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Haslam Lake Lang Creek Water Quality and Quantity Monitoring Program for 2013

Prepared for
Powell River Salmonid Enhancement Society
Funded by BC Timber Sales and
the Powell River Community Forest

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Summary

British Columbia Timber Sales and the Powell River Community Forest provide funds to the Powell River Salmonid Enhancement Society for monitoring water quality throughout the Haslam Lang Community Watershed. This report presents 2013 data (as well as selected 2010 through 2012 data to demonstrate trends) and discusses progress of the water quality monitoring program to date.

During 2013, the automated monitoring station located at the Salmon Enhancement Society Counting Station at the mouth of Lang Creek continued to record stage, rainfall, and water and air temperature on a continuous basis. The stage discharge curve prepared in 2012 data was used to determine flow. While the 2013 hydrograph followed the same trend as previous years, there were no peak flows recorded over 20 m3/s, less than ½ historic maximum discharge.

Bi-monthly, on-site sampling has continued at six strategic locations within the watershed throughout the 2013 season. This data provides an excellent historic record of special and temporal variability of water quality parameters. As well as capturing water quality data at distinct points in time at a number of locations, the repeated visits of the observer to sites throughout the watershed enhanced the understanding of local watershed health.

Water temperature recorders have been employed in 2013 on Anderson Creek, Blackwater Creek and at the hatchery on upper Lang Creek. This continuous temperature data is of high quality and provides important insights into temperature fluctuations during the critical maximum high water temperatures of summer. High summer water temperatures are likely a major source of stress on fish within Lang Creek. Enough data is available on a range of streams within the watershed that the dynamics of water temperature fluctuations are pretty well understood.

The pH meter was refurbished in February of 2013 increasing the reliability of that data. Newly collected data shows there is still a tendency for a swing from more acidic water in autumn-winter season to more alkaline water during the low summer flows. Salinity (EC) of water is low at all sites- approaching that of distilled water. There is a slight increase in EC during low flow periods in the summer when ground water makes up a greater portion of flow.

All digital data, well beyond what can be presented here, is archived at the office of the Powell River Salmonid Enhancement Society and can be made available to interested users.

Lidar data acquired by the Community Forest will be of considerable use for fish managers to more accurately locate small fish streams under the dense forest canopy of the watershed.

Some salmon returns data has been appended to this report. While positive trends in salmon returns are showing, the reason for increased populations is uncertain. The relationship between discharge and timing of stream flows and date of salmon returns needs further investigation. The importance of maintaining adequate release of water from the Haslam Lake weir becomes even more important with these earlier returns of salmon.

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I. INTRODUCTION

British Columbia Timber Sales (BCTS) and the Powell River Community Forest provided funding to the Powell River Salmon Enhancement Society in 2013 to monitor water quality within the Haslam Lang Watershed. The purpose of water quality monitoring is to

- provide information for resource management planning and decision making at the community, regional and federal level;
- establish baseline levels in support of specific criteria/objectives development and attainment reporting;
- provide information on the status, health, trends and uses of water resources;
- employ and train persons from local communities to foster interest and involvement in community watersheds.

This report presents a range of data collected during the 2013 monitoring season, makes some comparisons with historic data, comments on management significance of data and provides recommendations for ongoing monitoring.

II. BACKGROUND

The 12,800 ha watershed lies immediately east of Powell River confined to the drainages associated with Haslam Lake and Lang Creek. Elevations range from sea level at the mouth of Lang Creek to 1103 meters on Tin Hat Mountain. Most of the area falls within the Coastal Western Hemlock Biogeoclimatic zone. Douglas fir, red cedar, western hemlock and alder are the most common tree species found. Along the highest ridges on the north east portion of the watershed, one encounters the Mountain Hemlock Biogeoclimatic Zone. Most of the watershed has either been logged or burned in the last 80 years although small isolated patches of old growth remain. A network of forest roads is maintained within the watershed. An even more extensive network of old skid trails occurs at lower elevations throughout the watersheds and these are now used extensively for recreation activities.

Most of the watershed (excepting land immediately adjacent to lower Lang Creek) is comprised of crown land. Forestry for timber extraction is likely to be the major industrial use of the watersheds for the foreseeable future. Forest Development Plans have been drawn up, indicating future cutblocks and required access roads. The Ministry of Environment, Lands and Parks, (MoELP) completed the first Coastal Watershed Assessment Procedure (CWAP) in 1997. The results from this study indicated that the forest harvesting activities planned was conservative, and unlikely to influence hydrological characteristics of the watershed. Mining does not play much of a role on the area. Small rock quarries are used for the extraction of road ballast. Agriculture is restricted to a few small hobby farms along lower Lang Creek. Settlement (low density) is likewise confined to the southern strip adjacent to Lang Creek and even less so along the southern slopes of Haslam Lake. Being close to the population center of Powell River, the Haslam Lang area is popular with recreationists for riding ATVs, hiking, and non-motorized boating. Fisheries resources are substantial, particularly in the lower watershed. A large salmon population is supported along the course of Lang Creek within the lower 8 km of channel and adjacent tributaries. Major investment has been made in a fish hatchery, a counting station and

an artificial spawning channel on Lang Creek. In 2000, Lang Creek was classified as a sensitive stream because of its high fisheries values. In the summer of 2000, a second Coastal Watershed Assessment Procedure (CWAP) was carried out which supported the conclusions of the first CWAP. It also stressed that good management would be more important to the continued health of the watershed than the actual amount of watershed logged or roaded. The Community Forest, which is a major licensee, conducted an assessment of its roads positioned within the watershed area in 2009 which showed that the great majority of roads were being well managed. No substantial sediment sources from these roads or cutblocks had impacted water quality at the Powell River Water intake or on Lang Creek itself. Some of the more intractable management problems are related to recreation uses.

