Coquitlam/Buntzen Project Water Use Plan

Temperature Monitoring Lower Coquitlam River Project – Year 3 Report

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Trow Associates Inc.
Temperature Monitoring Program
Lower Coquitlam River
Coquitlam, BC
Year 3 Report

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LOWER COQUITLAM RIVER
DRAFT Year 3 Report

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1.0 Background

Coquitlam Reservoir is a natural lake that was enlarged by the construction of a dam at the head of the Lower Coquitlam River. Waters from Coquitlam Reservoir are diverted through tunnels to Buntzen Lake, a reservoir that supplies water for two hydroelectric generation stations on Indian Arm, and to the Greater Vancouver Water District’s (GVWD) drinking water system. Releases of water are also directed to the Lower Coquitlam River to maintain the features and functions of this stream and its associated riparian habitat.

BC Hydro’s Coquitlam-Buntzen Water Use Plan, Monitoring Plan Terms of Reference – January 2006 (updated December 2007) specifies that a monitoring program be carried out to assess the effects of reservoir operations on downstream river temperatures in order to guide decisions made regarding the balancing of the three main demands on the Coquitlam-Buntzen system. As identified, the demands are habitat (primarily fish habitat) on the Lower Coquitlam River, domestic water supply, and hydroelectric power generation. Two components of the CBWUP monitoring program are infrastructure upgrades at the Coquitlam Reservoir, to allow regulated and variable flows from the low level outlets, and a series of monitoring programs, that will allow the assessment of various flow regimes being implemented over a nine year period.

The Lower Coquitlam River Temperature Monitoring Program (the Program) has the objective of determining if and how water temperatures in the Lower Coquitlam River are influenced by reservoir operations. The Program will run for four years (2006 to 2009 inclusive) and culminate in an analysis that will answer two questions:

1) Is there a significant correlation between lower Coquitlam River temperatures and Coquitlam Reservoir operations? and

2) Is there a significant difference between the reservoir to river temperature gradient and lake to river temperature gradient(s) in similar but unregulated lower Fraser River tributaries?

The Program was initiated in November, 2005 with the installation of five water and one air temperature data loggers in the Lower Coquitlam River. Together with operations data (water releases to the Lower Coquitlam River) and water temperature data for Coquitlam Reservoir, obtained from the GVWD, these data will be used to answer the first question. In 2006 a search was conducted to locate data on water temperatures from one or more unregulated lake-river tributaries on the lower Fraser River. Candidate systems included the Harrison, Pitt, Chilliwack, Chehalis and Cultus systems. Data from the unregulated systems would be analyzed with lake and river water temperature data from the Coquitlam system to answer the second question. See Figure 1 for the location of the Coquitlam system in the lower Fraser Valley and Figure 2 for details of the sampling locations in the Coquitlam system.

2.0 Data

Although the Program is set up to run between January 2006 and December 2009, there was a substantial amount of data for some components of the Coquitlam system dating back to approximately the year 2000. It was decided that available historical data would be checked, formatted and stored with the 2006-2009 data. For details on this historical data and 2006 data please see the Year 1 Report.

The Year 1 Report noted that, of the candidate systems, only the Chehalis and the Chilliwack systems are suitable for comparison to the Coquitlam due to the similar size of their lakes, and the
similar grade, channel width and length of their river components. See Figures 3 and 4 for details of the Chehalis and Chilliwack systems including the sampling locations.

2.1 Data Acquisition

Data on water releases to the Lower Coquitlam River, reservoir water surface elevation and water and air temperatures in the Lower Coquitlam River were provided by BC Hydro. Water and air temperature data for Coquitlam Reservoir were provided by the GVRD.

Water temperature data for Chilliwack River and Chehalis River were provided by Department of Fisheries and Oceans (DFO) fish hatcheries operated on each river. A limited amount of historical water temperature data was available from DFO for Chilliwack Lake, but no data from 2006 or earlier was identified for Chehalis Lake.

