Regional District of Nanaimo Community Watershed Monitoring Network Three Year Trend Report 2011 - 2013

October 2014

Environmental Protection Division
Regional Operations Branch

Acknowledgements

This program would not be possible without the dedication, passion and excellent work of the participating stewardship groups: *Mid Vancouver Island Habitat Enhancement Society, Qualicum Beach Streamkeepers, Nile Creek Enhancement Society, Friends of French Creek Conservation Society, Nanaimo and Area Land Trust and Parksville-Qualicum Fish and Game Association.* Many thanks also to Island Timberlands for provision of safety gear and financial support.

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Executive Summary

This report presents a summary of trends observed in the first three years (2011, 2012 and 2013) of data collected as part of the Regional District of Nanaimo Community Watershed Monitoring Network (CWMN). This program is a partnership between Ministry of Environment, the Regional District of Nanaimo and local environmental stewardship groups. The goal of the program in its early stage was to conduct a simple, quick assessment of multiple watersheds to raise watershed health awareness in local communities and obtain a three year dataset for trend analysis. Longer term goals were to use trend data collected in the early stage to determine in which watersheds more detailed monitoring and/or improved watershed management need occur, and to assist in land use planning. In this document, data presented from 25 different sites in nine different watersheds were compared to existing BC Water Quality Guidelines (BC MOE, 1997) and/or Englishman River Water Quality Objectives (Barlak *et al*., 2010), applicable to other watersheds within the same ecoregion.

Based on water quality guidelines and objectives, exceedances of one of the measured parameters (temperature, dissolved oxygen or turbidity) occurred at 17 of 25 sample locations during at least one of the sample periods. Temperature and dissolved oxygen exceedances tended to be reflective of general summer conditions for most east coast streams, particularly in the lower watershed where the streams are wide, slow moving and have little stream cover. Seven of the sites with exceedances had exceedances of more than one of temperature, dissolved oxygen or turbidity and were highlighted as priority areas for continued sampling in 2014. As turbidity is associated with higher levels of other contaminants, it was considered the highest priority when determining at which sites more sampling needed to occur. It was recommended that additional sites be added upstream of the high turbidity sites to determine potential turbidity sources, and that supplementary data be collected to better assess water quality in critical areas. A number of additional recommendations were made for future sample years to retain data quality and use resources most efficiently.

Program Outline

The purpose of this report is to present a summary of trends observed in the first three years of data collected as part of the Regional District of Nanaimo Community Watershed Monitoring Network (CWMN) partnership. The CWMN partnership was initiated in 2011 by the Regional District of Nanaimo (RDN) and the British Columbia (BC) Ministry of Environment (MOE) to collect data across the RDN by community environmental stewardship organizations. The goal of the program in its early stage was to conduct a simple, quick assessment of multiple watersheds to raise watershed health awareness in local communities and obtain a three year dataset for trend analysis. Longer term goals were to use trend data collected in the early stage to determine in which watersheds more detailed monitoring and/or improved watershed management need occur, and to assist in land use planning.

The synergistic partnership between environmental stewardship groups, the MOE, the RDN and Island Timberlands is core to the success of this program. At the beginning of each sampling year (summer 2011, 2012 and 2013) the MOE, with assistance from the RDN, trained stewardship participants in monitoring protocols. Five stewardship groups within the RDN started participating in the monitoring program in 2011 (Nile Creek Enhancement Society (NCES), Friends of French Creek Conservation Society, Qualicum Beach Streamkeepers, Mid Vancouver Island Habitat Enhancement Society (MVIHES), Nanaimo and Area Land Trust (NALT) and Parksville-Qualicum Fish and Game Association), with safety gear and land access provided by Island Timberlands. These organizations sampled at a total of 25 different sites in nine different watersheds in 2011, 2012 and 2013. Samples were collected weekly according to BC MOE sampling procedures and quality assurance/quality control standards (BC MOE, 2003) between the dates listed in Table 1 below. Though more groups started participating from 2012 onwards, there are not yet three years of data from these groups; thus, their results are not presented here. Their data and all quality control data can be found in the CWMN annual data summary reports (Barlak, 2012 and 2013; Barlak and Fegan, 2014).

Table 1 – 2011, 2012 and 2013 Community Watershed Monitoring Network weekly sample periods. Note: MVIHES added a seventh sample location (Shelly Creek at Blower) in 2012 and only two years of data are presented for this site.

Year	Summer Low Flow (sampling occurred between)	Fall Rains (sampling occurred between)
2011	August 16 and September 13*	October 18 and November 15
2012	August 14 and September 11	October 16 and November 13
2013	August 13 and September 10	October 15 and November 12**

* NALT gathered only one sample on September 13;**NCES weekly sample period was between October 22 and November 19.

In this document, data presented were compared to existing BC Water Quality Guidelines (BC MOE, 1997) and/or Englishman River Water Quality Objectives (Barlak *et al*., 2010), applicable to other watersheds within the same ecoregion. Based on these Water Quality Guidelines or Objectives (Table 2), the data were grouped into summer and fall data (Quarter 3 and Quarter 4, respectively, where each quarter included five weekly samples in a 30 day period as required to determine if guidelines or objectives are being met per year. Six comparisons were examined: maximum and average temperature, minimum and average dissolved oxygen, maximum specific conductivity and maximum turbidity. Exceedances in the 2011, 2012 and 2013 data (Barlak, 2012 and 2013; Barlak and Fegan, 2014) are noted and priority areas are indicated. When any turbidity samples were less than 0 NTU, or not a true reading, calibration corrections were applied to all samples measured with the same instrument on that day and the corrected values presented here.

Table 2 - BC Water Quality Guidelines and/or Englishman River Water Quality Objectives.

Parameter	Guideline or Objective Value	Importance
Turbidity (Englishman River Water Quality Objective)	October to December: 5 NTU maximum January to September: 2 NTU maximum	Measures clarity or cloudiness of water. High values are associated with higher levels of other contaminants (e.g. bacteria).
Temperature (Englishman River Water Quality Objective)	Short Term, at any location in the river ≤ 17°C average weekly temperature. Long Term ≤ 15°C average weekly temperature. *Weekly averages could not be calculated with available data.	If too warm not aesthetically pleasing to drink and can affect health and survival of aquatic organisms.
Dissolved Oxygen (BC Water Quality Guideline for aquatic life)	30 day average 8 mg/L Instantaneous minimum 5 mg/L	If too low affects the health and survival of aquatic organisms.
Conductivity (no guideline)	No guidelines exist; coastal streams generally less than 80 µS/cm but can be more if significant ground water influences.	The more dissolved ions in water, the greater the electrical conductivity. Dilution decreases conductivity but groundwater influences or sediment introduced in water can increase it.

Climate data were reviewed from four Environment Canada weather stations across the RDN: Nanaimo Airport, Ballenas Island, Qualicum Airport and Qualicum River Hatchery (Environment Canada, 2014). These data helped determine if climate could have been an influencing factor on the measured parameters and to ensure that the fall flush was captured. In 2011 light fall rains were captured (Figure 1); however, the large fall flush occurred after the 2011 fall sample period had concluded. The large fall flush was captured in both 2012 and 2013 (Figure 2 and 3). In 2013 the first heavy rainfall happened during the summer sample period. Though there were some missing data points in the climate data, these were usually rare individual (one day) occurrences that occurred when little or no precipitation fell at other stations, thus their absence likely did not change general weekly trends observed.

Figure 1 - 2011 Weekly average precipitation across the Regional District of Nanaimo.

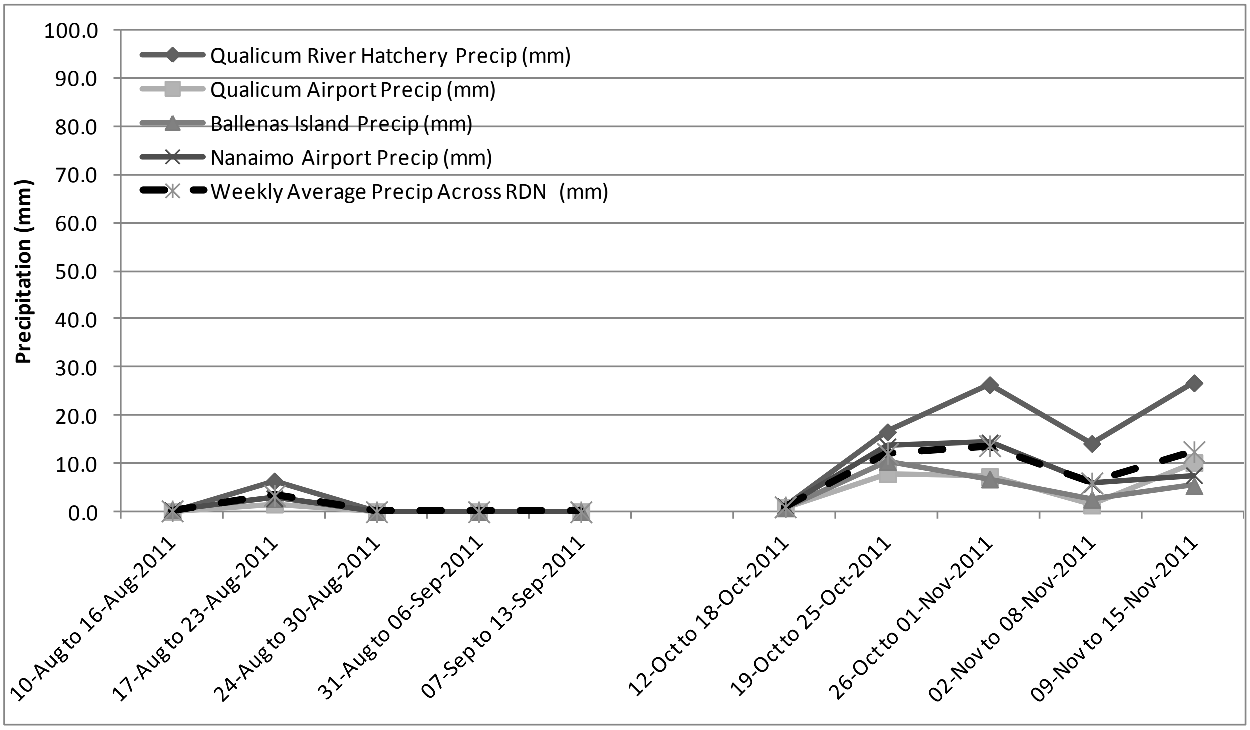


Figure 2 - 2012 Weekly average precipitation across the Regional District of Nanaimo.

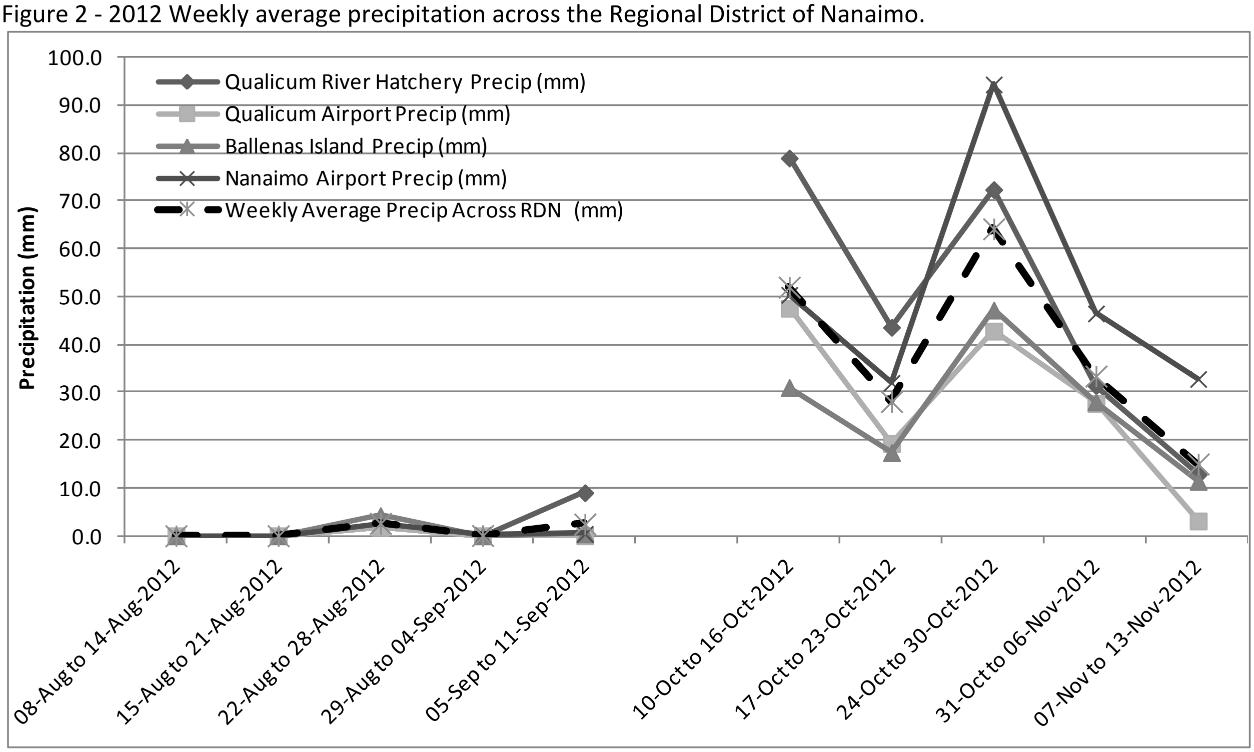
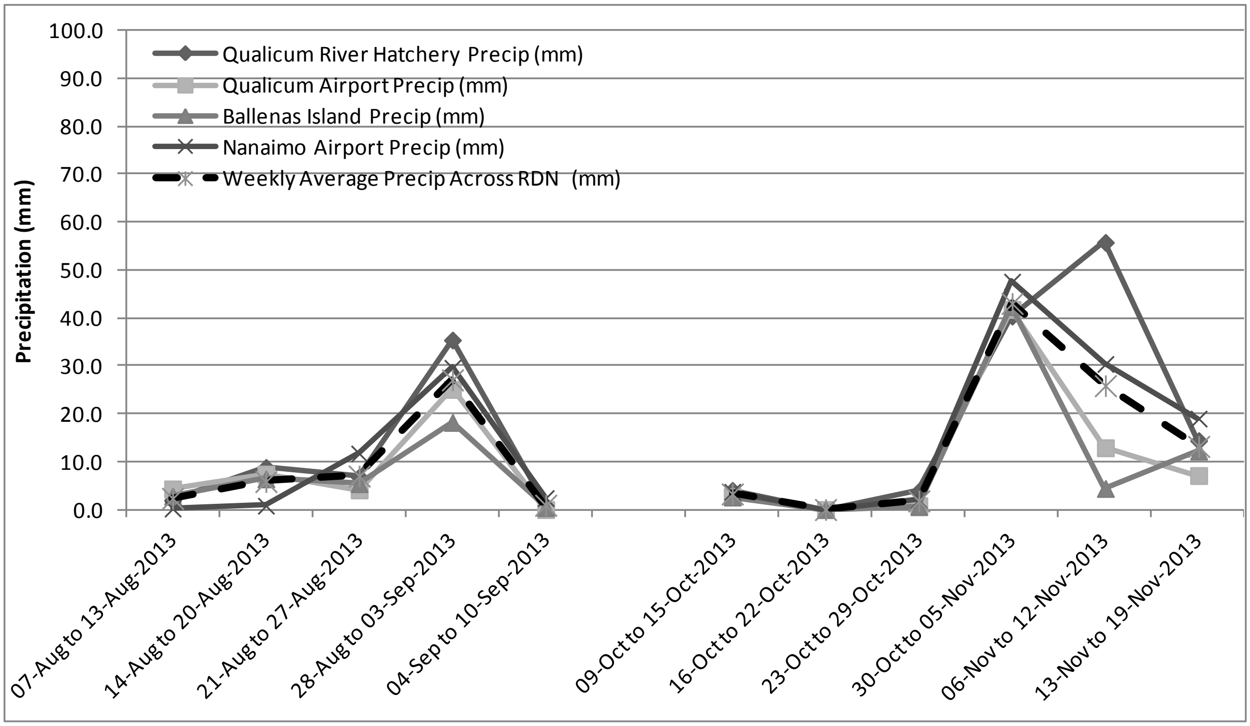
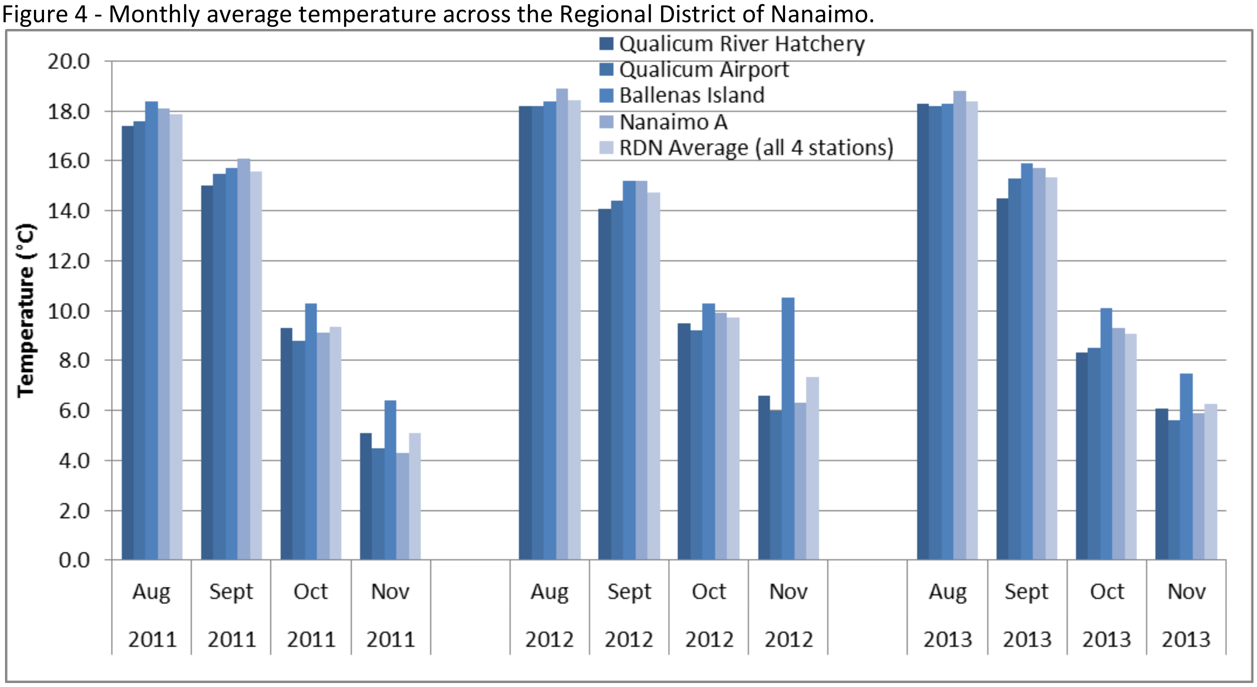