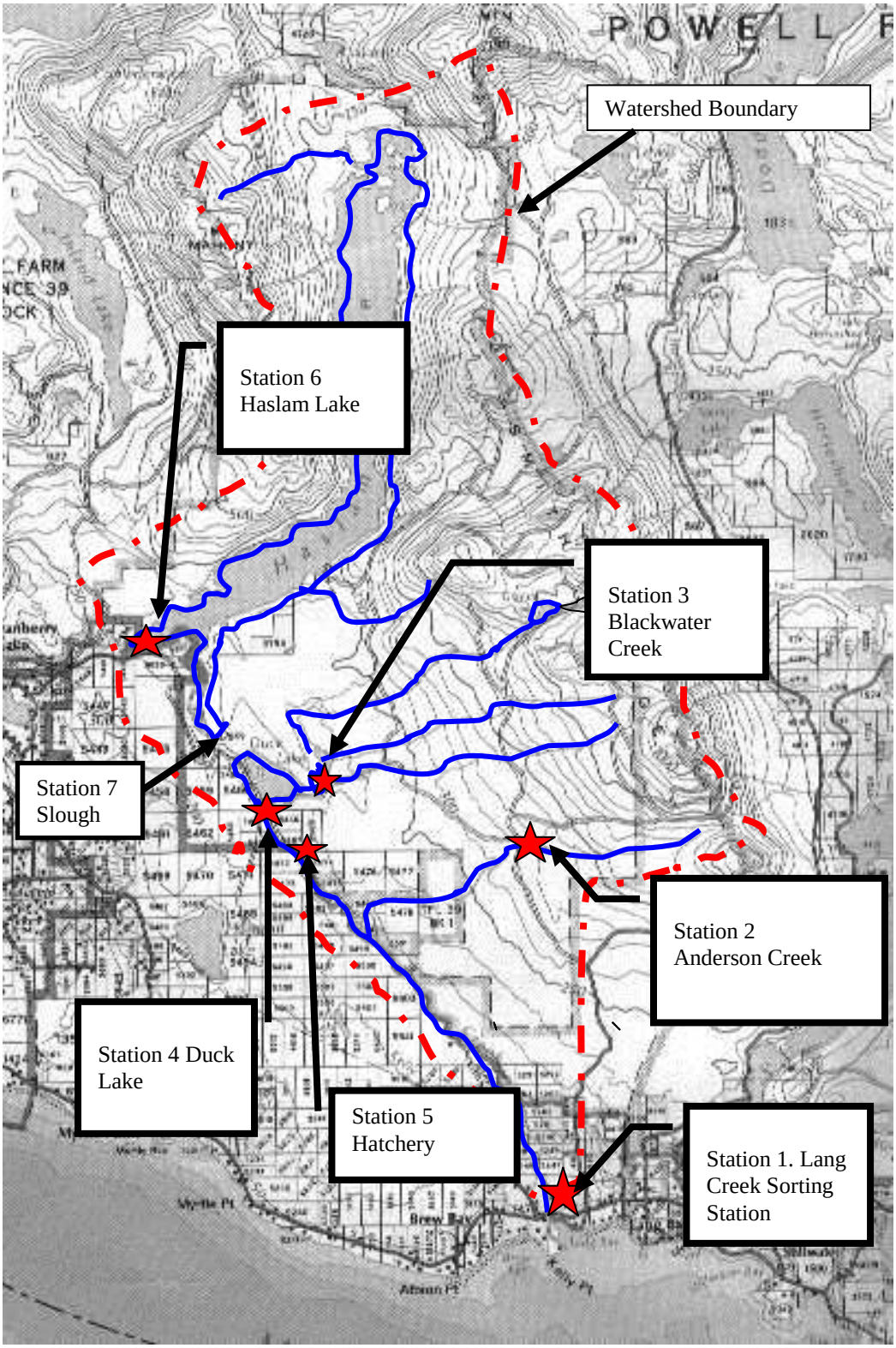
III. METHODOLOGY

This project was instigated to provide a continuation for a monitoring program than ran between 1997 and 2001 and restarted in 2008 within the Haslam Lang Community Watershed. Between 2001 and 2006, the Powell River Salmonid Enhancement Society maintained a small water quality data collection program. The water quality data that has been collected to date provides a reliable base line documenting water quality at strategic locations within the Haslam Lang Watershed. The sampling schedule is presented in Table 1. The sites chosen for water sampling were almost the same as those developed in the original program and are located on the map on Figure 1.

Table 1. Schedule for Monitoring Sites

Station	Sampling Interval	Sampling For
Station 1 Lang Creek Sorting Station Provincial Identification Number E220912	Continuous Bimonthly	Water temperature, stage, air temp, rainfall Portable meter to check on continuous recorders
Station 2 Anderson Creek Provincial Identification Number (4 km upstream of E220913)	Continuous Bimonthly	Temperature by Hobo Portable meter for turbidity, pH, specific conductivity, temp and stage
Station 3 Black Water Creek Provincial Identification Number E220914	Continuous Bimonthly	Temperature by Hobo Portable meter for turbidity, pH, specific conductivity, temp and stage
Station 4 Outlet of Duck Lake Provincial Identification Number E220915	Bimonthly	Portable meter for turbidity, pH, specific conductivity, temp, and lake level
Station 5 Upper Lang Creek Hatchery	Continuous	Temperature by Hobo
Station 6 Haslam Lake (near intake)	Bimonthly	Portable meter for turbidity, pH, specific conductivity ,temp and lake level
Station 7 Slough (at Haslam Weir)	Bimonthly	Portable meter for turbidity, pH, specific conductivity ,temp and lake level

Figure 1. Location of Monitoring Stations within Haslam Lang Community Watershed



IV. SAMPLING PROCEDURES

A. Water sampling for laboratory analyses

No laboratory analyses were conducted in 2013

B. Analysis using portable meters

Bi monthly analysis of water temperature, pH, turbidity and salinity were conducted using portable meters. Before sampling, the meters were calibrated with standard solutions following directions supplied by the meter manufacturers.

C. Automated samplers An automated stage, temperature and rainfall recorder is located at the mouth of Lang Creek. (Sorting Station) The processing and analysis of the continuous data from the sorting station was conducted by John Termuende of Termuende Hydrological Ltd. Data loggers (Hobos $_{TM}$) were used to record hourly water temperature on Anderson, Blackwater and on Lang Creek at the Hatchery below Duck Lake.

V. RESULTS AND DISCUSSION

Results and discussion of data collected during the course of the monitoring program are presented below. Not all data is presented here because of the sheer volume. Some water temperature data was collected at a 15 minute interval, others hourly over the whole year. All of the original digital information used to develop these figures and tables is available on Excel spread sheets at the Powell River Salmon Enhancement Society office.

A. Water Quality

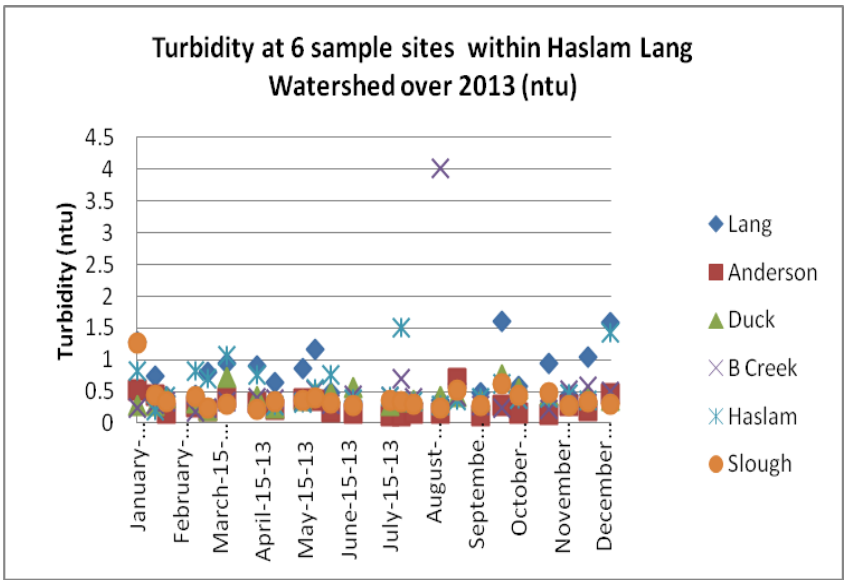
1. Laboratory Results: Water Chemistry and Biology

No new data was collected in 2013.