In response to the paucity of water temperature data available for Chilliwack and Chehalis Lakes, BC Hydro installed water temperature data loggers on both of these lakes in the summer of 2007. Due to uncertainty regarding the continuation of DFO water temperature monitoring program on Chilliwack River, BC hydro also installed two water temperature data loggers in the Chilliwack River in the summer of 2007. In December 2007, the Monitoring Plan Terms of Reference were amended to extend the program to the end of 2009 to compensate for the lack of 2006 data from a comparison system.

2.2 Data Quantity

A summary of 2008 data obtained for each of the systems is included in Table 1. As indicated in Table 1, hourly water temperature data were acquired for both Coquitlam Reservoir and the Lower Coquitlam River. For the Coquitlam Reservoir, hourly water temperature data is available for the following depths below reservoir surface (in metres): 1, 4, 6, 7, 8, 9, 10, 12, 15, 20, 25, 30, 40, and 50. Also available for the Coquitlam system were: mean daily air temperature and water release data for Coquitlam Reservoir; and Lower Coquitlam River mean daily discharge data. During the winter of 2007/2008 the air temperature data logger on the Lower Coquitlam River was lost and not replaced.

As shown in Table 1, available water temperature data for the Chilliwack system included daily data for the Chilliwack River at the DFO hatchery, and hourly data for the Chilliwack River (upstream from its confluence with Foley Creek) and in Chilliwack Lake near its outlet to Chilliwack River.

As shown in Table 1, available water temperature data for the Chehalis system included daily mean/minimum/maximum water temperature data for the Chehalis River at the DFO hatchery for the entire year and hourly data for Chehalis Lake (near the inlet of Skwellepil Creek) for the period June 5, 2008 to December 31, 2008. The water temperature data logger on Chehalis Lake was lost on December 3, 2007 when a debris slide entered the lake near the location of the logger. BC hydro contractors were not able to access Chehalis Lake to install a replacement logger until June of 2008.

2.3 Data Quality

Generally the quality of the water temperature and air temperature data for the three systems under study was found to be high. This was likely due in part to quality control and quality assurance procedures within the providing agencies (i.e. GVWD for Coquitlam Reservoir water
and air temperatures, and DFO for Chehalis and Chilliwack River water temperature data). Data loggers installed by BC Hydro in the Coquitlam River, Chilliwack River, Chilliwack and Chehalis Lakes are placed in pairs at each location. Comparison of the two data streams increases the likelihood that anomalous values (created in most instances by the data logger being out of the water), are detected and corrected.

Some types of errors are more easily detected than others. Spurious values are frequently encountered at either end of a data series, when the logger is recording air temperature instead of water temperature. Values recorded while the data logger is traveling to or from the site are easily detected upon graphing and are deleted from the series. Other errors such as instrument shift are harder to detect and can only effectively be rooted out by a careful system of field checks and duplicate instrumentation.

3.0 Data Presentation

Figure 5, shows the relationship between Coquitlam Reservoir water temperatures, Lower Coquitlam River water temperatures and total discharges to the Lower Coquitlam River from Coquitlam Lake for 2007. As noted above water temperature data for the Coquitlam Reservoir are available for depths ranging from one to 50 metres below the surface. As the water level in the Reservoir fluctuates, the thermistor chain providing the water temperature data for the Reservoir rises and falls with it, relative to fixed structures such as the dam low level outlets and fish valves. Since 2000, the maximum surface water elevation for the reservoir has been restricted to 149 metres above sea level (masl), due to dam safety concerns. Upon the completion of dam seismic upgrades in August 2008, the maximum allowable Reservoir water level increased to 155 masl. For Figure 5, it was important to display the water temperature in the Reservoir at the depth of the low level outlets and fish valves (approximately 139 to 140 masl). Two Reservoir water temperature curves are displayed; at 1 metre below surface and at the depth corresponding to the elevation of the low level outlets and fish valves (ranges from 6 to 9 metres below surface). Note that the largest discharges to the Lower Coquitlam River from Coquitlam Lake, in 2008, occurred late-April to early-May and late-September to December when there is little difference between near surface (1m depth) and temperatures in the 6 to 9 metre below surface strata of the Coquitlam Reservoir.

