

Water Quality Objective Monitoring, Klondike River Basin, 2010

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 River flows in a southerly direction for approximately 75 kilometers until its confluence with the Klondike River. It then flows west, down the valley as the Klondike River for approximately 42 kilometers until it joins the Yukon River near Dawson.

The North Klondike River, 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 River (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 2010, water samples were collected at 16 different sites in the Klondike River basin. Sampling commenced on May 18th, 2010 and a total of 406 samples were collected up until the end of the season on September 29th, 2010. A combination of automatic composite sampling and grab sampling methods were used in the basin.

Atmospheric data was collected using two portable weather stations, one located near the mouth of Bonanza Creek, the other at the North Klondike Fork. 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 May 18th, June 21st & 22nd, August 10th & 30th and September 30th 2010.

Basin total flow data was provided 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 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 Code | Alias | Location | Latitude | Longitude |
|---------------|------------|---|-----------|-------------|
| KL01 | K 01 | Klondike River mouth | 64.053480 | -139.439610 |
| KL02 | K 02 | Klondike River upstream of Bonanza Creek | 64.043110 | -139.409360 |
| KL03 | K 03 | Klondike River at Marcells Sauna | 64.047050 | -139.126740 |
| KL04 | K 04 | Klondike River downstream of Goring Creek and upstream of Hunker Creek | 64.058100 | -139.030917 |
| KL05 | K 05 | Klondike River at Dempster Highway | 63.990300 | -138.746120 |
| KL06 | K 06 | Klondike River downstream of Too Much Gold Creek and upstream of Dempster highway | 63.957776 | -138.690301 |
| KL07 | K 07 | Klondike River upstream of Too Much Gold Creek | 63.951313 | -138.666902 |
| KL08 | K 08 | Klondike River at highway washout downstream of Flat Creek | 63.957817 | -138.690050 |
| KL_NK01 | KN 01 | North Klondike River upstream of confluence with Klondike River | 64.001950 | -138.596220 |
| KL_BO_AD01 | K ADAM 01 | Adams Creek mouth | 63.934120 | -139.330990 |
| KL_AL01 | K ALLG 01 | All Gold Creek below all mining | 63.942630 | -138.617340 |
| KL_BO_EL01 | K ELDO 01 | Eldorado Creek mouth | 63.919430 | -139.313900 |
| KL_BO_EL06 | K ELDO 01A | Eldorado Creek Left Fork | 63.862610 | -139.245730 |
| KL_BO_EL05 | K ELDO 01B | Eldorado Creek Right Fork | 63.862610 | -139.245730 |
| KL_BO_EL02 | K ELDO 02 | Eldorado Creek downstream of French Gulch | 63.912670 | -139.314830 |
| KL_BO_EL03 | K ELDO 03 | Eldorado Creek upstream of French Creek | 63.908550 | -139.313817 |
| KL_BO_EL04 | K ELDO 04 | Upper Eldorado Creek background | 63.861867 | -139.245783 |
| KL_FL01 | K FLAT 01 | Flat Creek below all mining | 63.943080 | -138.602250 |
| KL_BO_EL_FR01 | K FREN 01 | French Gulch mouth | 63.908650 | -139.314417 |
| KL_HU_GO01 | K GOLDB 01 | Goldbottom Creek mouth | 63.964330 | -138.967060 |
| KL_HU_LA01 | K LAST 01 | Last Chance Creek mouth | 64.010500 | -139.090910 |
| KL_TO01 | K TOO 01 | Too Much Gold Creek mouth | 63.951317 | -138.667083 |
| KL_BO_VI01 | K VIC 01 | Victoria Gulch mouth | 63.912610 | -139.209300 |
| KL_BO01 | KB 01 | Bonanza Creek below all mining | 64.040540 | -139.408140 |
| KL_BO02 | KB 02 | Lower Bonanza Creek | 64.012950 | -139.370217 |
| KL_BO03 | KB 03 | Lower Bonanza Creek downstream of bridge | 63.970267 | -139.354717 |
| KL_BO04 | KB 04 | Bonanza Creek downstream of Adams Gulch | 63.935500 | -139.327983 |
| KL_BO05 | KB 05 | Bonanza Creek upstream of Adams Gulch | 63.934150 | -139.329770 |
| KL_BO06 | KB 07 | Bonanza Creek downstream of Eldorado Creek | 63.920467 | -139.316000 |
| KL_BO07 | KB 08 | Upper Bonanza Creek upstream of Eldorado Creek | 63.919430 | -139.313900 |
| KL_BO08 | KB 09 | Upper Bonanza Creek upstream of Victoria Gulch | 63.912610 | -139.209300 |
| KL_HU01 | KH 01 | Hunker Creek below all mining | 64.029430 | -139.178670 |
| KL_HU02 | KH 02 | Hunker Creek downstream of Henry Gulch | 64.028383 | -139.175217 |
| KL_HU03 | KH 04 | Hunker Creek downstream of Last Chance Creek | 64.013450 | -139.091870 |
| KL_HU04 | KH 05 | Hunker Creek upstream of Last Chance Creek | 64.010500 | -139.090910 |
| KL_HU05 | KH 06 | Hunker Creek downstream of Goldbottom Creek | 63.968800 | -138.982240 |
| KL_HU06 | KH 08 | Hunker Creek upstream of Goldbottom Creek | 64.964330 | -138.967060 |
| KL_HU07 | KH 09 | Hunker Creek above all mining left fork | 63.911050 | -138.885217 |
| KL_HU08 | KH 10 | Hunker Creek right fork | 63.890250 | -138.925217 |
| KL_HU09 | KH 11 | Hunker Creek above all mining and downstream of right and left fork | 63.915030 | -138.885010 |

