-Jul	17:38	473	606,500	6,946,604	627	bear scat	bear scat at Dip Creek; photos 1490-1491
8-Jul	17:43	474	606,626	6,946,499	640	moose	bull moose; moose skull with antlers on Dip Creek; photos 1492-1493
9-Jul	13:01	476	611,243	6,941,817	1,320	caribou droppings	caribou pellets on N-facing ridge south of Dip Creek
9-Jul	14:49	477	610,603	6,940,867	1,323	moose and bear droppings	moose pellets and bear scat on N-facing ridges south of Dip Creek
9-Jul	16:15	478	610,600	6,941,472	1,169	moose antlers	bull moose antlers on south side of Dip Creek
9-Jul	16:44	480	609,430	6,949,158	856	bear claw marks	bear claw marks on aspen; photo 1526
9-Jul	16:47	481	609,402	6,949,172	849	moose droppings	moose pellets
9-Jul	16:56	482	609,345	6,949,154	840	bear scat	bear scat; photos 1527-1528
9-Jul	17:06	483	609,205	6,949,213	846	bear claw marks	bear claw marks on aspen; photo 1529
9-Jul	17:18	484	609,147	6,949,267	842	bear scat	grouse droppings; bear scat (photos 1532-1533) and grizzly bear tracks
9-Jul	18:46	486	615,047	6,965,946	563	bear scat	bear scat on Canadian Creek; photo 1544
10-Jul	10:27	488	618,816	6,963,724	1,126	caribou antlers	bull caribou antler in Britannia Creek area; photos 1552-1553
10-Jul	10:40	489	618,743	6,963,643	1,136	moose droppings	moose pellets on SW-facing slope
10-Jul	11:37	490	601,265	6,943,372	754	moose droppings	moose pellets on S-facing slopes on north side of Dip Creek
10-Jul	11:48	491	601,312	6,943,431	769	moose and bear droppings	moose pellets and bear scat on S-facing ridge north of Dip Creek
10-Jul	11:59	492	601,347	6,943,433	765	bear scat	bear scat on S-facing slopes on N side of Dip Creek; photo 1572-1573
10-Jul	12:00	493	601,342	6,943,439	768	bear scat	bear scat on S-facing slopes on N side of Dip Creek; photo 1575-1576
10-Jul	12:06	494	601,391	6,943,445	775	moose droppings	moose pellets on S-facing slopes on north side of Dip Creek
10-Jul	12:18	495	601,270	6,943,365	749	bear scat	bear scat on S-facing slopes on north side of Dip Creek; photos 1577-1578
10-Jul	12:19	496	601,267	6,943,365	752	bear scat	bear scat on S-facing slopes on north side of Dip Creek; photos 1579-1580
10-Jul	13:20	497	600,685	6,942,727	649	moose	1st cow moose in oxbow lake south on Dip Creek
10-Jul	13:21	498	600,491	6,942,371	649	moose	2nd cow moose in oxbow lake south on Dip Creek
10-Jul	13:25	499	613,943	6,961,605	1,280	grizzly bear	chocolate-coloured grizzly bear observed feeding
10-Jul	17:26	500	611,829	6,956,759	-	bear scat	bear scat on trail to tank farm
10-Jul	17:29	501	611,251	6,958,739	1,196	bear scat	bear scat on trail to tank farm; photo 1601
10-Jul	17:31	502	610,539	6,958,945	1,268	bear scat	bear scat on trail to tank farm
10-Jul	17:32	503	610,513	6,958,945	1,270	bear scat	bear scat on trail to tank farm
10-Jul	18:11	504	611,549	6,956,498	1,172	bear scat	bear scat on trail to tank farm
11-Jul	-	-	616,372	6,966,651	-	black bear	observed by Scott Casselman on Canadian Creek
15-Aug	-	-			-	bull caribou	old shop at tank farm
16-Aug	-	-	616,058	6,968,432	-	black bear	barge landing
17-Aug	-	-	611,407	6,956,335	-	lynx	300 m from camp