Figure 6, shows the relationship between total discharges to the Lower Coquitlam River from Coquitlam Lake and the discharge of the Lower Coquitlam River data location CQM-R7 (Environment Canada’s 08MH002 hydrometric station) for 2008. Note that natural inputs (from mainstem groundwater discharges and tributary inflow) maintained Coquitlam River discharges at 08mh002 from falling below one cubic metre per second despite the absence of discharges from the Coquitlam Lake during October and November 2008.

Figures 7 and 8, illustrate the lake and river water temperatures in the Chilliwack and Chehalis systems, respectively. For both systems, near-surface lake water temperatures and river temperatures are similar throughout the year with the largest difference occurring late summer and fall when near-surface lake temperatures are approximately 2 degrees Celsius higher than river temperatures.

Figure 9, compares 2008 water temperatures in the Coquitlam Reservoir (1 mbs) and at the depth corresponding to the elevation of the low level outlets and fish valves, with those in Chilliwack and Chehalis Lakes. In 2008 the late spring and summer surface water temperatures in the
Coquitlam Reservoir were consistently three to five degrees Celsius higher than surface water temperatures in both Chehalis Lake and Chilliwack Lake.

Figure 10, compares 2008 water temperatures in the Lower Coquitlam River with those in the Chehalis and Chilliwack Rivers. From June to mid-August 2008, water temperatures in the Lower Coquitlam River at CQM-R3 were lower than those in both the Chilliwack and Chehalis by approximately two to four degrees Celsius. Then in the fall of 2008 (October to December) water temperatures in the Coquitlam River were one to three degrees Celsius higher than those in the Chilliwack and Chehalis Rivers.

Daily average, minimum and maximum and monthly average, minimum and maximum values for all parameters at all sites are contained in Appendix B (electronic version only).

4.0 Future Data Requirements

Dependable programs are now in place to provide hourly water temperature data for: Coquitlam Reservoir (GVRD); Lower Coquitlam River (BC Hydro); Chilliwack Lake and River (BC Hydro); and Chehalis Lake (BC Hydro). Daily minimum, maximum and mean water temperature data will continue to be available for the Chehalis River as long as DFO funding for the hatchery there is renewed.

5.0 Closing

This summary is the third of four reports to be completed as part of the Temperature Monitoring Program on the Lower Coquitlam River. The Year 1, 2 and 3 Reports, have been comprised of a compilation and brief summary of available data. The Year 4 Report will include the statistical analyses required to answer the two questions outlined in the Background Section above.

6.0 References


MacNair, Jason. 2009. pers. comm. Water temperature data from Chehalis Lake, Chilliwack Lake and Chilliwack River (unpublished) 2008

Patterson, David. 2009. pers.comm. Water temperature data (unpublished) from Chilliwack River 2008. Fisheries and Oceans Canada (DFO), Simon Fraser University, Burnaby, BC.
Appendix A
Table and Figures
## Table 1. Location Details and Summary of Available Data for All Stations

<table>
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<th>System</th>
<th>Parameter</th>
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**Notes**
- n/a: data not available
- *: incomplete; missing more than 60 days data from year
- h: data available as hourly values
- mm: data available as daily minimum/maximum
- d: data available as daily averages
- i: data with irregular availability; spot values
Figure 5. 2008 Coquitlam Reservoir Releases, Coquitlam Reservoir Water Temperatures at 1m below surface and at elevation of Low Level and Fish Outlets and Lower Coquitlam River Water Temperatures
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Figure 10. 2008 Water Temperature for Lower Coquitlam River (reach 3), Chilliwack River, and Chehalis River
Appendix B
Daily and Monthly Average Data
(electronic version only)