

Core Area Stormwater Quality Program

2018 Report

Capital Regional District | Parks & Environmental Services, Environmental Protection

Including the jurisdictions of:

City of Colwood
Township of Esquimalt
City of Langford
District of Oak Bay
District of Saanich
City of Victoria
Town of View Royal
Esquimalt First Nation
Songhees First Nation
Department of National Defence

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**CORE AREA STORMWATER QUALITY PROGRAM
2018 REPORT**

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CORE AREA STORMWATER QUALITY PROGRAM 2018 REPORT

1.0 INTRODUCTION

The Capital Regional District (CRD), Stormwater Quality Program plans and coordinates stormwater quality monitoring, and communicates results to participating municipalities. In the core area, this work is guided by the Core Area Liquid Waste Management Plan (LWMP) and done in consultation with municipalities, First Nations, and community groups, with the goal of protecting human health and the environment. The program works to identify and reduce contamination in stormwater, creeks and the ocean through monitoring, assessment, collaboration and education.

CRD staff identify contamination and impacts from stormwater due to various land use practices, through bacterial and chemical sampling. The program assesses stormwater discharges in the core area and assigns priority ratings for mitigative action for municipalities to consider. Where contamination is found, CRD staff conduct additional investigations and work with municipal staff to find and eliminate the source.

This report summarizes the results of work completed in 2018. In addition to routine monitoring, CRD conducted intensive sampling in Esquimalt and Victoria harbours, the Gorge, Portage Inlet and Esquimalt Lagoon. Inputs into these waterways, including Mill Stream, Cecelia Creek and five stormwater discharges were also assessed more comprehensively. Water and sediment quality data, including details about how discharges are rated for public health and environmental concern and sampling locations, are available in the *Core Area Stormwater Quality Program 2018 Supplemental Data* on the CRD website (www.crd.bc.ca).

2.0 RESULTS AND DISCUSSION

2.1 Stormwater Discharge Evaluations

The program evaluates water and/or sediment quality in approximately 550 core area stormwater discharges from the coastline between the Colwood-Metchosin border in the west and the Saanich-Central Saanich border in the east, including Esquimalt Lagoon, Esquimalt and Victoria harbours, the Gorge, Portage Inlet and the City of Langford coastline along Saanich Inlet (See Appendix A).

2.1.1 Public Health – *E. coli*

Each year, CRD staff collect water samples from a selection of stormwater discharges for measurement of bacteria levels. The extent of bacterial contamination, and potential for members of the public to contact the discharge flow, is used to rate each discharge for public health concern. This allows jurisdictions to undertake remedial measures where they will have the most benefit. Appendix G contains detailed information about the CRD public health concern rating system.

In 2018, the CRD assessed 166 stormwater discharges for *E.coli* concentrations in the fall and the summer. Sixty-three percent of the discharges had one or more *E.coli* counts greater than 200 colony forming units (CFU)/100 mL, a level that indicates sources of sewage or animal waste with potential to cause adverse effects for public health from primary recreational activities (e.g., swimming, diving). However, many of these discharges have low flows or are located where there is little risk of public contact. Considering the potential for contact, CRD staff assigned the following public health concern ratings:

- 66 low ratings
- 69 moderate ratings, and
- 31 high ratings (Table A, Figures A and B)

The overall number of high-rated discharges has remained the same since 2016; however, many of these are different discharges, due to repair of some sources, identification of new sources and fluctuations in bacterial levels. From 2017 to 2018, 12 of the previously high-rated discharges were assigned a lower rating and 12 were assigned a higher rating. The reasons for lower ratings in discharges that were previously rated high are summarized below:

- two cross-connections were found and repaired, and
- 10 discharges have lower levels of bacteria for unknown reasons; some of these are due to relining efforts and repairs

The following observations were noted in those discharges that have received a high rating in 2018 and were rated low or moderate in 2017:

- six discharges appear to have developed a new source of contamination since 2017,
- six have bacterial concentrations that have been high before but concentrations are highly-variable

Improvements in stormwater quality have resulted in a decline in the number of high-rated discharges in 2011-2016 (Table A), despite the ongoing addition of new sources of contamination that come up as infrastructure ages and new developments or renovations create the potential for stormwater-sewage cross-connections. Bacterial stormwater data and the public health concern ratings for each discharge can be found in appendices B and C, respectively.

2.1.2 Environment – Chemical Contaminants

CRD staff also rate stormwater discharges for environmental concern. Ratings are based on the concentrations of metals and organic contaminants measured in sediment within the stormwater collection system (i.e., pipes, manholes, ditches and creeks) relative to sediment quality guidelines for the protection of marine aquatic life. Discharges are sampled annually until the rating and contaminant(s) are confirmed. Once confirmed, a high rated discharge, it is targeted for corrective action and an investigation to locate the contaminant sources is initiated. Appendix G contains detailed information about the CRD environmental concern rating system. Stormwater discharge sediment data and ratings can be found in Appendix E.

In 2018, CRD staff assigned a high environmental concern rating to three discharges (306, 307 and 505) and two of these are on the list of discharges requiring corrective action (307 and 505). High-rated discharges in 2018, and those identified as needing corrective action, are shown on figures A and B.

CRD staff collected 22 sediment samples for assessment in 2018 (18 at the discharge and four upstream). Environmental concern ratings for the 18 stormwater flows sampled at the point of discharge are as follows:

- eight were assigned a low rating,
- seven were assigned a moderate rating, and
- three were assigned a high rating

Staff make recommendations for corrective action to find and eliminate sources of chemical contamination when the rating remains high for two years and the parameter(s) of concern are determined. One discharge rated high in 2018 (discharge 306) is not on the action list, as the contaminants have not been confirmed. In 2018, CRD recommends 20 discharges for corrective action in the core area (shown on Table C and figures A and B).

The number of discharges recommended for action has fluctuated from 18 to 22 for the past six years. The CRD added the following two discharges to the 2018 action list:

- Discharge 649 drains the Gorge Road Hospital parking lot and sediment at the end of the pipe has elevated copper, mercury and zinc. It is uncertain how much of the contamination is due to historical practices. Hospital staff are investigating the sources, which also include elevated bacterial levels.