Figure 3 - 2013 Weekly average precipitation across the Regional District of Nanaimo.



Air temperature data from these four weather stations were also reviewed for influence on average water temperature. Trends seen in the averages of air temperature for each of the summer quarters (Figure 4) were evident in water temperature values at all of the summer sample sites. Average summer air temperature (for August and September combined) was lowest in 2012 and highest in 2013.

Figure 4 - Monthly average temperature across the Regional District of Nanaimo.



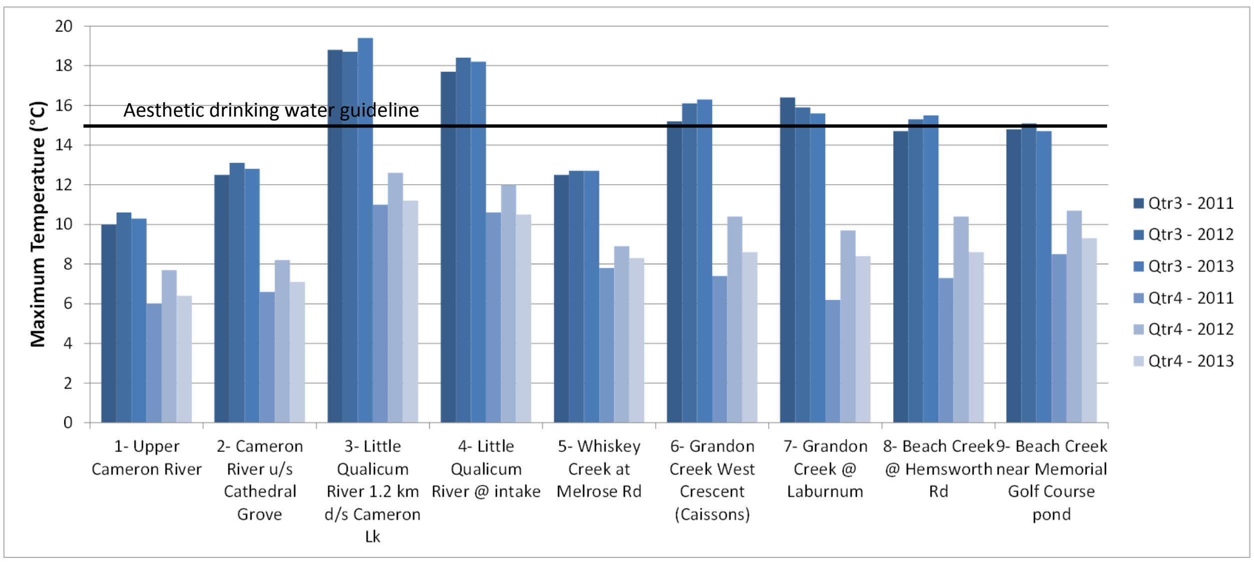
Data Summary

Summer and Fall 2011 - 2013

Qualicum Beach Streamkeepers and Parksville-Qualicum Fish and Game Association

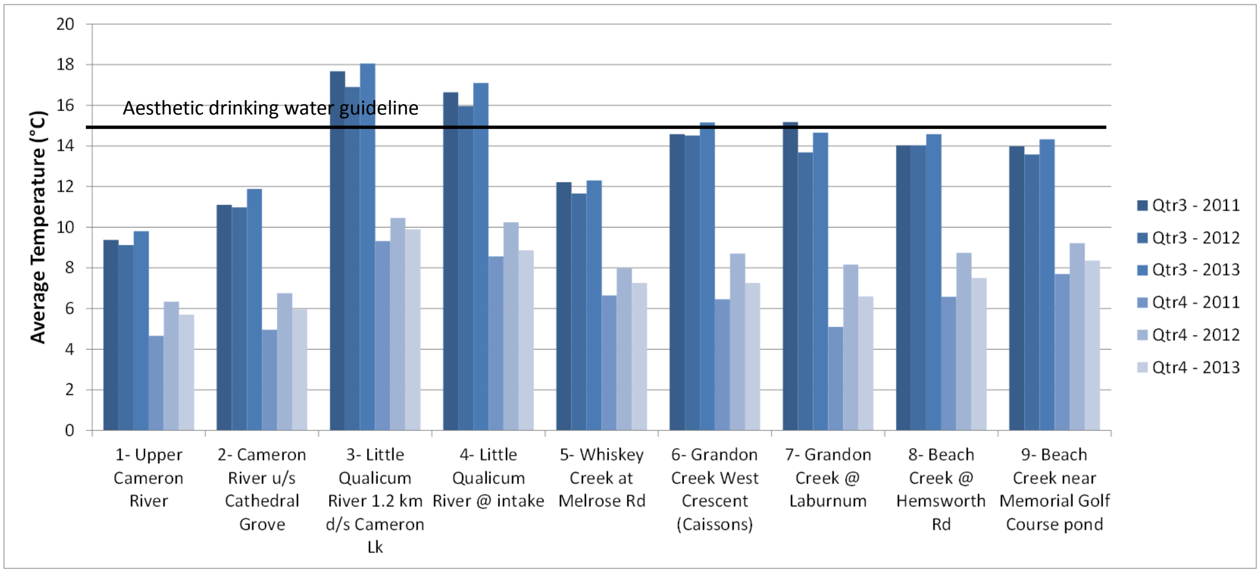
The maximum temperature in the summer groupings had the potential for exceedances of the aesthetic drinking water temperature guideline (weekly average ≤15°C) at the lower Little Qualicum River and Grandon Creek sites during each of the summer sample periods (Figure 5). Based on the maximum observed temperature, Beach Creek at Hemsworth Road also had the potential to exceed the aesthetic drinking water guideline in 2012 and 2013. At the lower Little Qualicum River sites the maximum summer water temperatures at times had potential to exceed the guideline for coho rearing (≤17°C). This is typical of many east coast Vancouver Island streams where the lower portions are wide and shallow or of streams downstream of wetlands or lakes (e.g. Cameron Lake); as long as refuges remain with lower temperatures, juvenile fish should be able to retreat to these during periods of elevated temperatures.

Figure 5 – Maximum temperature collected by Qualicum Beach Streamkeepers and Parksville-Qualicum Fish and Game Association.



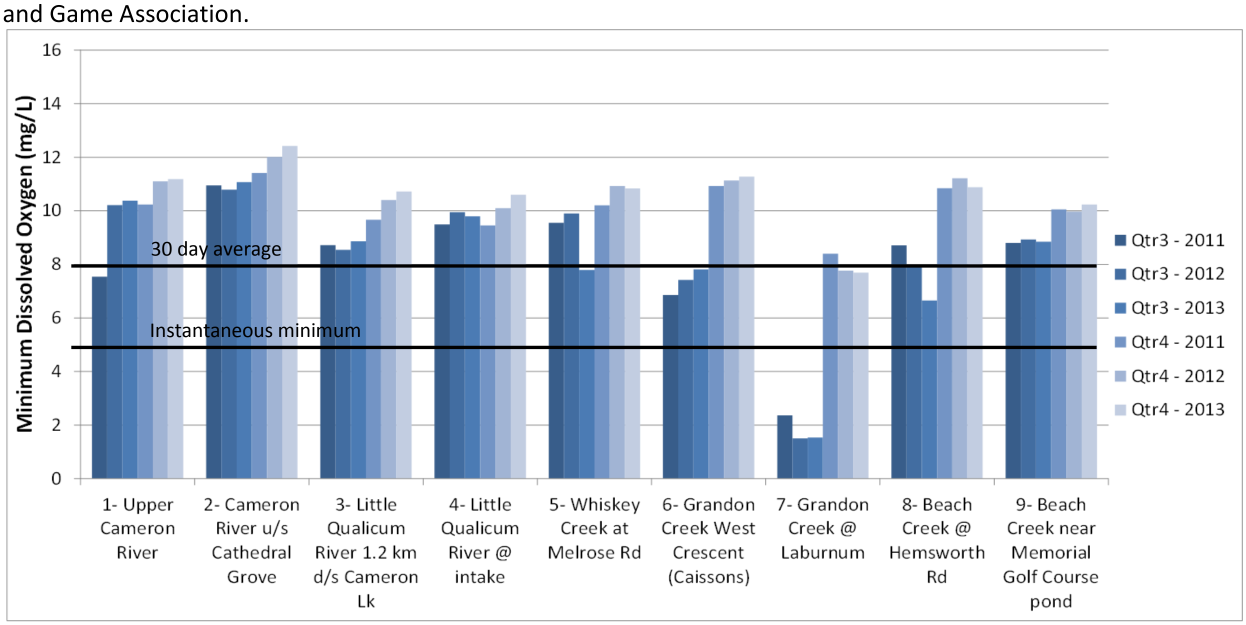
For the summer data collected, the average temperature showed a potential for exceedances of the aesthetic drinking water temperature guideline (weekly average ≤15°C) in the lower Little Qualicum River throughout all three of the sample periods (Figure 6). This guideline also had the potential for exceedance at the Grandon Creek at Laburnum site in 2011 and at the Grandon Creek West Crescent site in 2013. These higher temperatures are characteristic of wider, shallower portions of streams, or of streams downstream of wetlands or lakes with longer residence times; however, anthropogenic influences such as reduced riparian cover and land clearing could exacerbate these higher temperatures. Reviewing riparian cover upstream of sites with higher temperatures will help determine which areas may benefit from restoration of riparian areas. Monitoring of temperature should be prioritized at these sites after restoration work is complete to assess if restoration work helps reduce maximum in stream temperatures observed.

Figure 6 – Average temperature collected by Qualicum Beach Streamkeepers and Parksville-Qualicum Fish and Game Association.



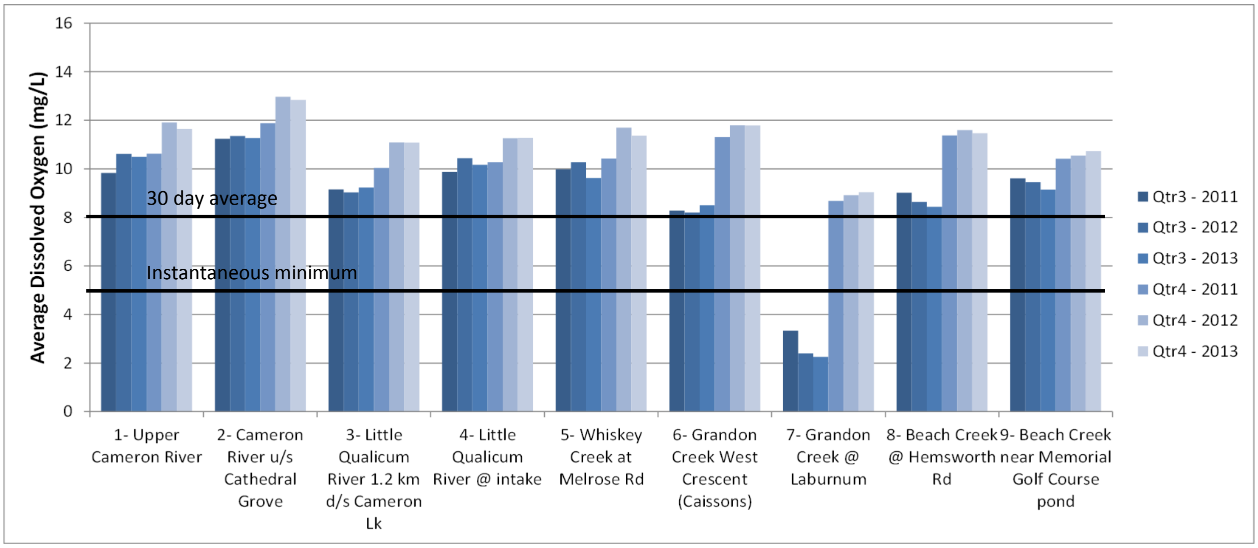
The minimum dissolved oxygen (DO) was below the instantaneous minimum aquatic life guideline of 5 mg/L in all of the summer sample periods at the Grandon Creek at Laburnum site (Figure 7).

Figure 7 – Minimum dissolved oxygen collected by Qualicum Beach Streamkeepers and Parksville-Qualicum Fish and Game Association.