18-Aug	-	-	616,098	6,964,795	-	bull moose	airstrip
20-Aug	-	-	611,202	6,960,600	-	bull caribou	on ore deposit
22-Aug	-	-			-	bull and cow caribou	N of ore deposit
24-Aug	-	-			-	1 bull and 8 cow caribou	between ore deposit and old shop
25-Aug	-	-	613,873	6,962,494	-	wolf	uphill from Britannia Creek
26-Aug	-	-	611,538	6,958,378	-	sow grizzly with 2 2-yr-old cubs	bottom of ore deposit
29-Aug	-	-	617,271	6,971,511	-	black bear	Britannia Creek
30-Aug	-	-	616,631	6,965,040	-	wolf	Britannia Creek
30-Aug	-	-			-	cow moose and 2-yr-old bull	down from Britannia Creek
31-Aug	-	-	610,575	6,959,760	-	2 bull caribou	north ridge of ore deposit
1-Sep	-	-	616,243	6,967,437	-	cow moose and calf	barge landing

Appendix C3. Wildlife Survey Data, Casino Project, 2008

Date	Time	Waypoint	Easting	Northing	Elevation (m)	Species	Comments
1-Sep	-	-	615,975	6,964,431	-	lynx	Britannia Creek
2-Sep	-	-	611,615	6,960,546	-	chocolate brown grizzly	N side of pass to Yukon River
3-Sep	-	-	615,992	6,963,950	-	black bear	Canadian Creek
5-Sep	-	-	609,993	6,955,887	-	black bear with 2 yrlg cubs	top of road to old camp
5-Sep	-	-			-	snowshoe hares	road from old camp to airstrip
7-Sep	-	-			-	robin and porcupine	on road
7-Sep	-	-			-	bull and cow caribou	turn on road to Placer camp
7-Sep	-	-	612,351	6,960,616	-	northern hawk owl	terrible two's
9-Sep	-	2	605,549	6,958,043	-	raptor pellet	photo 2132 and 2133
9-Sep	-	4	605,484	6,958,070	-	arctic gr. squirrel burrow	photo 2135
9-Sep	-	5	605,908	6,957,508	-	bear dig at gr. squirrel burrow	-
9-Sep	-	6	605,929	6,957,478	-	arctic gr. squirrel burrow	photos 2138 and 2139
9-Sep	-	7	605,945	6,957,408	-	northern bog lemming burrows	photo 2140
9-Sep	-	8	605,943	6,957,303	-	large gr. squirrel site	photos 2141 and 2142
9-Sep	-	9	605,783	6,956,666	-	moose droppings	-
9-Sep	-	10	601,338	6,951,194	-	northern harrier	foraging at site 3: open, wet dwarf birch meadow; photo 2146
9-Sep	-	11	602,957	6,947,115	-	moose droppings	site 4: birch/alder/lab tea habitat
9-Sep	-	12	602,983	6,947,152	-	moose droppings	site 4: birch/alder/lab tea habitat
9-Sep	-	13	603,035	6,947,209	-	moose droppings	site 4: birch/alder/lab tea habitat
9-Sep	-	14	603,026	6,947,255	-	moose droppings	site 4: birch/alder/lab tea habitat
9-Sep	-	15	603,005	6,947,355	-	moose droppings	site 4: birch/alder/lab tea habitat
9-Sep	-	16	603,057	6,947,386	-	moose droppings	site 4: birch/alder/lab tea habitat
9-Sep	-	17	602,943	6,947,575	-	moose droppings	site 5: bl. Spruce/sphagnum moss/lab tea/ willow stand
9-Sep	-	18	602,974	6,947,629	-	moose droppings	site 5: bl. Spruce/sphagnum moss/lab tea/ willow stand
9-Sep	-	19	602,916	6,947,834	-	spruce grouse droppings	site 5: bl. Spruce/sphagnum moss/lab tea/ willow stand
9-Sep	-	21			-	gray jay	at Casino camp
10-Sep	-	22	599,973	6,943,490	-	bear scat	s-facing aspen/wh. spruce/bearberry/buffaloberry habitat
10-Sep	-	23			-	northern flicker	s-facing aspen/wh. spruce/bearberry/buffaloberry habitat
10-Sep	-	24	599,976	6,943,553	-	bear scat	s-facing aspen/wh. spruce/bearberry/buffaloberry habitat
10-Sep	-	25	599,969	6,943,506	-	bear scat	s-facing aspen/wh. spruce/bearberry/buffaloberry habitat