- Discharge 505 in Cadboro Bay was confirmed to have elevated mercury and lead in some upstream sumps. Saanich staff removed contaminated sediment from the sumps and CRD staff will monitor to determine if the source is gone.

Contaminated sediment has been removed from another discharge on the list (614; Inner Harbour). City of Victoria removed sediment from an upstream catch basin in discharge in early 2018 and CRD will continue to monitor the discharge.

Many discharges recommended for action have been a concern for more than five years. Sources of contaminants in stormwater sediment can be complex to find and eliminate, as sediment is not always present when sampling, and contaminant levels fluctuate. In addition, non-point sources (e.g., from roadways, parking lots) and transient point sources (e.g., spills) exist. In some cases, sediment can remain for a long time, therefore, samples can reflect past practices that are no longer occurring.

Source control education has increased awareness of products used on commercial and private sites and contaminant levels leaving their properties. As well, the use and maintenance of stormwater rehabilitation units continues to increase. The CRD and municipalities will continue to work together to identify and eliminate potential sources of contamination for these discharges.

2.1.2.1 Aqueous Metals in Storm Drains

In 2018, CRD staff conducted intensive water quality sampling at the end of pipe (or the next upstream manhole) of seven stormwater discharges entering Victoria Harbour. These storm drains discharge into the east side of Victoria Harbour, between Belleville Street in the south and Jutland Road in the north. Staff collected five weekly samples for metals and bacteria in both summer and fall flush for five of the storm drains (613, 614, 627, 629 and 636) and in the fall for two additional storm drains (626, 634). The five storm drains sampled in both seasons, were sampled for the same parameters at the same frequency in 2013. These locations were chosen as metals contamination has been measured in sediment from these discharges.

Storm drain water quality data were compared to provincial water quality guidelines (WQGs) for protection of freshwater aquatic life¹. Although aquatic life guidelines would not apply to the storm drains themselves, as they do not represent viable habitat for aquatic life, these comparisons indicate potential impacts to the marine environment occurring, due to these discharges. Staff also compared these data to provincial WQGs for protection of marine aquatic life. As the discharge would be greatly diluted once it enters the ocean, values that were at least 10 times above the guideline are discussed below.

Water quality data from both 2013 and 2018 indicate that storm drains 613 (which drains into James Bay) and 629 (which drains into Rock Bay) had the highest concentrations of metals.

In 2013 and 2018, concentrations of metals, which occasionally exceeded the freshwater aquatic life guideline, were the same, with a few exceptions, and included aluminum, arsenic, cadmium, copper, lead, manganese, silver, selenium, vanadium and zinc. It is important to note that total metals concentrations were measured; however, the guideline for aluminum and cadmium are both dissolved metal guidelines, therefore, the dissolved portion of the metals in these samples may not exceed these guidelines. For cadmium, the previous guideline (based on a total concentration) was updated in 2015 to a dissolved concentration guideline and comparison to the new guideline results in less exceedances (only discharge 629 exceeds when compared to the new guideline, versus six stations when compared to the previous one). In addition, selenium and vanadium were not identified as exceeding guidelines in 2013, as data were only compared to the BC approved WQGs and these have working WQGs.

¹ (approved and working WQGs; see http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html)

Comparison of these data to provincial marine aquatic life guidelines showed that copper and zinc were often 10 times above those guidelines, especially in discharge 629, where some copper and zinc values were 100 times above the guidelines. One sample collected in discharge 629 (on November 7, 2018) had exceedances of the marine guideline by at least 100 times for a cadmium, 3,000 times for copper, 440 times for zinc and more than 10 times for cadmium and lead, This Indicates that something may have be dumped into the storm drain on that date.

Elevated zinc and/or copper was measured in the marine environment near these discharges at marine stations VH-4, VH-5B and VH-6A indicating that the storm drains are impacting the marine environment.

Table A. Number of Discharges with a High Public Health Concern Rating from 2005 to 2018

Area	2005	2006	2007	2011	2012	2013	2014	2015	2016	2017	2018
Colwood	0	0	0	1	0	0	1	0	0	0	1
View Royal	1	2	1	1	1	0	0	0	0	0	0
Esquimalt	7	7	8	7	7	8	7	5	6	6	7
Esquimalt private ¹	*	*	*	*	*	0	0	1	0	2	1
DND	0	0	0	0	0	0	0	0	0	0	0
Saanich	1	1	2	2	3	4	5	5	6	4	1
Saanich private ¹	*	*	*	*	0	0	0	0	0	0	0
Victoria	14	15	15	20	17	13	12	14	11	11	15
Victoria private ¹	2	3	5	3	1	1	2	2	2	2	1
Oak Bay	9	9	10	9	9	7	9	8	6	6	5
Langford	0	0	0	0	0	0	0	0	0	0	0
Total	34	37	41	43	38	33	36	35	31	31	31

Notes:

¹ Discharges that are not part of the municipal infrastructure are not under municipal jurisdiction and are separated out from the municipal totals.

* Private discharges included in the municipal totals.

