NORTH VANCOUVER
DISTRICT

2018 Annual Drinking Water Quality Report

April, 2019.

District of North Vancouver Utilities Department

Document: 3875402

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EXECUTIVE SUMMARY

This report is the seventeenth Drinking Water Quality Annual Report prepared by the District of North Vancouver. It provides water consumers with information about the quality of the potable water and the programs that support drinking water quality. Submission of this report to the Office of the Medical Health Officer for North Shore Vancouver Coastal Health fulfills regulatory obligations of the Drinking Water Protection Act, the British Columbia Drinking Water Protection Regulation and our application to the Medical Health Officer for an annual Drinking Water System Permit to operate a potable water system. This report adheres Metro Vancouver's "Water Quality Monitoring and Reporting Plan for the GVWD and Member Municipalities", a template for the Greater Vancouver Water District and member municipalities water quality monitoring and reporting.

The Greater Vancouver Water District and the District of North Vancouver employ a multi-barrier science based approach that encompasses water from the source to the point of delivery. This approach ensures consistent delivery of a reliable supply of safe drinking water. All potable water supplied to District of North Vancouver is treated at the Seymour Capilano Filtration Plant. In 2018, 100% of the District of North Vancouver water samples met or exceeded regulatory requirements. The combined efforts of the Greater Vancouver Water District and the District of North Vancouver once again resulted in excellent water quality for our customers.

1 SOURCE WATER

All water supplied to the District of North Vancouver (DNV) by the Greater Vancouver Water District (GVWD or Metro) comes from the Capilano or Seymour surface water reservoirs followed by secondary treatment at the Seymour Capilano Filtration Plant (SCFP). Metro uses multiple barriers to protect and produce and supply safe drinking water including watershed protection, water treatment, source quality testing, transmission point quality testing and ongoing operation and maintenance of the water systems.

Prior to 2009, Metro's treatment of both the Capilano and Seymour sources was primary disinfection including chlorine. In 2010 Seymour source water was treated at the Seymour Capilano Filtration Plant (SCFP). The SCFP incorporates multiple disinfection processes including ultra filtration, ultraviolet radiation disinfection and chlorine. In 2015 tunnels were commissioned that linked the Capilano source water to the SCFP marking a significant water treatment and quality milestone for the DNV and the region.

Metro analyses source water for bacteriological, chemical and physical parameters according to the "BC Drinking Water Protection Regulation" and the "Water Quality Monitoring and Reporting Plan for the GVWD and Member Municipalities – 2018". The "2018 - GVWD Quality Control Annual Report Volume 1" summarises water quality for all of the Metro Vancouver service area and is made available by August 2019 on their website www.metrovancouver.org. The report demonstrates that drinking water supplied by Metro to DNV met or exceeded all water quality standards and guidelines in 2018.

2 DNV DISTRIBUTION SYSTEM & QUALITY ASSURANCE TESTING

2.1 General

The DNV water distribution system delivers potable water to its customers through a waterworks system incorporating 376 km of water mains, 7 water pumping stations, 11 water storage reservoirs, and 37 pressure reducing stations. A population of approximately 86,000 is served through 21,500 service connections.

In 2018, Metro measured 20.1 million cubic metres of water delivered to the DNV distribution system through nineteen metered connections. This represents a 1% increase in volume over 2017. A map of the overall water system, showing pressure zones is included in Appendix A.

2.2 Sampling and Testing

Sampling is performed in three scheduled categories according to the requirement of the British Columbia Drinking Water Protection Regulation (the Regulation);

1. ***Weekly*** (bacteriological, chemical and physical parameters),
2. ***Quarterly*** (Disinfection by-products), and

3. ***Semi-Annually*** (Metals).

Health Canada's Guideline for Drinking Water Quality (the Guideline) sets category parameter limits on peer-reviewed scientific based research as either maximum acceptable concentrations, aesthetic objective or operational guidance values.

- Maximum Acceptable Concentrations (MAC) are set for parameters that are known to detrimentally impact human health.
- Aesthetic Objectives (AO) are set for parameters which consumers base opinions about the drinkability of water.
- Operational Guidelines (OG) are set for parameters that could detrimentally impact water quality in the distribution system.

With the exception of temperature and free chorine residual, which are analysed and recorded by DNV staff at the time of sampling, all other parameters are analysed and reported by the accredited Lake City Metro lab after being collected and transported by DNV operators.

2.2.1 Scheduled Weekly Sampling

In 2018 DNV staff collected a total of 1,321 regular scheduled samples from 39 sample sites or an average of 110 samples per month. This exceeds the Regulations population based sample requirement for DNV of 34 sites and 86 samples per month. Sample collection is scheduled weekly on a rotating basis using strategic grouping of sample sites distributed across the system. Generally 13 samples are collected twice weekly for a total of 26 samples per week.

Locations of weekly sample points are distributed according to the regulation recommendations as follows;

- 10% of sampling points at "source" (supply points from Metro transmission mains),
- 40% of sampling points at locations with medium flow,
- 40% of sampling points at locations with low flow, and
- 10% of sampling points at system dead-ends (very low flow).

Scheduled weekly analysis can be grouped into two categories bacteriological and chemical or physical parameters. Standards for water distribution systems are dictated by the requirements of the Regulation and the Health Canada's Guidelines for Canadian Drinking Water Quality. The guidelines provide either a maximum allowable concentration (MAC), an athletic objective (AO) or an operational guidance (OG) value.

- Bacteriological parameters guidelines are:
  - Escherichia coli (E coli): MAC none detectable per 100mL
  - Total coliform: MAC none detectable in 100mL
  - Heterotrophic plate count (HPC): OG less than or equal to 500 CFU/mL
  - Turbidity: OG less than or equal to 5.0 NTU

- Chemical or physical parameter guidelines are:
    - Chlorine: OG between 0.04 – 2.0 mg/L
    - Temperature: AO less than or equal to 15° C
    - pH: OG between 7.0 and 10.5

Figure 1 below shows the number of scheduled weekly sample collected and analysed in 2018 on a monthly basis.

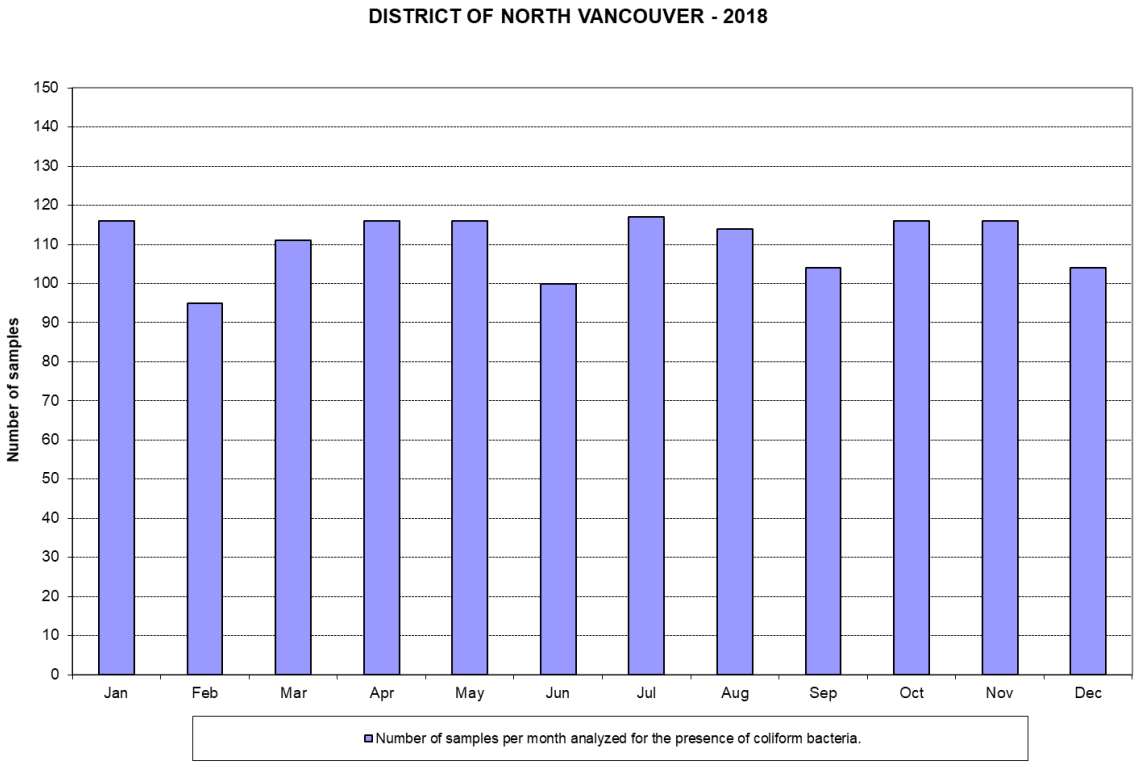


Figure 1. Number of Scheduled Weekly Samples Collected

2.2.2 Quarterly Disinfection By-Products Sampling

Haloacetic acids (HAA) and Trihalomethanes (THM) are groups of compounds that can form as by-products when water is treated with chorine. The Guideline maximum allowable concentrations for the running quarterly averages are 80 ppb for HAA and 100 ppb for THM with the added recommendation that they be kept as low as reasonably achievable (ALARA) without compromising disinfection.

In conformance with the regulation, DNV staff collected 16 samples for HAA and THM disinfection by-product analysis.

2.2.3 pH

A measurement of pH in the distribution system is made at the same time as the disinfection by-products at one of the four locations on a quarterly basis. The Guideline does not provide a required value but sets a target range of 7.0-10.5 and is primarily for corrosion control. Metro controls and stabilises pH at the source.

2.2.4 Metal Semi-Annual Sampling

In 2018 DNV staff collected 8 samples for analysis at 4 locations for metal testing in conformance with regulatory requirement.

2.2.5 Unscheduled Sampling

In addition to the scheduled weekly, quarterly and semi-annual samples, additional samples are collected and analysed when warranted for water quality complaint, operational concern or maintenance activity. All water quality complaints are investigated immediately. The majority of water quality complaints received are about discolored water. The cause of discolored water in the DNV tend to can fall into one of two categories:

1. An unintentional consequence of DNV or private activities (water main flushing, hydrant flow testing, construction activities or pipe breaks). Planned and unexpected work is performed in a manner that limits the impact on water quality, however, sometimes it occurs.
2. Spontaneous degradation of cast iron pipe. Cast iron pipe naturally breaks down and can release corrosion product that can, in sufficient concentration, make water appear discolored, typically orange or brown in color.

In 2018 a total of 103 unscheduled samples were collected and analysed.

3 RESULTS

The DNV water sampling program meets the regulatory requirements for sample location, frequency and quantity. Analytical results are provided by Metro to DNV on a weekly basis and reviewed internally upon receipt. The five year summary of scheduled weekly sample results (free chlorine residual, total Coliform, E-coli, HPC, turbidity and temperature) for each sample site are presented in Appendix B. A summary of the results by parameter is provided below.

3.1 Scheduled Weekly Bacteriological Parameter Results

Bacteriological standards for water distribution systems are dictated by the requirements of the regulation and by Health Canada's Guidelines for Canadian Drinking Water Quality which provide the following criteria:

- **E. coli:** Escherichia coli is an indicator of potential micro bacteriological contamination and possible pathogens. Some strains of E coli are pathogenic. The guideline states that the MAC is zero detectable E. coli per 100 mL sample.
- **Total Coliform:** Coliforms occurs naturally in water sources and alone are not pathogenic but indicate the potential presence of pathogens. The guideline states that the MAC is 10 or less

total coliform per 100 mL sample and that 90% or more of the samples for a given month must have zero detectable total coliform per 100 mL sample.

- **HPC:** Heterotrophic plate count is used to monitor general bacteriological quality. The Guideline does not provide an allowable level but instead offers the OG that increases in HPC concentrations above a baseline level of 500 CFU/mL s are undesirable.
- **Turbidity**: Particles in drinking water can inhibit treatment and indicate potential quality concerns. The Guidelines suggests an OG of supply water turbidity target of < 1 Nephelometric Tubidity Unit (NTU) or "best possible" and should not exceed 5.0 in distribution systems.

All samples collected in 2018 met all guidelines for safe potable water. There were no occurrences of detectable E-coli nor Total Coliform. All samples were below the recommended maximum HPC and turbidity level and are stable over time. The annual DNV average HPC and turbidity for the last five years are presented below.

