

Water Quality Objective Monitoring, Stewart River Watershed, 2009

Hydrologic Characteristics of the Stewart River Drainage Basin

The Stewart River, a major tributary to the Yukon River, drains an area of approximately 51,000 square kilometres and has an overall channel length of approximately 533 km. The Stewart River is one of the principal tributaries of the Yukon River, flowing more than 480 kilometres from its headwaters in the Mackenzie Mountains and joining the Yukon River 112 kilometres above Dawson City. The river is navigable for most of its length and is a transportation route for lead ore from its upper reaches. It was explored (1850) by Robert Campbell of the Hudson's Bay Company

In 2009, water samples were collected at 12 different sites in the Stewart River basin. Sampling commenced on June 8th, 2009 and a total of 238 samples were collected up until the end of the season on September 16th, 2009. A combination of automatic composite sampling and grab sampling methods were used in the basin. An additional 80 samples were collected by E.M.R staff during routine mine inspections.

Atmospheric data was collected using three portable weather stations, one located near the mouth of the Stewart River, another near the mouth of Clear Creek and the last at a background site on the Stewart River.

Basin total flow data was provided to us by the Water Survey of Canada station located near the mouth of the Stewart River. Flow data for the individual tributaries to the Stewart River was collected at the time of sampling by the staff of E.M.R CS&I 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 Stewart River Watershed

SITE CODE	LOCATION	LAT_Y	LONG_X
ST 07	Stewart River background	63.45445	-136.94208
ST 06	Stewart River u/s Clear Creek	63.61183	-137.63992
ST 05	Stewart River u/s Maisy May Creek	63.23539	-138.81273
08-0729	unnamed LL trib for Stewart	63.20464	-138.82657
ST 04	Stewart River u/s Scroggie Creek	63.19949	-138.85118
ST 03	Stewart River u/s Barker Creek	63.18350	-138.90445
ST 02	Stewart River u/s Henderson Creek	63.35333	-139.46181
ST 01	Stewart River mouth	63.29113	-139.41042
ST BAR 01	Barker Ck Below All Mining BAM	63.17785	-138.89928
ST BLAC 01	Black Hills Creek Below All Mining (BAM)	63.32137	-138.76973
ST CLEA 01	Clear Creek	63.62825	-137.60947
ST CLEA 02	Clear Creek u/s highway bridge	63.62825	-137.60947
ST MAIS 01	Maisy May Creek mouth	63.25449	-138.84766
ST SCR 01	Scroggie Creek mouth	63.18696	-138.83366

Water Quality Objective Monitoring, Stewart River Watershed – Summary

Three automatic water sampling station and three weather stations were set up and maintained from June 19th, 2009 until shutdown on September 16th, 2009. Due to rapid changes in stream and river levels throughout the basin, on more than one occasion, water monitoring equipment was damaged or disabled and monitoring data was lost or not collected. Similar to the problems affecting water sampling equipment, weather stations were damaged or disabled by rapid changes in the monitoring environment. Some atmospheric data was lost or not collected due to the subsequent instrumentation failure.

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

The overall 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, there is a direct correlation to geological / environmental conditions influencing the amount of solids concentrations in the water.

A one day, basin wide rain event on July 2nd and then a long term rain event that began on August 14th and continued almost until the end of August had a huge detrimental effect on the water quality in the basin.

In most cases, rain fall, either as 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 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.

In addition to environmental factors influencing the water quality in the drainage (i.e. rapidly decreasing mean water levels, high volume, short and long term rain events, high mean daily temperatures further degrading permafrost effecting ground water penetration and releasing additional sediment into receiving waters), placer mining operations on both Barker and Black Hills Creek had an influence on the water quality of the Stewart River.

The Placer deposits found on both Barker and Black Hills Creek contain disproportionate fractions of extremely fine grained, colloidal material that is very hard to settle and is easily put into suspension. This sediment consists mostly of non-aggregated clays and organic material that when analysed produces extremely low levels of settleable solids versus abnormally high levels of suspended solids. Generally placer sediments found in and around the Klondike area

produce levels of Total Suspended solids (TSS) to Settleable Solids (SS) in a ratio of 1500 mg/L TSS: 1.0 ml/L SS. The material currently being mined or disturbed in the Stewart basin through the mining process produce TSS concentrations that are approximately 13000 mg/L TSS: 1.0 ml/L SS.

That being said, in **all cases** the mining licensees currently operating on both Barker and Black Hills Creek have discharged effluent levels well below their allowable effluent discharge permit level of 1.5 ml/l Settleable Solids (although high Total Suspended Solids concentrations were detected in the receiving waters of the Stewart River this past monitoring season).