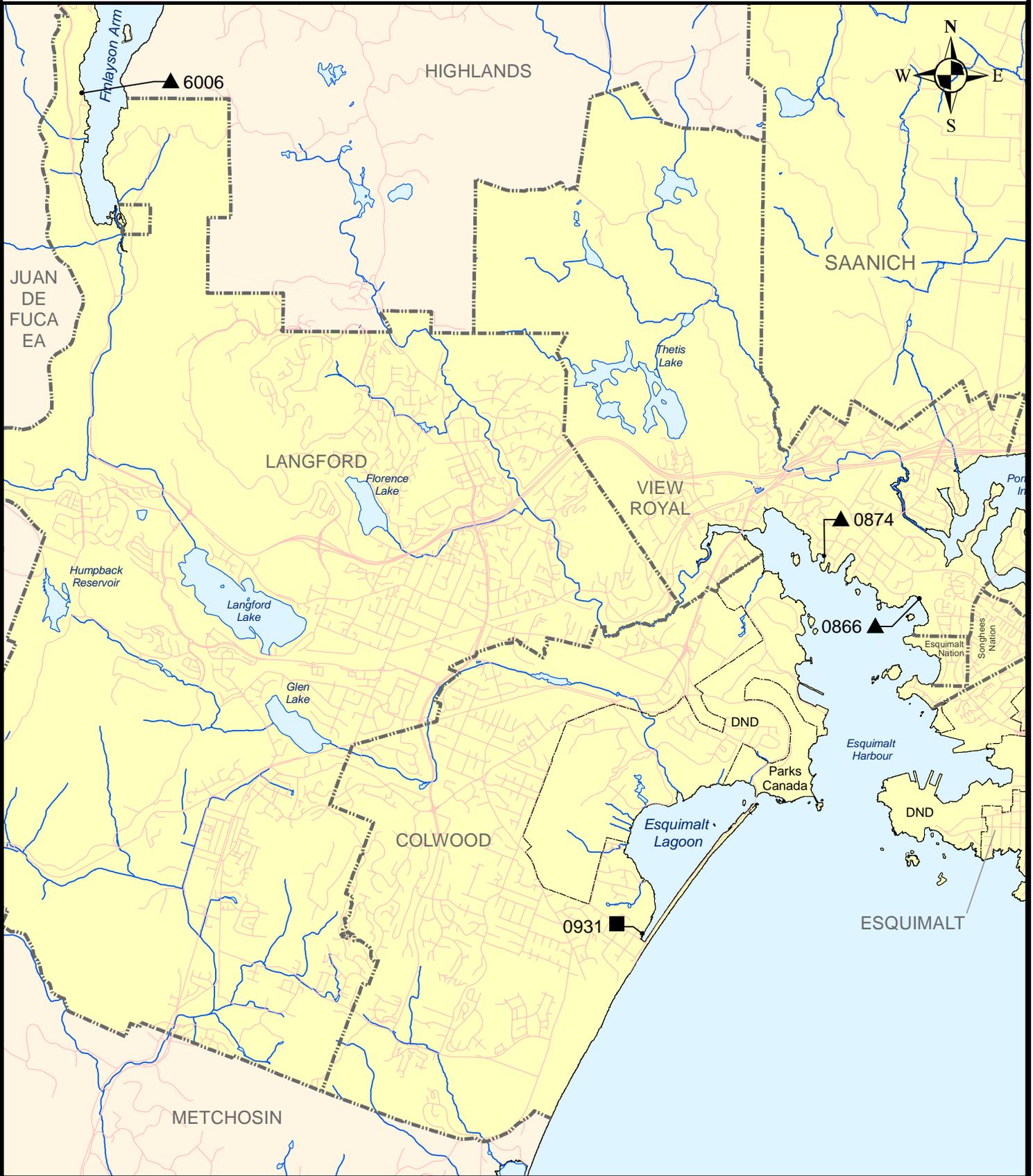
Table B. Discharges Rated High for Public Health Concern in 2018

Jurisdiction	Stormwater Discharge Number
City of Colwood	931
Township of Esquimalt	744, 744B, 749, 780, 781, 805, 806
Township of Esquimalt – private ¹	749A
City of Langford	-
District of Oak Bay	245, 307, 318, 320, 322
District of Saanich	503
City of Victoria	208/209, 214, 216, 222, 229, 603, 607, 610, 611, 613, 619, 641, 650, 769, 777A
City of Victoria – private ¹	649
Town of View Royal	-
Esquimalt First Nation	-
Songhees First Nation	-
DND	-

Notes:

¹ Discharges that are not part of the municipal infrastructure are not under municipal jurisdiction

Figure A - Core Area 2018
 Stormwater Discharges Requiring Action for Public Health and Environmental Concerns
 (Metchosin to Esquimalt Border)