10-Sep	-	26	599,913	6,943,440	-	bear claw marks on aspen	s-facing aspen/wh. spruce/bearberry/buffaloberry habitat; photo 2180
10-Sep	-	27	599,893	6,943,498	-	bear claw marks on aspen	s-facing aspen/wh. spruce/bearberry/buffaloberry habitat
10-Sep	-	28	599,918	6,943,380	-	red squirrel midden, hare and grouse pellets	bl. spr/willow/lab tea habitat
10-Sep	-	29	600,028	6,943,296	-	moose droppings	bl. spr/willow/lab tea habitat
10-Sep	-	30			-	tundra swans on oxbow lake	same oxbow as wypt 497 moose
10-Sep	-	31	620,421	6,951,948	-	moose droppings	Rude Creek airstrip; aspen/spr habitat; photos 2191 and 2192
10-Sep	-	32	620,197	6,951,895	-	moose droppings	Rude Creek airstrip; aspen/spr habitat; photos 2191 and 2192
10-Sep	-	33	620,198	6,951,819	-	moose droppings	Rude Creek airstrip; aspen/spr habitat; photos 2191 and 2192
10-Sep	-	34	620,207	6,951,834	-	bear scat	Rude Creek airstrip; aspen/spr habitat; photos 2191 and 2192
10-Sep	-	35	620,207	6,951,822	-	bear scat	Rude Creek airstrip; aspen/spr habitat; photos 2191 and 2192
10-Sep	-	36	620,352	6,951,932	-	fox scat	Rude Creek airstrip; aspen/spr habitat; photos 2191 and 2192
10-Sep	-	37	620,670	6,952,004	-	bear ant log	bl. spr/willow/lab tea habitat
10-Sep	-	38	620,653	6,951,979	-	moose droppings	bl. spr/willow/lab tea habitat
10-Sep	-	39	620,614	6,951,984	-	moose droppings	bl. spr/willow/lab tea habitat
10-Sep	-	40	620,666	6,951,804	-	spruce grouse	bl. spr/willow/lab tea habitat
10-Sep	-	41	620,655	6,941,809	-	spruce grouse	site 3: bl. spr/sphagnum moss/bog cranberry habitat; photos 2205 and 2206
10-Sep	-	42	620,633	6,951,755	-	red squirrel midden	site 3: bl. spr/sphagnum moss/bog cranberry habitat; photos 2207
10-Sep	-	43	620,679	6,951,765	-	red squirrel midden	site 3: bl. spr/sphagnum moss/bog cranberry habitat
10-Sep	-	44	620,645	6,951,693	-	red squirrel midden; moose pellets	site 3: bl. spr/sphagnum moss/bog cranberry habitat
10-Sep	-	45	620,632	6,951,572	-	moose droppings	trail to Placer camp
10-Sep	-	46	620,600	6,951,584	-	moose droppings	trail to Placer camp

Appendix C3. Wildlife Survey Data, Casino Project, 2008

Date	Time	Waypoint	Easting	Northing	Elevation (m)	Species	Comments
10-Sep	-	47	620,563	6,951,603	-	moose droppings	trail to Placer camp
10-Sep	-	48	620,531	6,951,566	-	moose antler	trail to Placer camp
10-Sep	-	49	620,501	6,951,569	-	moose droppings	trail to Placer camp
10-Sep	-	50	620,617	6,951,610	-	moose droppings	trail to Placer camp
10-Sep	-	51	620,729	6,951,611	-	wolf scat	trail to Placer camp
10-Sep	-	52	620,788	6,951,631	-	bear scat	trail to Placer camp
10-Sep	-	53	620,813	6,951,652	-	bear scat	trail to Placer camp
10-Sep	-	54	620,788	6,951,635	-	moose droppings	trail to Placer camp
10-Sep	-	55	620,871	6,951,669	-	moose droppings	trail to Placer camp
10-Sep	-	56	608,648	6,945,807	-	moose droppings	bl. spr/sphagnum moss/lab tea habitat
10-Sep	-	57	608,637	6,945,816	-	moose droppings	bl. spr/sphagnum moss/lab tea habitat
10-Sep	-	58	608,536	6,946,054	-	spruce grouse pellets	site 4: bl. spr/bog cranberry/lab tea habitat
