



Water Quality Monitoring Annual Report 2015



Klondike Watershed

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Water Quality Objective Monitoring, Klondike River Basin, 2015

Hydrologic and Geomorphic Characteristics of the Klondike River Drainage Basin

The Klondike River, a major tributary to the Yukon River, drains an area of approximately 7800 square kilometers and has an overall channel length, including the North Klondike River, of approximately 160 Km.

The North Klondike River, a tributary of the Klondike River, drains an area of approximately 1100 square kilometers. From its headwaters in the Ogilvie Mountains, the North Klondike flows in a southerly direction for approximately 75 kilometers until its confluence with the Klondike. It then flows west, down the valley as the Klondike for approximately 42 kilometers until it joins the Yukon River near Dawson. The North Klondike, for its first 58 kilometers, flows through a narrow valley entrenched between high mountains, the remaining length of the Klondike River flows south through relatively flat topography. The banks of the river are stable with relatively little erosion except during flood periods.

Water Survey of Canada's gauging stations are located near the mouth of the north Klondike (09EA004, Km 9.5 Dempster Highway), and at the mouth of the Klondike River (09EA003) near Dawson.

North Klondike

Topographical drainage Basin	1100 Sq. Kilometers
Area of Lakes	<2%
Area of Forest	<44%
Channel Length	76.5 Kilometers
Terrain	glaciated

Klondike

Topographical drainage Basin	7800 Sq. Kilometers
Area of Lakes	<1%
Area of Forest	<30%
Channel Length	160 Kilometers
Terrain	Left Limit: non-glaciated Right Limit: glaciated

In 2015, water samples were collected at 24 sites in the Klondike River basin. Sampling commenced on May 11, 2015 and 389 samples were collected up until the end of the season on September 30, 2014. A combination of automatic composite sampling and grab sampling methods were used in the basin. In addition to automated sampling equipment, newly acquired level monitoring instrumentation was installed at two sites, on Bonanza Creek, just upstream of the confluence with the Klondike River and on Hunker Creek, upstream of the highway crossing which is below all mining (BAM). This new monitoring equipment has provided us with additional data that correlates with the precipitation data collected via our portable weather stations and has allowed us to derive changes in stream flow and water velocity at these sites. An additional 142 samples were collected by CMI staff during routine mine inspections.

Atmospheric data was collected using two portable weather stations located at Hunker Creek and Bonanza Creek, both below all mining. Additional information was provided through the Yukon Government Community Services weather station at the Klondike Fire Center, located at the Dawson City Airport.

Blitz sampling events took place in the Klondike River basin on several occasions throughout the 2015 field season.

Basin total flow data was provided to us by the Water Survey of Canada station located near the mouth of the Klondike River. Flow data for the individual tributaries to the Klondike River was collected at the time of sampling by the staff of E.M.R CMI using the methodology outlined in the Yukon Placer Secretariat's, Water Quality Monitoring Protocol.

Site Codes and Global Position of Water Quality Sampling Locations in the Klondike River Watershed

SITE DESCRIPTION	SITE CODE	LATITUDE_DD	LONGITUDE_DD
Klondike River mouth	KL01	64.05348	-139.43961
Klondike River upstream of Bonanza Creek	KL02	64.04311	-139.40936
Klondike River upstream of Hunker Creek	KL03	64.03619	-139.20204
Klondike River downstream of Goring Creek and upstream of Hunker Creek	KL04	64.05810	-139.03092
Klondike River at Dempster Highway	KL05	63.99030	-138.74612
Klondike River downstream of Too Much Gold Creek and upstream of Dempster highway	KL06	63.95778	-138.69030
Klondike River upstream of Too Much Gold Creek	KL07	63.95131	-138.66690
Klondike River at highway washout downstream of Flat Creek	KL08	63.95782	-138.69005
North Klondike River upstream of confluence with Klondike River	KL_NK01	64.00195	-138.59622
Adams Creek mouth	KL_BO_AD01	63.93412	-139.33099
All Gold Creek below all mining	KL_AL01	63.94263	-138.61734
Eldorado Creek mouth	KL_BO_EL01	63.91943	-139.31390
Eldorado Creek Left Fork	KL_BO_EL06	63.86261	-139.24573
Eldorado Creek Right Fork	KL_BO_EL05	63.86261	-139.24573
Eldorado Creek downstream of French Gulch	KL_BO_EL02	63.91267	-139.31483
Eldorado Creek upstream of French Creek	KL_BO_EL03	63.90855	-139.31382
Upper Eldorado Creek background	KL_BO_EL04	63.86187	-139.24578
Flat Creek below all mining	KL_FL01	63.94308	-138.60225
French Gulch mouth	KL_BO_EL_FR01	63.90865	-139.31442
Goldbottom Creek mouth	KL_HU_GO01	63.96433	-138.96706
Last Chance Creek mouth	KL_HU_LA01	64.01050	-139.09091
Too Much Gold Creek mouth	KL_TO01	63.95132	-138.66708
Victoria Gulch mouth	KL_BO_VI01	63.91261	-139.20930
Bonanza Creek below all mining	KL_BO01	64.04054	-139.40814
Lower Bonanza Creek	KL_BO02	64.01295	-139.37022
Lower Bonanza Creek downstream of bridge	KL_BO03	63.97027	-139.35472
Bonanza Creek downstream of Adams Gulch	KL_BO04	63.93550	-139.32798
Bonanza Creek upstream of Adams Gulch	KL_BO05	63.93415	-139.32977
Bonanza Creek downstream of Eldorado Creek	KL_BO06	63.92047	-139.31600
Upper Bonanza Creek upstream of Eldorado Creek	KL_BO07	63.91943	-139.31390
Upper Bonanza Creek upstream of Victoria Gulch	KL_BO08	63.91261	-139.20930
Hunker Creek below all mining	KL_HU01	64.02943	-139.17867
Hunker Creek mouth - most upstream fork	KL_HU01C	64.03619	-139.20204
Hunker Creek mouth fork with multiple channels - larger creek bed	KL_HU01B	64.03592	-139.20201
Hunker Creek mouth behind Fischer's gas station	KL_HU01A	64.03382	-139.20634
Hunker Creek downstream of Henry Gulch	KL_HU02	64.02838	-139.17522
Hunker Creek downstream of Last Chance Creek	KL_HU03	64.01345	-139.09187
Hunker Creek upstream of Last Chance Creek	KL_HU04	64.01050	-139.09091
Hunker Creek downstream of Goldbottom Creek	KL_HU05	63.96918	-138.98291
Hunker Creek upstream of Goldbottom Creek	KL_HU06	64.96433	-138.96706
Hunker Creek above all mining left fork	KL_HU07	63.91105	-138.88522
Hunker Creek right fork	KL_HU08	63.89025	-138.92522
Hunker Creek above all mining and downstream of right and left fork	KL_HU09	63.91503	-138.88501