0 0.5 1 Kilometres
 Projection: UTM ZONE 10N NAD 83

- Discharges Requiring Action**
- High Public Health Rating
 - ▲ High Environmental Rating and/or Recommended for Action
- Municipal Boundaries
 DND Boundaries
 ~~~ Streams and Rivers  
 --- Roads  
 ■ Stormwater Monitoring Area

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**Table C. Discharges Recommended for Action Due to Elevated Sediment Contaminant Levels**

| Jurisdiction                                 | Discharges Recommended for Corrective Action | Total     |
|----------------------------------------------|----------------------------------------------|-----------|
| City of Colwood                              | -                                            | 0         |
| Township of Esquimalt                        | 737, 742, 749, 806                           | 4         |
| Township of Esquimalt – private <sup>1</sup> | -                                            | 0         |
| City of Langford                             | 6006                                         | 1         |
| District of Oak Bay                          | 250, 307, 310                                | 3         |
| District of Saanich                          | 505                                          | 1         |
| District of Saanich – private <sup>1</sup>   | -                                            | -         |
| City of Victoria                             | 216, 603, 614, 620,<br>627, 629, 634, 636    | 8         |
| City of Victoria – private <sup>1</sup>      | 649                                          | 1         |
| Town of View Royal                           | 866, 874                                     | 2         |
| DND                                          | -                                            | 0         |
| <b>Total</b>                                 |                                              | <b>20</b> |

**Notes:**

<sup>1</sup> Discharges that drain from private property do not fall under municipal jurisdiction.

**3.0 SOURCE INVESTIGATIONS**

The program conducted source investigations in the catchment areas of 17 stormwater discharges for bacterial contaminant sampling and four discharges for chemical contaminant sampling.

**3.1 Bacterial Investigations**

In 2018, CRD staff conducted source investigations in six stormwater catchment areas. Saanich and CRD staff identified a sewer-to-stormwater cross-connection in discharge 501, which drains to Cadboro Bay. It was repaired shortly afterwards. CRD and Oak Bay staff narrowed down a sewer-to-stormwater cross-connection in the catchment of discharge 320, which drains to Willow's Beach. Oak Bay staff are working with the homeowner to make repairs. CRD staff have narrowed down one additional source, but the results need to be confirmed. Investigations are ongoing in three of the discharges, due to presence of multiple sources, lower fecal coliform counts or lack of flows to sample in 2018. The status of bacterial investigations completed by CRD staff in 2018 is summarized in Table D.

**Table D. 2018 Summary of Stormwater Fecal Coliform Source Investigations by CRD staff**

| Discharge | Municipality | Sampling Events | Status                                                  |
|-----------|--------------|-----------------|---------------------------------------------------------|
| 320       | Oak Bay      | 1               | Found a sanitary to stormwater cross-connection         |
| 322       | Oak Bay      | 1               | Inconclusive – low bacterial counts                     |
| 501       | Saanich      | 1               | Found and fixed a sewage to stormwater cross-connection |
| 727       | Esquimalt    | 1               | Inconclusive                                            |
| 4         | Esquimalt    | 1               | Narrowed, needs confirming                              |
| 769       | Victoria     | 5               | Inconclusive; Ongoing                                   |

### 3.2 Chemical Contaminant Investigations

In 2018, IWMP staff conducted chemical contaminant source investigations in sediment from one discharge catchment area (307). Results from this discharge are inconclusive, but indicated that there are lower concentrations of zinc and polycyclic aromatic hydrocarbons, but higher concentrations of lead upstream. Sampling was carried out using a sediment trap after Oak Bay removed contaminated sediment from two manholes upstream. CRD will continue investigations. It was noted that elevated lead was discovered in three adjacent discharges along this shoreline, therefore, the source maybe due to historical practices along this shoreline.

Overall, CRD staff have narrowed down sources in 10 of the 18 catchments on the action list and continue to work with municipal staff on eliminating or lessening these sources.

### 4.0 MARINE SURFACE WATER MONITORING

In 2018, CRD staff conducted water sampling in Esquimalt Lagoon, Esquimalt and Victoria harbours, the Gorge and Portage Inlet to compare these water quality parameters with the BC Ministry of Environment and Climate Change Strategy (ENV) draft water quality objectives for these waters (ENV, draft) and to assess if water quality has changed over time (the last sampling events were in fall of 2011 and summer of 2012). CRD staff collected surface water samples weekly for five consecutive weeks in summer and during fall flush for a total of 280 measurements (10 at each of the 28 sites) for bacteria, metals and physical parameters, including dissolved oxygen.

Based on data collected in 2011 and 2012, ENV proposed draft water quality objectives for fecal coliforms, enterococci, dissolved oxygen, cadmium, copper and zinc in all areas, and nitrate in Esquimalt Lagoon only (ENV, draft). These water quality objectives may change, especially those that address fecal coliforms and enterococci, as ENV has changed the guidelines for those parameters with regards to recreational and cultural uses.