2. Turbidity measurements with portable meter

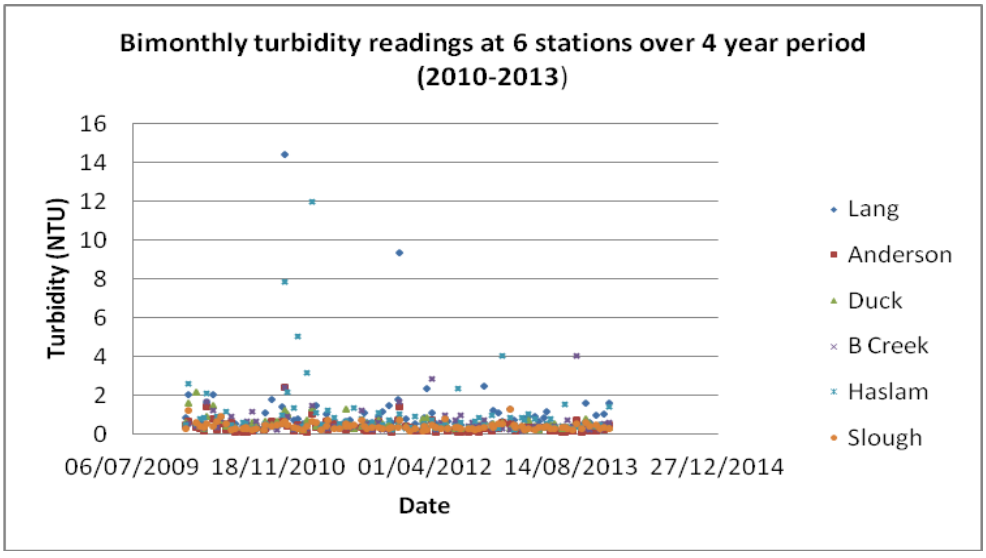
Turbidity events are episodic and easily missed with spot sampling. However, given the technical difficulties of acquiring good continuous turbidity data, spot recordings, such as these, provide an indication of the range and timing of turbidity events that can be expected. Bimonthly spot turbidity samples were measured over 2013 at 6 station representing a range of watershed characteristics. The results on Fig. 2 showed overall a low level of turbidity with an absence of major turbidity events at all stations. No values measured exceeded 4 ntu. The one 4 ntu value was recorded in August on Blackwater Creek after a period of rainfall at the end of August after a long period of good weather. The source of this sediment was not discovered.

Figure 2.



On Figure 3 all bimonthly turbidity data is presented for the period 2010 through 2013. Although there are a few outliers in earlier years, the data indicates no major changes in sediment generation for 2013.

Figure 3.



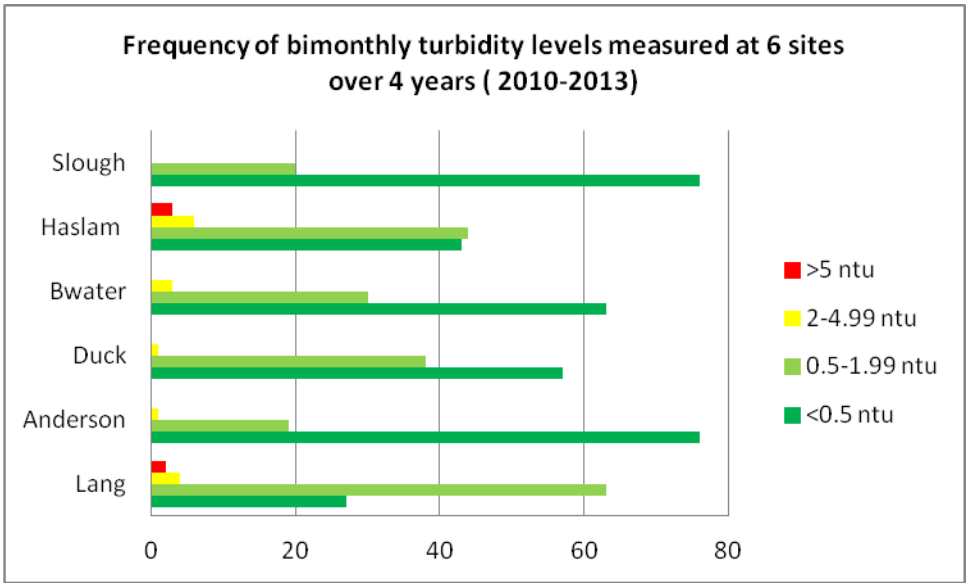
On Table 2 all bimonthly turbidity samples taken over the past 4 years are compiled. Of the total of 576 samples taken at 6 sites, <1 % of the samples exceeded 5 ntu, 2.6% fell between 2 and 4.99 ntu, 37.2 % of samples fell between 0.5 and 2 ntu and 59.4% of samples were less than 0.5 ntu. The great majority of these small turbidity events recorded were considered to be natural, i.e. not influenced by human activities.

Table 1

	<0.5 ntu	0.5-1.99 ntu	2-4.99 ntu	>5 ntu
Lang	27	63	4	2
Anderson	76	19	1	
Duck	57	38	1	
Bwater	63	30	3	
Haslam	43	44	6	3
Slough	76	20		
Total	342	214	15	5
%	59.4	37.2	2.6	0.9

These results are presented graphically on Figure 4.

Figure 4



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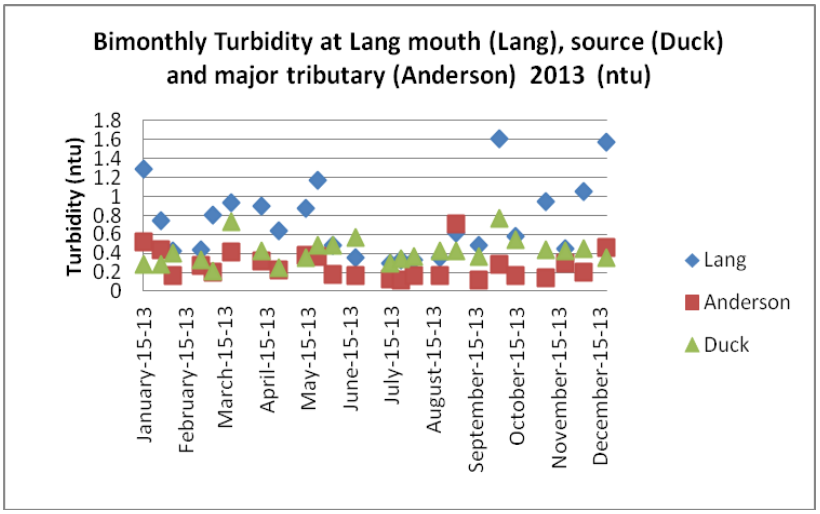
As shown on Figure 4, occasional turbidity peaks in excess of 5 (which exceed Ministry of Health guidelines) occur on Lang Creek and Haslam Lake. In the 96 samples collected from 2010-2013 at the Lang Creek Sorting Station, only 2 sample exceeded 5 ntu. These events were considered to have been generated from natural sediment sources adjacent to the channel rather than any human activity on adjacent forest lands. In the same period there were 3 events on Haslam Lake where turbidity exceeded 5 ntu resulting from excavation activities on the land adjacent to the shoreline. It is understood that the turbidity measured at the sampling area adjacent to the shoreline did not reflect water quality at the Haslam Lake Municipal water intake.

On Figure 5 turbidity data from the head waters and mouth of Lang Creek are presented as well as from the major tributary entering Lang Creek below Duck Lake. As in previous years, it is

apparent that the turbidity events occuring at the mouth of Lang Creek are always the highest and must have been generated along the channel of the Lang Creek and its tibutaries and not upstream of Duck Lake which acts as an effective buffer.