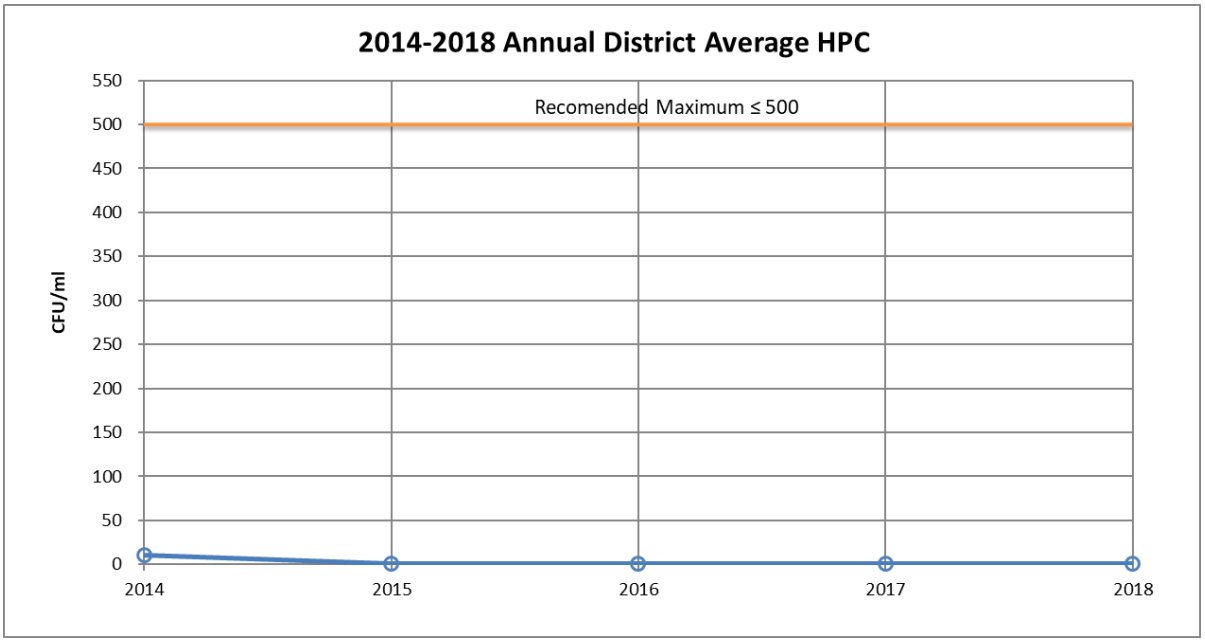


Figure 2. HPC Five Year Annual Averages

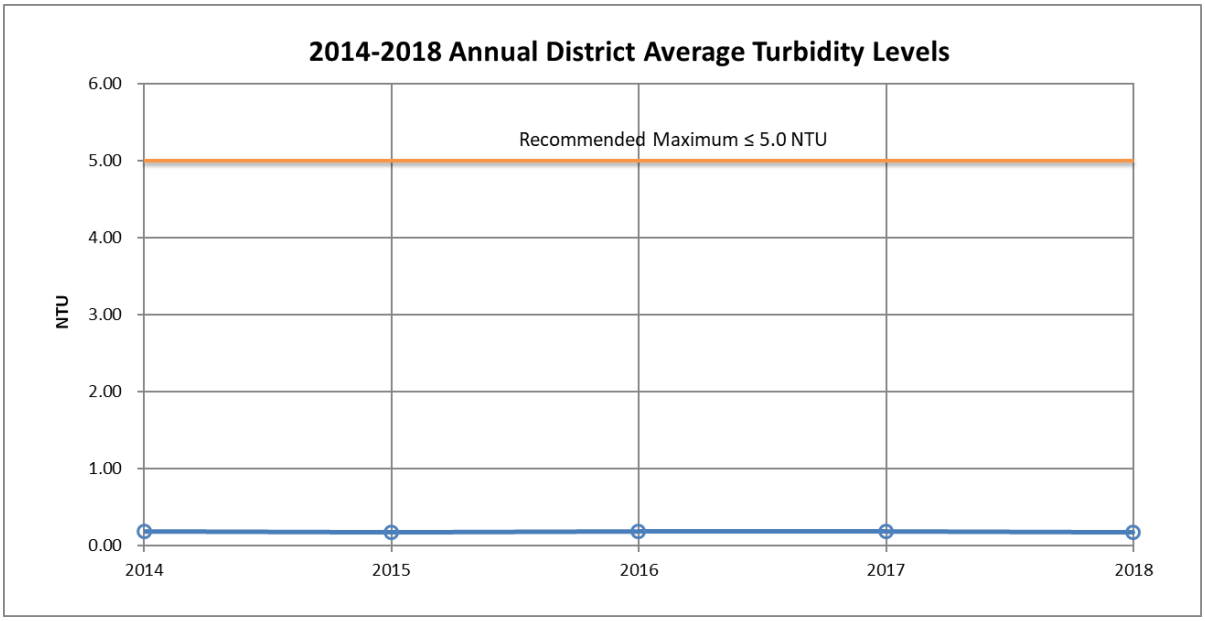


Figure 3. Turbidity Five Year Annual Averages.

3.2 Scheduled Weekly Chemical and Physical Parameter Results

Chemical and physical parameters, chlorine, temperature and pH, results for 2018 are summarised below.

- **Chlorine:** Chlorine is used in the disinfection process and a residual amount in the distribution system is desirable to maintain potable water quality. In 2018 all samples were within the OG range for residual chlorine, 0.04-2.0 mg/L and above the OG of 0.2 mg/L. The average system-wide chlorine residual was 0.68 mg/L. The annual DNV average free chlorine for the past 5 years is presented below in figure 4.
- **Temperature:** The temperature of drinking water can impact water quality and is an aesthetic parameter. The guidelines provide an AO for water temperature at less than or equal to 15°C. In 2018, 29 samples or 2% were above 15°C and occurred primarily during the months of August and September. The highest temperature recorded was 18 °C, the lowest temperature recorded was 3 °C and the annual system average was 8.9 °C.
- **pH:** pH is a measure of acidity/basicity and can impact corrosion rates of the distribution systems. The operational guideline is 7.0-10.5 in drinking water and the average pH for our system in 2018 was 7.4.

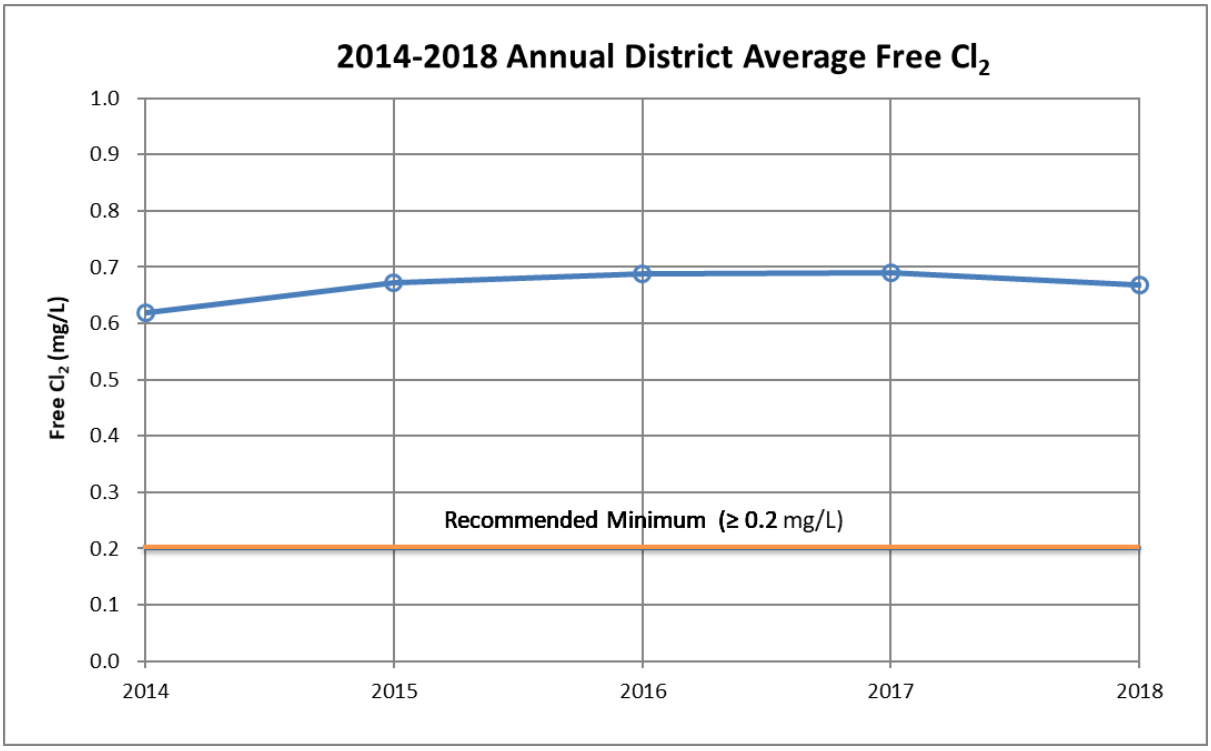


Figure 4. Free Cl2 Five Year Annual Averages.

3.3 Quarterly Disinfection By-products Results

Quarterly disinfection by-products tested were well below guideline limits and are presented below in Table 1.

		THM (ppb)			HAA (ppb)	
Sample	Date Sampled	Total Trihalomethanes	Total THM Quarterly Average (Guideline Limit 100 ppb)		Total Haloacetic Acid	Total HAA Quarterly Average (Guideline Limit 80 ppb)
DNV-727	13-Feb-18	21	**21**		20.9	**21**
DNV-727	30-May-18	20	**21**		17.2	**19**
DNV-727	8-Aug-18	17	**19**		7.9	**15**
DNV-727	20-Nov-18	29	**22**		19.2	**16**
DNV-733	13-Feb-18	22	**22**		22.7	**23**
DNV-733	30-May-18	23	**23**		21	**22**
DNV-733	8-Aug-18	25	**23**		13.3	**19**
DNV-733	20-Nov-18	34	**26**		21	**20**
DNV-734	13-Feb-18	19	**19**		23.7	**24**
DNV-734	30-May-18	19	**19**		12.9	**18**
DNV-734	8-Aug-18	17	**18**		7.3	**15**
DNV-734	20-Nov-18	35	**23**		20.4	**16**
DNV-736	13-Feb-18	21	**21**		22	**22**
DNV-736	30-May-18	24	**23**		22.5	**22**
DNV-736	8-Aug-18	21	**22**		11.9	**19**
DNV-736	20-Nov-18	37	**26**		41.2	**24**

Table 1. Quarterly Disinfection By-products 2018 Results

3.4 Scheduled Semi-Annual Metal Results

A total of eight samples from four locations were analyzed for metals, including copper, lead and zinc. Sample sites, results, and maximum concentrations are given in Table 2 below. All samples tested for metals were below the maximum acceptable concentration guidelines for Canadian Drinking Water Quality. Where the guideline limit is 'none', Health Canada has determined that there is currently no scientific evidence of aesthetic or detrimental health effects for that parameter at the levels typically found in drinking water.

Parameter (Unit)	Canadian Guideline Limit	SITE: DNV-721 2838 Panorama Dr.		SITE DNV-730 Braemar Reservoir		SITE: DNV-734 1181 West 22nd		SITE; DNV-747 1231 Lennox St. PRV	
		06/12/2018	12/04/2018	06/12/2018	12/04/2018	06/12/2018	12/04/2018	06/12/2018	12/04/2018
Aluminium Total (µg/L)	200*	26	42	25	44	25	48	26	58
Antimony Total (µg/L)	6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic Total (µg/L)	10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Barium Total (µg/L)	1000	3.1	3.6	2.6	2.6	2.5	2.8	2.5	2.5
Boron Total (µg/L)	5000	<10	<10	<10	<10	<10	<10	<10	<10
Cadmium Total (µg/L)	5	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Calcium Total (µg/L)	none	5040	5220	4800	4740	4410	4730	4770	4620
Chromium Total (µg/L)	50	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cobalt Total (µg/L)	none	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Copper Total (µg/L)	≤1000	2.2	1.7	0.6	<0.5	6.4	5.0	<0.5	<0.5
Iron Total (µg/L)	≤ 300	8	21	<5	8	<5	7	<5	<5
Lead Total (µg/L)	10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Magnesium Total (µg/L)	none	143	132	152	136	151	133	155	134
Manganese Total (µg/L)	≤ 50	0.7	1.8	1.1	2.0	1.5	1.8	2.1	3.4
Mercury Total (µg/L)	1.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Molybdenum Total (µg/L)	none	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel Total (µg/L)	none	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Potassium Total (µg/L)	none	133	152	134	152	133	144	135	142
Selenium Total (µg/L)	50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Silver Total (µg/L)	none	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sodium Total (µg/L)	≤ 200,000	1300	1460	1360	1450	1350	1410	1370	1430
Zinc Total (µg/L)	≤ 5000	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0

**No health-based guideline for aluminium has been established in Canada, however where aluminum based coagulants are used in water treatment this operating guideline has been set.*

Table 2. 2017 Semi Annual Metal parameter, Guideline Limits and Results

3.5 Unscheduled Results

In addition to scheduled samples, 103 unscheduled samples were collected and analysed in 2018. Twenty three (23) samples were in response to customer or staff requests and eighty (80) were in response to operational incidents or planned capital construction activities such as water main breaks or water main construction. All results were within the guideline recommended limits with the exception of 2 sample from the same location on a new main which had not been connected to the system which had detected total coliform. Subsequent flushing and retesting resulted in zero total coliform.

4 OPERATIONS, MAINTENANCE & CAPITAL PROGRAMS

4.1 Water System Scheduled Maintenance

Scheduled annual system maintenance programs that support water quality includes water main flushing, reservoir cleaning and scheduled water facility inspections. We follow the AWWA flushing program standards. Our 2018 flushing program focused on 30,455m of primarily cast iron pipe which is know to create discolored water. Two reservoirs were cleaned in 2018, Hyannis South and North. All of our facilities are inspected weekly.

The DNV uses permanent flushing stations or regularly scheduled flushing to maintain water quality in areas with chronic aesthetic issues related to cast iron pipe. We are eliminating the flushing stations by upgrading cast iron with our standard water main pipe, lined ductile iron. There are two permanent flushing stations remaining in our system.

The DNV uses and integrated a SCADA system to optimise pumping, reservoir filling and retention time to support water turnover and quality.

4.2 Capital Upgrades

The DNV has a fully funded water main replacement program that uses a risk based protocol with seventeen weighted hazard criteria. The DNV's water main replacement program takes into consideration multiple parameters to prioritise the annual replacement schedule. The DNV standard replacement water main is ANSI/AWWA C151 & C140 special class 50 cement lined ductile iron pipe and specified in our Design Guidelines of our Development Servicing Bylaw.

Our prioritisation protocol heavily weighs the potential of failure, consequence of failure, and water quality. The 2018 DNV construction crews completed the replacement of 5,425 metres of pipe including 61% asbestos cement (AC), 31% cast iron (CI) and 8% a mix of copper (Cu), galvanised (Ga), ductile iron (DI) and steel (St).

The water main replaced in 2018 is listed below.

WMP Project Street Name	Pipe Material and Length per Project						Length (m)
	AC	CI	Cu	DI	Ga	St	
Bowser Watermain		52					52
Brockton WMR	120						120
Chaucer WMR	255	102					357
Cliffridge Clements WMR		219					219
E 11th Drayton WMR	388	269					657
Granada WMR		167			44		211
Lower St Andrews WMR	126						126
MSP WMR	668					88	756
Phyllis Langworthy WMR	406		57				463
Pine/Redwood WMR		379					379
St Annes Monton Winton WMR	124	221	38	48			431
Tudor WMR		53		78			131
Upper Appin WMR	506						506
Wavertree Watermain		67			60		128
Williams 26th WMR	718						718
Woodbine Watermain		172					172
Grand Total	**3,310**	**1,701**	**95**	**126**	**104**	**88**	**5,425**

Table 3. Water Main Replaced in 2018

In 2019 we plan to replace 6,288 m of water main, 70 % asbestos cement, 28% cast iron and the balance a mix of copper and steel.

The planned Water main replacement for 2019 is listed below.

WMR Project Street Name	Pipe Material				Length(m)
	AC	CI	Cu	ST	
Brookridge WMR	115				115
Coleman WMR		259			259
Dollarton WMR		299			299
Fromme WMR	125				125
Grantham WMR		94			94
Kilmer WMR	284				284
Lynn Canyon WMR	153				153
Lytton WMR	190				190
Macgowan WMR	169				169
Mill WMR	187			14	201
Mountain Hwy WMR	398	51			449
Oakwood WMR		492			492
Paisley Burnage Brantwood WMR	108	538	90		736
Panorama WMR	223				223
Scott WMR	184				184
Sunnyside Terrace WMR	71		50		122
Torquay Hoskins WMR	448				448
Trillium WMR	257				257
Upper St Andrews WMR	189				189
W 19th WMR	176				176
W 23rd WMR	377				377
Wellington WMR	637				637
Wendel WMR	110				110
Total Lenghts (m)	**4,401**	**1,733**	**141**	**14**	**6,288**

Table 4. Proposed Water Main Replacement 2019

4.3 Operator Training & Qualification

The DNV's distribution system is EOCP classified as a Level 3 system. The DNV currently has distribution system operators with Level 3 operator's certification from the EOCP, keeping the DNV in full compliance with current requirements.

5 ISSUES, INCIDENTS & RESPONSE PLANS

5.1 Boil Water Advisory

A precautionary boil water advisory is issued when, in consultation with the Vancouver Coastal Health, a situation exists that increases the risk of possible contamination. We issued one precautionary boil water advisory in January 2018 affecting 30 single family homes in the Woodlands community as a result of a water main repair.