Data collected in 2018 were compared to these objectives, as well as the ENV WQGs (approved and working guidelines) for parameters without objectives. This report compares the data to the updated objectives for fecal coliforms and enterococci, in consistency with the recently completed report, *Water Quality Objectives for Sooke Inlet, Harbour, Basin and Tributary Streams*<sup>2</sup>. The marine data and relevant objectives and guidelines can be found in Appendix G. The following parameters were outside the draft water quality objectives:

- dissolved oxygen was below the objective in all stations, with the exception of two stations in Portage Inlet and two stations in Esquimalt Lagoon,
- copper was above at least one of the objectives in two stations in Esquimalt Harbour, four stations in Victoria Harbour, one station in the Gorge and one station in Portage Inlet,
- cadmium was above the objective in three stations in Esquimalt Lagoon (including the station just outside the lagoon),
- zinc was above the objective in four stations in Victoria Harbour, one station in the Gorge and one station in Portage Inlet,
- fecal coliforms was above at least one of the objectives in one station in Esquimalt Harbour, eight stations in Victoria Harbour, two stations in the Gorge, three stations in Portage Inlet and all five stations in Esquimalt Lagoon,
- enterococci was above at least one of the objectives in one station in Esquimalt Harbour, four stations in Esquimalt Lagoon, two stations in Victoria Harbour, one station in the Gorge and three stations in Portage Inlet,

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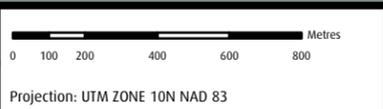
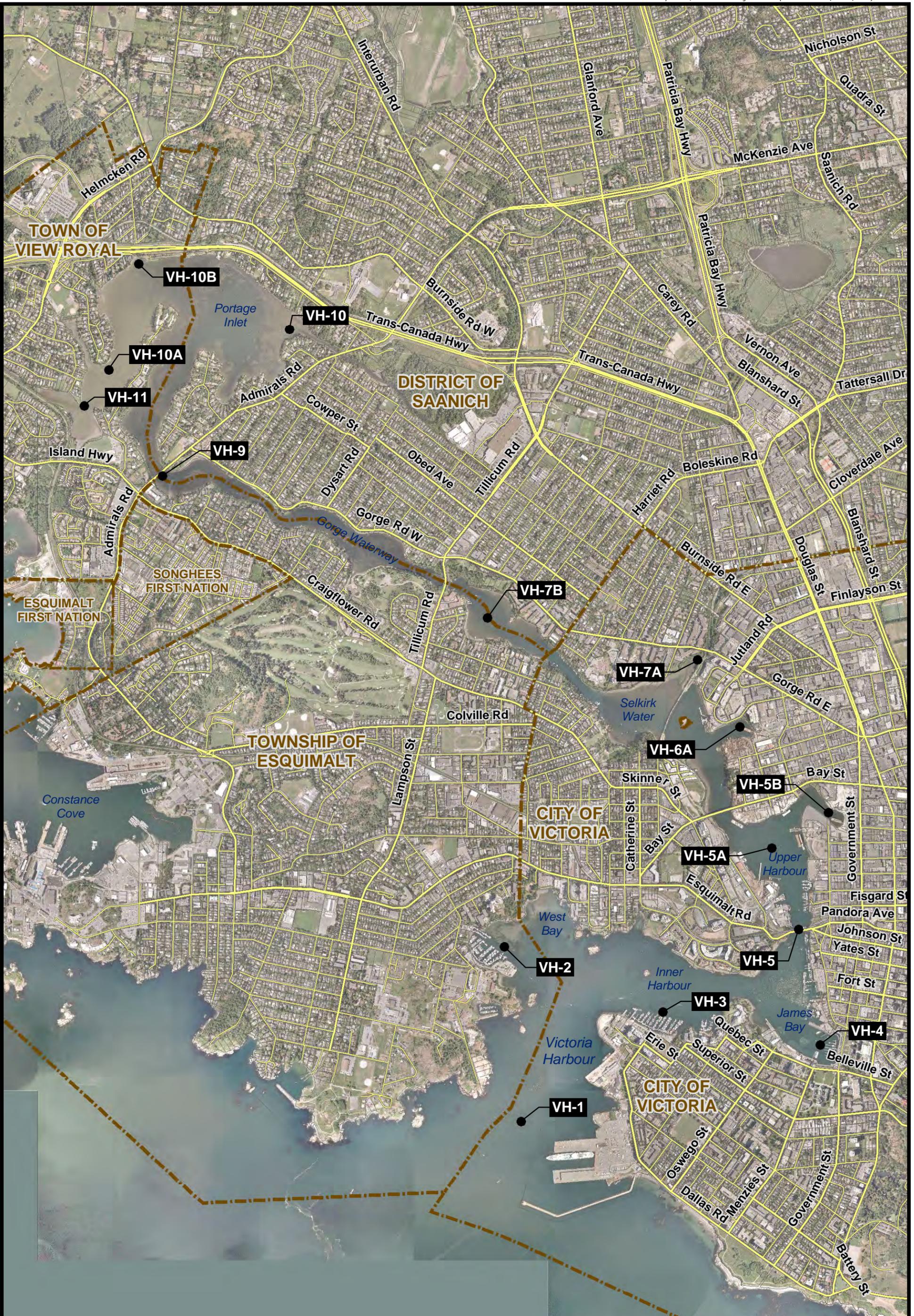
<sup>2</sup> (see: [https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-objectives/bc\\_env\\_sooke\\_wqos\\_2019\\_final.pdf](https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-objectives/bc_env_sooke_wqos_2019_final.pdf))

Compared to the 2011 and 2012 marine water quality data the following observations were made:

- Boron is naturally elevated in BC marine waters (ranges from 3,700 to 4,300 µg/L; Moss and Nagpal, 2003) relative to BC marine guidelines. The levels of boron in the 2011 and 2012 data were not a concern; however, marine boron concentrations appeared higher in some areas in 2018. Concentrations above 5,000 µg/L were measured in many stations in Esquimalt and Victoria harbours in 2018, while the maximum measurement was 3,960 µg/L in 2011/2012.
- As in 2011/2012, dissolved oxygen continued to be low in most areas in 2018 and is a concern. Hypoxia and declining oxygen levels are a concern in Juan de Fuca Straight (Johannessen et al., 2014), however it is not known how that may be impacting our harbours. Interestingly less exceedances were observed inland in Portage Inlet and in Esquimalt Lagoon. Outside of Esquimalt Lagoon, and in Esquimalt Harbour, lower oxygen measurements were observed only in the fall, with the exception of the mud flats at the end of Mill Stream.
- Less exceedances of cadmium and zinc were observed in 2018. This is likely due to different analysis methods (chelation metals method) that led to lower detection limits. The previous data was analyzed with a higher detection limit and the threshold for acceptability (a detection limit not more than 10% of the guideline level) was either not met or just met.
- Lower nitrate concentrations were measured in Esquimalt Lagoon in 2018 resulting in no exceedances of the water quality objective. While elevated nitrate levels have been measured in the freshwater inputs to the lagoon which is home to many birds, it is possible that two very elevated nitrate values measured in 2011/2012 were erroneous, as they were an order of magnitude higher than other than other measurements.
- CRD staff measured caffeine and seven pharmaceuticals and personal care products (PPCPs) once in all 28 stations in 2018. Caffeine was detected in six of 10 stations in Victoria Harbour and two of eight stations in Esquimalt Harbour (using a detection limit of 0.02 µg/L). Where caffeine was detected, concentrations ranged between 0.106 µg/L in VH-07B (downstream of Tillicum Bridge) and 0.828 µg/L (VH-07A at the mouth of Cecelia Creek).
- None of the PPCPs was measured above the detection limit of 0.02 µg/L, including: Acetaminophen, Carbamazepine, Fluoxetine, Primidone, Sildenafil, Sulfamethoxazole and Trimethoprim.

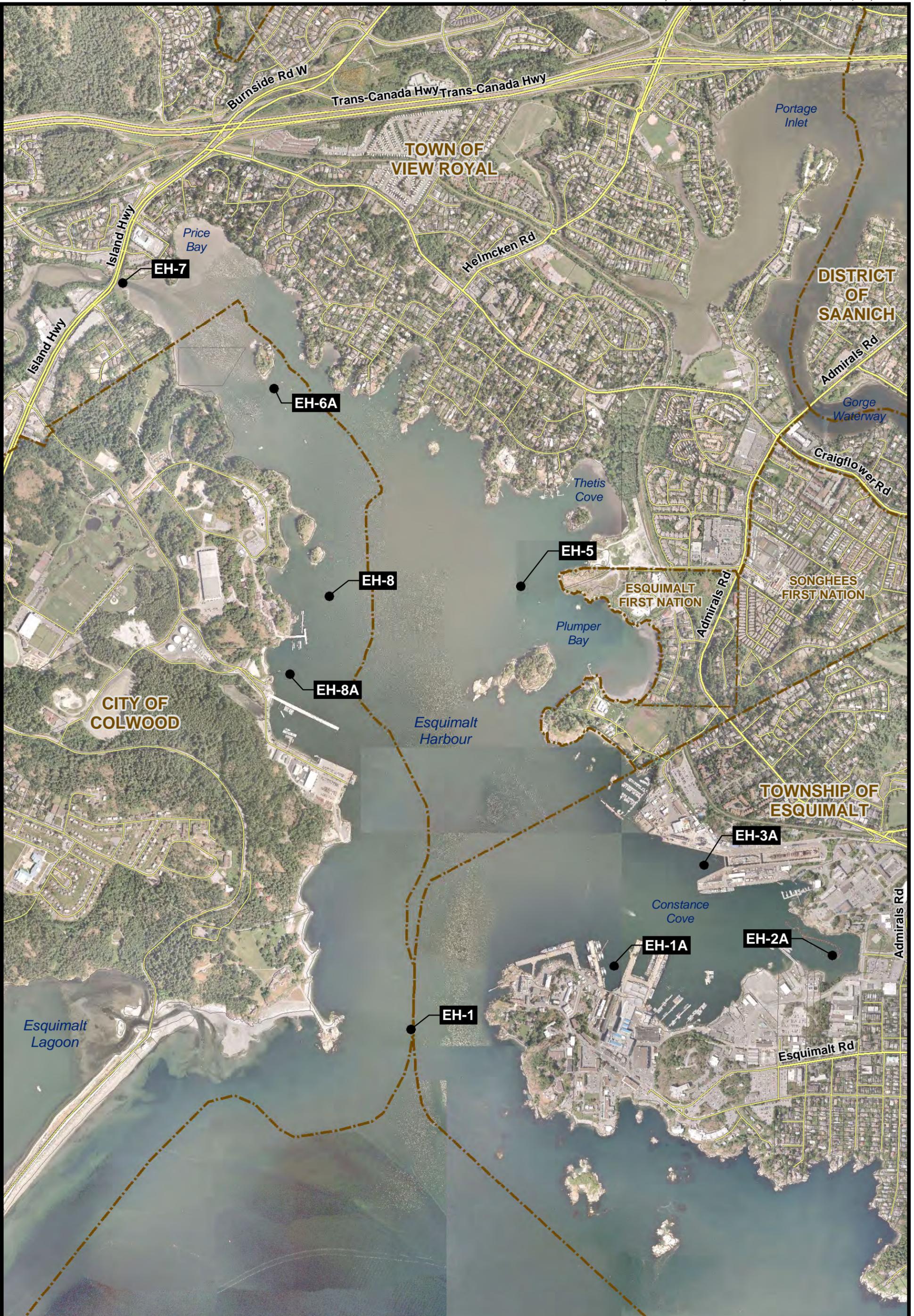
#### **4.1 Storm Drains as Sources**

The source of elevated zinc and copper observed in the marine environment may have been due to storm drain inputs. Copper was elevated in VH-4 and VH-5B, which are near stormwater discharges with elevated copper and zinc. Storm drains 613 and 614 discharge into James Bay (VH-4), and discharges 626, 627 and 629 discharge into Rock Bay (VH-5B). Water quality data from both 2013 and 2018 indicate that storm drains 613 and 629 had the highest concentrations of metals of the seven storm drains for which CRD has aqueous metals data.



# VICTORIA HARBOUR/GORGE/PORTAGE INLET WATER QUALITY OBJECTIVES SAMPLING STATIONS

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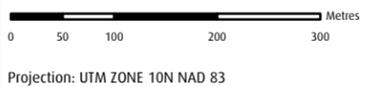


0 100 200 400 Metres  
 Projection: UTM ZONE 10N NAD 83



## ESQUIMALT HARBOUR WATER QUALITY OBJECTIVES SAMPLING STATIONS

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Projection: UTM ZONE 10N NAD 83



## ESQUIMALT LAGOON WATER QUALITY OBJECTIVES SAMPLING STATIONS

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**Table E. Attainment of Draft Marine Water Quality Objectives for Esquimalt Harbour, Victoria Harbour, the Gorge, Portage Inlet and Esquimalt Lagoon**