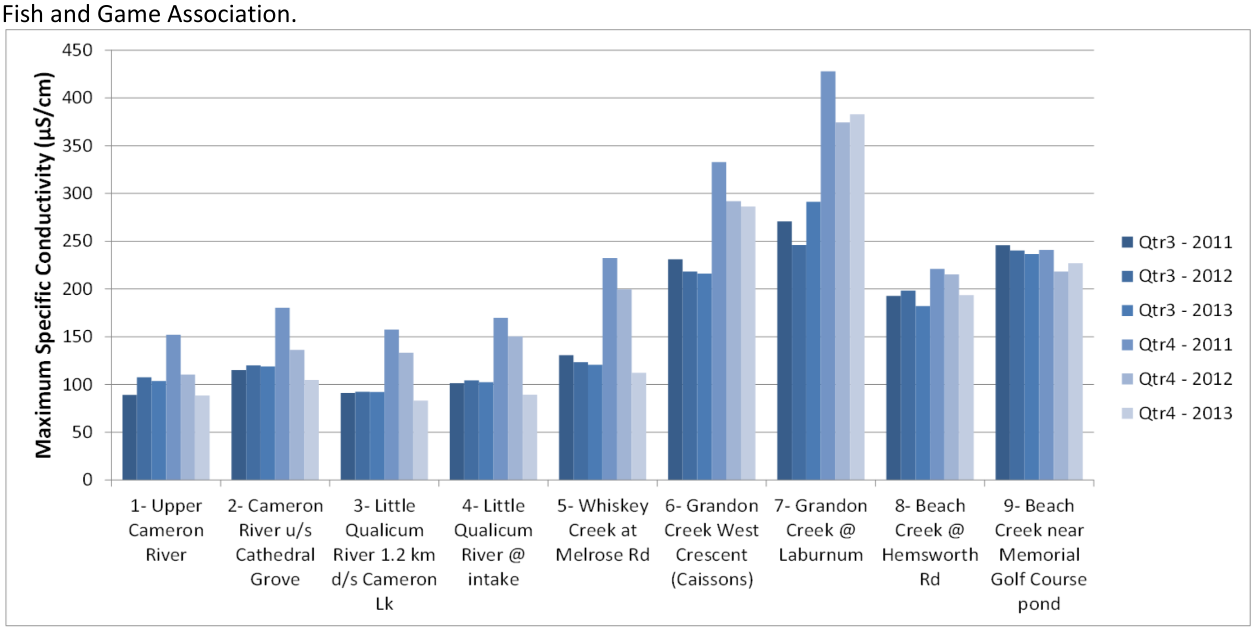
The average DO (Figure 8) was below the recommended 30 day average of 8 mg/L for all of the summer sampling periods for the Grandon Creek at Laburnum site with average values at 3.33 mg/L, 2.40 mg/L and 2.25 mg/L (not shown in figure below) for 2011, 2012 and 2013. Low minimum and average DO values may be indicative of very low flow or still water at the Grandon Creek at Laburnum site. This may be a naturally very low flow stream in summer. DO data collected and salmonid observations in this stream (Habitat Wizard, 2013) highlight this Grandon Creek sample location as a potential site for future monitoring and investigation into stream flow.

Figure 8 – Average dissolved oxygen collected by Qualicum Beach Streamkeepers and Parksville-Qualicum Fish and Game Association.



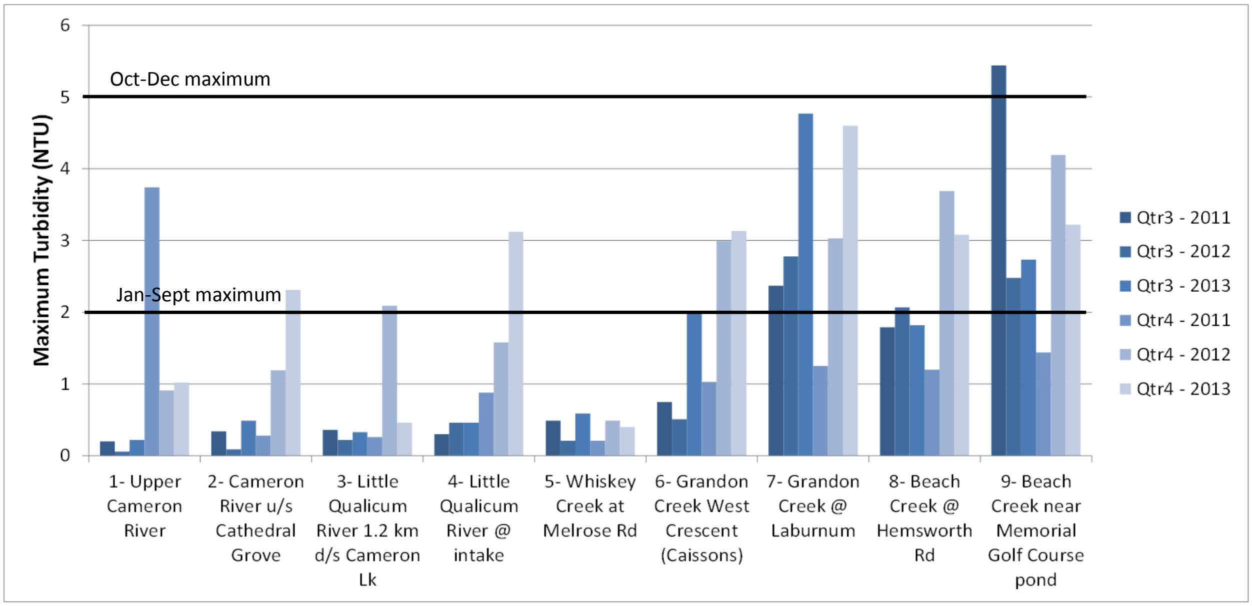
The maximum conductivity was higher than levels typical of coastal streams in both Grandon and Beach Creeks during all sample periods (Figure 9). Higher levels were also experienced at all sites during fall 2011. These higher levels were attributed to calibration error (Barlak, 2012), but when considered relative to the 2012 and 2013 data, could have been further influenced by a lower dilution level in the streams as the 2011 fall flush was not captured. In Grandon and Beach Creeks these higher levels appear to be associated primarily with increased turbidity and possibly groundwater influences at all times. No groundwater studies are currently available for these areas to confirm groundwater influences. Specific conductivity data collected indicates that continued monitoring at the Grandon and Beach Creek sites may be beneficial for further trend analysis.

Figure 9 – Maximum specific conductivity collected by Qualicum Beach Streamkeepers and Parksville-Qualicum Fish and Game Association.



The January through September summer low flow maximum turbidity objective of 2 NTU was at times exceeded in both Grandon and Beach Creeks in all three summer sample periods (Figure 10). At all sites increased fall maximum turbidity values were primarily associated with rainfall events in each of the sample years and did not exceed October to December turbidity objectives (5 NTU) in any samples collected. The proximity of these creeks to residential development areas suggests that increased anthropogenic turbidity inputs could account for higher turbidity levels when there was no precipitation. This was supported at times by detailed field observations (e.g. dredging in a nearby pond in 2011 at Beach Creek near Memorial Golf Course). Low flow sites where nutrient inputs occur can also have increased algal growth that can result in higher turbidity. Additional data collection of turbidity at these sites will help discern long term trends, while more in depth sampling (e.g. for nutrients or algae) may help determine some potential sources of turbidity during low flows. Reviewing riparian cover upstream of sites with higher turbidity will help determine which areas may benefit from restoration of riparian areas.

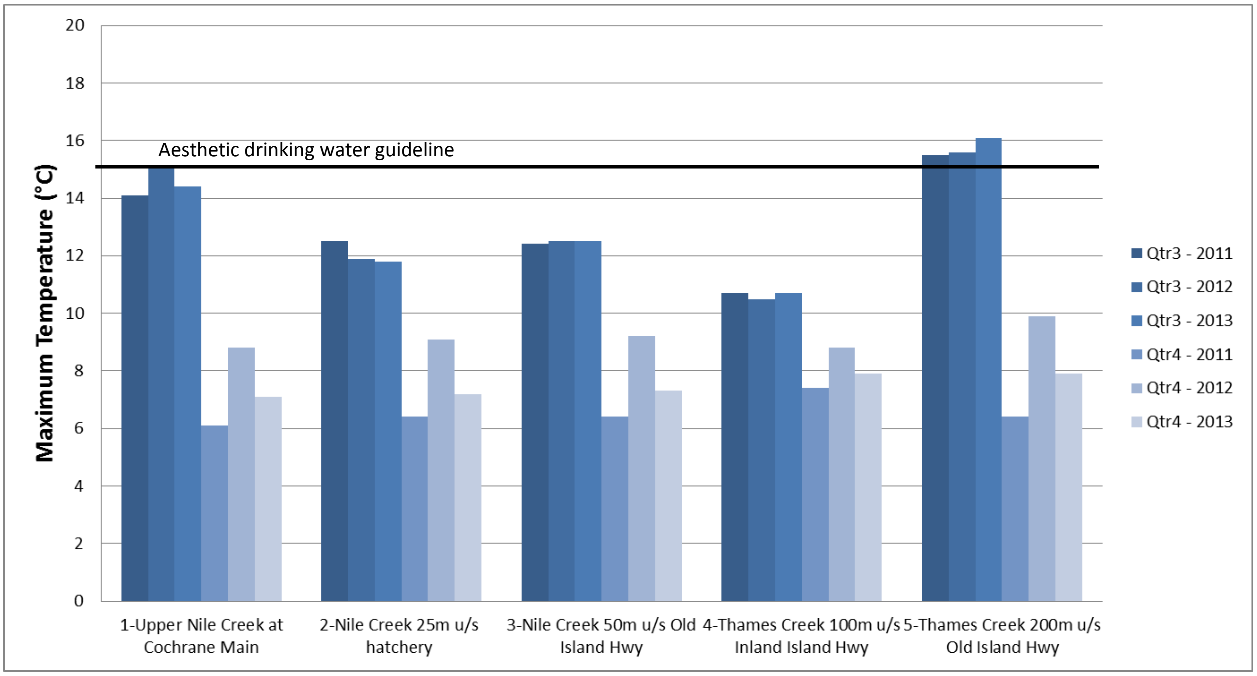
Figure 10 – Maximum turbidity collected by Qualicum Beach Streamkeepers and Parksville-Qualicum Fish and Game Association.



Nile Creek Enhancement Society

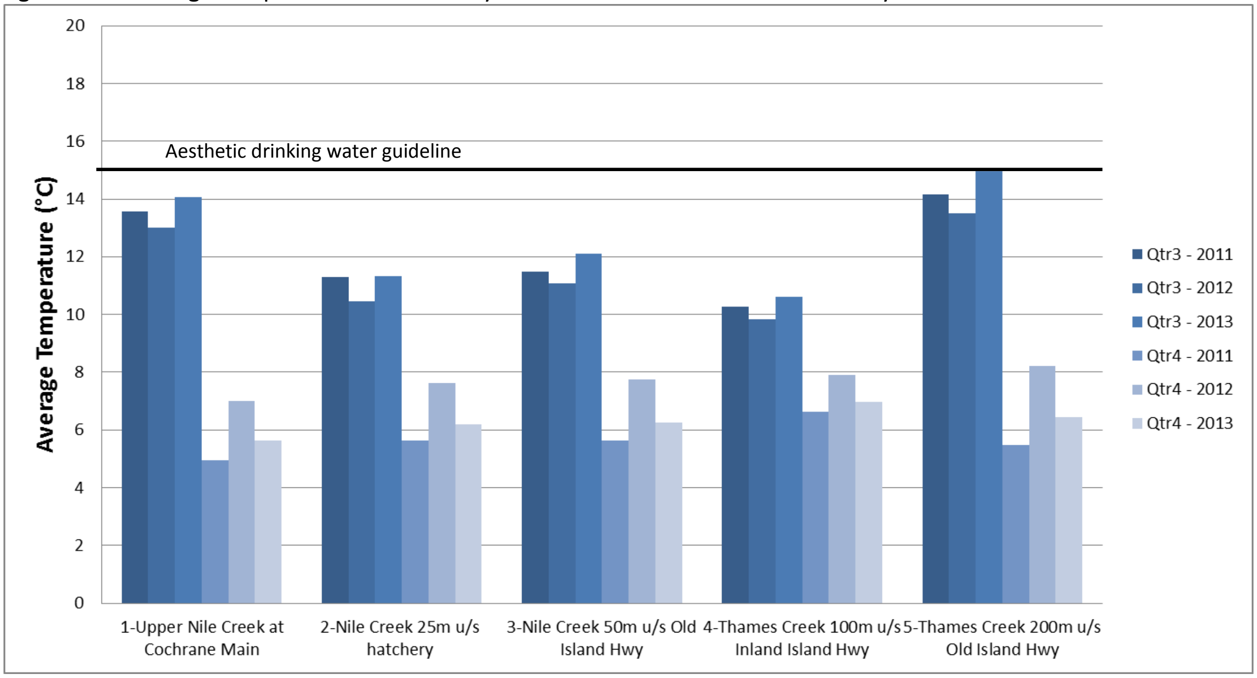
The maximum temperature had the potential for exceedances of the aesthetic drinking water temperature guideline (weekly average ≤15°C) at one site in Thames Creek during each of the summer sample periods and in the upper Nile Creek during the 2012 summer monitoring (Figure 11).

Figure 11 – Maximum temperature collected by the Nile Creek Enhancement Society.



The average temperature had the potential for exceedances of the aesthetic drinking water temperature guideline (weekly average ≤15°C) at Thames Creek 200 m u/s Old Island Hwy during the 2013 summer sample period (Figure 12). These potential exceedances are typical of many Vancouver Island streams. As there are no known drinking water withdrawals from Thames Creek, and summer temperatures observed were below the guideline for coho rearing (≤17°C), these elevated temperatures are not a concern. Higher maximum and average temperatures are typically experienced in reaches that are wider and shallower, while lower amounts of ground water recharge in certain areas could also be a factor. Riparian cover and local hydrology should be evaluated to assess potential influence on temperature trends.

Figure 12 – Average temperature collected by the Nile Creek Enhancement Society.



Minimum and average dissolved oxygen (DO) are shown in Figures 13 and 14 below and the maximum specific conductivity is shown in Figure 15 below. No exceedances of dissolved oxygen guidelines were recorded and specific conductance was within the typical range for coastal British Columbia streams.

Figure 13 – Minimum dissolved oxygen collected by the Nile Creek Enhancement Society.