5.2 Customer Complaints

We recorded twenty one (21) customer complaints for either colour or odor. Fourteen (14) or 70% resulted from either know construction/operational activities or cast iron mains with documented discoloration potentials.

5.3 Ductile Iron Supply & Storage

One incident that resulted in repeat total coliform detected in new ductile iron pipe, not yet tie into the system, lead us to investigate and change our pipe storage and purchase practices. Pipe stored in our secondary area (Beach Yard) is elevated on skids and wrapped and all new DI pipe is ordered with factory caps on the ends.

5.4 Security

There were no security threats to the DNV system in 2018.

We had one incident of Hydrant vandalism in the Woodlands neighbourhood that was reported to the RCMP. The incident had no impact water quality.

DNV water storage reservoirs and pumping facilities have secured access, intrusion detection linked to the automated SCADA alarm system and designed fail safe valve operation to inhibit or reduce the impact of security threats. Each facility is attended a minimum of once per week for routine operation and maintenance.

5.5 Water Main Breaks

We responded to 19 emergency water main breaks in 2018. Water main break response protocol includes maintaining positive pressure to protect the water system from potential contamination.

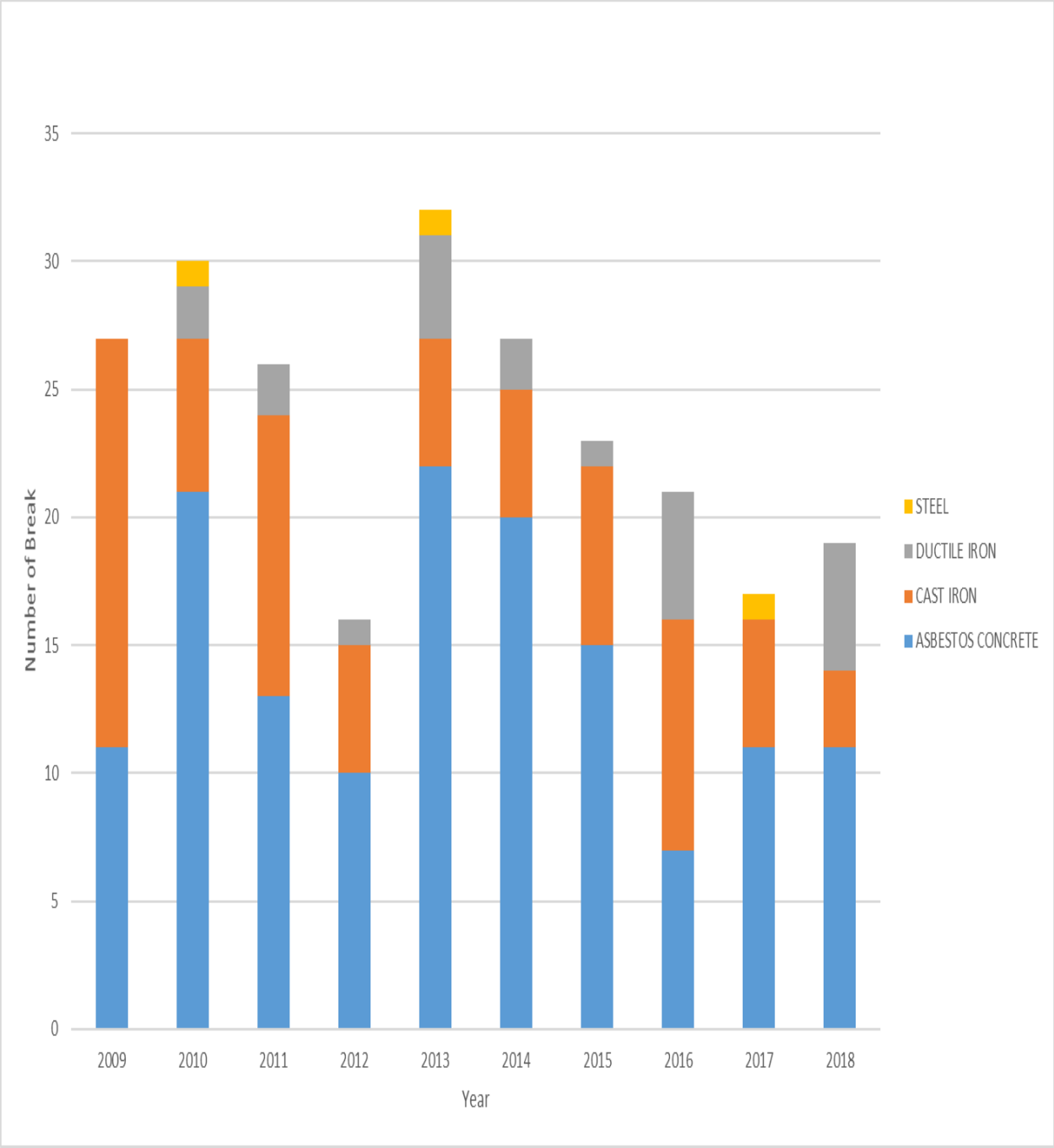


Figure 5. 10-Year Water Main Break Summary

5.6 Notification & Emergency Response

The table below outlines our notification process for unusual situations that could potentially affect water quality and notification is required.

NOTIFICATION FOR UNUSUAL SITUATIONS POTENTIALLY AFFECTING WATER QUALITY			
Situation	**Notifying Agency**	**Agency Notified**	**Time Frame For Notification**
E. coli -positive sample	GVWD	DNV and Vancouver Coastal Health (North Shore)	Immediate
Chemical Contamination	GVWD DNV	Vancouver Coastal Health (North Shore)	Immediate
Turbidity > 5 NTU (Coquitlam Reservoir only)	GVWD	DNV and Vancouver Coastal Health (North Shore)	Immediate
GVRD Source treatment failure	GVWD	DNV and Vancouver Coastal Health (North Shore)	Immediate in any situation in which the BCSDWR or the GCDWQ may not be met
Loss of pressure	GVWD DNV	GVWD Operations and Vancouver Coastal Health (North Shore)	Immediate
Water main break with contamination suspected	DNV	Vancouver Coastal Health (North Shore) PEP	Immediate
Water main break with no suspect contamination	DNV	Vancouver Coastal Health (North Shore) PEP	As required by Health Authority. PEP as soon as possible

Table 5. Water Quality Notification

5.7 Response Plans

The flow diagram below illustrates the process that has been put in place for response to incidents that could potentially affect water quality during a loss of system integrity. Additional or cascading response protocols are outlined after the chart.

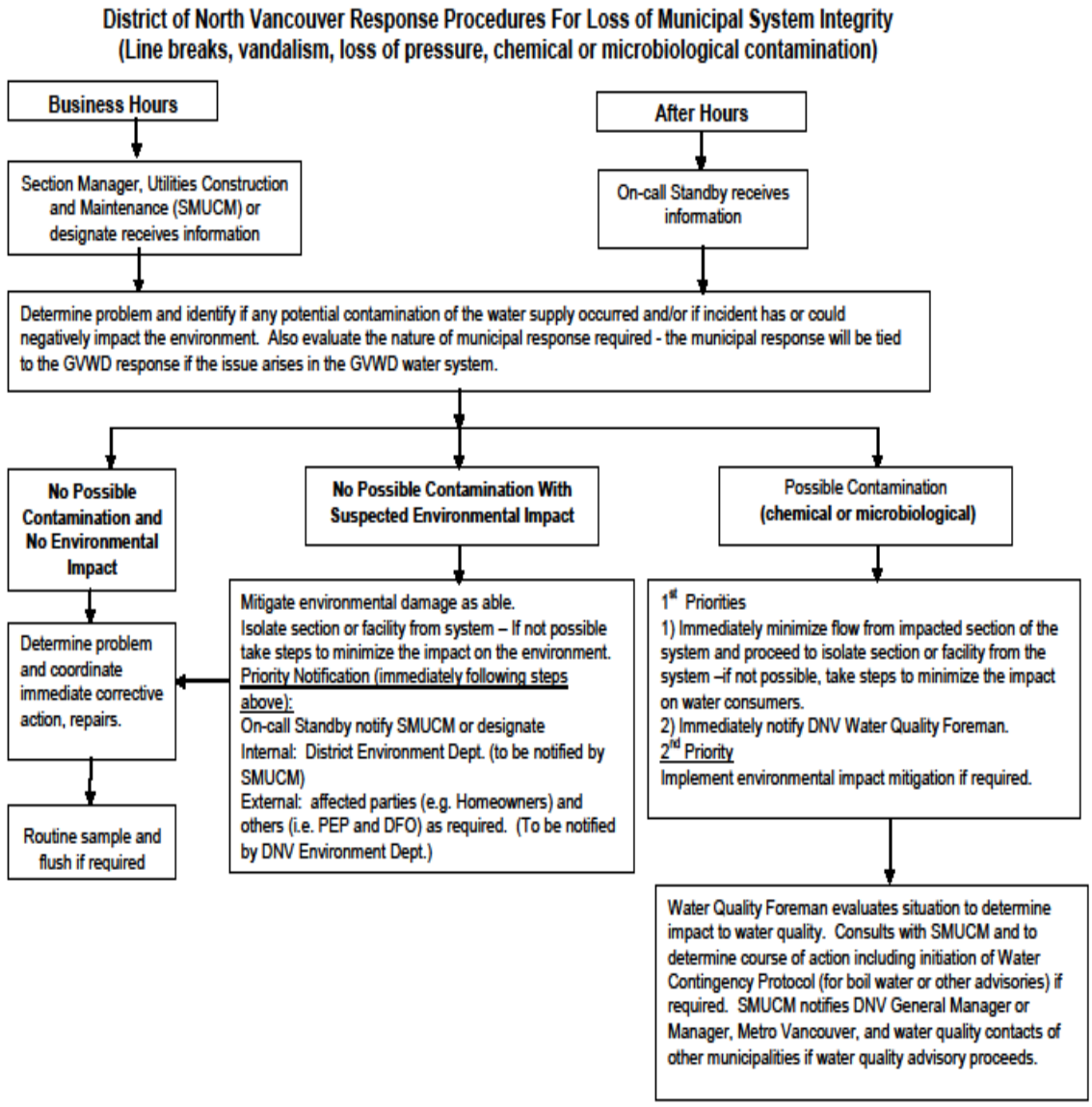


Figure 6. Loss of System Integrity Response

5.8 Response Plans

- ***Water main Breaks***

Water main breaks pose an increased risk for potential contamination. Response procedure and repair practices are in place to reduce the risk of contamination. In instances where contamination of the system is suspected, DNV Utilities crews make adjustments to isolate the section or facility from the system. The DNV immediately consults with Vancouver Coastal Health (North Shore) regarding further actions, and all water quality complaints from the public will be immediately and thoroughly investigated for potential contamination.

Following all water main breaks, water samples are analysed from the vicinity of the break and tested for bacteriological, chemical and physical parameters.

- ***Turbidity Events***

Turbidity in the DNV water distribution system is monitored on a regular basis through the water sampling program. Water sampling results yielding readings greater than 1 NTU are scrutinized. All areas from which turbidity results > 5 NYU are flushed and re-sampled for free chlorine and turbidity. Flushing in areas with turbidity < 5NTU is at the operators discretion.

- ***Loss of Pressure Due to High Demand***

In the event of adverse pressure loss due to high demand, DNV Utilities crews make adjustments to the system to isolate the section or facility and then take measures to supplement pressure in the affected area. The DNV immediately consults with GVWD and Vancouver Coastal Health (North Shore) regarding further actions and all water quality complaints from the public are immediately investigated.

- ***Positive E-coli Results***

If a sample submitted from DNV and analysed by the Metro Vancouver laboratory or the BC Centre for Disease Control tests positive for E. coli, the following response plan will be put into action.

i) Results of interim samples, if any, from the site will be examined by the lab. Interim samples are any samples that may have been taken from the site in the period between when the E. coli -positive sample was taken and when it was determined to be positive.

ii) The chlorine residual noted on the sampler's field sheet will be reviewed by the lab and compared to previous readings to determine if there had been a localized loss of disinfectant residual.

iii) The DNV Section Manager of Utilities Construction and Maintenance (SMUCM) or designate and Vancouver Coastal Health (North Shore) will be notified immediately by the laboratory.

iv) Arrangements will be made for the immediate collection of a repeat sample (including, where possible, samples from upstream and downstream of the positive sample location).

v) Vancouver Coastal Health (North Shore) will be contacted and the need for a "boil water" advisory will be evaluated.

vi) If a "boil water" advisory is warranted, the public notification process as outlined in the Water Quality Monitoring And Reporting Plan For The GVRD and Member Municipalities will be followed.

vii) The lab will contact the DNV with repeat sample results and the results of the species identification tests. The DNV will contact Vancouver Coastal Health (North Shore) to evaluate these results and to determine whether or not the advisory can be lifted.

- ***Chemical Contamination***

In the event of chemical contamination in the DNV water distribution system, Vancouver Coastal Health (North Shore) will be immediately notified. Immediate steps will be taken to isolate the contaminated area and the level of contamination will be determined through water sampling and testing. The chemical will be identified and any public health risk factors associated with the chemical presence will be determined. Through consultation with Vancouver Coastal Health (North Shore), a public advisory will be carried out.