| Parameter        | Objective                                      | Attainment                                                                                         |                                                          |                                                                                                                                                                               |                                                                                                                             |                                                                              |                                                                                           |
|------------------|------------------------------------------------|----------------------------------------------------------------------------------------------------|----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
|                  |                                                | Esquimalt Harbour (14 stations)                                                                    |                                                          | Victoria Harbour, the Gorge and Portage Inlet (14 stations)                                                                                                                   |                                                                                                                             | Esquimalt Lagoon (5 stations)                                                |                                                                                           |
|                  |                                                | Summer 2018                                                                                        | Fall 2018                                                | Summer 2018                                                                                                                                                                   | Fall 2018                                                                                                                   | Summer 2018                                                                  | Fall 2018                                                                                 |
| Fecal Coliform   | ≤ 14 CFU/100 mL (median or geomean)            | <b>Yes:</b><br>all stations                                                                        | <b>Yes:</b><br>all stations                              | <b>Yes:</b><br>VH-1, VH-2, VH-3, VH-7B, VH-9<br><b>No:</b><br>VH-4, VH-5, VH-5A, VH-5B, VH-6A, VH-7A, VH-10, VH-10A, VH-10B                                                   | <b>Yes:</b><br>VH-2, VH-3, VH-9<br><b>No:</b><br>VH-1, VH-4, VH-5, VH-5A, VH-5B, VH-6A, VH-7A, VH-7B, VH-10, VH-10A, VH-10B | <b>Yes:</b><br>EL-1B, EL-2A<br><b>No:</b><br>EL-1A, EL-7, EL-REF             | <b>Yes:</b><br>EL-REF<br><b>No:</b><br>EL-1A, EL-1B, EL-2A, EL-7                          |
| Fecal Coliform   | ≤ 43 CFU /100 mL (90 <sup>th</sup> percentile) | <b>Yes:</b><br>8 stations<br><b>No:</b><br>EH-2A<br>(based on all 10 samples from summer and fall) | See summer, based on all 10 samples from summer and fall | <b>Yes:</b><br>VH-3, VH-5, VH-7B, VH-9<br><b>No:</b><br>VH-1, VH-2, VH-4, VH-5A, VH-5B, VH-6A, VH-7A, VH-10, VH-10A, VH-10B<br>(based on all 10 samples from summer and fall) | See summer. 90 <sup>th</sup> percentiles are based on all 10 samples from summer and fall                                   | <b>No:</b><br>all stations<br>(based on all 10 samples from summer and fall) | See summer. 90 <sup>th</sup> percentiles are based on all 10 samples from summer and fall |
| Enterococci      | ≤ 35 CFU/100 mL (geometric mean)               | <b>Yes:</b><br>All stations                                                                        | <b>Yes:</b><br>All stations                              | <b>Yes:</b><br>13 stations<br><b>No:</b><br>VH-5B                                                                                                                             | <b>Yes:</b><br>12 stations<br><b>No:</b><br>VH-5B, VH-7A                                                                    | <b>Yes:</b><br>4 stations<br><b>No:</b><br>EL-7                              | <b>Yes:</b><br>3 stations<br><b>No:</b><br>EL-1B, EL-7                                    |
|                  | ≤ 70 CFU/100 mL (instantaneous maximum)        | <b>Yes:</b><br>8 stations<br><b>No:</b><br>EH-2A                                                   | <b>Yes:</b><br>8 stations<br><b>No:</b><br>EH-2A         | <b>Yes:</b><br>11 stations<br><b>No:</b><br>VH-5B, VH-6A, VH-10                                                                                                               | <b>Yes:</b><br>9 stations<br><b>No:</b><br>VH-5B, VH-6A, VH-7A, VH-10A, VH-10B                                              | <b>Yes:</b><br>3 stations<br><b>No:</b><br>EL-1A, EL-7                       | <b>Yes:</b><br>1 station<br><b>No:</b><br>EL-1A, EL-1B, EL-7, EL-REF                      |
| Dissolved oxygen | 5 mg/L (min)                                   | <b>Yes:</b><br>8 stations<br><b>No:</b><br>EH-7                                                    | <b>No:</b><br>All stations                               | <b>Yes:</b><br>11 stations<br><b>No:</b><br>VH-5, VH-5A, VH-6A                                                                                                                | <b>Yes:</b><br>12 stations<br><b>No:</b><br>VH-2, VH-5B                                                                     | <b>Yes:</b><br>3 stations<br><b>No:</b><br>EL-1A, EL-1B                      | <b>Yes:</b><br>4 stations<br><b>No:</b><br>EL-7                                           |