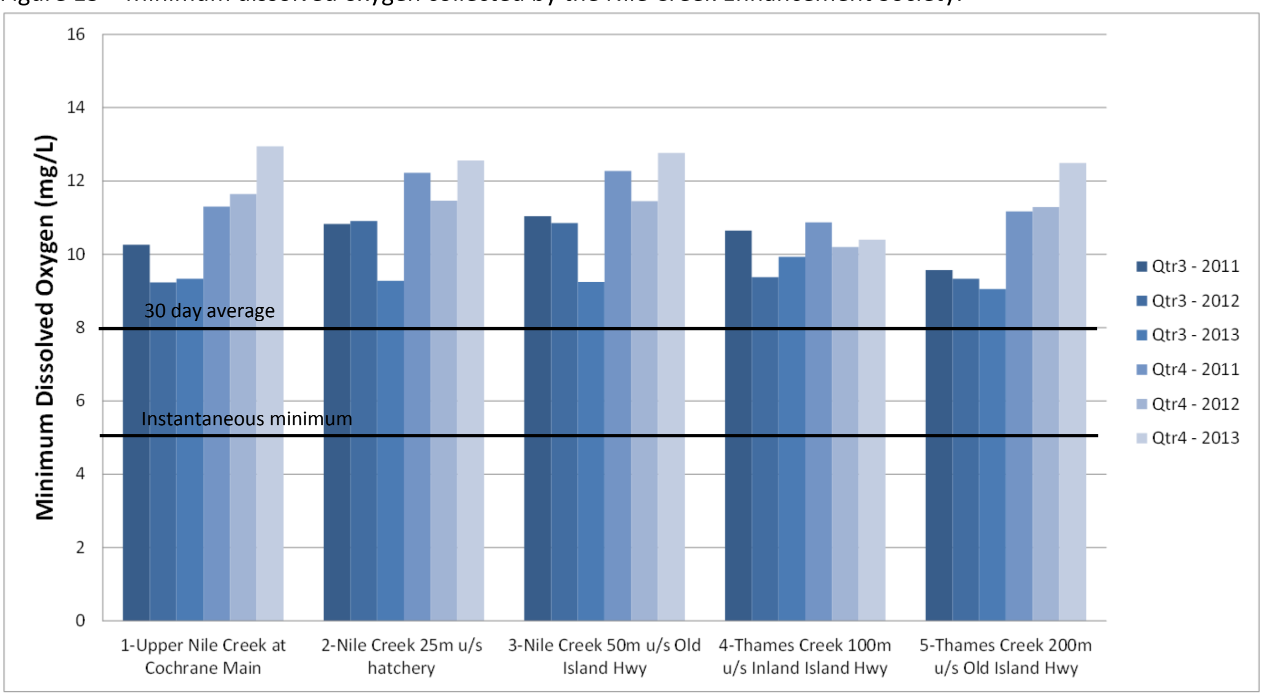


Figure 14 – Average dissolved oxygen collected by the Nile Creek Enhancement Society.

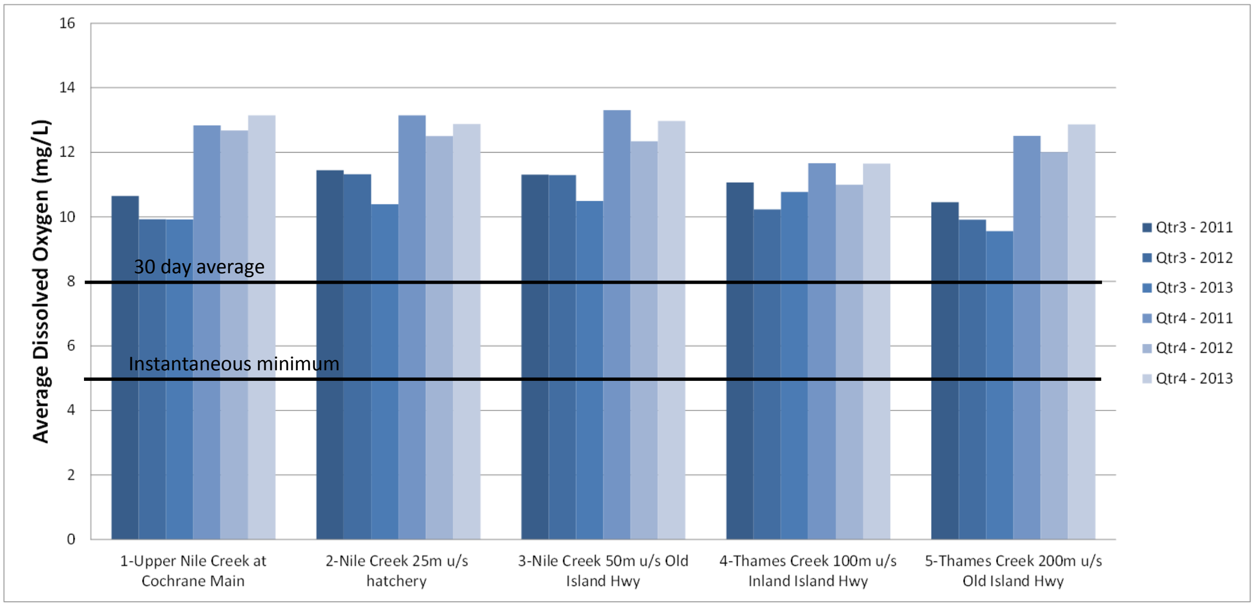
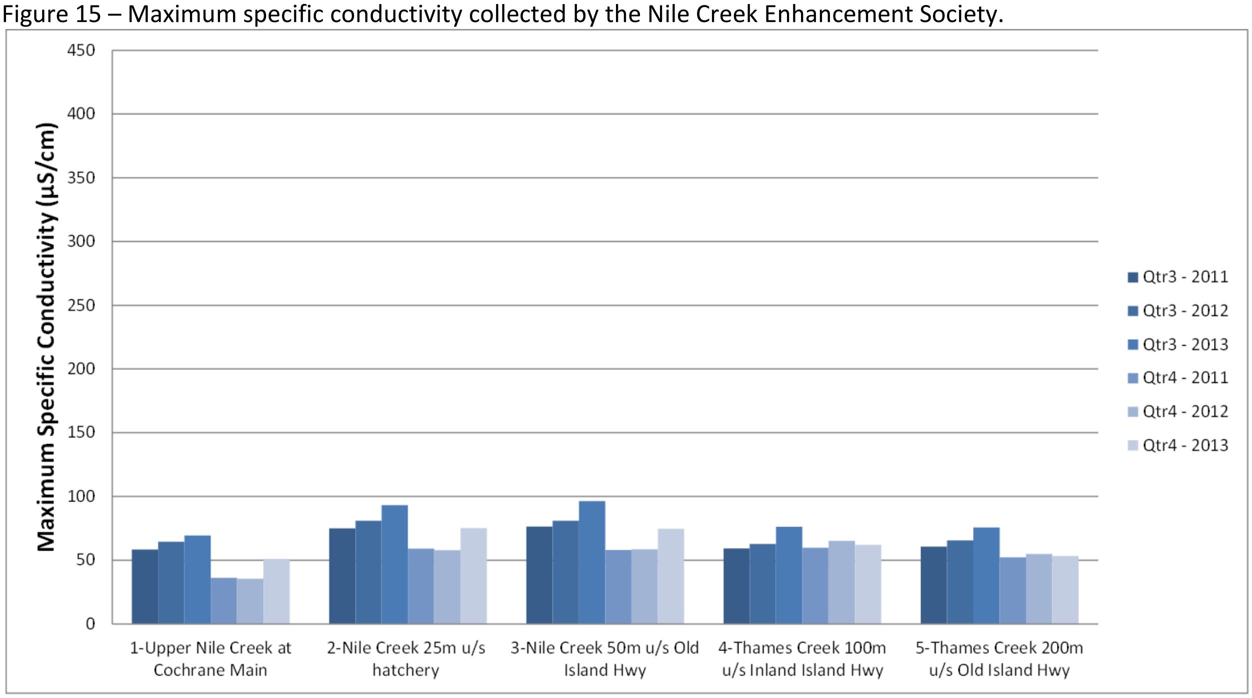
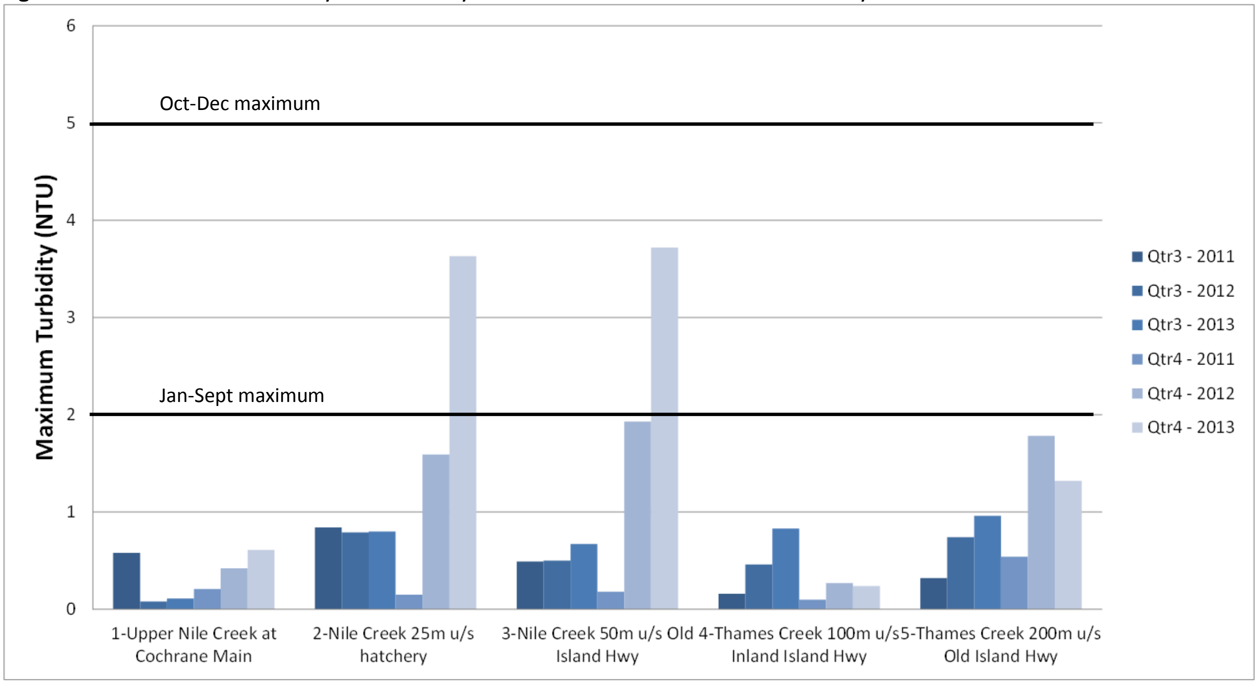


Figure 15 – Maximum specific conductivity collected by the Nile Creek Enhancement Society.



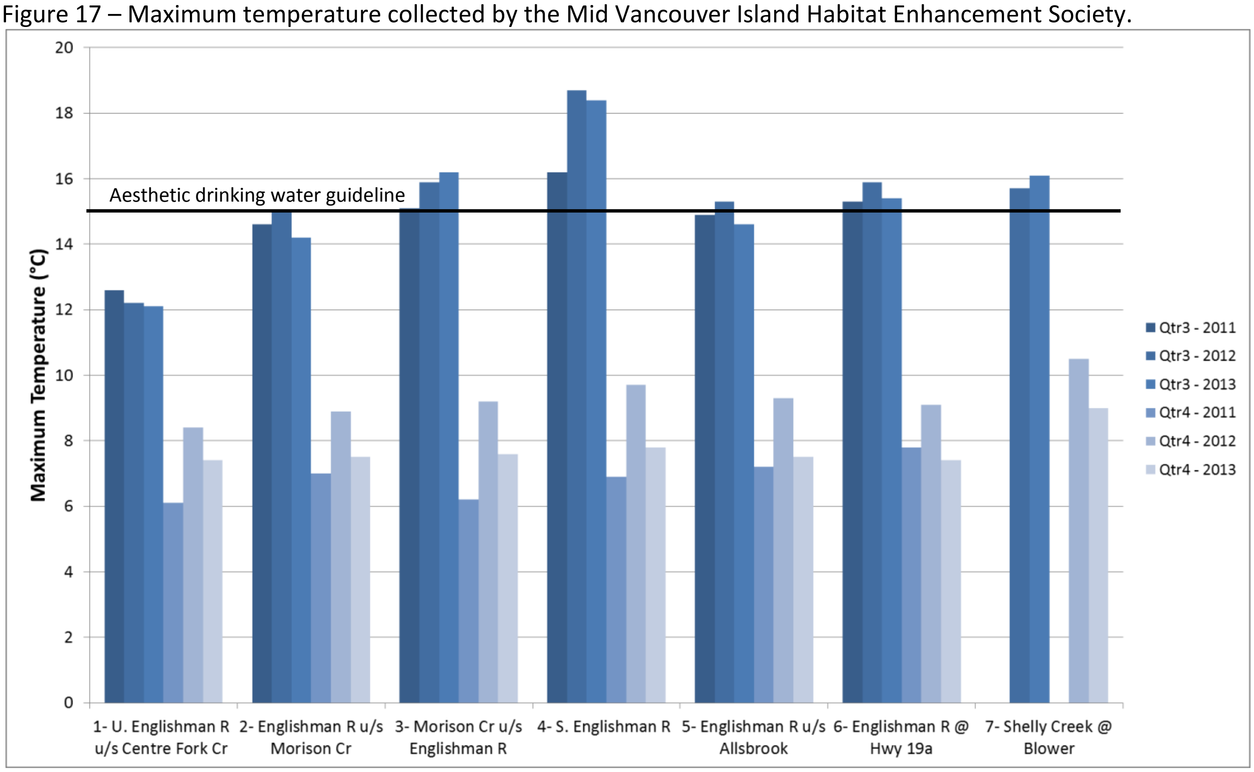
Maximum turbidity values did not exceed Water Quality guidelines for the summer (Jan. – Sept. 2 NTU) or the fall (Oct. – Dec. 5 NTU) during any of the sample periods (Figure 16). Increases in turbidity were associated with rainfall events and tended to be highest in the lower watershed sites.

Figure 16 – Maximum turbidity collected by the Nile Creek Enhancement Society.



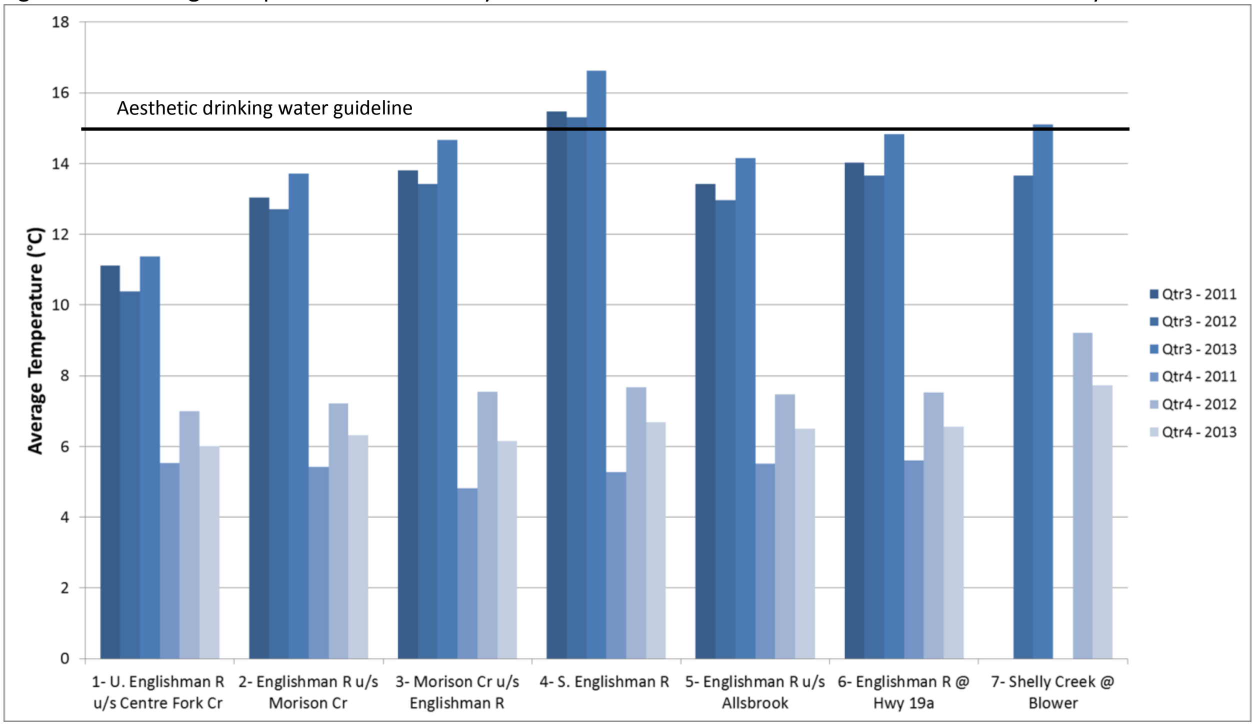
The maximum temperature indicates the potential for exceedances of the aesthetic drinking water temperature guideline (weekly average ≤15°C) in the summer sample periods at all sites except the Upper Englishman River (Figure 17). Maximum summer water temperatures had the potential to exceed the guideline for coho rearing (≤17°C) in the South Englishman River in 2012 and 2013. As long as refuges remain with lower temperatures, juvenile fish should be able to retreat to these during periods of elevated temperatures. Maximum temperatures at the South Englishman River site highlight it as a potential priority area to determine if elevated temperatures are related to the wide and shallow nature of this site, low flows, hydrology of the upper watershed (low elevation, inputs from shallow lakes and a wetland) or other factors. There are currently no studies available with more information on Furguson Swamp, which is upstream of the South Englishman site.