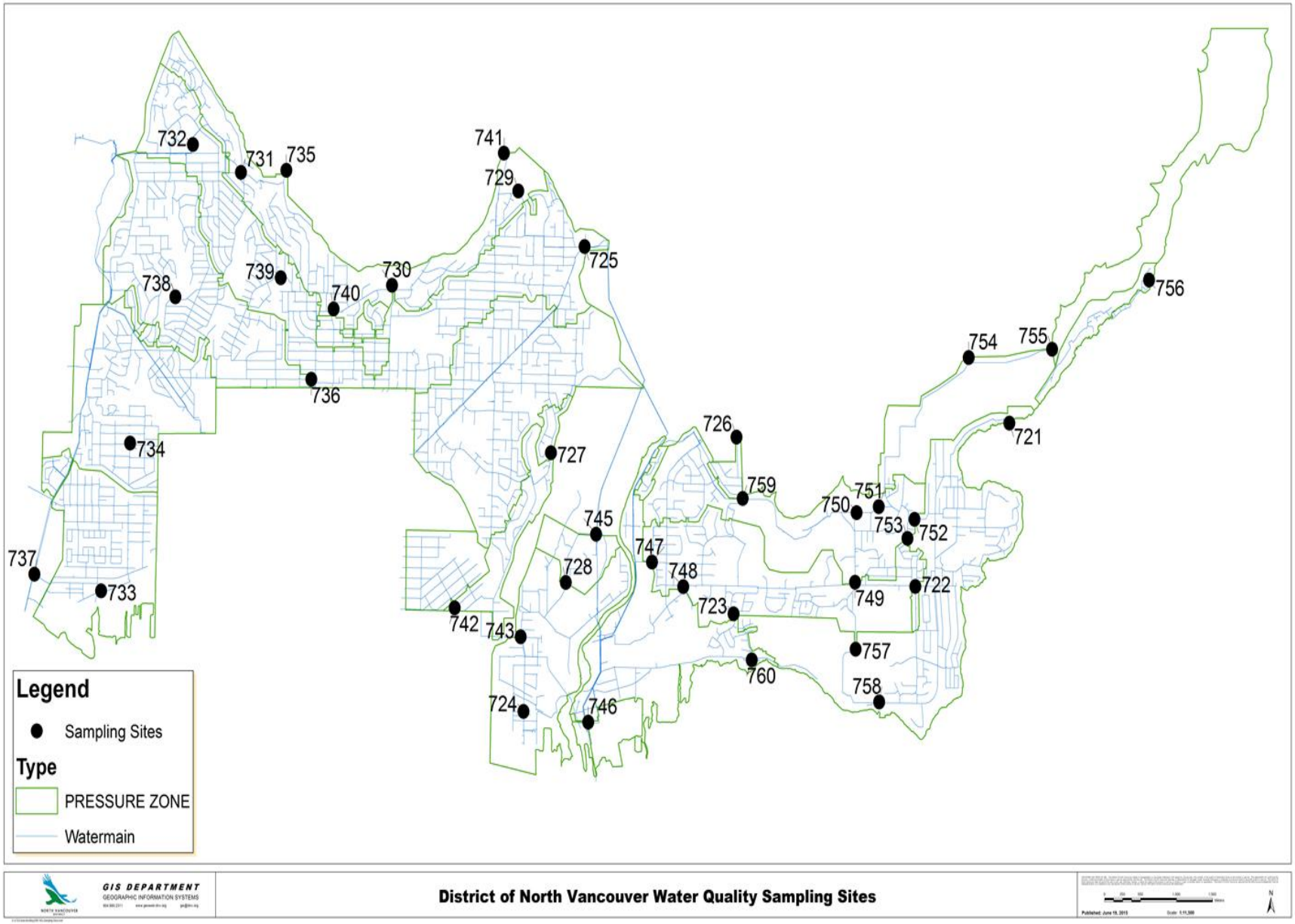
- ***Source Water Event***

In 2007 a task force comprised of Metro Vancouver, Vancouver Coastal Health, Fraser Health and member municipalities developed a communications template for source water major turbidity events. The template outlines the responsibilities of Metro Vancouver, the Health Authorities, and municipalities for notification and communications to each other and to the public.

- ***GVRD Disinfection Failure***

Upon notification by GVWD Operations that an interruption in disinfection has occurred, DNV Water Quality personnel will immediately commence monitoring free chlorine residual levels at strategic locations and will contact the Vancouver Coastal Health (North Shore) if continued loss of residual is observed.

APPENDIX A: Water System, Sample Sites and Sample Schedule.

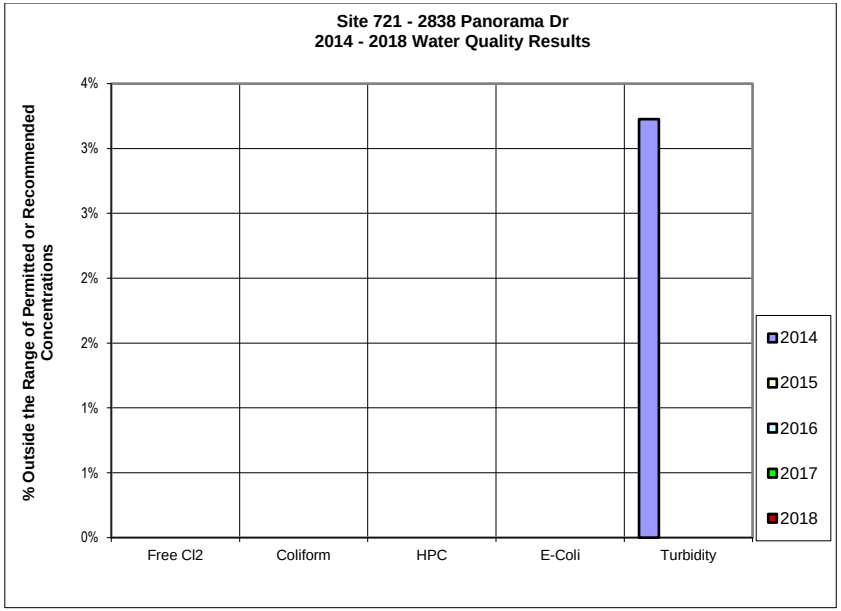

732
731
735
741
729
725
739
730
738
740
756
754
755
736
726
721
734
727
759
751
750
745
753
752
737
747
728
748
722
733
749
723
742
743
757
760
758
724
746
Legend
Sampling Sites
Type
PRESSURE ZONE
Watermain
GIS DEPARTMENT
GEOGRAPHIC INFORMATION SYSTEMS
District of North Vancouver Water Quality Sampling Sites

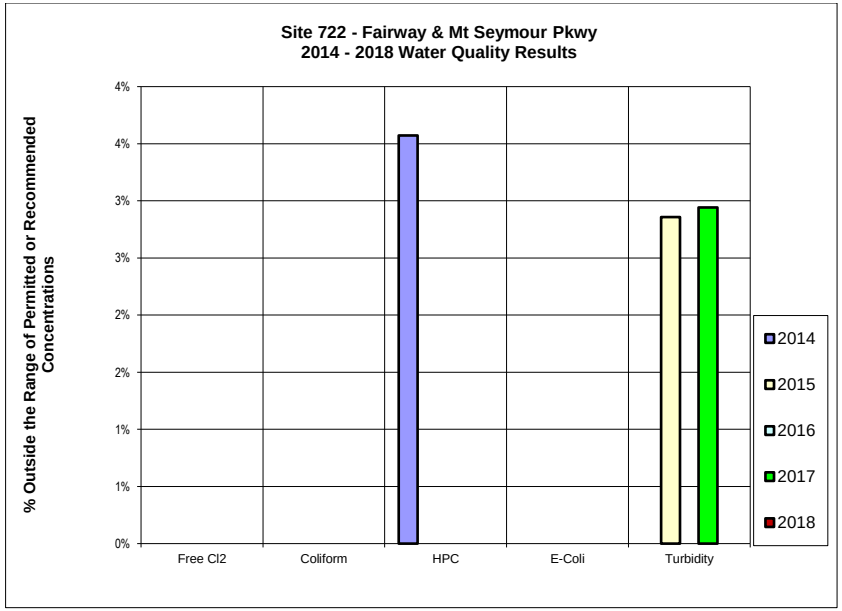
Site I.D.	Lab No.	Sample Site Location	Flow Rate
1	721	2838 Panorama Dr.	Low
2	722	Fairway & Mt Seymour Pkwy.	Medium
3	723	Plymouth Dr & Fairfield Dr.	Low
4	724	LS #13 Dominion & Mountain Hwy.	Low
5	725	Marion Pump Station	Source
6	726	Hyannis Reservoir	Low
7	727	Hoskins Rd & Kilmarnock Cres.	Medium
8	728	Lillooet Road	Low
9	729	Ramsay Pump Station	Medium
10	730	Braemar Reservoir	Low
11	731	Skyline Pump Station	Medium
12	732	Sarita Pump Station	Source
13	733	McKeen Ave & Phillip Ave.	Medium
14	734	Pemberton Heights	Low
15	735	Prospect Reservoir	Medium
16	736	PRV #4 (W Queens Rd. & Lonsdale Ave.)	Dead End
17	737	N. of BC Rail Tracks just East of Lower Cap. Rd.	Source
18	738	3906 Sunnycrest Dr.	Medium
19	739	376 Cartelier Rd.	Medium
20	740	PRV #5 (190 E. Braemar Rd.)	Medium
21	741	Mountain Hwy Reservoir (North up access Rd., N. of Mountain Hwy.)	Low
22	742	PRV # 11 (Across from 1086 Cloverly St.)	Source
23	743	PRV #7 (N across from 481 Mountain Highway)	Dead End
24	744	Not in use	
25	745	PRV # 13 (N. of 1388 Monashee Drive (Capilano College))	Source
26	746	PRV #17 (60 Riverside Dr.)	Medium
27	747	PRV # 19 (1231 Lennox St.)	Dead End
28	748	PRV # 16 (2592 Bendale Rd.)	Dead End
29	749	PRV # 18 (3728 Mt. Seymour Parkway)	Low
30	750	up path behind 1610 Mt. Seymour Rd.	Medium
31	751	Access Rd, N. end of Cascade Ct.	Low
32	752	PRV # 25 (4068 Deane Pl.)	Medium
33	753	PRV # 20 (1501 Theta Ct.)	Low
34	754	Woodlands reservoir (2.1 km N. of Hixon Rd. on Indian River Dr.)	Low
35	755	PRV # 26 3.7 km NE of Hixon Rd. on Indian River Dr.	Low
36	756	End of Fire Lane # 7 (Firelane #7 is 3.6 km from Hixon Rd.)	Dead End
37	757	PRV 200 m south of 879 Roche Point Dr.	Medium
38	758	3860 Dollarton Hwy.	Medium
39	759	Hyannis Pump Station (1919 Hyannis drive)	Low
40	760	3000 Block Dollarton Hwy.	Low

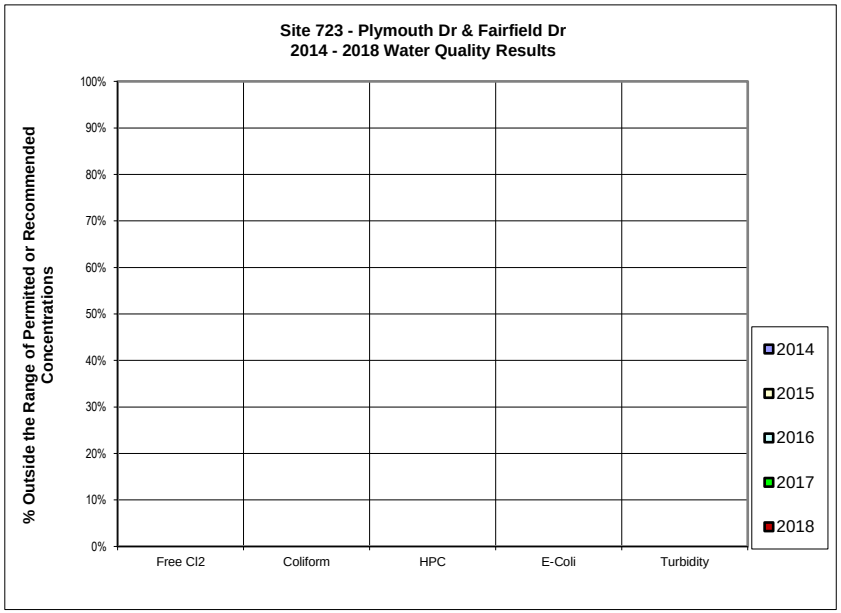
DISTRICT OF NORTH VANCOUVER
WATER QUALITY SAMPLING AND REPORTING
CALENDAR - 2018

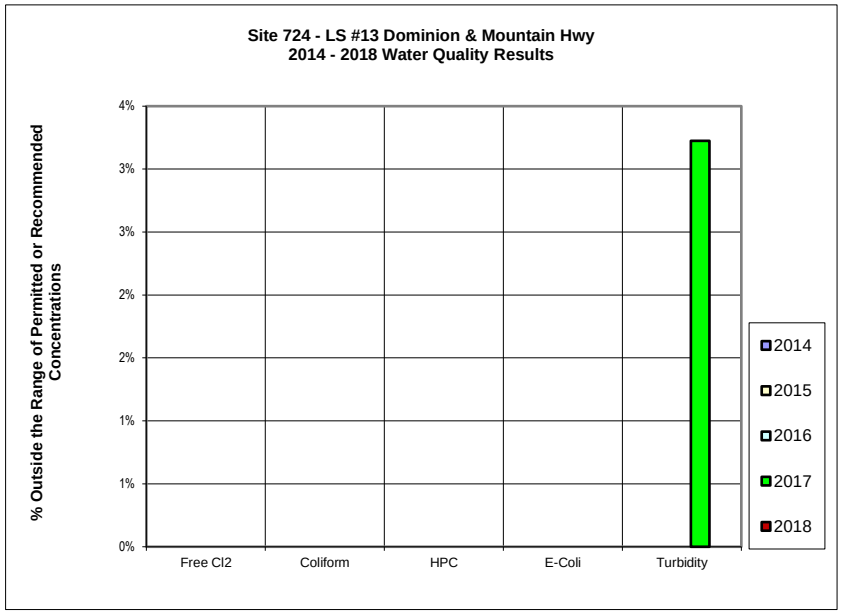
	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
DISTRIBUTION SYSTEM SAMPLING																								
bacteria, turbidity, chlorine, temperature (twice weekly)	xx xx	xx xx	xx xx	xx xx	xx xx	xx xx	xx xx	xx xx	xx xx	xx xx	xx xx	xx xx	xx xx	xx xx	xx xx	xx xx	xx xx	xx xx	xx xx	xx xx	xx xx	xx xx	xx xx	xx xx
HAA's, THM's, pH (quarterly)			X							X					X							X		
metals - copper, lead, zinc (semi-annually)							X															X		
NOTIFICATION																								
Annual Report:																								
Annual report sent to MHO							X																	
MHO responds to Council										x														
Staff report to Council												x												
Posted on Web														x										

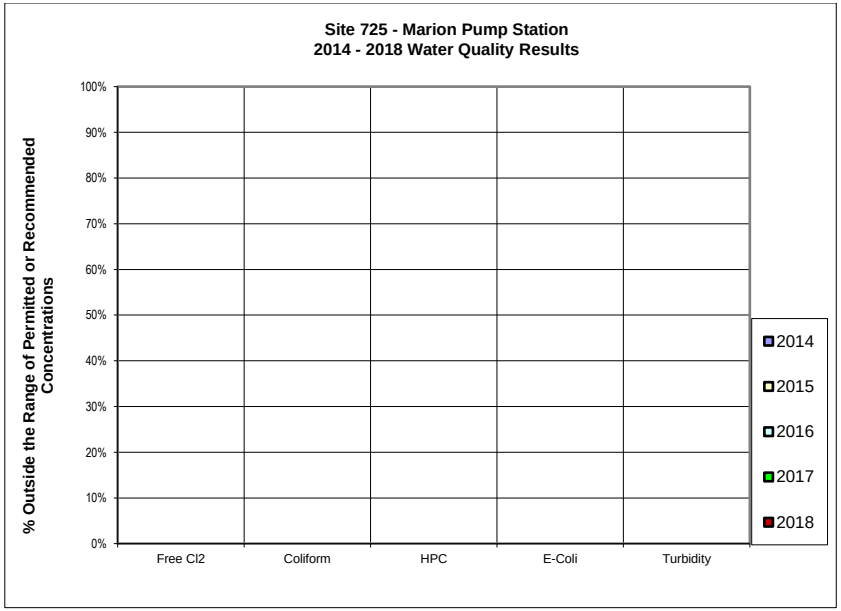
APPENDIX B: Five Year Results by Water Quality Sample Site. 2014 - 2018