Figure 5



3. pH with portable meter

Figure 6 shows the bimonthly pH at 6 sample sites throughout the watershed. pHs tend to be neutral to slightly acidic in the autumn and winter months and very slightly more alkaline during low flows of summer.

Figure 6

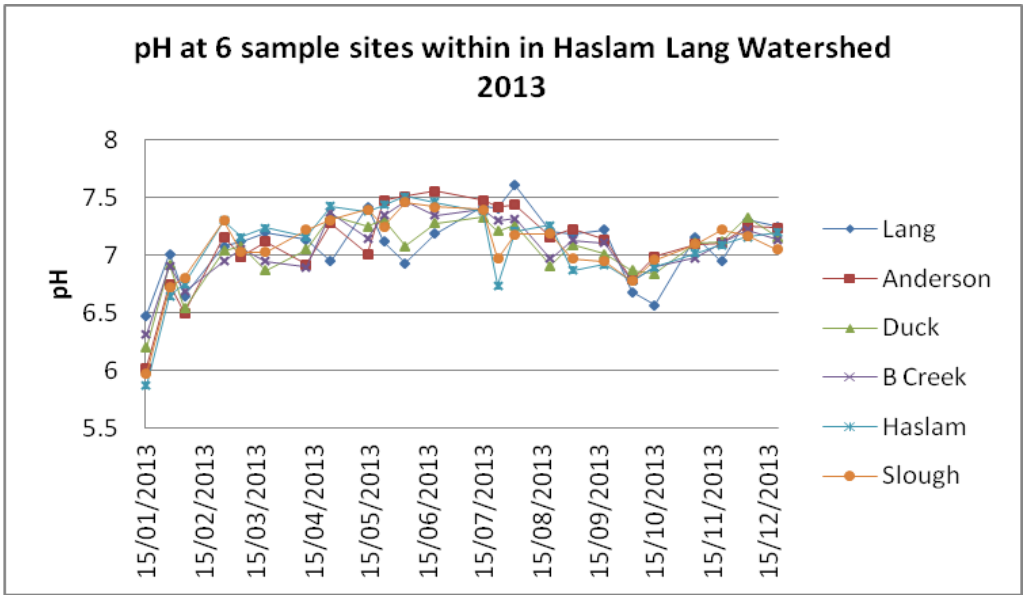
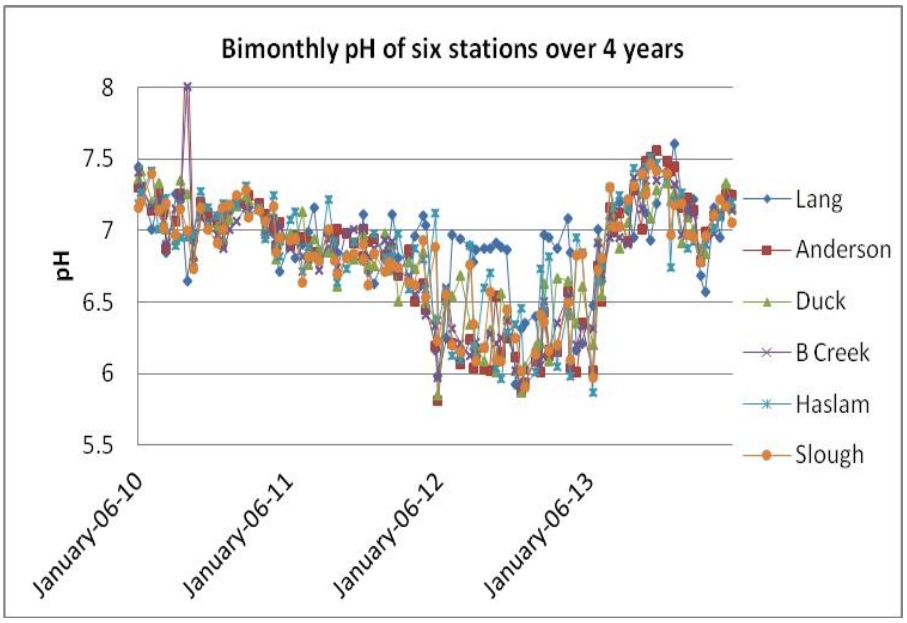


Figure 7 shows the variability over 2010 through 2013 in pH for the 6 sampling sites within the watershed. While there appears to be an overall trend towards slightly decreasing pH between 2010 and 2012, the drift was likely the result of the pH meter electrode is gradually failing over time combined with degrading of calibration fluid. The data collected in 2013 has become more reliable with the use of the new pH meter

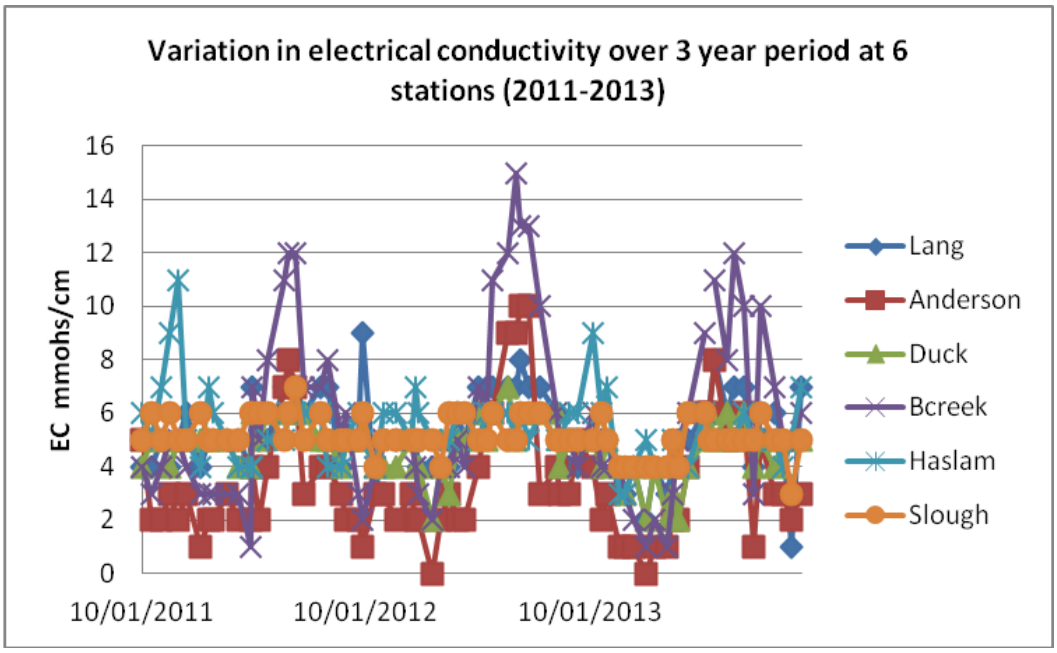
Figure 7



4. Electrical Conductivity (measure of soluble salts)

Figure 8 shows the levels of electrical conductivity of water measured over all the 6 sites over the sampling period 2011-2013. These levels (between 0 and 15 mmoh/cm) indicate a very low level of dissolved salts as is expected in coastal watersheds dominated by granitic bedrock. There is a slight anomaly associated with Blackwater Creek where ECs are somewhat more hghly elevated in the summer. As with the increase in pH, these small increases are likely associated with the dust generation from the crushed limestone road bed.