Figure 17 – Maximum temperature collected by the Mid Vancouver Island Habitat Enhancement Society.



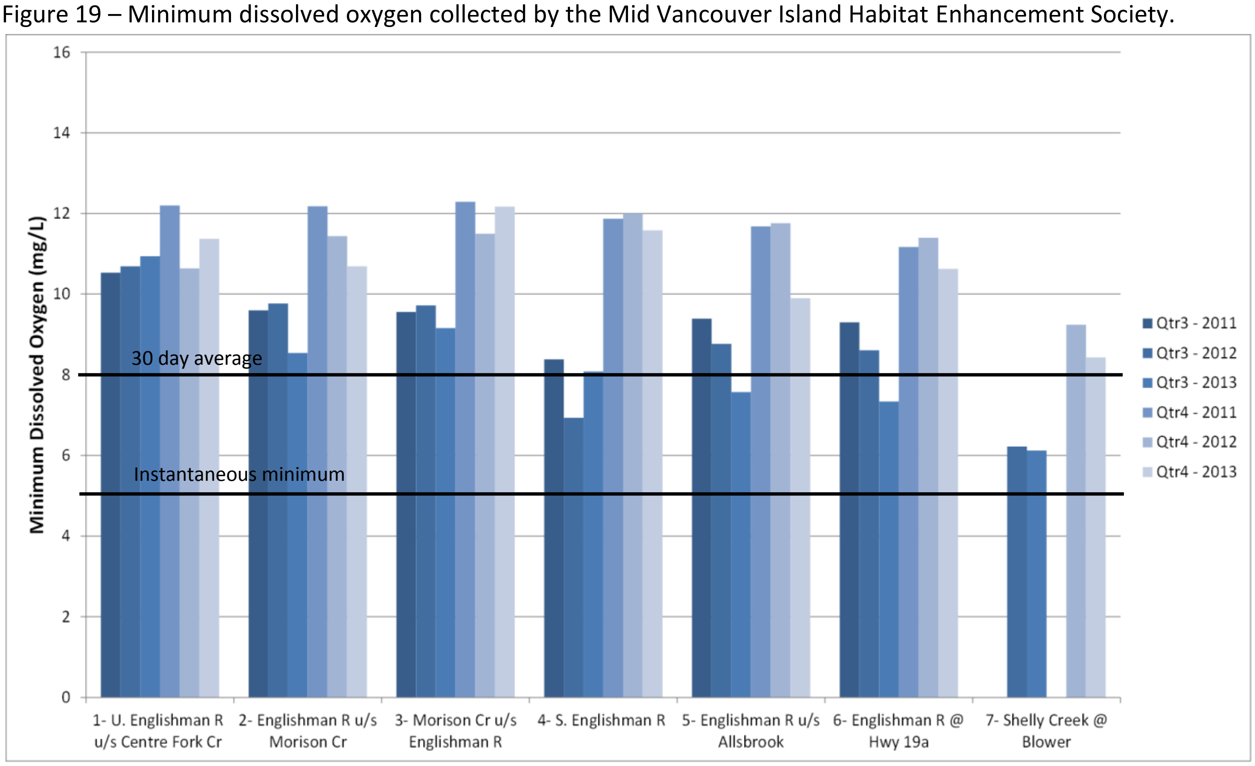
Average temperature values had the potential for exceedances of the aesthetic drinking water temperature guideline (weekly average ≤15°C) in each of the summer sample periods for the South Englishman River site and in summer 2013 for the Shelly Creek at Blower site (Figure 18). This is typical of many east coast Vancouver Island streams where the lower portions are wide and shallow; however, more exposure due to less vegetative cover could also increase maximum and average temperatures. Reviewing riparian cover and local hydrology upstream of sites with higher temperatures will help determine which areas may benefit from restoration of riparian areas, and potential hydrological influences on temperature trends. Monitoring of temperature should be prioritized at these sites after restoration work is complete to assess if restoration work helps reduce maximum in stream temperatures observed.

Figure 18 – Average temperature collected by the Mid Vancouver Island Habitat Enhancement Society.



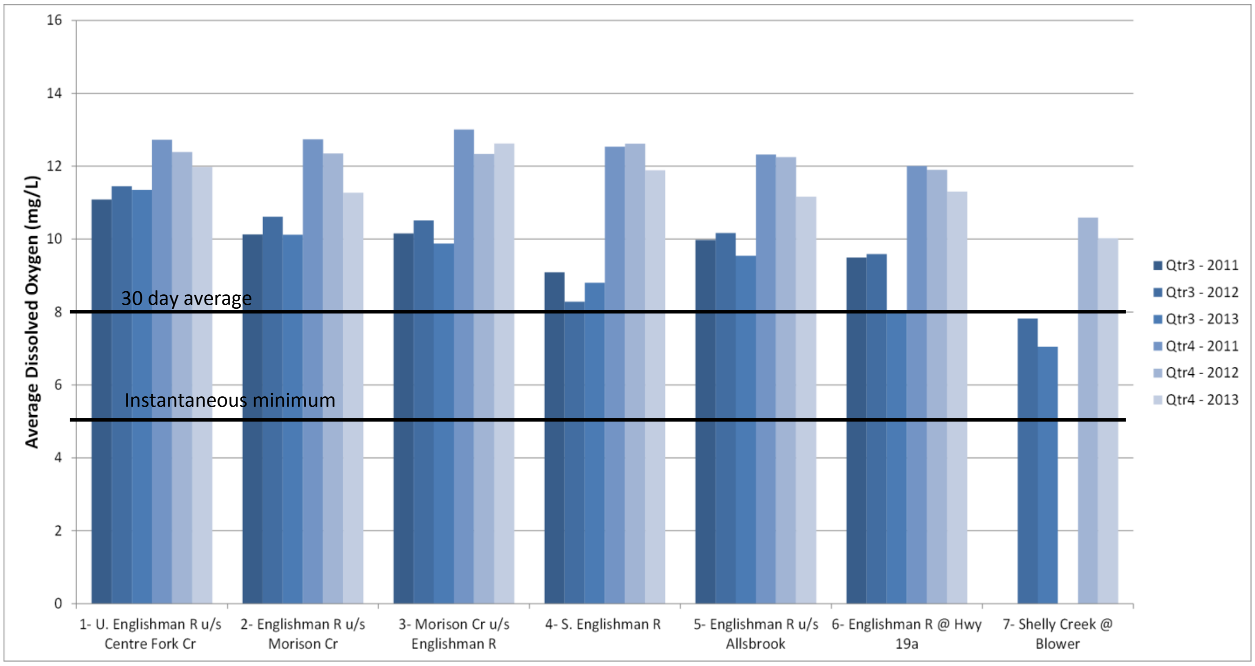
Minimum dissolved oxygen (DO) was above the instantaneous minimum of 5 mg/L for each of the sample periods (Figure 19).

Figure 19 – Minimum dissolved oxygen collected by the Mid Vancouver Island Habitat Enhancement Society.



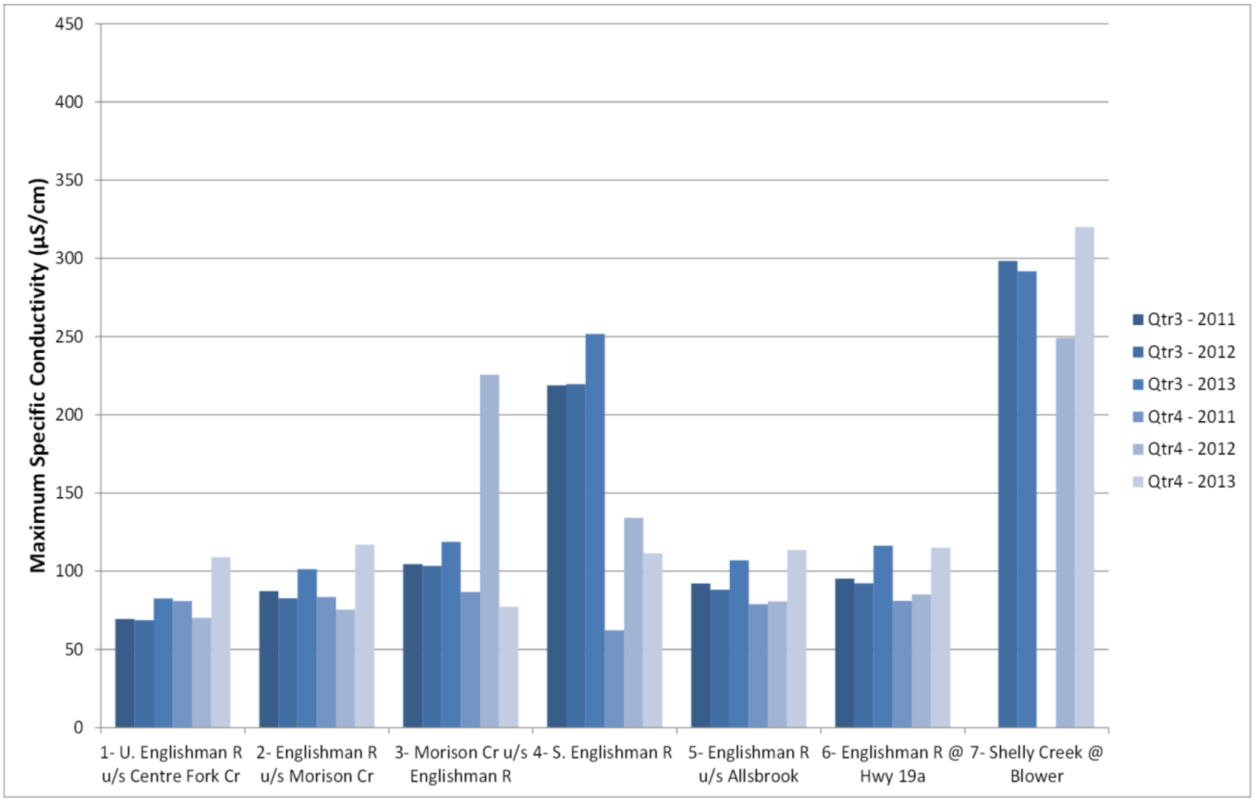
Average DO (Figure 20) was below the recommended 30 day average objective of 8 mg/L in the summer periods for 2012 and 2013 at the Shelly Creek site (average of 7.82 mg/L and 7.05 mg/L, not shown on figure below) and for 2013 at the Englishman River at Highway 19a site (average of 7.98 mg/L, not shown) for the summer low flow period. Low DO values may be indicative of very low flow in the lower reaches of the Englishman River watershed and these sites are of interest for continued monitoring and collection of flow data.

Figure 20 – Average dissolved oxygen collected by the Mid Vancouver Island Habitat Enhancement Society.



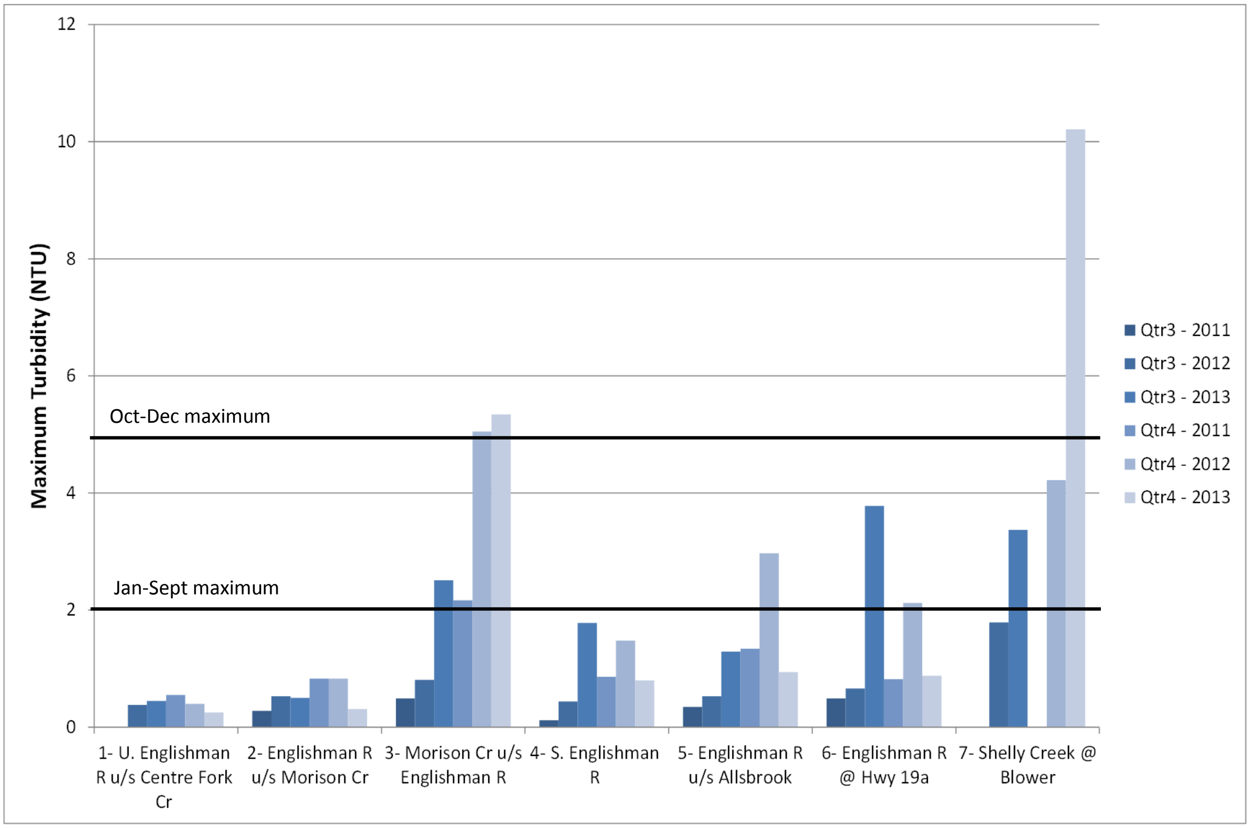
At the South Englishman River site in the summer and at the Shelly Creek site in the summer and fall, the maximum specific conductivity was higher than levels typical of coastal streams (Figure 21). These values were not typically associated with increased turbidity and were most likely influenced by higher groundwater inputs, particularly during lower flows. A groundwater/ surface water interaction study completed in the lower Englishman River watershed (GW Solutions, 2012) concludes that, in the lower section of the watershed and down to its estuary, the overburden aquifers contribute approximately 30% of the summer low flow. Though such a study has not been done for Shelly Creek or the South Englishman River, the higher specific conductivity at these sites suggests even more groundwater inputs than in the lower Englishman River. The 2012 fall Morrison Creek elevated value was most likely due to an excess of debris in the stream on October 23, 2012 and was associated with an increase in the turbidity value for that sample date.