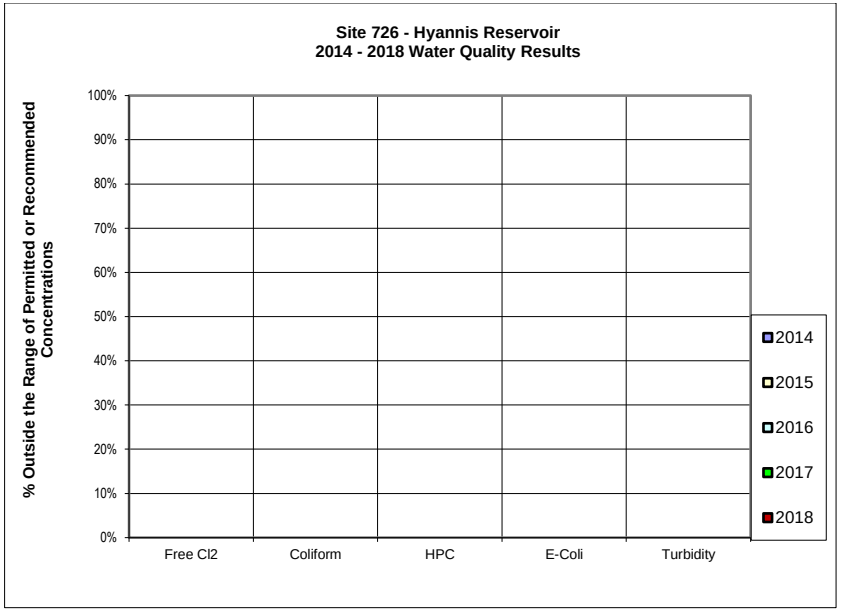

Site 721 - 2838 Panorama Dr
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
4%
3%
3%
2%
2%
1%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

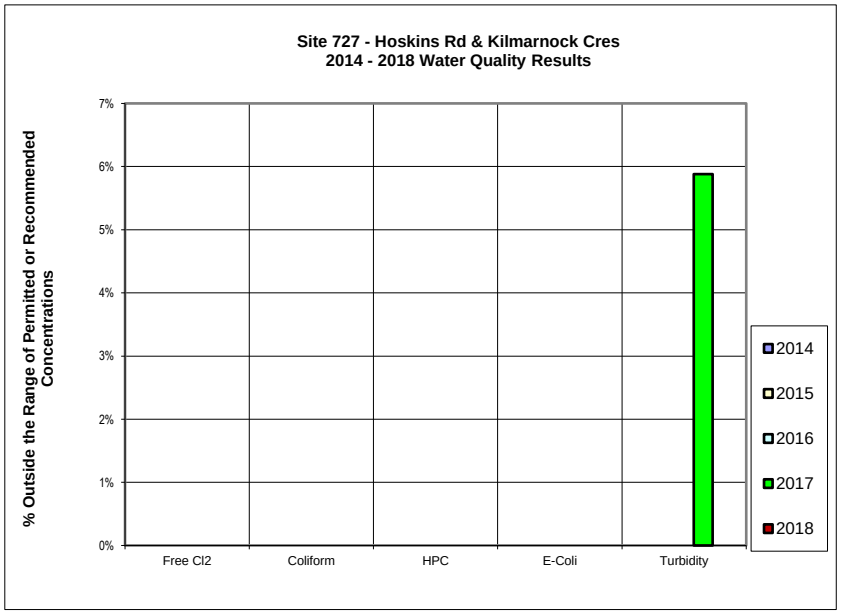

Site 722 - Fairway & Mt Seymour Pkwy
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
4%
4%
3%
3%
2%
2%
1%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

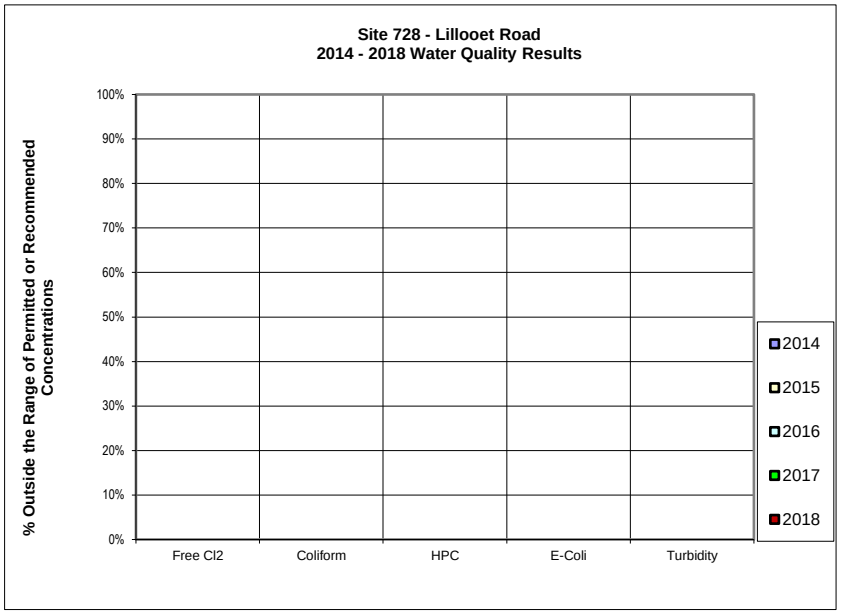

Site 723 - Plymouth Dr & Fairfield Dr
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

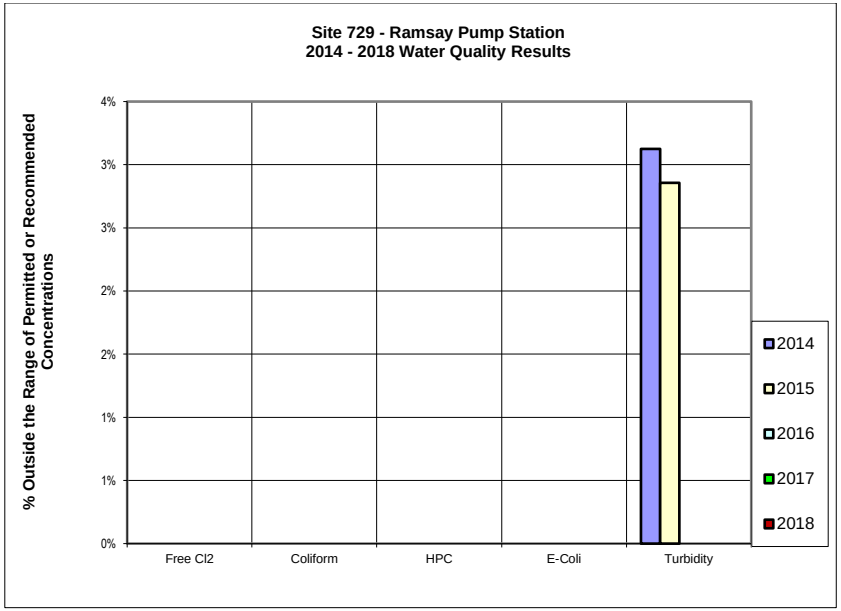

Site 724 - LS #13 Dominion & Mountain Hwy
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
4%
3%
3%
2%
2%
1%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

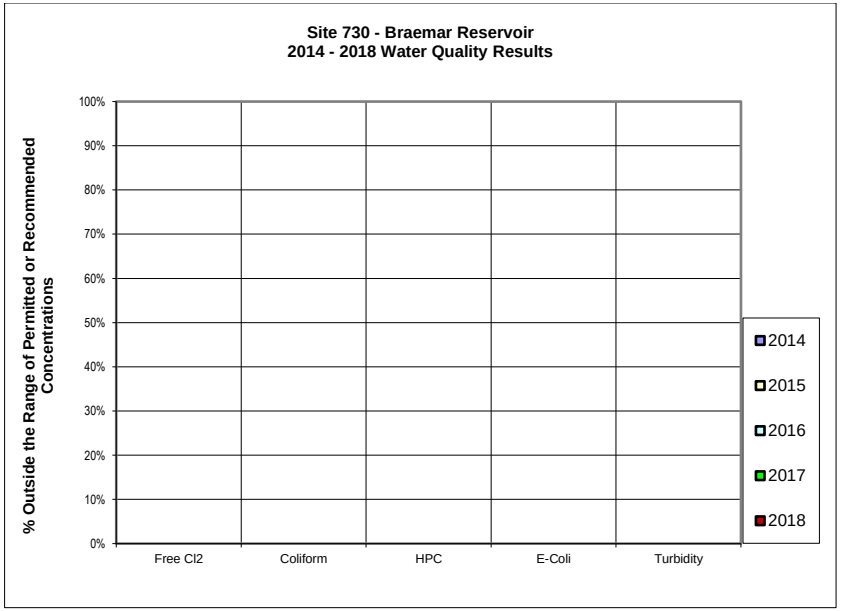

Site 725 - Marion Pump Station
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

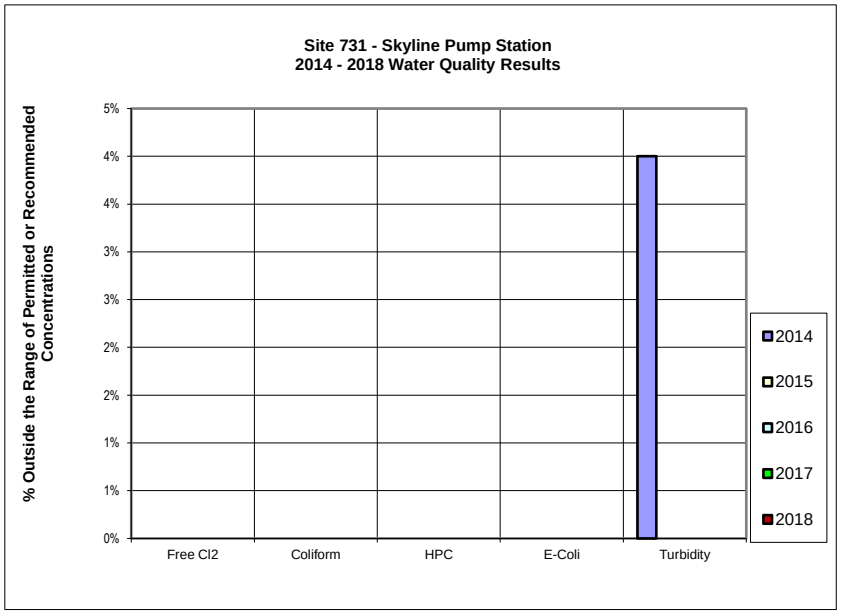

Site 726 - Hyannis Reservoir
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

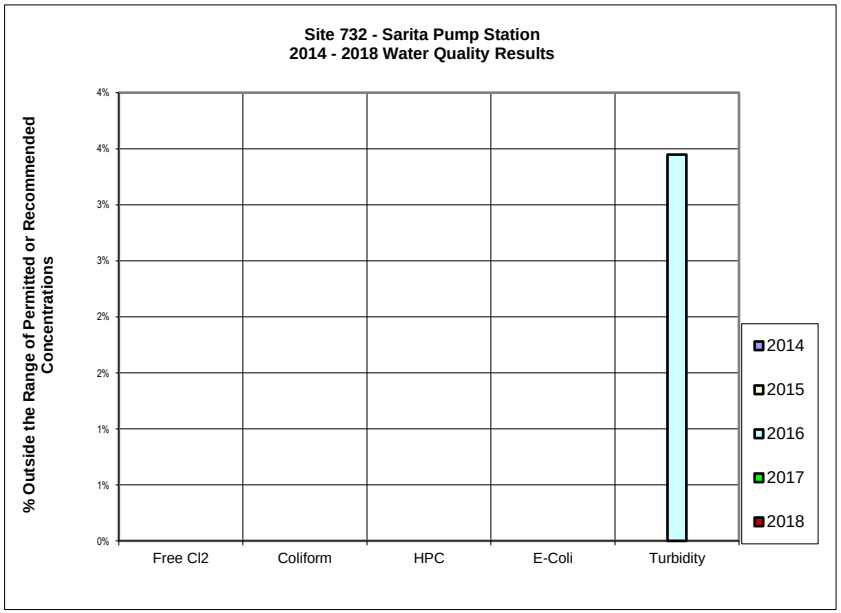

Site 727 - Hoskins Rd & Kilmarnock Cres
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
7%
6%
5%
4%
3%
2%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

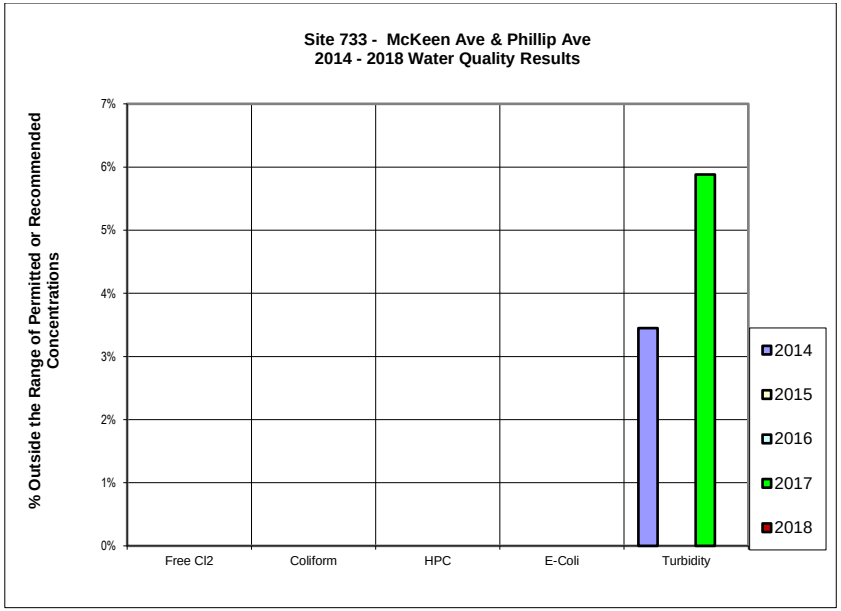

Site 728 - Lillooet Road
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

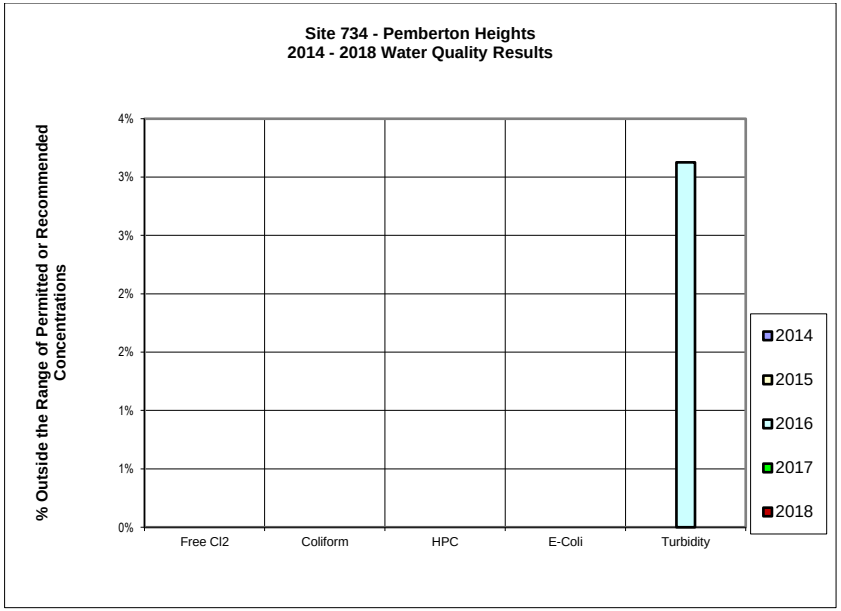

Site 729 - Ramsay Pump Station
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
4%
3%
3%
2%
2%
1%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