Water Quality Objective monitoring, Klondike River Watershed – Summary

Because of extensive monitoring activities conducted in this watershed between 2004 and 2014, which provided vast amounts of data for comparative purposes, and due to a large number of both active and historic mines in the drainage area, the Klondike River Watershed was once again designated a ‘watershed of interest’ for monitoring in 2015.

Two automatic water-sampling stations, two portable weather-monitoring stations and two level loggers were set up and maintained from May 27, 2015 until shutdown on September 30, 2015. Water sampling sites in the Klondike received multiple visits during the monitoring season owing to their close proximity to Dawson.

From the data obtained by these instruments and through on site visits and sampling conducted by CMI staff, the following observations regarding the water quality in the basin can be made:

On average, at the four Klondike River sites monitored during the 2015 season, the water quality of the Klondike River, met the minimum objectives set under the *Fish Habitat Management System* 72% of the time. All of the exceedances of the minimum water quality objectives (WQO) occurred during spring runoff, from the end of May to the beginning of June.

Out of the 343 water samples collected at the remaining 21 Klondike Watershed sites monitored during the 2014 season, the water quality met the minimum objectives set under the *Fish Habitat Management System* 72% of the time. Most of the exceedances of the WQO were recorded at Hunker and Bonanza Creeks with the majority on Hunker Creek at the highway crossing, below all mining.

On those occasions when the WQO were not met and the Total Suspended Solids levels were greater than the objectives, a direct correlation between environmental conditions and the volume of solids in the water was observed. In most cases, rainfall, as either localized events or basin wide occurrences, increased the amount of surface run off and subsequent soil erosion from the land, increasing the input of sediment into the receiving waters. These increases occurred simultaneously at the time of the rain event or immediately in a period of one or two days after the rain event, as surface water continued draining from the land and ground water infiltrated the watercourse.

Increases in sediment-laden ground and surface water entering the system add to the amount of sediment in the water. The ability of the receiving water to dilute these inputs of sediment is negated by the re-suspension of streambed material and by the further erosion of the streams banks that occurs along with the increased flows that are generated by the aftermath of these rain events.

Water Quality Objective monitoring, Klondike River Watershed – Summary Cont.

A heavy, fast running spring freshet and several major precipitation events lead to increased flows and sediment input as well as the re-suspension and further erosion of stream bed & bank material. This additional material lead to a **decrease in overall water quality for the Klondike River in 2015**. The seasonal average TSS of the Klondike River in 2015 was 23.2 mg/L, which is 5.6 mg/L higher than in 2014 when on average it was running at 17.6 mg/L.

It is important to note that the water quality at site KL_HU01, which is below all mining and the last point of measurement on Hunker Creek before the creek crosses under the highway, Total Suspended Solids Analysis of samples collected at this site were usually above the WQO of 80 mg/L, on average running at 283 mg/L. After Hunker creek passes under the highway through culverts, it drains into a short straight 100-meter channel, which then discharges into a braided, multichannel wetland, eventually draining through three distinct channels and several indistinct points into the Klondike River. Between the highway and the Klondike River, more than 80% of the solids settle out in this braided wetland area, entering the receiving waters of the Klondike. The average discharge directly into the Klondike River from these multiple point and non-point sources was 46 mg/L, still well below the water quality objective of 80 mg/L.