|                  | 8 mg/L (average)                               | <b>Yes:</b><br>8 stations<br><b>No:</b><br>EH-7                                                    | <b>No:</b><br>All stations                               | <b>Yes:</b><br>5 stations<br><b>No:</b><br>VH-1, VH-3, VH-4, VH-5, VH-5A, VH-5B, VH-6A, VH-7A, VH-7B                                                                          | <b>Yes:</b><br>2 stations<br><b>No:</b><br>VH-1, VH-2, VH-3, VH-4, VH-5, VH-5A, VH-5B, VH-6A, VH-7A, VH-7B, VH-9, VH-10B    | <b>Yes:</b><br>3 stations<br><b>No:</b><br>EL-1A, EL-1B                      | <b>Yes:</b><br>4 stations<br><b>No:</b><br>EL-REF                                         |

Table E, continued

| Parameter | Objective                                       | Attainment                                              |                             |                                                                     |                                                                                    |                                                          |                                                         |
|-----------|-------------------------------------------------|---------------------------------------------------------|-----------------------------|---------------------------------------------------------------------|------------------------------------------------------------------------------------|----------------------------------------------------------|---------------------------------------------------------|
|           |                                                 | Esquimalt Harbour<br>(14 stations)                      |                             | Victoria Harbour, the Gorge<br>and Portage Inlet<br>(14 stations)   |                                                                                    | Esquimalt Lagoon<br>(5 stations)                         |                                                         |
|           |                                                 | Summer 2018                                             | Fall 2018                   | Summer 2018                                                         | Fall 2018                                                                          | Summer 2018                                              | Fall 2018                                               |
| Cadmium   | 0.12 µg/L (max)                                 | <b>Yes:</b><br>All stations                             | <b>Yes:</b><br>All stations | <b>Yes:</b><br>All stations                                         | <b>Yes:</b><br>All stations                                                        | <b>Yes:</b><br>3 stations<br><b>No:</b><br>EL-1A, EL-REF | <b>Yes:</b><br>3 stations<br><b>No:</b><br>EL-1A, EL-2A |
| Copper    | 3 µg/L (max)                                    | <b>Yes:</b><br>7 stations<br><b>No:</b><br>EH-3A, EH-2A | <b>Yes:</b><br>All stations | <b>Yes:</b><br>9 stations<br><b>No:</b><br>VH-2, VH-3, VH-5B, VH-10 | <b>Yes:</b><br>9 stations<br><b>No:</b><br>VH-2, VH-4, VH-5B, VH-7A                | <b>Yes:</b><br>All stations                              | <b>Yes:</b><br>All stations                             |
|           | 2 µg/L (average)                                | <b>Yes:</b><br>All stations                             | <b>Yes:</b><br>All stations | <b>Yes:</b><br>12 stations<br><b>No:</b><br>VH-5B                   | <b>Yes:</b><br>12 stations<br><b>No:</b><br>VH-2, VH-4, VH-7A                      | <b>Yes:</b><br>All stations                              | <b>Yes:</b><br>All stations                             |
| Zinc      | 10 µg/L (max)                                   | <b>Yes:</b><br>All stations                             | <b>Yes:</b><br>All stations | <b>Yes:</b><br>12 stations<br><b>No:</b><br>VH-5B                   | <b>Yes:</b><br>7 stations<br><b>No:</b><br>VH-2, VH-4, VH-5B, VH-6A, VH-7A, VH-10B | <b>Yes:</b><br>All stations                              | <b>Yes:</b><br>All stations                             |
| Nitrate   | 3.7 mg/L<br>(average; Esquimalt<br>Lagoon only) | Na                                                      | Na                          | Na                                                                  | Na                                                                                 | <b>Yes:</b><br>All stations                              | <b>Yes:</b><br>All stations                             |

Notes: Average values are based on a minimum five weekly samples collected over a 30-day period

## 5.0 MAJOR WATERCOURSE MONITORING

In 2018, CRD staff continued to monitor Bee, Bowker, Cecelia, Colquitz, Colwood, Craigflower, Douglas, Hospital, Noble, Selleck and Tod creeks, and Mill Stream to provide information about watershed health.

Each year, CRD staff collect water quality data twice at the discharge of each creek, providing a snapshot of creek health conditions in the wet and dry seasons, but conduct more comprehensive watershed health assessments in two to three core area watercourses with the goal to assess each watercourse in this manner every five years.

In 2018, Cecelia Creek and Mill Stream were assessed more extensively, including measuring water quality five times in 30 days in summer and fall at various locations in the watershed, and undertaking a health assessment of the benthic invertebrate animals living in the creeks. Additional water quality parameters, including metals, were measured as well. Sampling five times in 30 days allows for better comparison to BC WQGs.