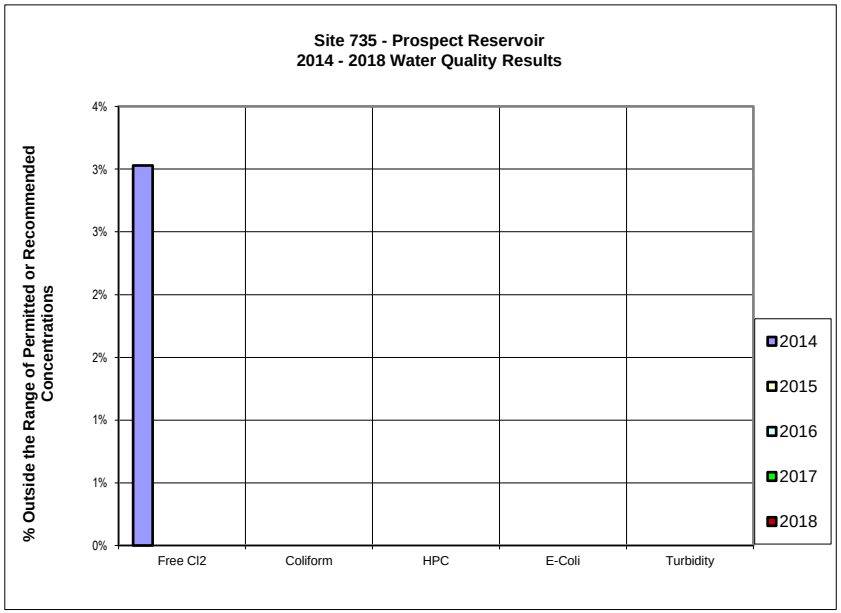

Site 730 - Braemar Reservoir
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

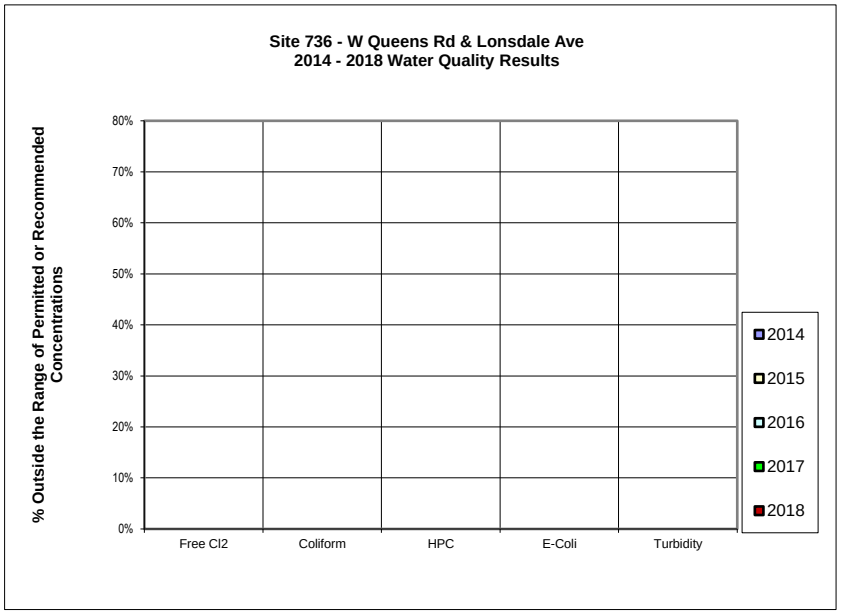

Site 731 - Skyline Pump Station
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
5%
4%
4%
3%
3%
2%
2%
1%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

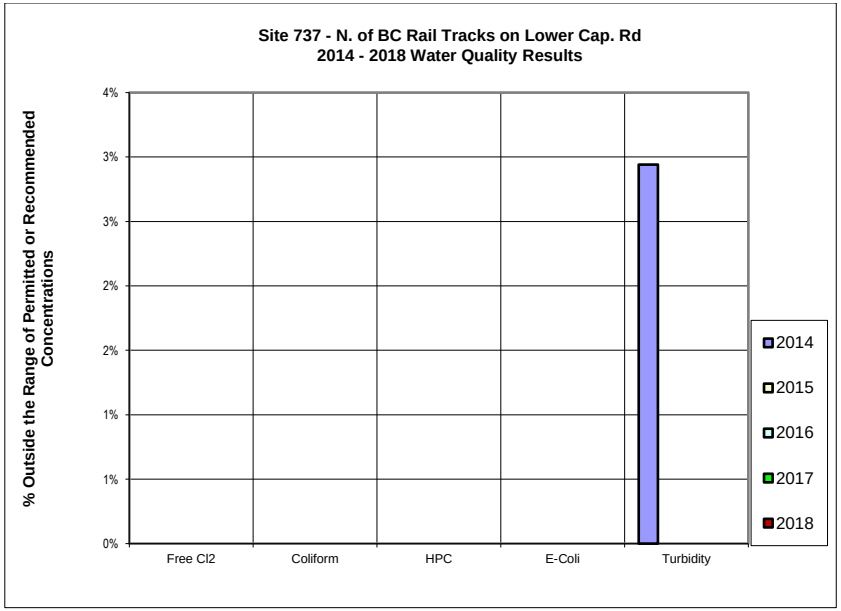

Site 732 - Sarita Pump Station
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
4%
4%
3%
3%
2%
2%
1%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

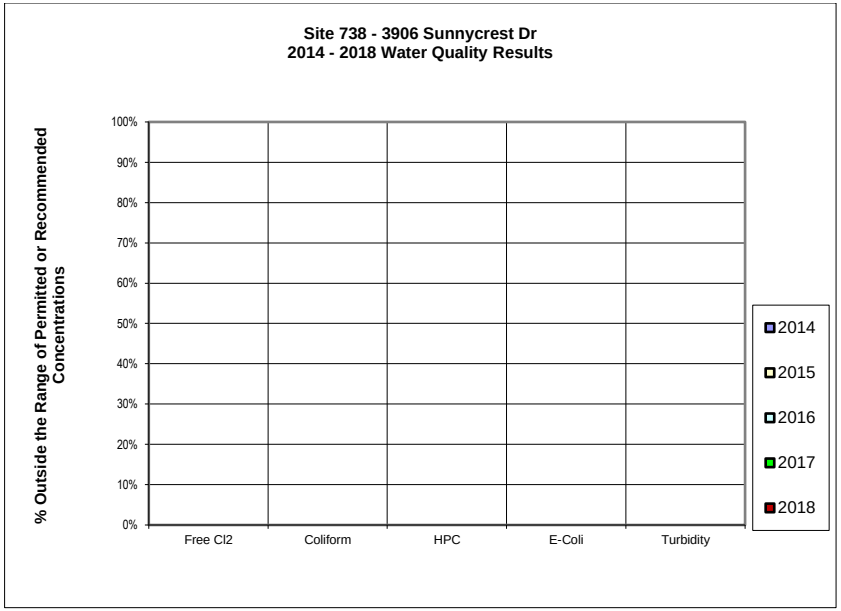

Site 733 - McKeen Ave & Phillip Ave
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
7%
6%
5%
4%
3%
2%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

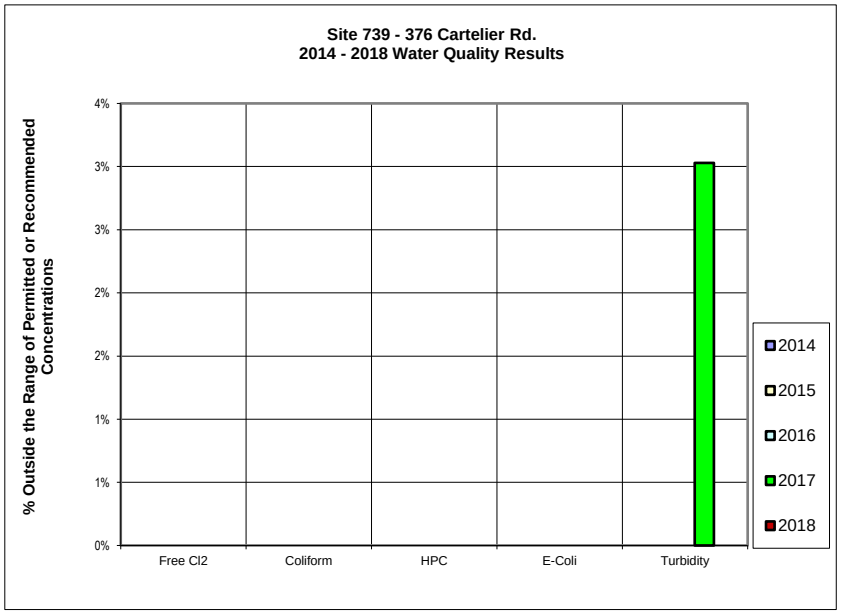

Site 734 - Pemberton Heights
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
4%
3%
3%
2%
2%
1%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

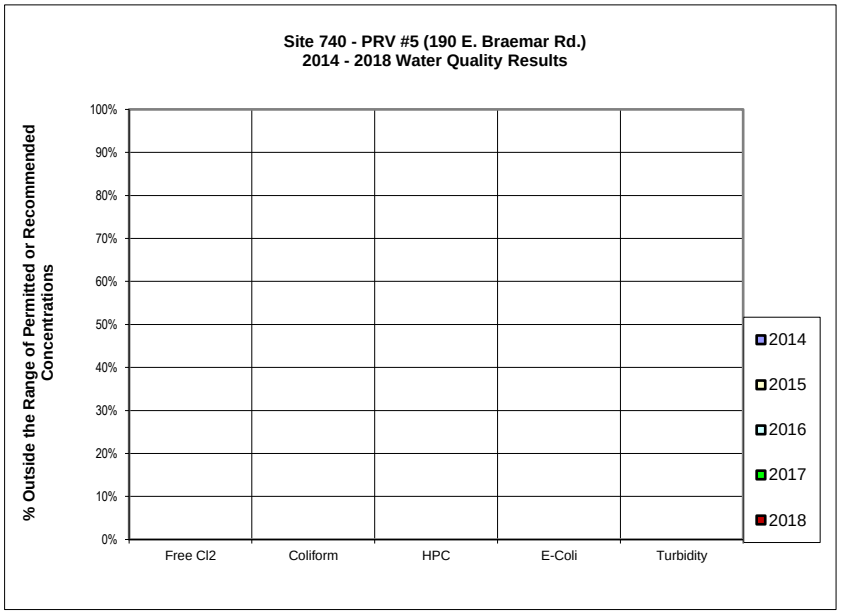

Site 735 - Prospect Reservoir
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
4%
3%
3%
2%
2%
1%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

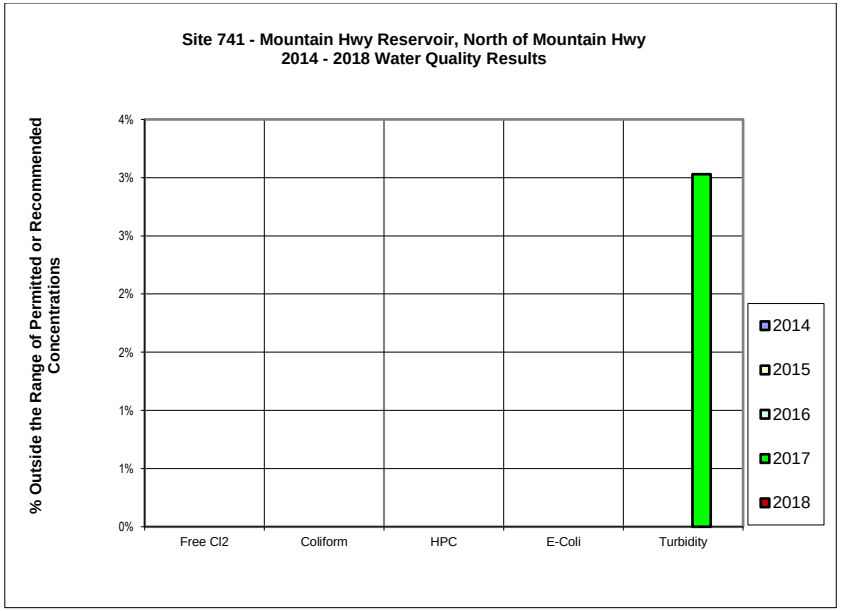

Site 736 - W Queens Rd & Lonsdale Ave
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
80%
70%
60%
50%
40%
30%
20%
10%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

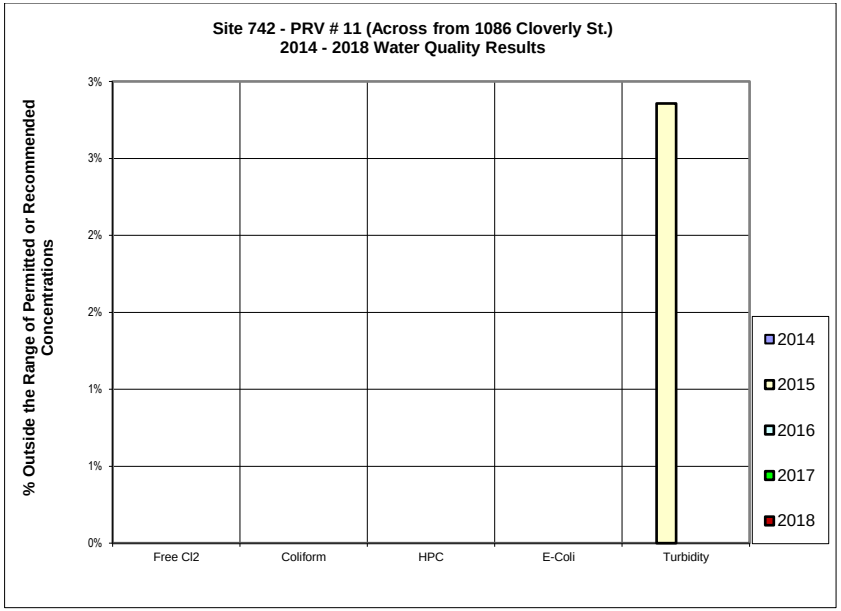

Site 737 - N. of BC Rail Tracks on Lower Cap. Rd
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
4%
3%
3%
2%
2%
1%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