Figure 8.



B. Water Temperature Monitoring Results

1. Bimonthly Manual collection from 6 sites within the watershed

Figure 9 shows the range of, and variability between water temperatures of the major sampling sites over 2013. Highest summer temperatures (>24 ^{o} C) are recorded at the surface of lakes, (Haslam, Slough, Duck) and lowest summer temperatures from small streams under forest cover (Anderson and Blackwater Creek) that depend on ground water flow. The lower Lang Creek site had intermediate summer temperatures because warmer Duck Lake water is cooled as it flows through shaded riparian zone of Lang Creek. The data from the previous 3 years (2010-2013) is also presented in Figure 10 which shows a mirroring of same trend.

Figure 9

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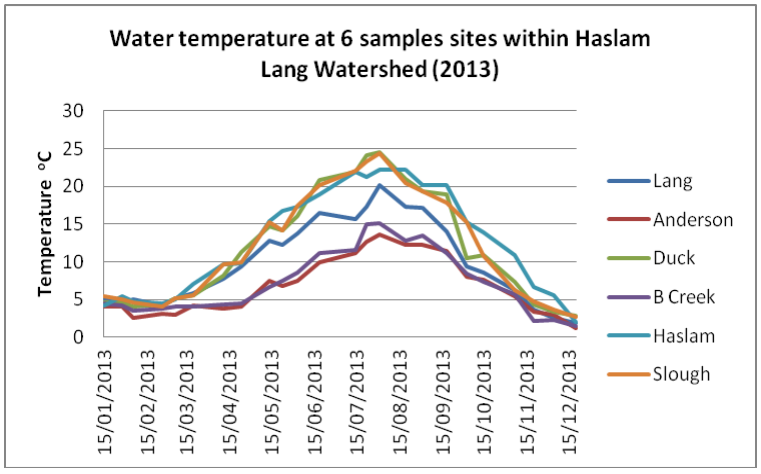
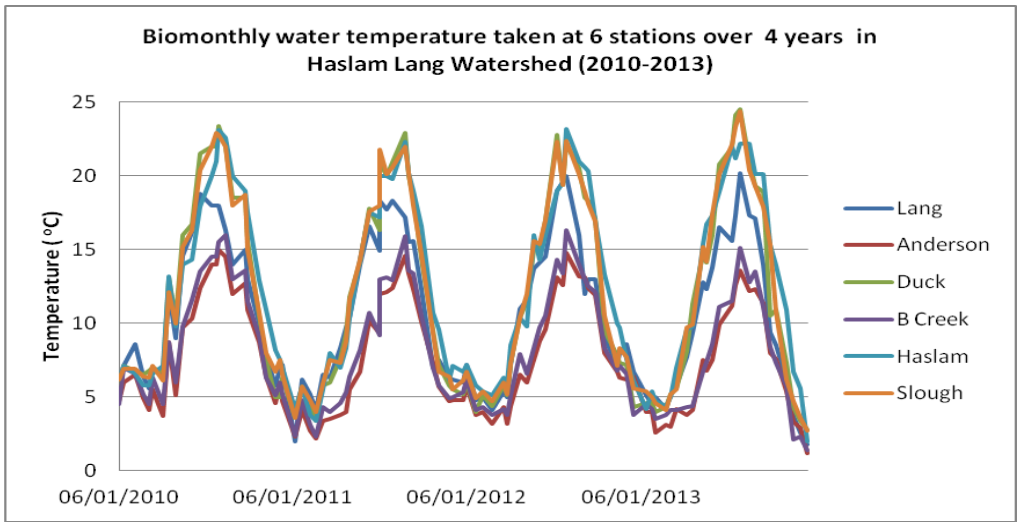
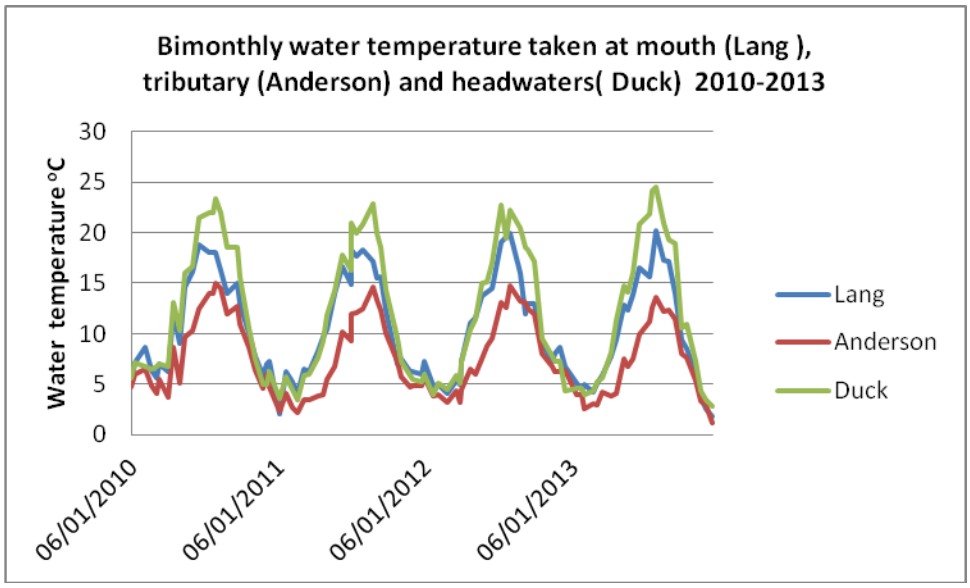


Figure 10



On Figure 11 bimonthly water temperatures are recorded for the period 2010 through 2013 for 3 stations. The cooling effect of Lang Creek water passing from its outlet on Duck Lake to the mouth at the sorting station is clearly plotted. During the hottest period in the summer, Lang Creek can be cooled as much as 4 degrees centigrade along its passage between Duck Lake and the mouth. Evapotranspiration and direct shading from riparian vegetation likely generate this cooling effect as well as additions of cooler water from Anderson Creek and two other unnamed creeks east of Anderson Creek and ground water seeping directly into Lang Creek channel. Previous reports have stressed the importance of these small streams as cool water havens for salmonids while the main channel of Lang Creek is much warmer.