Water Quality Objective monitoring, Klondike River Watershed – Summary

Because of extensive monitoring activities conducted in this watershed between 2004 and 2009 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 ‘*major*’ watershed for monitoring in 2010.

Four automatic water sampling stations were set up and maintained from May 21st 2010 until shutdown on September 23rd 2010, as well as two portable weather monitoring stations. Water sampling sites in the Klondike received multiple visits during the monitoring season due to their close proximity to Dawson.

From the data obtained by these instruments and through on site visits and sampling conducted by employees of the Department of Energy, Mines and Resources Client Services and Inspections Branch, the following observations regarding the water quality in the basin can be made:

On average, the water quality in the basin, met the minimum objectives set under the *Fish Habitat Management System* throughout the monitoring season. 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, rain fall, either as localised 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 water course.

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 stream bed 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.

All of these factors; precipitation leading to increased sediment input and increased flows from these rain events re-suspending and further eroding material, lead to an increase in suspended solids concentrations in 2010 when compared with the results from 2009 and a very slight decrease in overall water quality. The seasonal average TSS for 2010 was < 25 mg/L which is approximately 10 mg/L higher than 2009.

**The Fish Habitat Management System - Klondike River Watershed (Category A)
Sample Results that Exceed Water Quality Objectives for 2010**