Figure 21 – Maximum specific conductivity collected by the Mid Vancouver Island Habitat Enhancement Society.



Maximum summer turbidity levels exceeded the January to September guideline of 2 NTU in the 2013 summer sample period at Morrison Creek upstream Englishman River, Englishman River at Highway 19a and Shelly Creek at Blower sites (Figure 22). The October to December 5 NTU maximum was exceeded in the fall in 2012 and 2013 at Morrison Creek upstream Englishman River and in 2013 at the Shelly Creek at Blower sites. These exceedances were primarily associated with precipitation events. When rainfall events are not associated with increased turbidity upstream, anthropogenic activities (i.e. from recreational swimming at the Highway 19a site) and algal growth in the lower watershed may be influencing these observations. Further monitoring at and upstream of these sites will help confirm trends and potential turbidity sources. Reviewing riparian cover upstream of these sites will help determine which areas may benefit from restoration efforts.

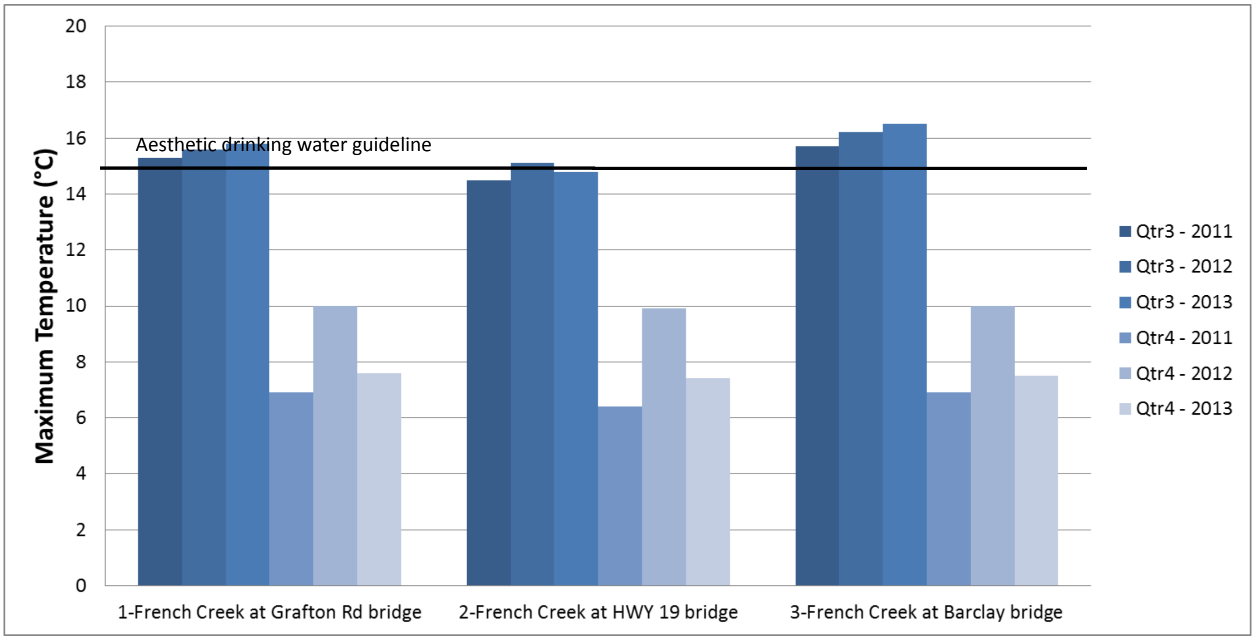
Figure 22 – Maximum turbidity collected by the Mid Vancouver Island Habitat Enhancement Society.



Friends of French Creek Conservation Society

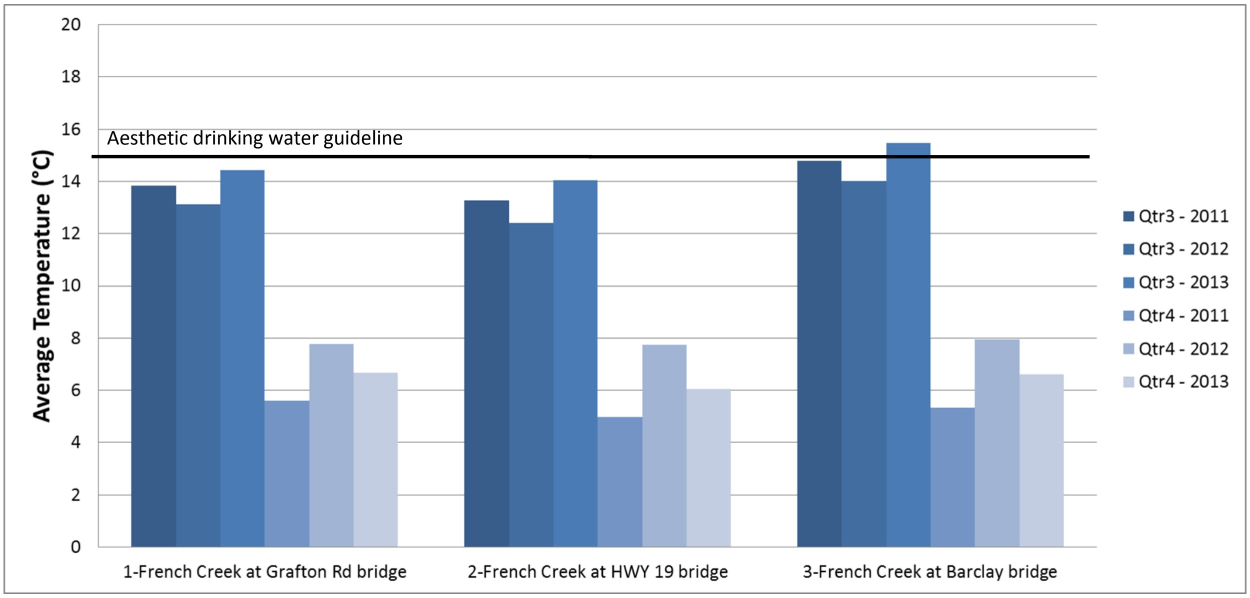
The maximum temperature (Figure 23) indicates there was potential for exceedances of the aesthetic drinking water temperature guideline (weekly average ≤15°C) at all three sites during each of the summer sampling periods. In the 2013 summer period the maximum temperature neared the guideline for coho rearing (≤17°C) but did not exceed it at the Barclay bridge site.

Figure 23 – Maximum temperature collected by the Friends of French Creek Conservation Society.



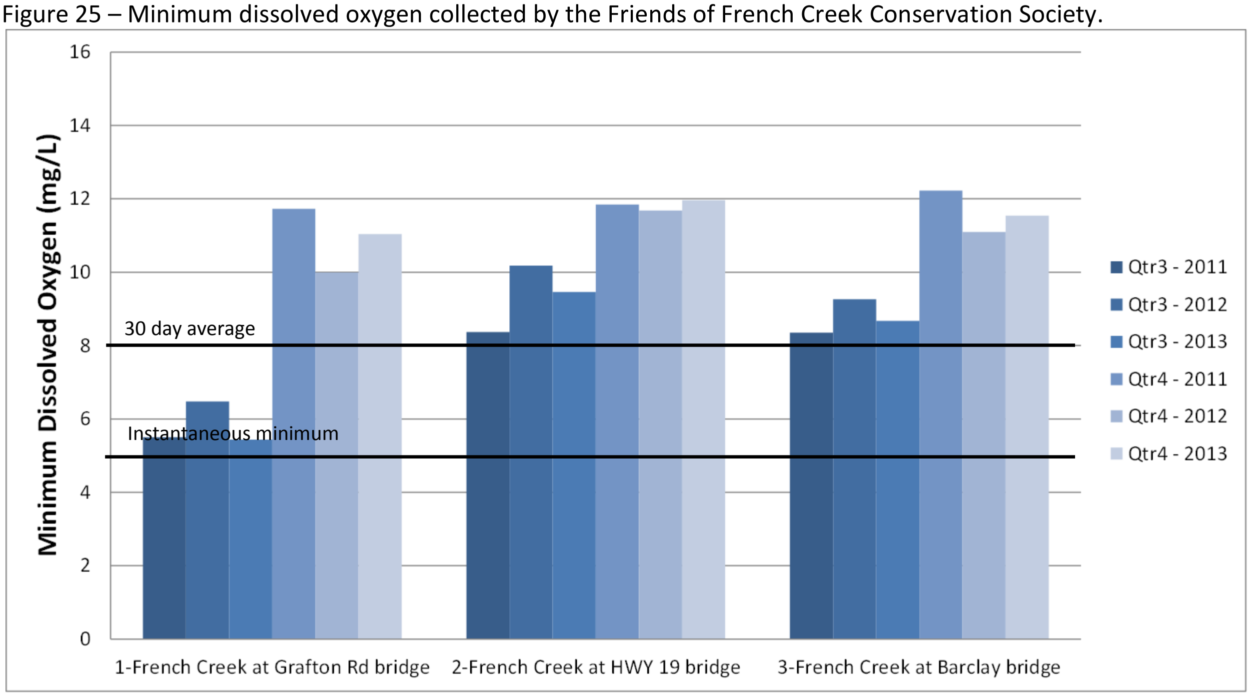
The average temperature collected had the potential for exceedances of the aesthetic drinking water temperature guideline (weekly average ≤15°C) in the summer at the French Creek at Barclay bridge site and at the Grafton Road bridge site in 2013 (Figure 24). The slightly lower maximum and average temperatures at the Highway 19 bridge site on French Creek could be due to more in-stream or over-stream vegetative cover or due to a potential influx of ground water into French Creek near this site. Assessing riparian cover and hydrology upstream of the sample sites will provide a better understanding of potential influences (e.g. riparian cover in rural residential areas, inputs from Hamilton Marsh) on temperature trends and which areas may benefit from restoration work. Monitoring of temperature should be prioritized at the Barclay bridge site after restoration work is complete to assess if restoration work helps reduce maximum in stream temperatures observed.

Figure 24 – Average temperature collected by the Friends of French Creek Conservation Society.



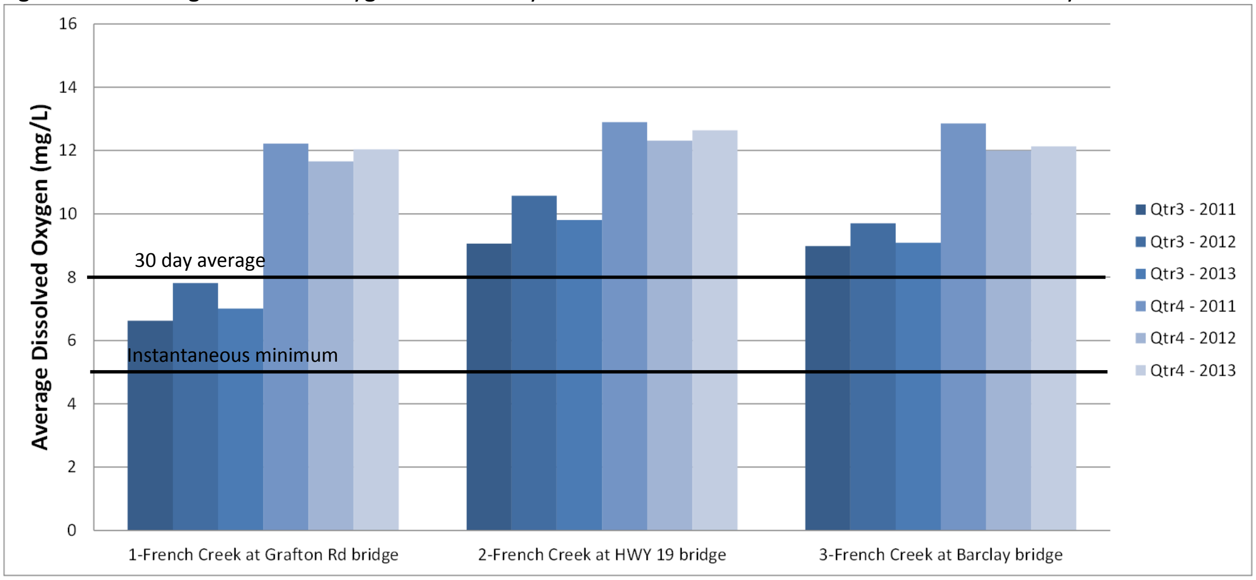
At the dates and times sampled, the minimum dissolved oxygen (DO) did not drop below the guideline for the instantaneous minimum of 5 mg/L (Figure 25).

Figure 25 – Minimum dissolved oxygen collected by the Friends of French Creek Conservation Society.



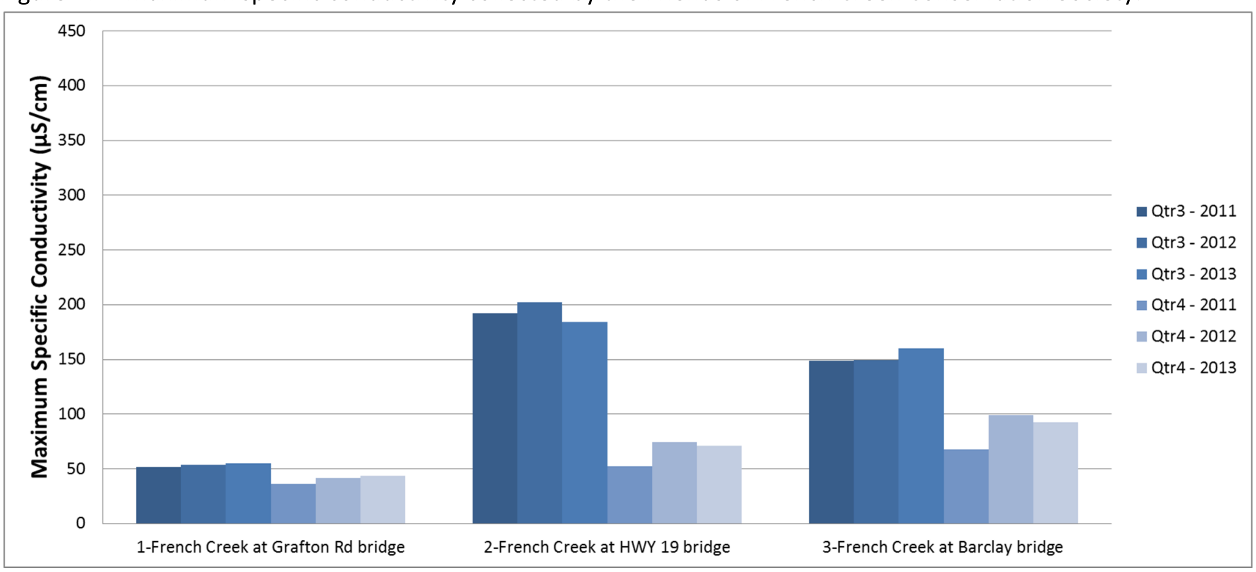
Average DO (Figure 26) at the Grafton Road site was below the recommended 30 day average throughout each of the summer sampling periods (average of 6.62 mg/L, 7.81 mg/L and 7.01 mg/L in 2011, 2012 and 2013, not shown in figure below). Low DO values were associated with very low flow or still water at this site. To better understand low DO trends at this site, future monitoring should be completed and assessed relative to flow data.