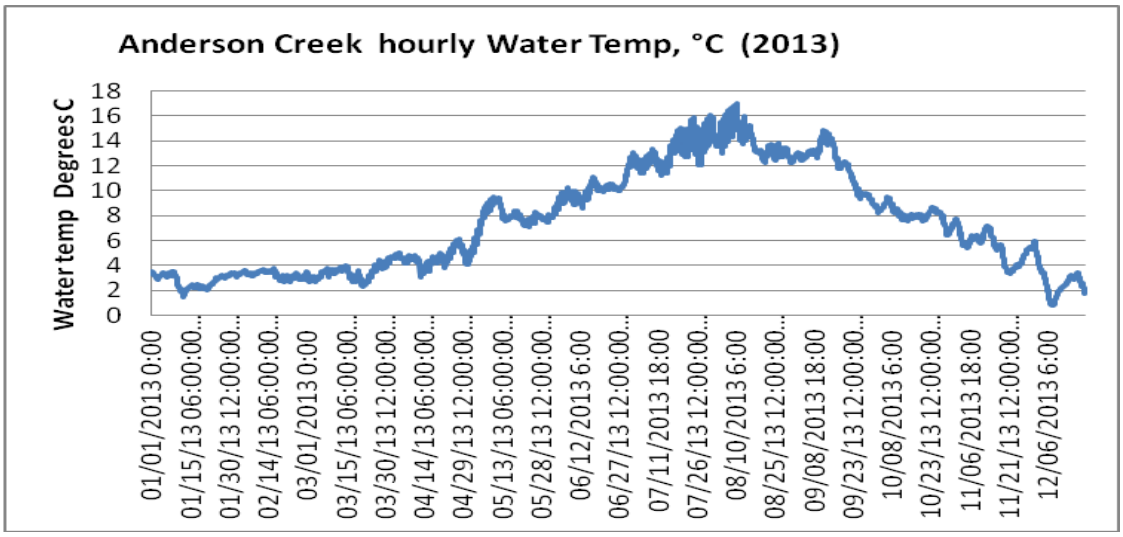
Figure 11.



2. Continuous water temperature records

On Figure 12 continuous water temperature data for Anderson Creek during 2013 is provided.

Figure 12.



On Figure 13, note that for the warmest period of the summer, the minimum daily temperature of 15 degrees centigrade on Anderson Creek acts as an important sanctuary for heat stressed fish from the main stem of Lang Creek where water temperatures can be well over 20 ^{o}C. Daily fluctuations of 3 degrees are normal during the warmest periods in the summer, even though very little of the stream channel itself is exposed to direct sunlight.

Figure 13

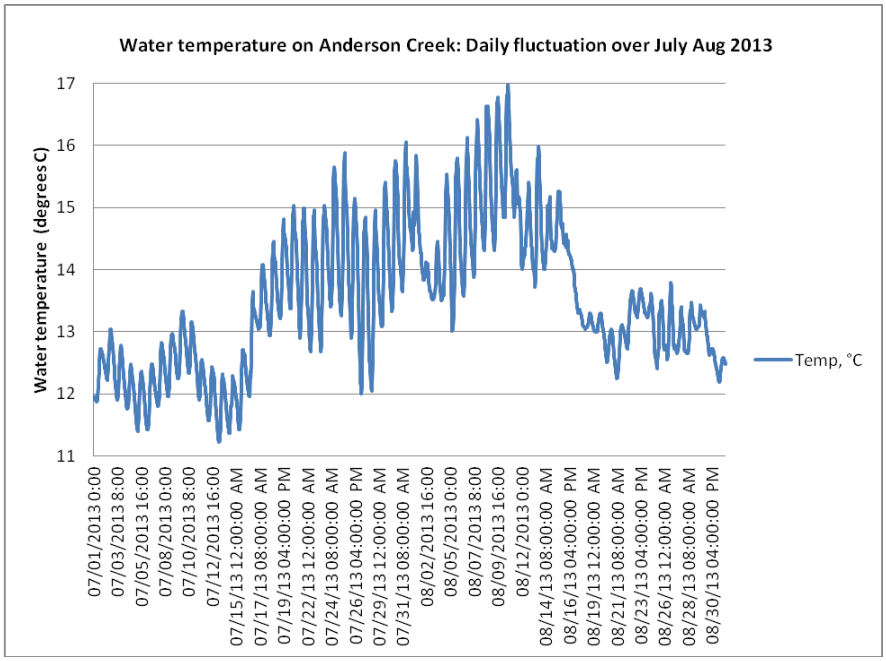
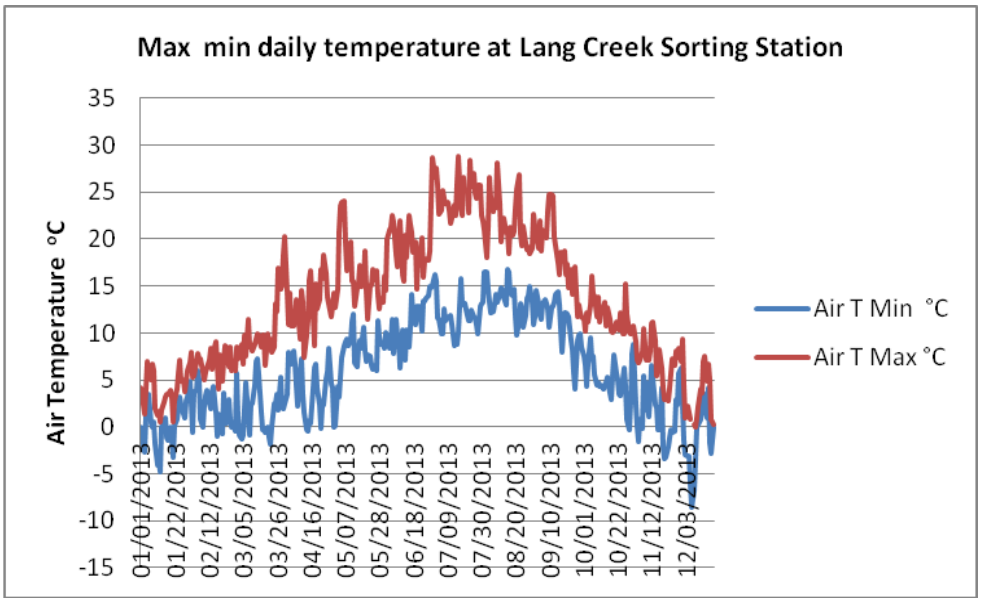


Figure 14 provides daily max min air temperatures collected from the sorting station on lower Lang Creek over 2013.