10-Sep	-	59	608,530	6,946,045	-	porcupine chewings	site 4: bl. spr/bog cranberry/lab tea habitat
10-Sep	-	60	608,516	6,946,081	-	red squirrel midden	site 4: bl. spr/bog cranberry/lab tea habitat
10-Sep	-	61	608,503	6,946,116	-	red squirrel midden	site 4: bl. spr/bog cranberry/lab tea habitat
10-Sep	-	62	608,468	6,946,117	-	moose droppings	site 4: bl. spr/bog cranberry/lab tea habitat
10-Sep	-	63	611,661	6,973,470	-	bear scat	site 5: poplar/rose/Viburnum habitat on island in Yukon River
10-Sep	-	64	611,574	6,973,561	-	beaver sign	site 5: poplar/rose/Viburnum habitat on island in Yukon River
10-Sep	-	65	611,563	6,973,571	-	moose droppings	site 5: poplar/rose/Viburnum habitat on island in Yukon River
10-Sep	-	66	-	-	-	caribou pellets	site 5: poplar/rose/Viburnum habitat on island in Yukon River
10-Sep	-	67	611,453	6,973,646	-	beaver sign	site 5: poplar/rose/Viburnum habitat on island in Yukon River
10-Sep	-	68	613,775	6,972,974	-	bear scat	site 6: birch/rose/Equisetum/Viburnum habitat on island in Yukon River; photo 2224
10-Sep	-	69	613,762	6,972,998	-	bear scat	site 6: birch/rose/Equisetum/Viburnum habitat on island in Yukon River; photo 2228
10-Sep	-	70	613,749	6,973,104	-	moose droppings	site 6: birch/rose/Equisetum/Viburnum habitat on island in Yukon River
10-Sep	-	71	613,797	6,973,120	-	moose antler	site 6: birch/rose/Equisetum/Viburnum habitat on island in Yukon River
10-Sep	-	72	613,752	6,973,016	-	2 bear scats	site 6: birch/rose/Equisetum/Viburnum habitat on island in Yukon River; photo 2230
11-Sep	-	73			-	chipmunk	barge landing
11-Sep	-	74	635,391	6,957,527	-	northen bog lemming burrows	site 1: bl. spr/willow/bog cranberry/lab tea habitat
11-Sep	-	75	635,320	6,957,581	-	spr. grouse pellets	site 1: bl. spr/willow/bog cranberry/lab tea habitat
11-Sep	-	76	635,312	6,957,606	-	caribou pellets	site 1: bl. spr/willow/bog cranberry/lab tea habitat
11-Sep	-	77	635,314	6,957,666	-	caribou pellets	site 1: bl. spr/willow/bog cranberry/lab tea habitat
11-Sep	-	78	635,328	6,957,650	-	bear scat	site 1: bl. spr/willow/bog cranberry/lab tea habitat
11-Sep	-	79			-	caribou	near wypt 51 in alpine tundra habitat; photos
11-Sep	-	80	611,848	6,959,863	-	caribou pellets	site 2: dwarf birch/willow/moss/lichen habitat
11-Sep	-	81	611,739	6,959,552	-	moose droppings	site 2: dwarf birch/willow/moss/lichen habitat
11-Sep	-	82	611,747	6,959,541	-	bear scat	site 2: dwarf birch/willow/moss/lichen habitat
11-Sep	-	83	611,799	6,959,416	-	caribou pellets; bear scat	near tank farm
11-Sep	-	84	610,189	6,958,862	-	caribou pellets	near tank farm
11-Sep	-	85	610,115	6,958,851	-	bear scat	near tank farm
11-Sep	-	86	610,102	6,958,855	-	caribou pellets	near tank farm
11-Sep	-	87	610,091	6,958,858	-	moose droppings	near tank farm
11-Sep	-	88	610,032	6,958,883	-	caribou pellets	near tank farm
11-Sep	-	89	609,927	6,958,989	-	caribou pellets	near tank farm
11-Sep	-	90	609,963	6,958,929	-	caribou pellets	near tank farm
11-Sep	-	91	609,440	6,947,118	-	bull moose	jctn Dip and Casino Ck
11-Sep	-	92	609,872	6,947,252	-	bear scat	jctn Dip and Casino Ck

Notes:

Dashes indicate no data were available.