**The Fish Habitat Management System -Stewart River Watershed (Category A)
Sample Results that Exceed Water Quality Objectives for 2009**

Sampling Station	ST 01	ST 02	ST BAR 01	ST 03	ST SCR 01	ST 04	ST CLEA 01	ST 06	ST 07	Other
Location Description	Mouth	u/s YN HEN 01	BAM	u/s ST BAR 01	Mouth	u/s ST SCR 01	Mouth	u/s ST CLEA 01	AAM	
Sample Type	Auto/Grab	Grab	Grab	Grab	Grab	Grab	Auto/Grab	Grab	Auto/Grab	
Lat Y	63.29113	63.35333	63.17785	63.18350	63.18696	63.19949	63.61630	63.61183	63.45445	
Long X	-139.41042	-139.46181	-138.89928	-138.90445	-138.83366	-138.85118	-137.64114	-137.63992	136.94208	
Habitat Classification	Moderate-H	Moderate-H	Moderate-L	High	Moderate-M	High	Moderate-H	High	High	
Water Quality Objective (mg/L)	25	25	80	25	50	25	25	25	25	
Date of Sampling										
06/08/09	179.0		727.0	138.0	0.5	160.0	0.9	111.5	200.5	
06/09/09	212.7									
06/10/09	283.7						1.8			
06/11/09	251.8									
06/12/09	153.0									
06/13/09	101.5									
06/14/09	108.5									
06/15/09	98.3									
06/16/09	138.2									
06/17/09	106.8									
06/18/09	108.1									
06/19/09	77.9						7.7		81.3	
06/20/09	84.1						34.0		86.2	
06/21/09	102.7						13.0		92.1	
06/22/09	86.7						4.1		79.6	
06/23/09	72.0						2.5		69.1	
06/24/09	45.5						3.9		70.5	
06/25/09							5.6		63.9	
06/26/09							6.6		56.1	
06/27/09							7.4		50.6	
06/28/09							4.6		51.4	
06/29/09							8.2		72.3	
06/30/09							6.2		73.1	
07/01/09							11.8		84.1	
07/02/09	27.5		15.5	25.5	4.0	34.9	2.0		46.1	
07/03/09	32.3						2.5		64.6	
07/04/09	30.3						0.5		95.8	
07/05/09							2.6		77.2	
07/27/09	4.0		390.0	2.3	3.1	3.4	1.3	4.0		
08/20/09	7.1						5.5		80.3	

**The Fish Habitat Management System -Stewart River Watershed (Category A)
Sample Results that Exceed Water Quality Objectives for 2009**

Sampling Station	ST 01	ST 02	ST BAR 01	ST 03	ST SCR 01	ST 04	ST CLEA 01	ST 06	ST 07	Other
Location Description	Mouth	u/s YN HEN 01	BAM	u/s ST BAR 01	Mouth	u/s ST SCR 01	Mouth	u/s ST CLEA 01	AAM	
Sample Type	Auto/Grab	Grab	Grab	Grab	Grab	Grab	Auto/Grab	Grab	Auto/Grab	
Lat Y	63.29113	63.35333	63.17785	63.18350	63.18696	63.19949	63.61630	63.61183	63.45445	
Long X	-139.41042	-139.46181	-138.89928	-138.90445	-138.83366	-138.85118	-137.64114	-137.63992	136.94208	
Habitat Classification	Moderate-H	Moderate-H	Moderate-L	High	Moderate-M	High	Moderate-H	High	High	
Water Quality Objective (mg/L)	25	25	80	25	50	25	25	25	25	
Date of Sampling										
08/21/09	75.8						1.3		94.2	
08/22/09	125.3						0.9		92.0	
08/23/09	130.3						1.9		60.7	
08/24/09	37.4						19.4		42.5	
08/25/09	57.1						16.2		31.3	
08/26/09	35.9						14.2		23.8	
08/27/09	35.3						3.4		19.5	
08/28/09	32.5								26.2	
08/29/09							4.8		31.8	
08/30/09	35.8						57.0		39.6	
08/31/09	49.4						71.2		34.5	
09/01/09	39.6						11.1		44.7	
09/02/09	45.0						8.6		53.0	
09/03/09	54.7						5.9		96.7	
09/04/09	94.6						4.8		67.0	
09/05/09	60.0						11.3		45.7	
09/06/09	41.6						24.1		42.7	
09/07/09	31.5						9.0		25.6	
09/08/09							6.0		25.7	
09/14/09	19.1		93.4	11.6	40.9	11.4	2.7	10.6		
Total Seasonal Average TSS (mg/L) by site	56.1		247.4	44.3	12.1	52.4	6.1	42.0	52.2	
Number of days sampled	64		5	4	4	4	90	3	45	

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