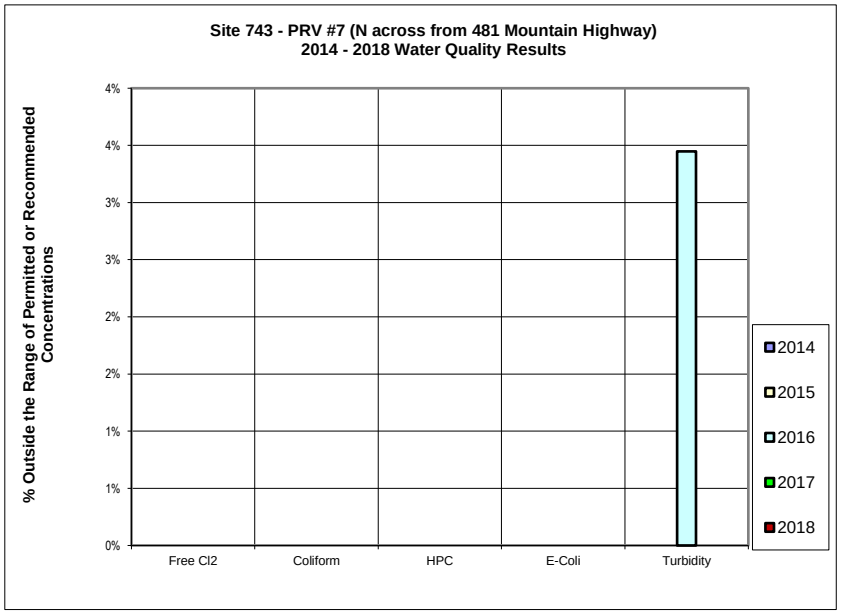

Site 738 - 3906 Sunnycrest Dr
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

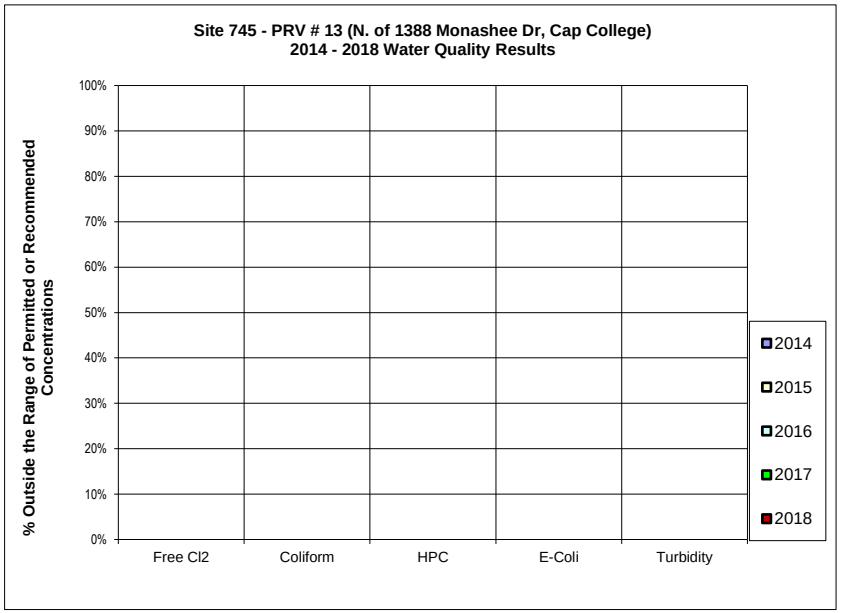

Site 739 - 376 Cartelier Rd.
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
4%
3%
3%
2%
2%
1%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

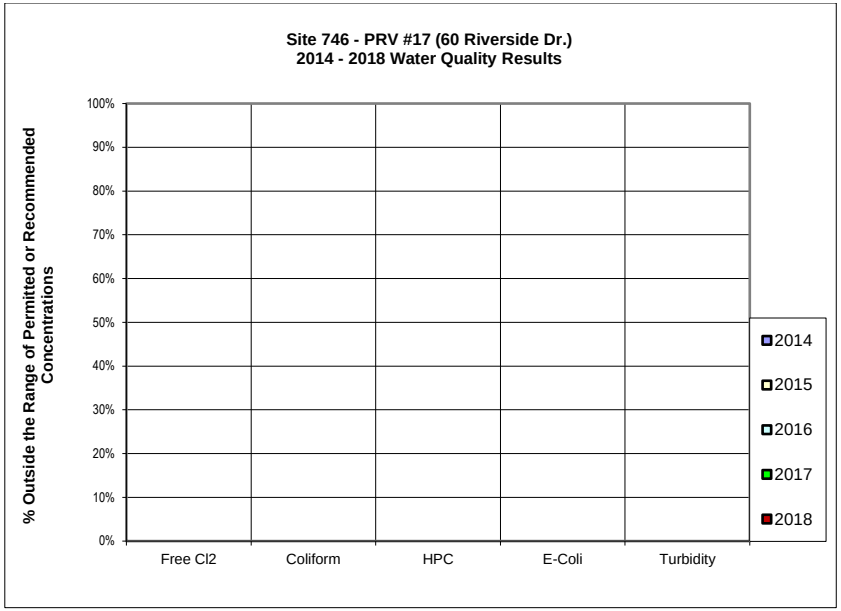

Site 740 - PRV #5 (190 E. Braemar Rd.)
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

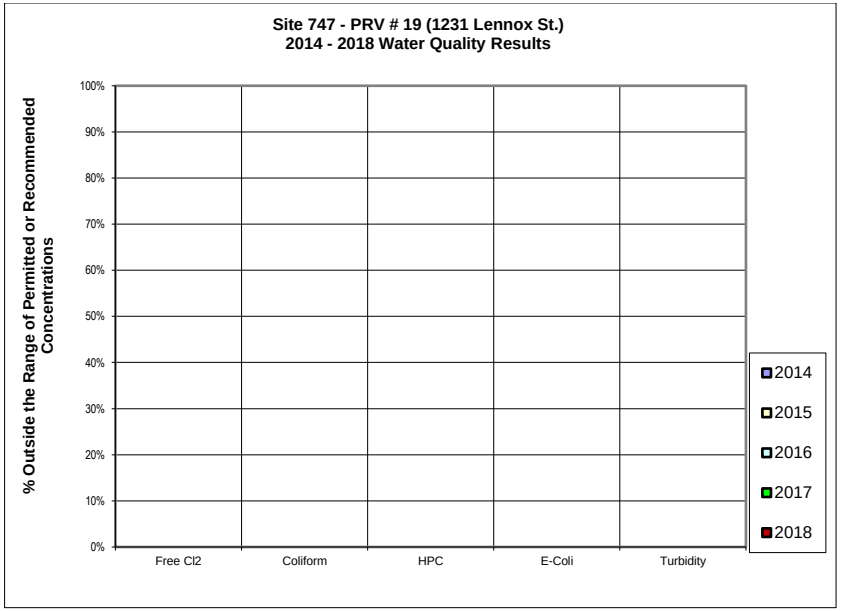

Site 741 - Mountain Hwy Reservoir, North of Mountain Hwy
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
4%
3%
3%
2%
2%
1%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

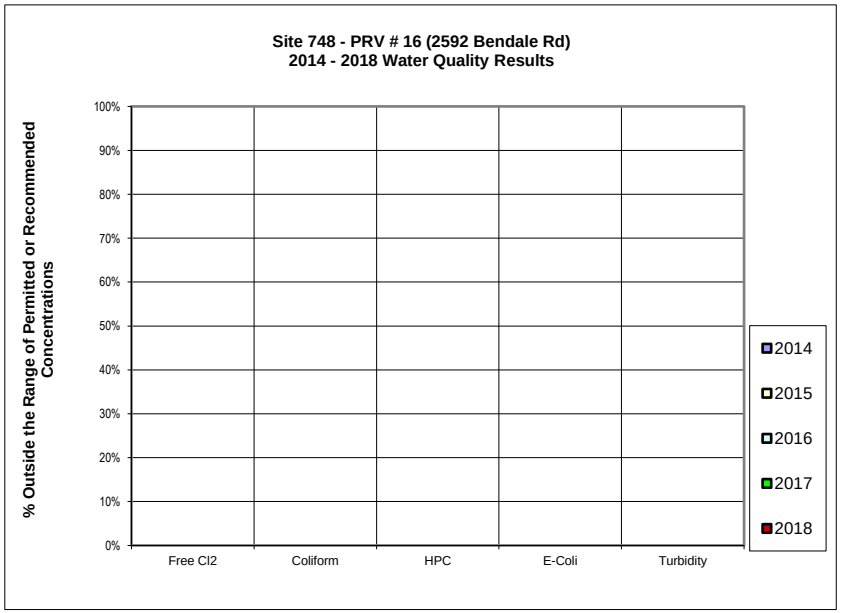

Site 742 - PRV # 11 (Across from 1086 Cloverly St.)
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
3%
3%
2%
2%
1%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

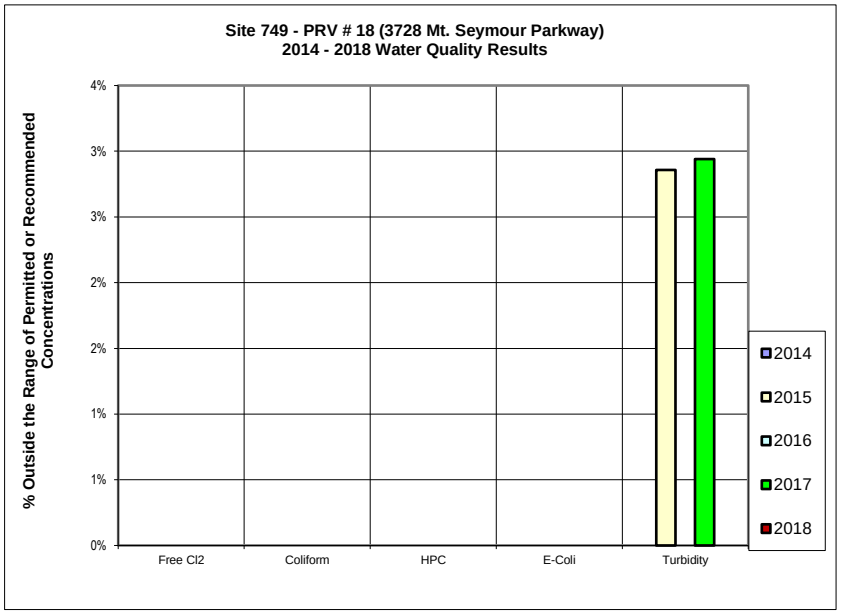

Site 743 - PRV #7 (N across from 481 Mountain Highway)
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
4%
4%
3%
3%
2%
2%
1%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

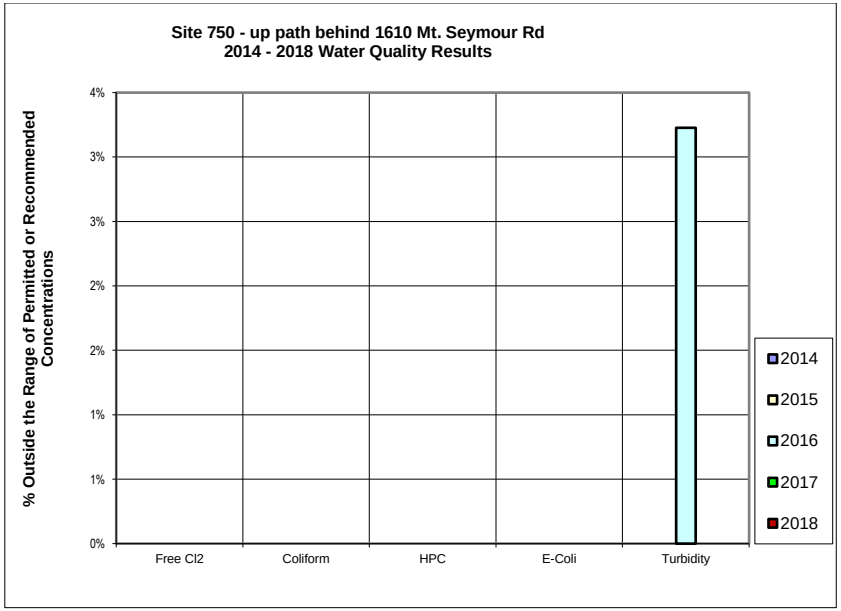

Site 745 - PRV # 13 (N. of 1388 Monashee Dr, Cap College)
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

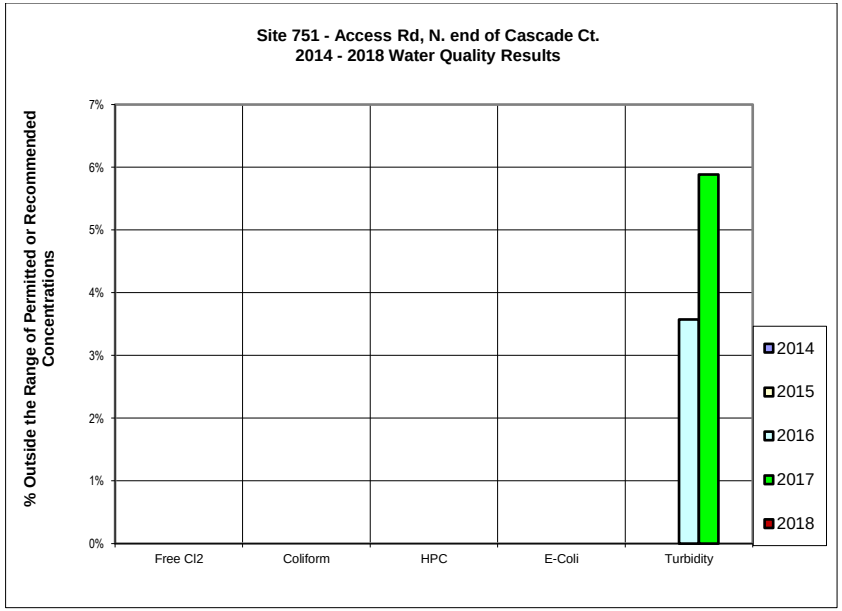

Site 746 - PRV #17 (60 Riverside Dr.)
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

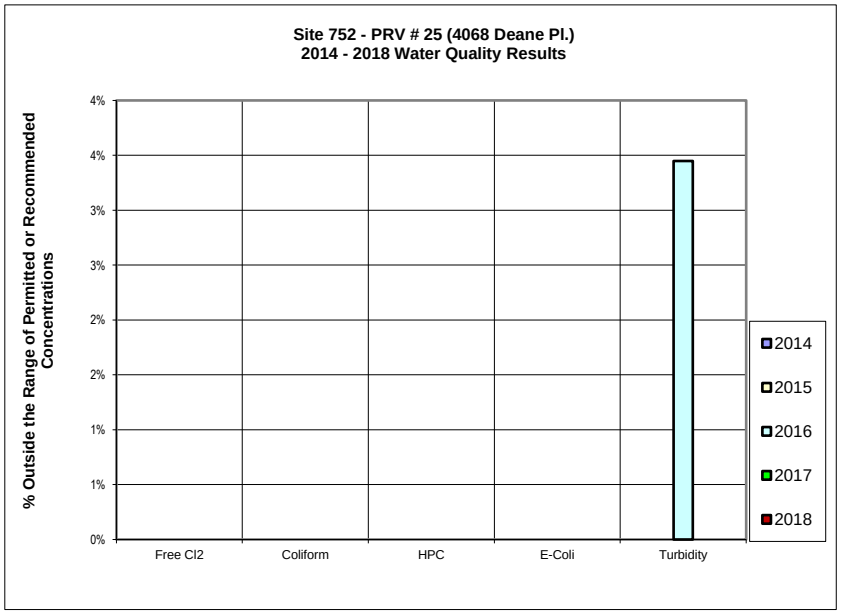

Site 747 - PRV # 19 (1231 Lennox St.)
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