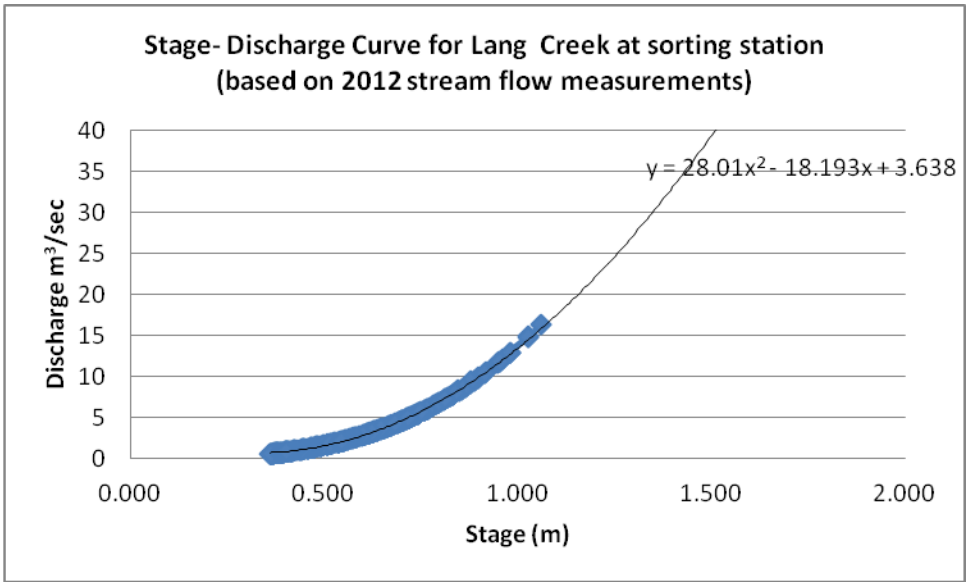
Figure 14



C. **Discharge of Lang Creek over 2013**

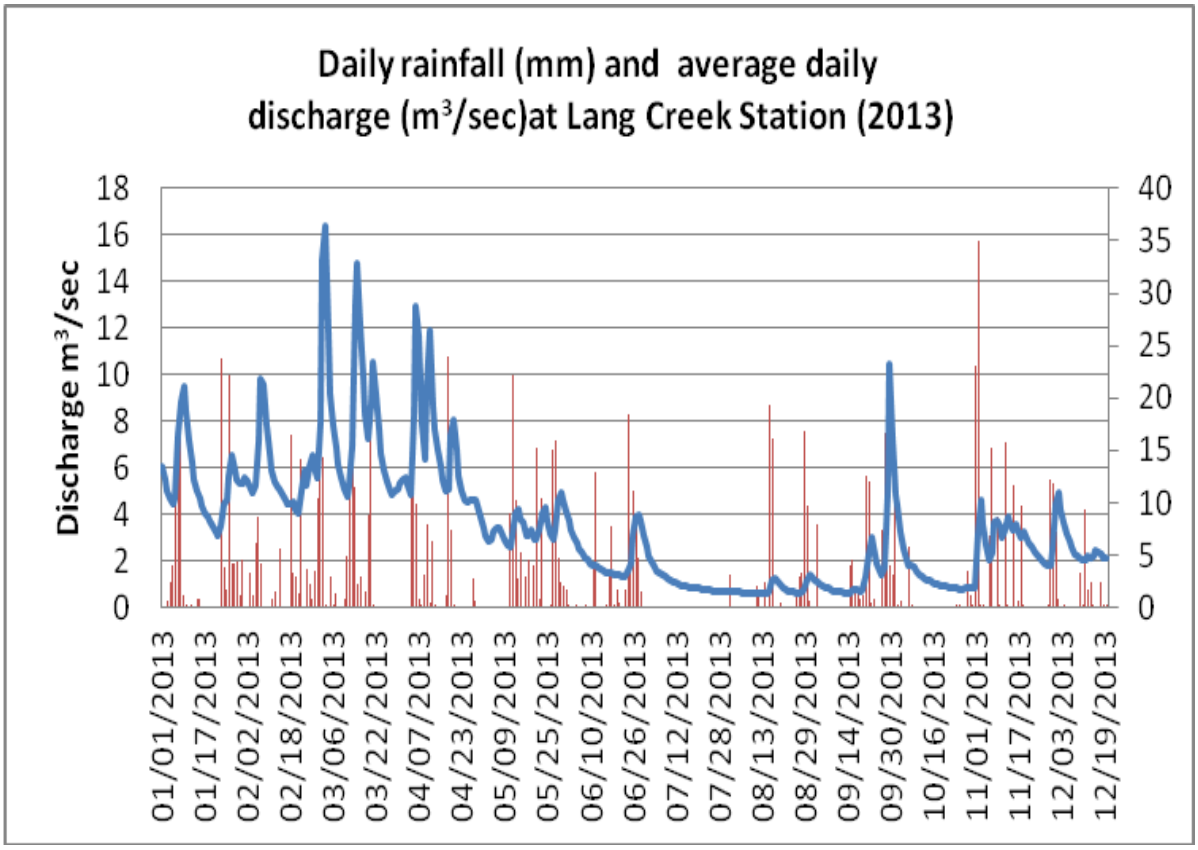
The stage discharge curve used in this analysis is presented on Figure 15.

Figure 15.



On Figure 16 the hydrograph for 2013 is presented with daily rainfall. This hydrograph is similar to previous years except for a reduced maximum peak flow. The highest recorded flow in 2011 was 35 m^3/sec, in 2012 25 m^3/sec and for 2013 18 m^3/sec. Total rainfall at the sorting station was 1030 mm in 2013.

Figure 16



VI. CONCLUSIONS AND RECOMMENDATIONS

The 2013 season was successful at capturing good water quality/ quantity data. The fact that the Powell River Salmon Enhancement Society is largely a volunteer-run organization makes this achievement more impressive. The data collected in 2013 supports a general conclusion that water quality was not significantly impacted by its various users over 2013. The salmon return data presented in the annex indicates that, in general, salmon population are healthy and in recent years have not been exposed to water quality changes that would negatively impact their survival.

Given that there was no major flood over 2013 and Lang Creek channel at the sorting station remained unchanged, the calibration curve recalculated in 2012 was considered to still provide an accurate assessment of discharge at various stages.

Re-sampling the six watershed stations for normal water chemistry should be considered should funds become available. (TTS, turbidity, CaCO3 equivalent, TOC, colour, total metals)

The new pH meter is working well and providing reliable data.

The disturbed ground nearby the Haslam intake has hardened up and revegetated which has measurable improved the water sample quality at that station.

As recreation uses of the watershed appear to be increasing, it is important that any expanded use is properly planned and implemented so as to avoid negative water quality impacts. Potential for fecal contamination at the informal campsite on Duck Lake is an ongoing concern.

The Community Forest's acquisition of Lidar mapping provides an excellent means to update watershed maps. The location of stream channels can now be precisely located under the dense forest canopy. Upgrading maps is of particular interest for Anderson Creek and the two small tributaries that support resident coho.