The Fish Habitat Management System - Klondike River Watershed (Category A)
 Sample Results that Exceed Water Quality Objectives for 2015

Sampling Station	KL01	KL_BO01	KL02	KL_HU01 AT HWY XING	KL_HU01A, KLONDIKE CONFL.	KL03	KL05	KL06	KL_NK01	KL_FL01
Location Description	Mouth	BAM	u/s KL_BO01	BAM	Mouth	u/s KL_HU01	at dempster hwy	u/s dempster hwy	u/s of Klondike R	Mouth
Sample Type	Grab	Auto/Grab	Grab	Auto/Grab	Auto/Grab	Grab	Grab	Grab	Auto/Grab	Grab
Lat Y	64.05348	64.04054	64.04237	64.02943	64.03382	64.03529	63.99030	63.95778	64.00195	63.94316
Long X	-139.43961	-139.40814	-139.40956	-139.17867	-139.20634	-139.20909	-138.74612	-138.69030	-138.59622	-138.60188
Habitat Classification	Area of special consideration	Moderate-L	Area of special consideration	Moderate-L	Moderate-L	High	High	High	High	Moderate-L
Water Quality Objective (mg/L)	25	80	25	80	80	25	25	25	25	80
Date of Sampling										
11-May-15							106.0		32.0	166.0
27-May-15	96.0	35.6	86.8							
28-May-15	70.0	17.0	65.6	40.8	27.6		55.6		68.5	14.5
29-May-15		227.1								
4-Jun-15		1376		44.8						
5-Jun-15		180.8		58.7						
16-Jun-15	8.4	7.6	25.2	17.7						
26-Jun-15		31.2		116.0						
28-Jun-15		12.0		138.0						
2-Jul-15		8.8		187.2						
12-Jul-15		73.3		683.0						
13-Jul-15		377.0		2160.0						
14-Jul-15		2463.0		4157.0						
15-Jul-15		203.3		1257.3						
16-Jul-15		61.5		1070.7						
17-Jul-15		138.7		243.3						
18-Jul-15		97.3		704.0						
19-Jul-15		25.0		208.7						
20-Jul-15		18.8		204.0						
21-Jul-15		17.6		285.3						
22-Jul-15		36.0		134.7						
23-Jul-15		13.0		114.7						
24-Jul-15		10.5		139.3						
25-Jul-15		14.0		110.0						
26-Jul-15		29.5		418.7						
27-Jul-15	6.0	27.5	4.0	420.0	39.5					
28-Jul-15	4.8	82.0	5.6	87.2			5.2		12.0	4.5
29-Jul-15		612.8		142.0						
30-Jul-15		204.0		349.6						
31-Jul-15		75.2		156.4						
1-Aug-15		66.4		141.2						
2-Aug-15		28.0		109.2						
3-Aug-15		18.0		88.0						
7-Aug-15		11.6		91.6						
8-Aug-15		16.4		80.4						
18-Aug-15		135.2		58.4						
19-Aug-15		804.4		643.2						
20-Aug-15		223.8								
21-Aug-15		123.6		267.6						
22-Aug-15		48.0		98.4						
23-Aug-15		166.0		51.2						
24-Aug-15		278.8		148.4						
25-Aug-15	15.6	75.2	77.6	861.2	38.4		13.2		21.2	15.6
26-Aug-15		49.2		260.0						
27-Aug-15		621.6		152.8						
28-Aug-15		605.6		660.8						
29-Aug-15		288.8		4230.0						
30-Aug-15		146.8		1266.8						
31-Aug-15		70.4		967.6						
1-Sep-15		41.6		342.8						
2-Sep-15		32.0		223.6						
3-Sep-15		15.6		112.0						
4-Sep-15		18.4		128.8						
5-Sep-15		33.2		127.6						
6-Sep-15		20.4		119.2						
7-Sep-15		27.6		237.2						
8-Sep-15		36.8		239.6						
9-Sep-15	1.6	12.4	8.4	2070.0			4.4		21.2	5.6
10-Sep-15	6.4	9.6	18.4	1216.4	54.0					
11-Sep-15		15.0		293.6						
12-Sep-15		22.4		283.6						
13-Sep-15		12.8		388.0						
14-Sep-15		11.2		154.8						
15-Sep-15		14.4		188.4						
16-Sep-15		10.8		105.6						
17-Sep-15		29.2		123.6						
18-Sep-15		17.2		286.8						
20-Sep-15		10.8		112.8						
22-Sep-15		8.0		113.6						
23-Sep-15		5.6		90.4						
25-Sep-15		43.6		138.8						
26-Sep-15		12.4		110.8						
29-Sep-15		6.4	4.0	30.4						
Total Seasonal Average TSS (mg/L) by site	18.5	87.5	26.5	283.3	39.9		2.8	25.2	25.1	4.8
Number of days sampled	14	126	12	112	4		8		8	8

Legend

Not continuously monitored

Water Samples that are: Above / Below the Water Quality Objective