BC ENV has started developing draft WQO however, they are incomplete (especially for metals) or the same as the guideline; therefore all data is compared to the BC WQGs (approved and working).

### 5.1 Water Quality Data

Cecelia Creek water quality data indicated that copper, zinc, phosphorus, nitrite, temperature, dissolved oxygen, turbidity, suspended solids and iron were at concentrations that could result in adverse effects on freshwater aquatic life. Bacteria were also elevated indicating sewage presence in the creek. These parameters of concern are the same as those identified in 2013 (the last time the creek was intensely sampled), with the exception of iron, which was elevated in each of the three locations on October 29 during heavy rainfall. The station SW0641-3D (pipe that drains Washington Street) had the highest levels of many parameters.

In Mill Stream, water quality varied across the four stations in 2018, but was good at the mouth and near the Langford-Colwood border, with almost no exceedances of WQGs (phosphorus and pH in one measurement). The station at Treanor Avenue (SW0886-6) had the poorest water quality with low dissolved oxygen in summer and exceedances of the copper, suspended solids and turbidity guidelines. Phosphorus was above the draft Vancouver Island objective in all the stations, including Hazlitt Creek (886-9; a tributary of Mill Stream), which was previously considered a possible reference site. The parameters of concern are similar to those observed in 2013, with the exception of those observed at Hazlitt Creek, which showed a decline in water quality.

Water quality results suggest a change in the farthest upstream station in Hazlitt Creek. Lower flows in 2018 and possibly some land use changes upstream may be the result of turbidity, dissolved oxygen, phosphorus and iron (total and dissolved) concentrations that were outside guidelines, as well as an elevated pH measurement. Average turbidity was elevated in summer and fall of 2018, but not in 2013; however, these elevated measurements were not associated with higher flows or elevated suspended solids, therefore, may be due to algae. Phosphorus values were higher in 2018; the summer average (with standard deviation;  $31 \pm 1$ ) was twice as high as the 2013 average (with standard deviation;  $15 \pm 3$ ). CRD staff measured low dissolved oxygen in summer until early November, likely due to low flows. Total and dissolved iron was above guidelines in all measurements at this station, while iron concentrations were below the guidelines in 2013.

CRD data indicate that the water quality parameters of most concern in core area creeks are bacteria, phosphorus, turbidity and metals. Some sites also experience low dissolved oxygen and elevated temperature in the summers. This is consistent with what is seen throughout the region wherever there is increased human presence. The draft Vancouver Island phosphorus objective was exceeded in all CRD creeks due to human and animal presence in these watersheds.

Water quality is important in these creeks, but hydrological changes and physical alteration are also a concern. Therefore, benthic invertebrate community data and hydrological data are also collected.

## **5.2 Benthic Invertebrate Community Data**

Benthic invertebrates live in or on the bottom of streams and are good indicators of stream health. Their community composition reflects the overall condition of the aquatic environment and depends on water and sediment quality, as well as hydrology.

CRD data indicate that the benthic invertebrate communities in Colwood and Tod creeks and Mill Stream (at the discharge) are healthy, based on their similarity to invertebrate communities in minimally impacted Vancouver Island creeks. Benthic invertebrate community data from downstream locations in Bee, Bowker, Cecelia and Colquitz creeks indicate that these communities are not healthy and it is recommended that upstream activities impacting the watershed be identified and managed.

The Hilsenhoff Biotic Index indicates the amount of organic and nutrient pollution in a stream based on species distribution and their tolerance to such pollution. Mill Stream was deemed "Very Good" with slight organic pollution probable. Colwood, Colquitz (downstream of Elk Lake), Craigflower, Douglas, Mill Stream (at Treanor Road) and Tod creeks were deemed "Good" with some organic pollution likely; Colquitz, and Bee creeks were deemed "Fair" with fairly substantial pollution likely; and Bowker and Cecelia were deemed "Fairly Poor" with substantial pollution likely. A slight degradation of the Hilsenhoff Biotic Index in Colwood Creek in 2012 compared to 2017 (from 4.38 to 4.80), and Cecelia Creek in 2013 compared to 2018 (from 6.38 to 7.49) suggests that pollution may be increasing in these creeks and further study is warranted.

## **6.0 2019 PROGRAM**

The program will continue to work with municipal partners, First Nations and community groups to achieve LWMP goals to identify stormwater discharges of public health and environmental concern and investigate the sources of contamination. In 2019, CRD staff will continue to work together with CRD municipalities, First Nations and others to identify and reduce bacteria and contaminant levels in stormwater discharges, creeks and the marine receiving environment. Focused watercourse sampling will be undertaken in Bee, Selleck and Bowker creeks.

## **7.0 REFERENCES**

BC Ministry of Environment and Climate Change Strategy, draft. Water Quality Objectives for Capital Regional District Harbours and Watersheds. BC Ministry of Environment and Climate Change Strategy.

Moss, S.A. and N. Nagpal. 2003. Ambient Water Quality Guidelines for Boron. BC Ministry of Environment, Lands and Parks. Victoria, BC. Available online:  
<http://www.env.gov.bc.ca/wat/wq/BCguidelines/boron/boron.html>