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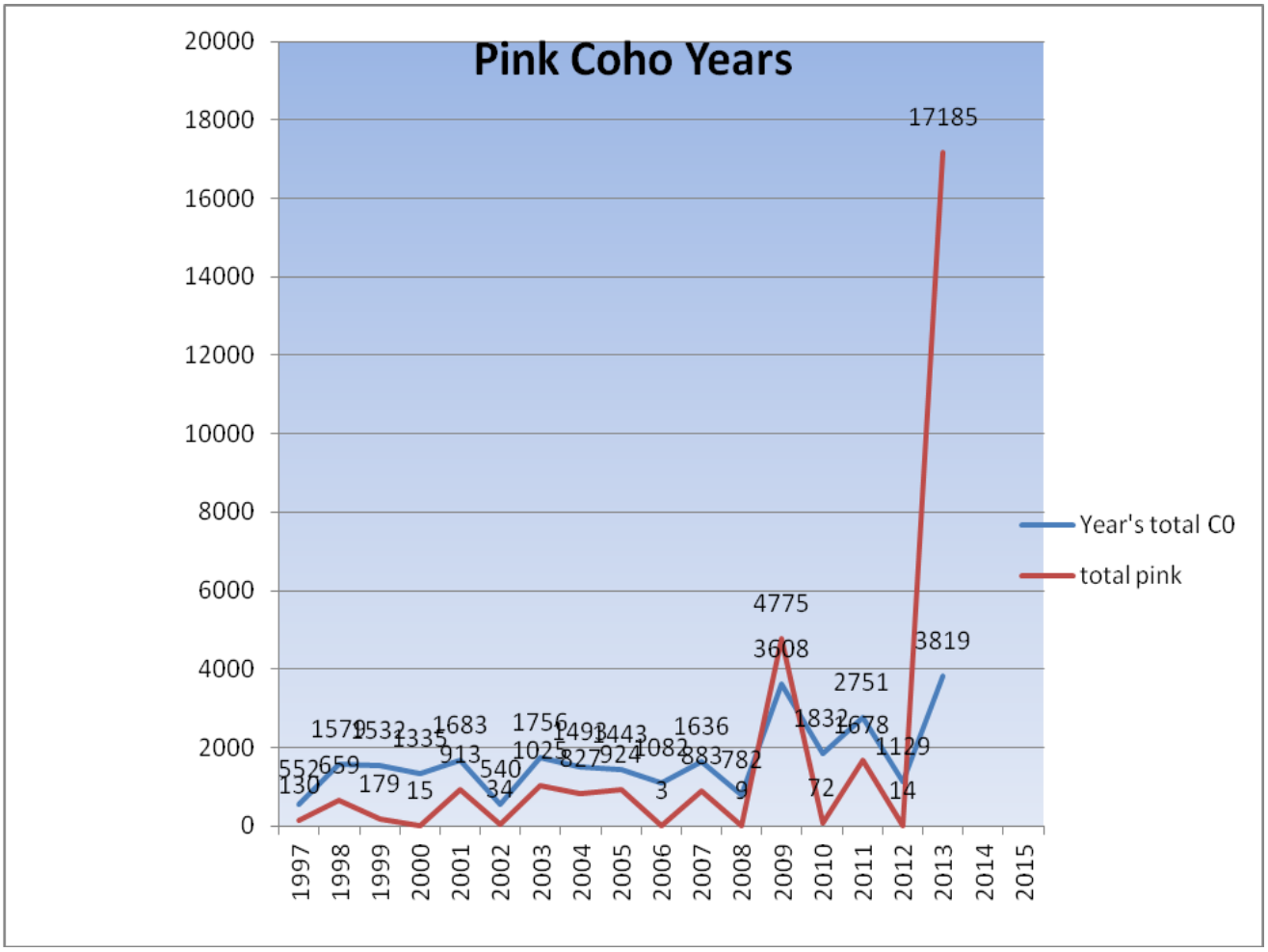
Annex

The Powell River Salmon Enhancement Society has collected data on historic salmon returns on Lang Creek. Coho returns were better than average in 2013, in fact the highest on record for any fry release[1] and the Pink returns were unprecedented with 5 times greater numbers than any previous year. While definitive interpretation of the meaning of these data is not possible, one can infer, at least, that present land use is not having a negative effect on Coho and Spring populations on Lang Creek.

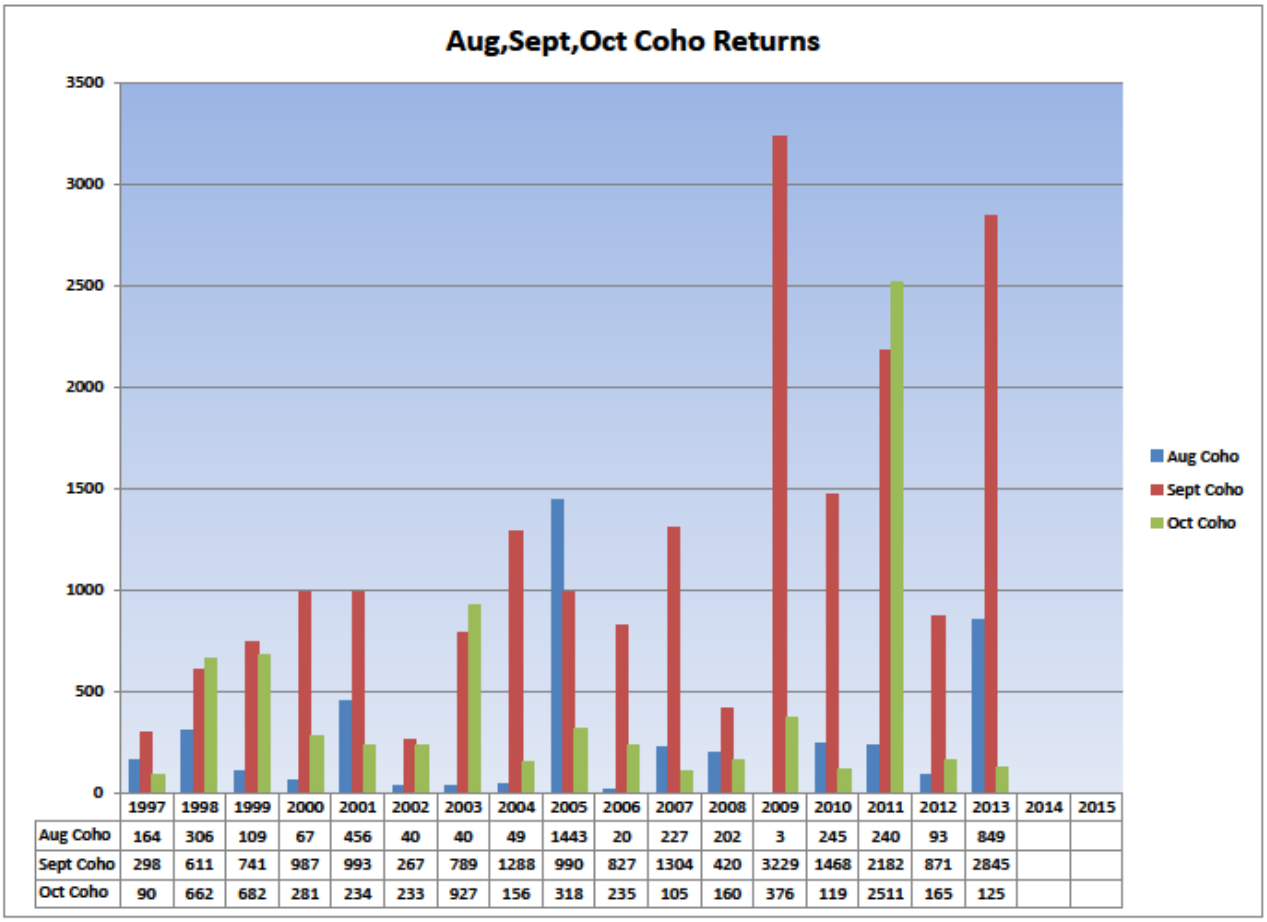
Timing of returns of Chinook and to a lesser extent Coho has also shifted over the years. Recently Lang Creek is experiencing an increasing proportion of returning fish coming into the stream earlier even though stream discharges are still low. There are as yet no theories to explain these changes. These population dynamics should be watched closely because early returns puts even more emphasis on mainaining adequate release from the slough weir on.Haslam Lake.

Figure 17. Pinks and Coho returns between 1997 and 2013 as measured at Lang Creek Sorting Station



[1] Fingerling released have had higher returns

Figure 18. Timing and numbers of Coho returns to Lang Creek (1997- 2013)



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Aug Coho	164	306	109	67	456	40	40	49	1443	20	227	202	3	245	240	93	849		
Sept Coho	298	611	741	987	993	267	789	1288	990	827	1304	420	3229	1468	2182	871	2845		
Oct Coho	90	662	682	281	234	233	927	156	318	235	105	160	376	119	2511	165	125		

Figure 19. Timing and numbers of Chinook returns to Lang Creek (1997-2013)