| Sampling Station | KL01 | KL_BO01 | KL02 | KL_HU01 | KL04 | KL05 | KL06 | KL_NK01 | KL_FL01 |
|--|-------------------------------|------------|-------------------------------|------------|-------------|-----------------|------------------|-------------------|------------|
| Location Description | Mouth | BAM | u/s KL_BO01 | BAM | 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 | Grab | Grab | Grab | Auto/Grab | Grab |
| Lat Y | 64.05348 | 64.04054 | 64.04237 | 64.02943 | 64.05810 | 63.99030 | 63.95778 | 64.00195 | 63.94316 |
| Long X | -139.43961 | -139.40814 | -139.40956 | -139.17859 | -139.03092 | -138.74612 | -138.69030 | -138.59622 | -138.60188 |
| Habitat Classification | Area of special consideration | Moderate-L | Area of special consideration | Moderate-L | High | High | High | High | Moderate-L |
| Water Quality Objective (mg/L) | 25 | 80 | 25 | 80 | 25 | 25 | 25 | 25 | 80 |
| Date of Sampling | | | | | | | | | |
| 18-May | 326.0 | 3.7 | 27.1 | 39 | | 21.5 | | | 4.4 |
| 20-May | 86.1 | | 80.6 | 29.5 | | | | 24.9 | |
| 21-May-10 | | 8.0 | | 32.3 | | | | 40.0 | |
| 22-May-10 | | 3.1 | | 32.2 | | | | 59.3 | |
| 23-May-10 | | 4.9 | | 30.2 | | | | 46.2 | |
| 24-May-10 | | 5.9 | | 24.7 | | | | 85.3 | |
| 25-May-10 | | 5.5 | | 37.6 | | | | 47.7 | |
| 26-May-10 | | 4.9 | | 32.2 | | | | 43.2 | |
| 27-May-10 | | 5.2 | | 17.8 | | | | 42.5 | |
| 28-May-10 | | 2.6 | | 14.6 | | | | 38.2 | |
| 29-May-10 | | 2.9 | | 11.2 | | | | 45.3 | |
| 30-May-10 | | 1.4 | | 10.6 | | | | 81.3 | |
| 31-May-10 | | 2.6 | | 19.4 | | | | 45.3 | |
| 1-Jun-10 | | 1.6 | | 10.6 | | | | 31.7 | |
| 2-Jun-10 | | 2.1 | | 11.0 | | | | 29.2 | |
| 3-Jun-10 | | 2.1 | | 8.2 | | | | 26.7 | |
| 4-Jun-10 | | 3.5 | | 10.0 | | | | 27.7 | |
| 11-Jun | | 4.9 | | 141.5 | | | | 4.2 | |
| 12-Jun | | 6.5 | | 131.3 | | | | 4.2 | |
| 13-Jun | | 3.5 | | 225.3 | | | | 4.8 | |
| 22-Jun | | 20.2 | | 99.3 | | 2.9 | | 2.4 | |
| 24-Jun-10 | | 280.7 | 138.4 | 110.0 | | | | 4.8 | |
| 25-Jun-10 | | 45.2 | 27.8 | 44.3 | | | | 1.2 | |
| 30-Jun-10 | | 25.7 | 25.8 | 52.3 | | | | 1.3 | |
| 13-Jul-10 | | 7.0 | 96 | 20.0 | | | | 4.3 | |
| 23-Jul-10 | | 73.0 | 117.3 | 87.7 | | | | 126.8 | |
| 24-Jul-10 | | 180.5 | 104.5 | | | | | 0.2 | |
| 25-Jul-10 | | 63.7 | 80.2 | | | | | 1.1 | |
| 3-Aug-10 | | 7.3 | 5.5 | 88.7 | | | | 0.1 | |
| 5-Aug-10 | | 8.4 | 3.5 | 97.3 | | | | 0.2 | |
| 18-Aug-10 | | 181.5 | 2.6 | 82 | | | | 4.1 | |
| 19-Aug-10 | | 370.8 | 3.9 | | | | | 4.1 | |
| 31-Aug-10 | | 95.0 | 4.6 | 39 | | | | 2.8 | |
| 1-Sep-10 | 4.3 | 54.3 | 2.4 | 91 | | | | 3.1 | |
| 2-Sep-10 | | 147.2 | 0.3 | 367 | | | | 2.5 | |
| 3-Sep-10 | | 123.7 | 3.8 | 41.5 | | | | 3.9 | |
| 16-Sep-10 | | 8 | 1 | 278.0 | | | | 0.6 | |
| 17-Sep-10 | | 4.7 | 2.7 | 144.6 | | | | 0.9 | |
| 18-Sep-10 | | 6.7 | 0.2 | 81.7 | | | | 0.5 | |
| Total Seasonal Average TSS (mg/L) by site | 15.2 | 22.5 | 11.5 | 44.5 | n/a | 6.6 | n/a | 9.9 | 3.7 |
| Number of days sampled | 9 | 118 | 96 | 119 | 0 | 4 | 0 | 110 | 3 |

Legend

Not continuously monitored
Water Samples that are: **Above** / **Below** the Water Quality Objective