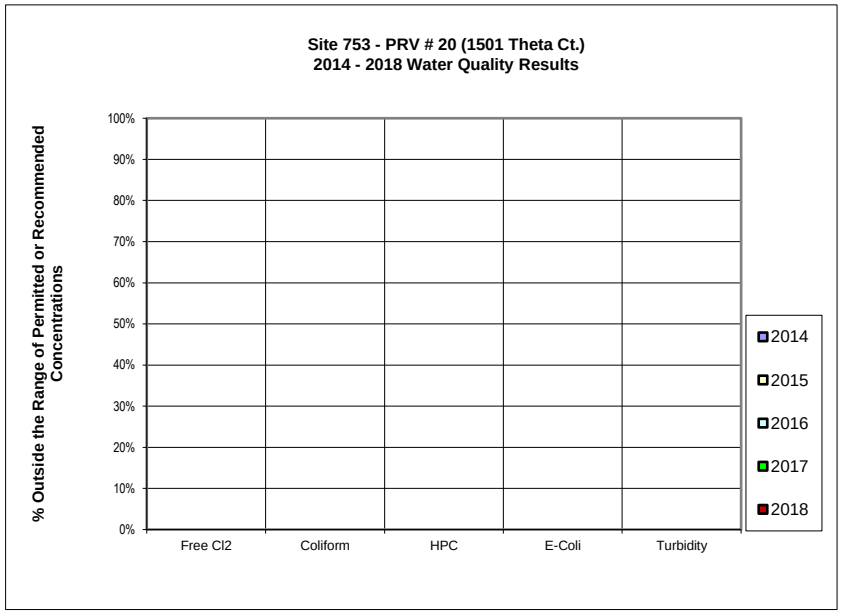

Site 748 - PRV # 16 (2592 Bendale Rd)
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

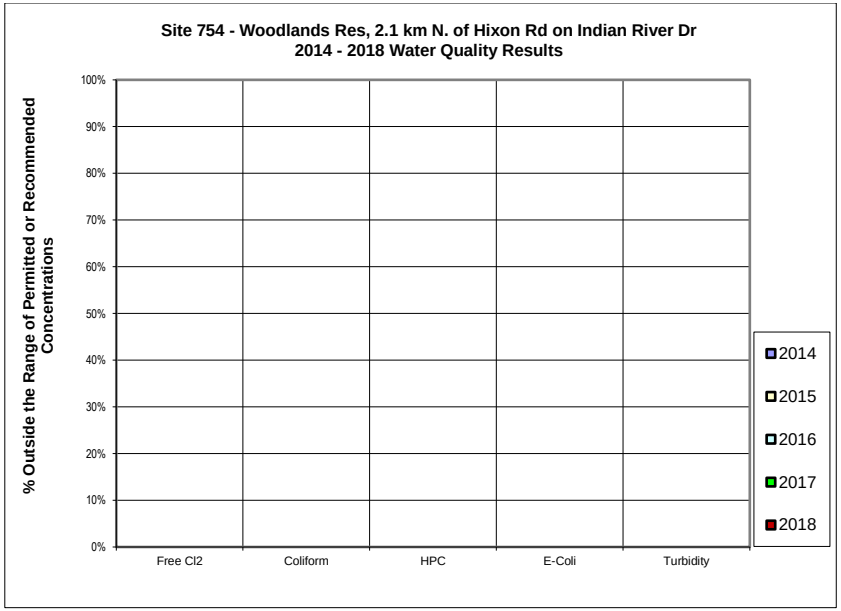

Site 749 - PRV # 18 (3728 Mt. Seymour Parkway)
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
4%
3%
3%
2%
2%
1%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

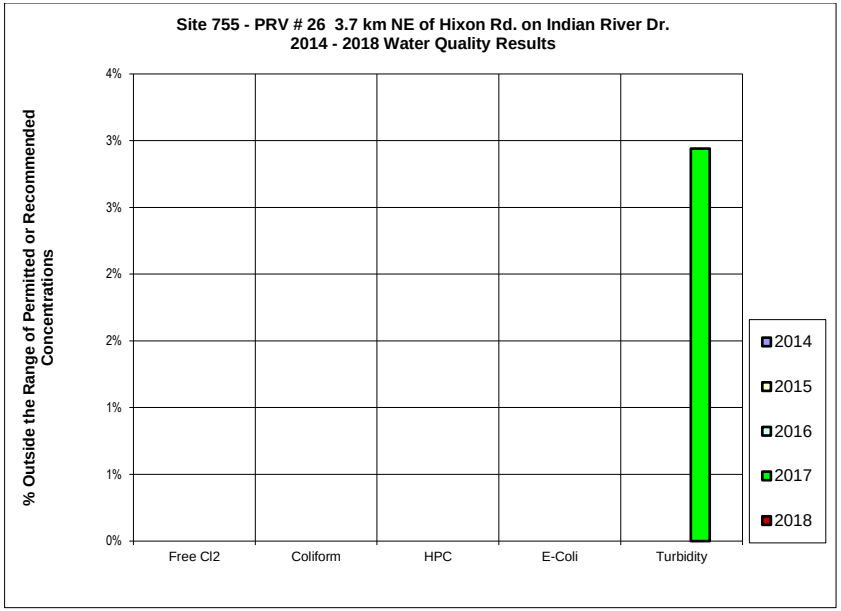

Site 750 - up path behind 1610 Mt. Seymour Rd
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
4%
3%
3%
2%
2%
1%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

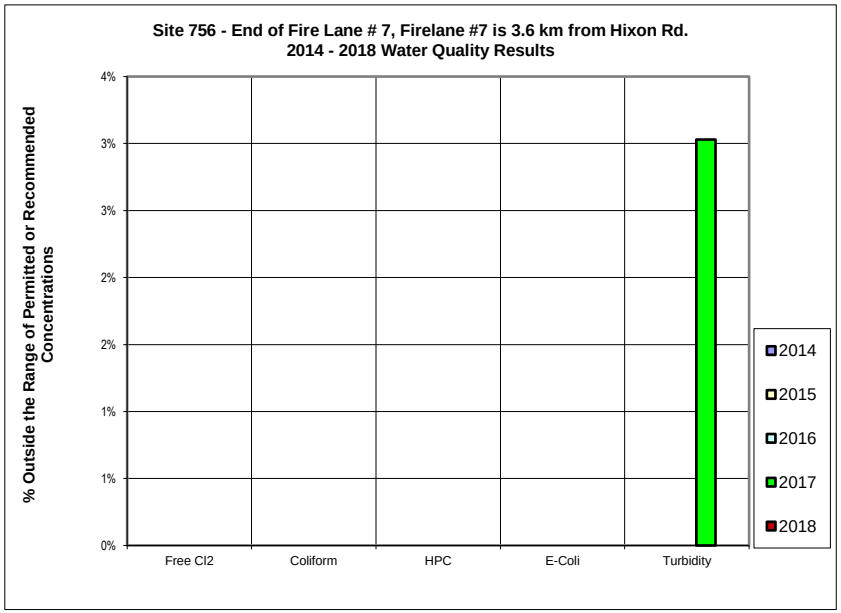

Site 751 - Access Rd, N. end of Cascade Ct.
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
7%
6%
5%
4%
3%
2%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

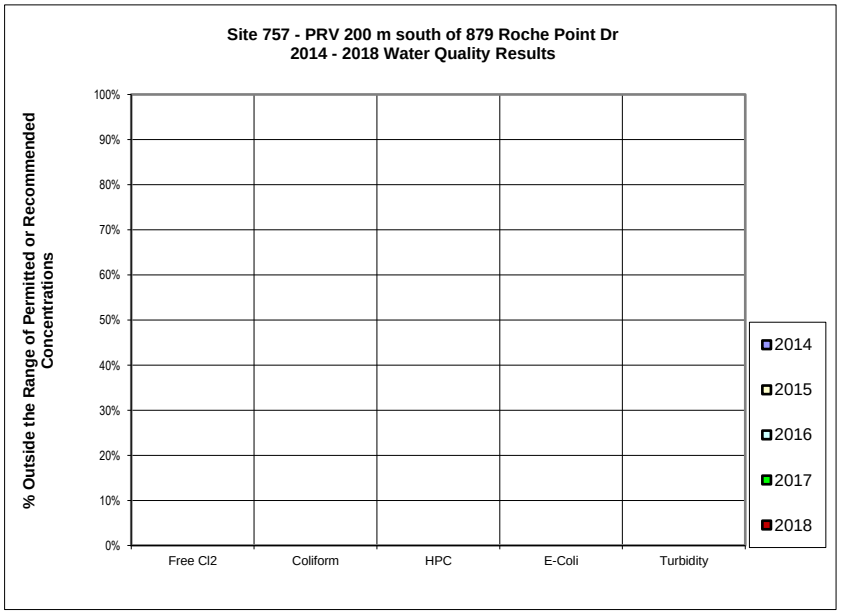

Site 752 - PRV # 25 (4068 Deane Pl.)
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
4%
4%
3%
3%
2%
2%
1%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

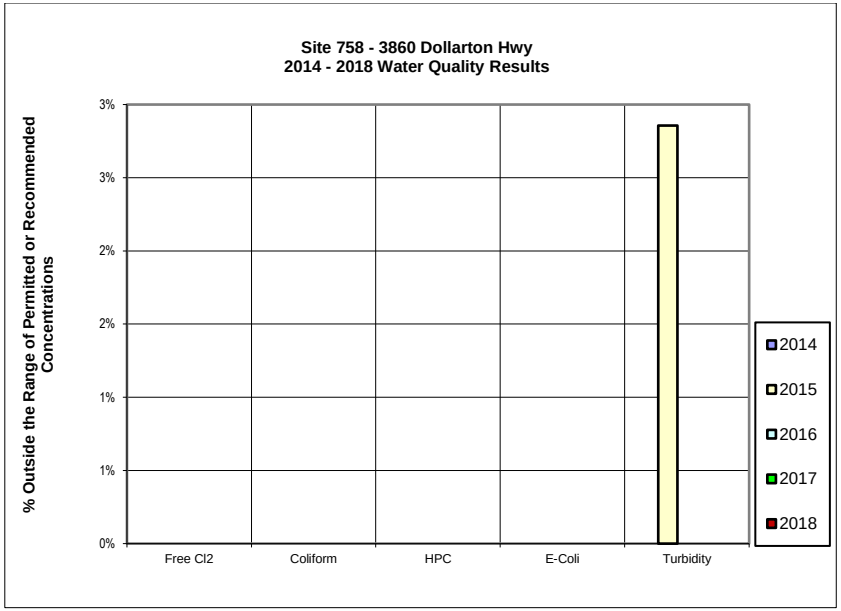

Site 753 - PRV # 20 (1501 Theta Ct.)
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

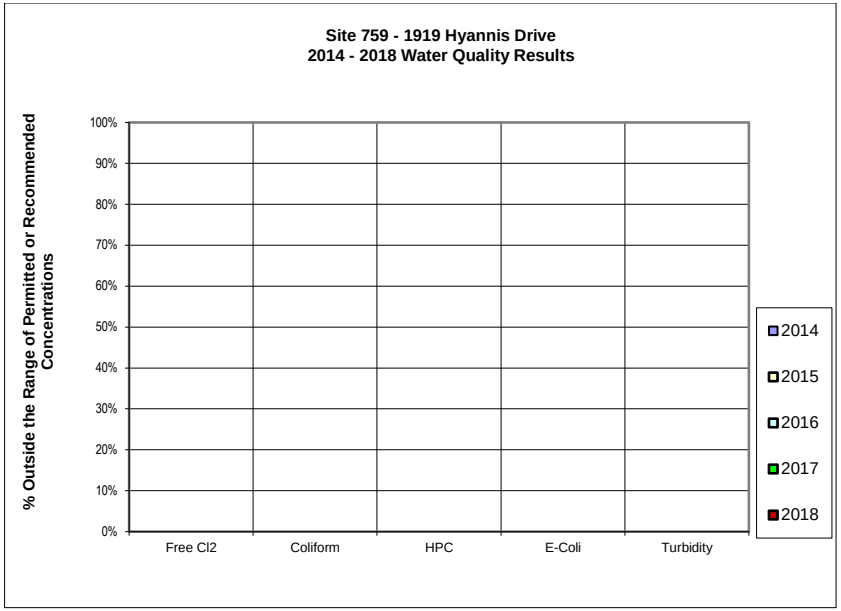

Site 754 - Woodlands Res, 2.1 km N. of Hixon Rd on Indian River Dr
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018

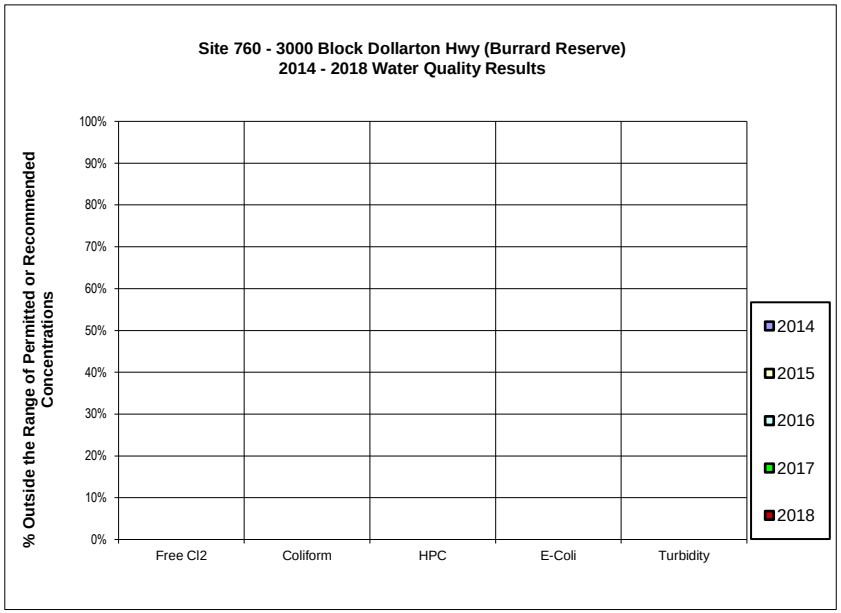

Site 755 - PRV # 26 3.7 km NE of Hixon Rd. on Indian River Dr.
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
4%
3%
3%
2%
2%
1%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018


Site 756 - End of Fire Lane # 7, Firelane #7 is 3.6 km from Hixon Rd.
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
4%
3%
3%
2%
2%
1%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018


Site 757 - PRV 200 m south of 879 Roche Point Dr
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018


Site 758 - 3860 Dollarton Hwy
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
3%
3%
2%
2%
1%
1%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018


Site 759 - 1919 Hyannis Drive
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018


Site 760 - 3000 Block Dollarton Hwy (Burrard Reserve)
2014 - 2018 Water Quality Results
% Outside the Range of Permitted or Recommended Concentrations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Free Cl2
Coliform
HPC
E-Coli
Turbidity
2014
2015
2016
2017
2018