Figure 26 – Average dissolved oxygen collected by the Friends of French Creek Conservation Society.



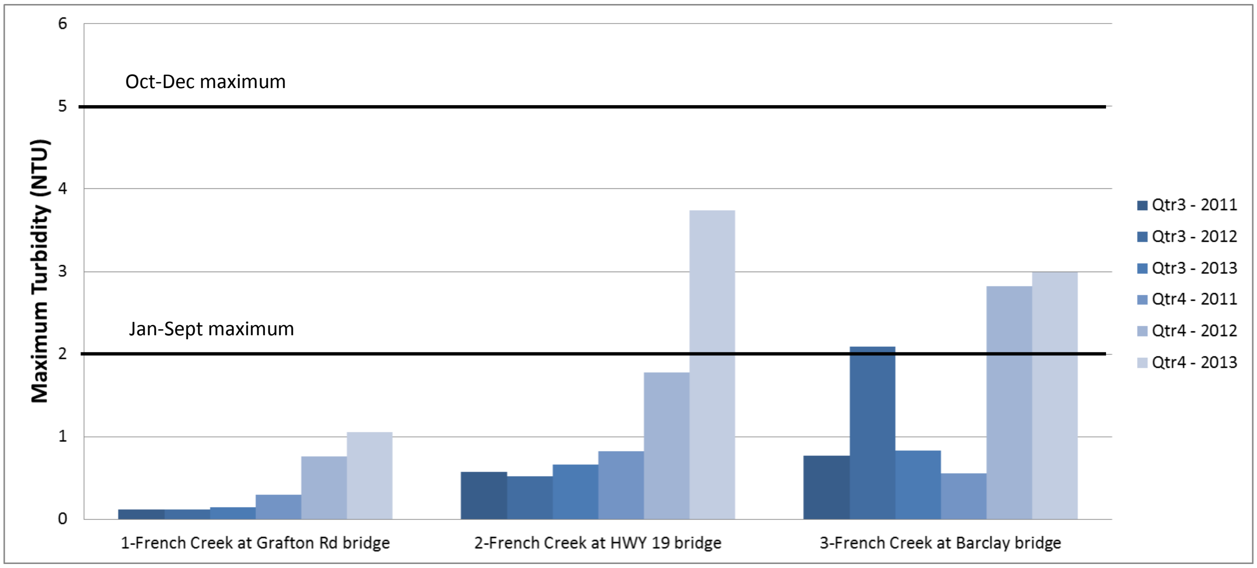
At the Highway 19 and Barclay Bridge sites, the summer maximum specific conductivity was higher than levels typical of coastal streams in each of the sample years (Figure 27). As the higher values at both of these sites were consistently seen in each of the years, they are most likely influenced by higher groundwater inputs. No studies are currently available on groundwater in this area.

Figure 27 – Maximum specific conductivity collected by the Friends of French Creek Conservation Society.



Summer maximum turbidity levels were well below the January to September maximum of 2 NTU for each of the summer periods except in 2012 at the Barclay bridge site (Figure 28). The higher turbidity levels experienced at this site in 2012 were associated with an excavator working upstream during that sample date and thus were not considered to be an ongoing issue. Known failing septic issues in the area may also be influencing values observed (Barlak and Phippin, 2014). To determine if nutrient or microbiological inputs are contributing to increased turbidity, more in depth sampling is recommended at Barclay Bridge site. The increase in the fall values at all three sites were associated with rainfall events.

Figure 28 – Maximum turbidity collected by the Friends of French Creek Conservation Society.

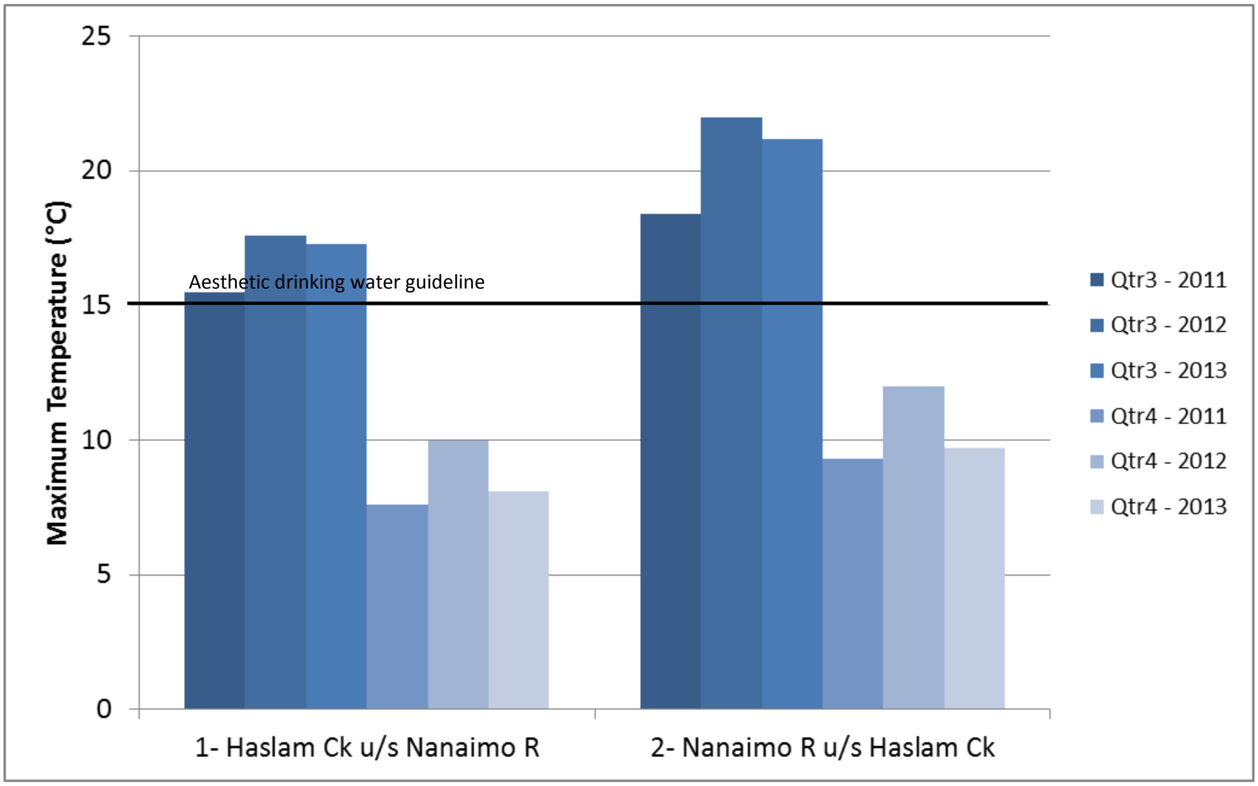


Nanaimo and Area Land Trust

As NALT summer 2011 data was collected on one sample date only, the six parameters shown in the graphs for this sample period reflect only this one sample date and not the maximum, minimum or average.

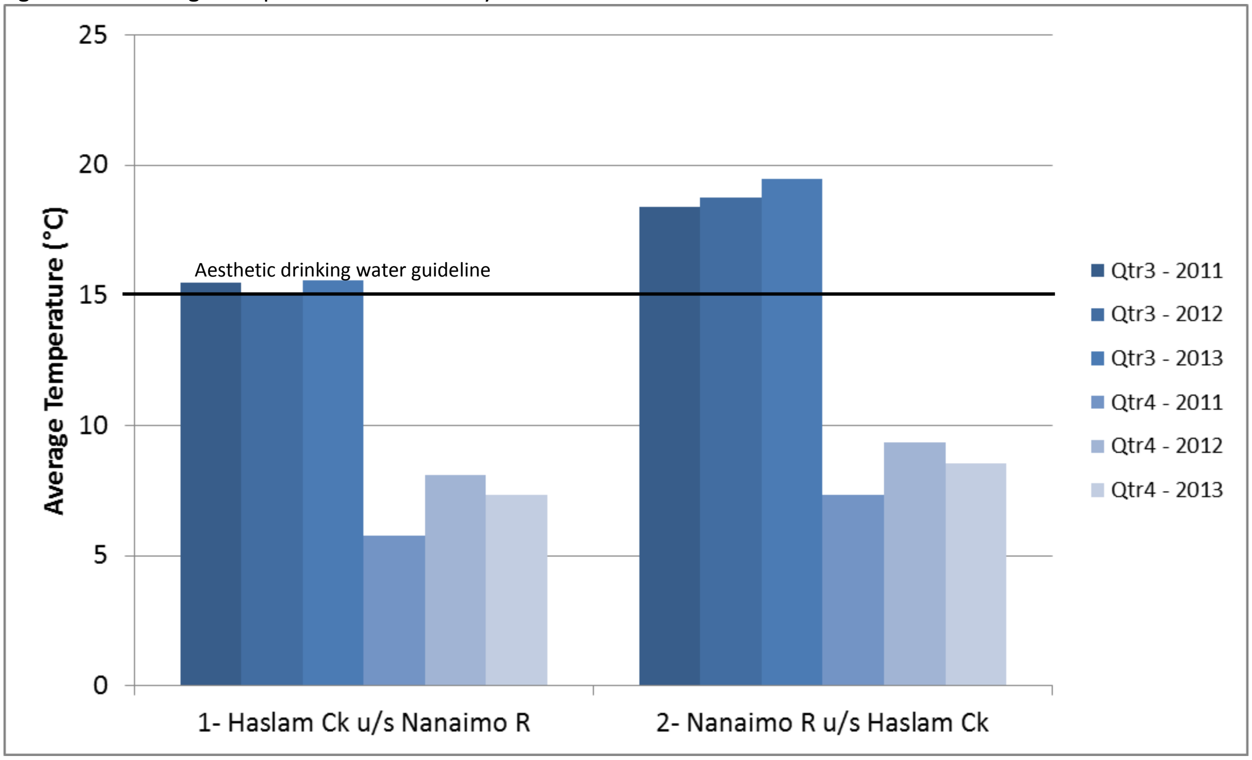
For the maximum temperature, there was potential for exceedances of the aesthetic drinking water temperature guideline (weekly average ≤15°C) throughout the summer sample periods at both sample sites (Figure 29). Both sites experienced potential summer maximum temperature exceedances of the guideline for coho rearing (≤17°C) in each of the years except for Haslam Creek in 2011.

Figure 29 – Maximum temperature collected by the Nanaimo and Area Land Trust.



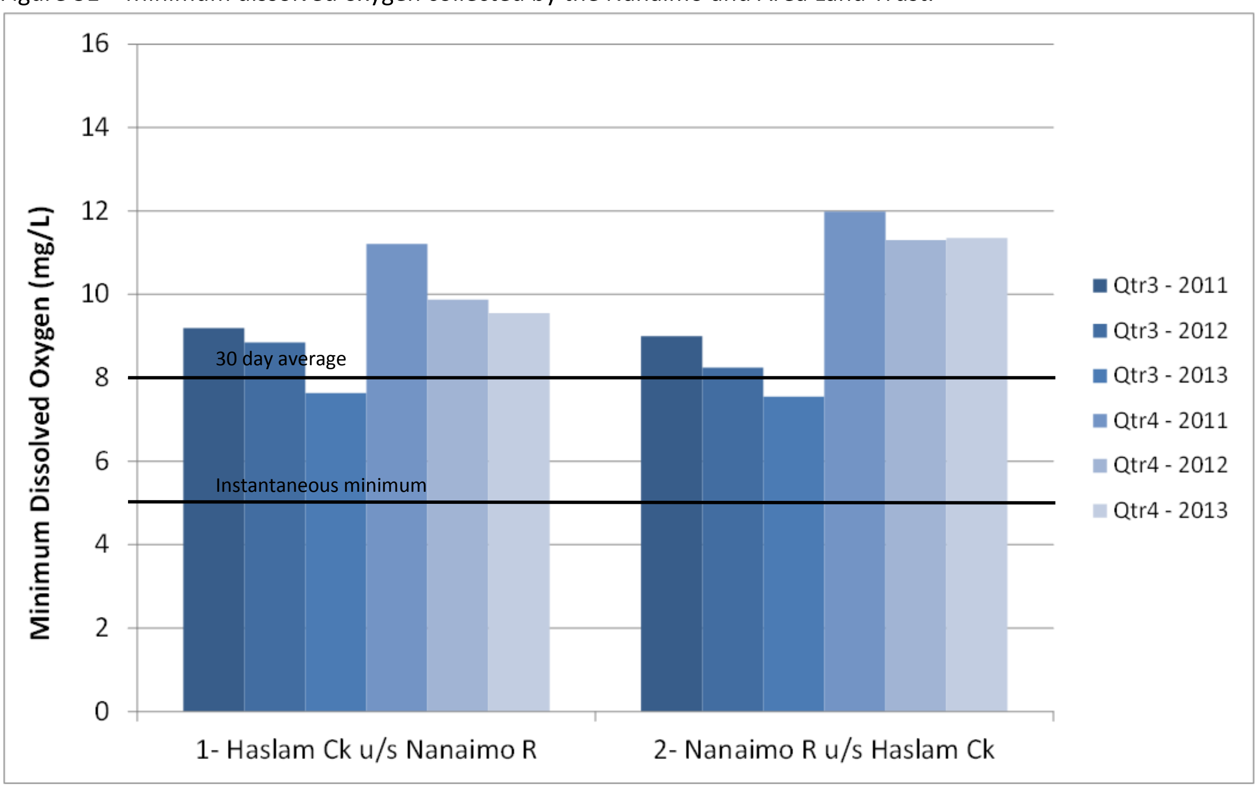
For the summer average temperature, potential exceedances of the aesthetic drinking water temperature guideline (weekly average ≤15°C) were seen at both sample locations in 2012 and 2013 (Figure 30). The 2012 and 2013 summer average temperatures exceeded the guideline for coho rearing (≤17°C) at the Nanaimo River upstream Haslam Creek site. These maximum and average temperatures are typical of many east coast Vancouver Island streams where the lower portions are wide and shallow. As long as lower temperature refuges remain, juvenile fish should be able to retreat to these areas during times of increases in temperature. Assessing upstream riparian cover and hydrology upstream, as well as having more sites both upstream and downstream, would help determine temperature inputs and where restoration efforts may be most beneficial.

Figure 30 – Average temperature collected by the Nanaimo and Area Land Trust.



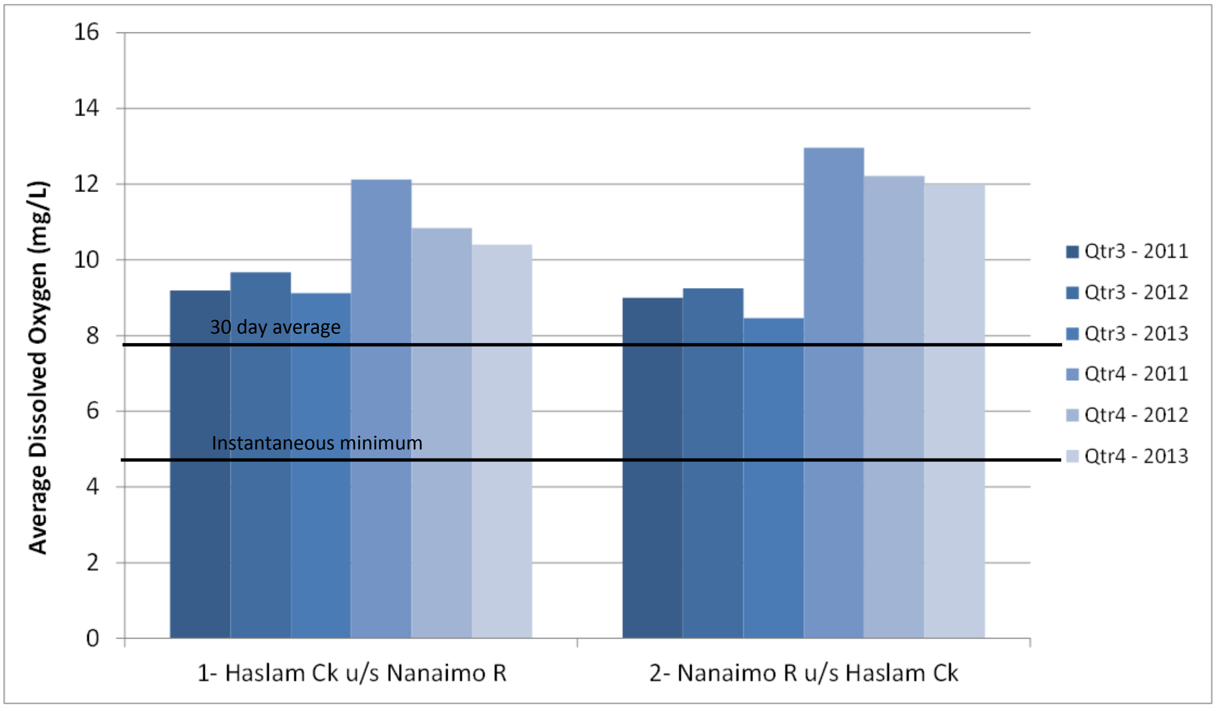
Minimum dissolved oxygen (DO) values were above the instantaneous minimum of 5 mg/L in each of the sample periods (Figure 31).

Figure 31 – Minimum dissolved oxygen collected by the Nanaimo and Area Land Trust.



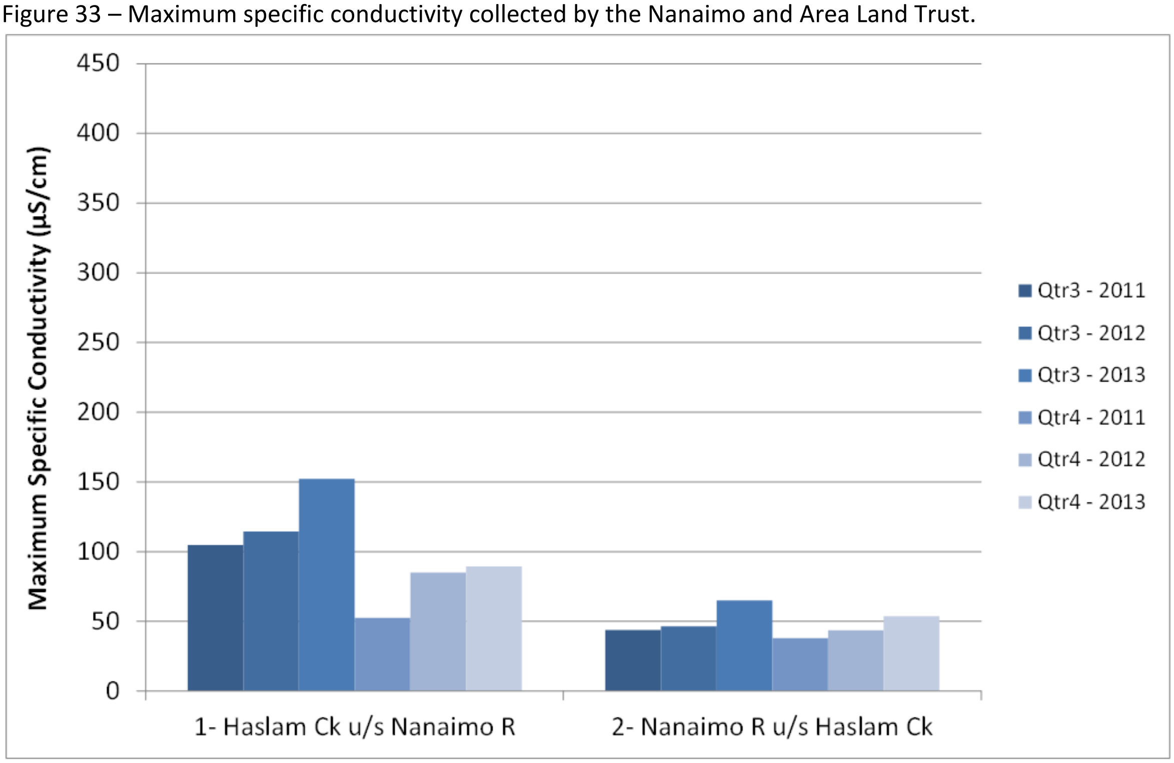
Average DO values did not drop below the 8 mg/L 30 day average guideline during the sample periods (Figure 32).

Figure 32 – Average dissolved oxygen collected by the Nanaimo and Area Land Trust.



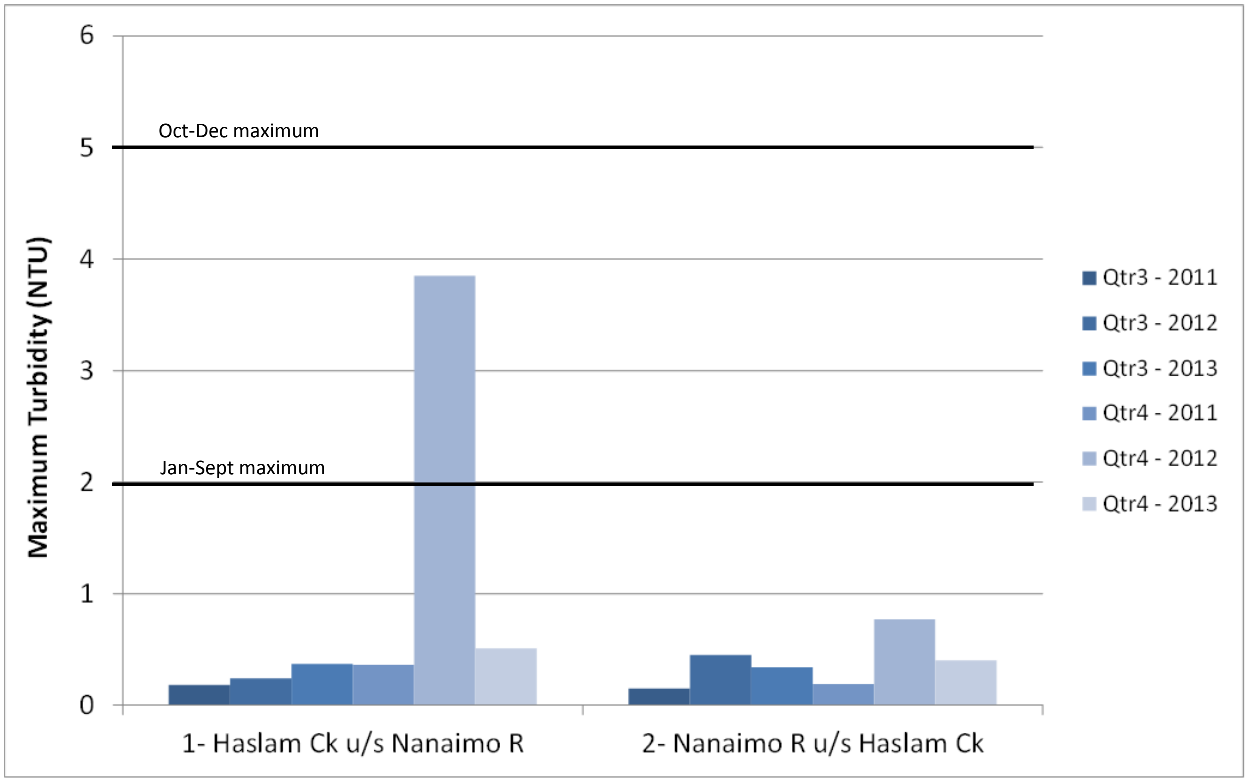
Summer maximum specific conductivity values were slightly higher at the Haslam Creek upstream Nanaimo River site (Figure 33). This increase may indicate groundwater influence at this site.

Figure 33 – Maximum specific conductivity collected by the Nanaimo and Area Land Trust.



The maximum turbidity data collected were below both the summer (2 NTU) and winter (5 NTU) drinking water guidelines (Figure 34). In the Haslam Creek upstream Nanaimo River site, the large increase may have been associated with field observations of high numbers of dead spawned fish and very high water levels on October 30, 2012. Slight increases in turbidity were associated with rainfall events.

Figure 34 – Maximum turbidity collected by the Nanaimo and Area Land Trust.



Recommendations

A summary of the findings of the trend analysis from data collected from 2011 to 2013 can be seen in Table 3. Exceedances in temperature, turbidity and dissolved oxygen are considered below, Specific conductivity is not included in Table 3 as there are no guidelines or objectives set for this water quality parameter.

Table 3 – Summary of Community Watershed Monitoring Network three year trend analysis.

Group	Watershed	Sample Location	Parameter	Guideline	Exceeded Periods
QBS	Little Qualicum R.	1.2 km d/s Cameron R.	Temperature	weekly avg. ≤17°C	Summer 2011-2013
		at intake	Temperature	weekly avg. ≤17°C	Summer 2011-2013
	Grandon Creek	West Crescent (Caissons)	Temperature	weekly avg. ≤15°C	Summer 2011-2013
			Turbidity	>2 NTU (Jan-Sept)	Summer 2013
		at Laburnum	Temperature	weekly avg. ≤15°C	Summer 2011-2013
			Dissolved Oxygen	Inst. Min. 5mg/L	Summer 2011-2013
			Turbidity	>2 NTU (Jan-Sept)	Summer 2011-2013
	Beach Creek	at Hemsworth Rd	Temperature	weekly avg. ≤15°C	Summer 2012, 2013
			Turbidity	>2 NTU (Jan-Sept)	Summer 2012
		near Memorial Golf C.	Turbidity	>2 NTU (Jan-Sept)	Summer 2011-2013
NCES	Thames Ck	200m u/s Old Isl. Hwy	Temperature	weekly avg. ≤15°C	Summer 2011-2013
	Nile Creek	upper at Cochrane M.	Temperature	weekly avg. ≤15°C	Summer 2012
MVIHES	Englishman River	Morrison Ck u/s ER	Temperature	weekly avg. ≤15°C	Summer 2011-2013
			Turbidity	>2 NTU (Jan-Sept)	Summer 2013
		S. Englishman R	Temperature	weekly avg. ≤17°C	Summer 2011-2013
		ER u/s Allsbrook	Temperature	weekly avg. ≤15°C	Summer 2012
		ER at Hwy 19a	Temperature	weekly avg. ≤15°C	Summer 2011-2013
			Dissolved Oxygen	Inst. Min. 5mg/L	Summer 2013
			Turbidity	>2 NTU (Jan-Sept)	Summer 2013
		Shelly Creek at Blower	Temperature	weekly avg. ≤15ºC	Summer 2012, 2013
			Dissolved Oxygen	Inst. Min. 5mg/L	Summer 2012, 2013
			Turbidity	>2 NTU (Jan-Sept)	Summer 2013
			Turbidity	>5 NTU (Oct-Dec)	Fall 2013
FFCCS	French Creek	Barclay bridge	Temperature	weekly avg. ≤15°C	Summer 2011-2013
		Grafton Rd bridge	Temperature	weekly avg. ≤15°C	Summer 2011-2013
			Dissolved Oxygen	30 day avg. 8mg/L	Summer 2011-2013
NALT	Nanaimo River	Haslam Ck u/s NR	Temperature	weekly avg. ≤15°C	Summer 2012, 2013
		NR u/s Haslam Ck	Temperature	weekly avg. ≤17°C	Summer 2012, 2013

Based on water quality guidelines and objectives, exceedances of one of the measured parameters (temperature, dissolved oxygen or turbidity) occurred at 17 of 25 sample locations during at least one of the sample periods. Temperature exceedances are reflective of general summer conditions for most east coast streams, particularly in the lower watershed where the streams are wide, slow moving and have little stream cover, or where there are lakes or marshy areas upstream. Data collected to date as part of this program supports this statement. Assessing upstream and site specific stream cover at these sites should be completed to assist in prioritizing more temperature monitoring. Similarly, low dissolved oxygen levels in some of the smaller streams are indicative of slow moving or stagnant streams. Many streams on the east coast of Vancouver Island go sub surface during the summer, and some have inputs from surrounding groundwater aquifers (e.g. Lower Englishman River as studied by GW Solutions, 2012). Groundwater/surface water interactions in some of the streams in this program are supported by observations of high specific conductivity and the low DO in some streams. It is currently beyond the capacity of this program to determine if low flows are completely natural or influenced by surface or groundwater withdrawals, but collecting flow data would help in understanding these streams.

Seven of the sites listed in the Table 3 had exceedances of more than one of temperature, dissolved oxygen or turbidity, with six of these sites showing turbidity exceedances (only French Creek at Grafton did not show turbidity exceedances). Thus, these seven sites are highlighted as priority areas for continued sampling in 2014 (Table 4). As turbidity is associated with higher levels of other contaminants, it was considered the highest priority when determining at which sites more sampling (i.e. lab analysis for additional parameters) needed to occur. It is recommended that additional sites be added upstream of the high turbidity sites to determine potential turbidity sources.

Table 4 – Summary of sites with exceedances of more than one parameter during the 2011-2013 sample periods.

Group	**Watershed**	**Sample Location**	**EMS ID**
QBS	Grandon Creek	West Crescent (Caissons)	E288090
QBS	Grandon Creek	at Laburnum	E288091
QBS	Beach Creek	at Hemsworth Rd	E288092
MVIHES	Englishman River	Morrison Creek u/s ER	E248835
MVIHES	Englishman River	ER at Hwy 19a	121580
MVIHES	Englishman River	Shelly Creek at Blower	E290452
FFCCS	French Creek	Grafton Rd bridge	E243024

To complete the three year trend data it is recommended for the 2014 sample year that:

- Monitoring continue in streams where turbidity was shown in exceedance.
- Nanaimo and Area Land Trust complete the 2014 monitoring to add a third full year of summer sampling to their data set.
- The community organizations that were added in 2012 (Departure Creek Streamkeepers, Harbour City River Stewards, Island Waters Fly Fishers and Vancouver Island University) continue monitoring in 2014 so that a three year trend of data can be completed.

To better discern why exceedances occurred at the seven sites listed in Table 4 the following modifications should be considered:

- Sampling at strategic points upstream of these sites to determine possible sources of impacts.
- The addition of hydrometric flow measurements, assessments of the physical structure of the stream, the condition of the stream, and riparian habitat upstream of the sample site to better assess/interpret the water quality of these areas.
- Include collection of supplementary data and parameters that can be used to better identify future sites for educational opportunities and restoration work (e.g. *E.coli*, nutrients, metals).

The following general recommendations are made for future monitoring years:

- Re-training of calibration and sampling procedures should occur at least once each year of the program.

- Emphasize sampling techniques to ensure no disturbance of stream bottom.
- Quality control samples (e.g. duplicates sent for lab analysis and duplicate meter readings on 10% of samples) should occur and techniques for collecting samples reviewed.
- The importance of getting five samples in 30 days for comparison to objectives should be emphasized.
- Greater flexibility in the fall sample period to ensure that the fall flush is captured in the fall rains sample period.
- After 2013, data collected be reported on every second or third year to better discern trends in the data; data will still be annually entered into MOE database and available to all groups and the public.
- Linking sampling events (done every 3 to 5 years) in those streams where MOE water quality attainment sampling needs to occur (i.e. Englishman River, French Creek, Little Qualicum River)

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