

2018-2019

Skagit Stream Team Water Quality Report

*Citizen Monitoring Summary for Samish Bay, Padilla Bay,
Ace of Hearts, Gages Slough, Trumpeter Basin,
Kulshan Creek and Nookachamps Creek*



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2018 - 2019 Annual Water Quality Report



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2018-2019 Skagit Stream Team Annual Water Quality Report

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I. Introduction

This report summarizes the results of the 2018-2019 Skagit Stream Team Program, the twentieth consecutive year of data collection by volunteers. From October 2018 through August 2019, sixty-seven dedicated citizen volunteers monitored the water quality of freshwater streams that drain into Skagit County's Samish Bay, Padilla Bay, the Skagit River and Burrows Bay. In addition, nine of those volunteers formed the Padilla Bay Storm Team, sampling ten sites in the Padilla Bay watershed during sixteen rain events.

This report is meant to provide useful and reliable background water quality data. It is not intended to provide a legal documentation of water quality violations. All data and methods are available to the public.

Background

The Skagit Stream Team Program was established in 1998 to educate and involve local citizens in the protection and stewardship of local streams. Sponsors include Skagit Conservation District (SCD) in partnership with the Padilla Bay National Estuarine Research Reserve (PBNERR), City of Mount Vernon, City of Burlington, City of Anacortes, and Skagit County. Funding was provided by the Washington State Conservation Commission, the Washington State Department of Ecology's Centennial Clean Water Fund Program, and partnering jurisdictions. Local citizens volunteered over 1,090 hours during the 2018-2019 sampling season.

Skagit Stream Team Objectives

- To inspire community stewardship of water resources by educating local citizens about land use and non-point sources of pollution and involving them in the process of water quality data gathering;
- To develop and implement a routine sampling program that can be used to assess water quality trends, characterize the existing water quality of priority freshwater drainages, and determine how water quality conditions compare to State Standards;
- To document improvements in water quality as a result of the implementation of Best Management Practices on farmlands and the repair and/or replacement of failing septic systems;
- To teach community volunteers the sampling and analytical techniques used by environmental professionals, how to manage the data collected and create a database, and the importance of establishing a long-term water quality monitoring program.

Volunteers measured fecal coliform (FC) bacteria, dissolved oxygen (DO), water temperature, turbidity, and total depth. Some of the questions the study hoped to address were:

- How do water quality conditions compare to State Standards in our priority watersheds?
- Could water quality conditions support aquatic life such as salmon?

II. Methods

Efforts were made to insure high quality data from this volunteer-based study. Quality Assurance/Quality Control (QA/QC) plans and laboratory plans were submitted to and approved by the WA Department of Ecology. These plans have since been updated and revised. Volunteers were given ten hours of training before sampling in the field, and were accompanied by a trainer for their first sampling. All analysis and collection methods are detailed in the QA/QC plan, and are available on request.

The Samish watershed had two upper and two lower teams, and was coached by Cindy Pierce, SCD. The Padilla Bay watershed had two teams each on No Name Slough, Joe Leary Slough, and in the village of Bay View, coached by Susan Wood, PBNERR. Nookachamps Creek had two upper and two lower teams coached by Cindy Pierce, SCD. Kulshan Creek, and Trumpeter Basin each had two teams coached by Kristi Carpenter, SCD. Gages Slough had two teams coached by Cindy Pierce. Ace of Hearts/Happy Valley Creek sites were monitored by two teams coached by Susan Wood.

At each site, samples were usually taken every two weeks. Temperature, dissolved oxygen (DO), and salinity (when applicable) were measured on-site with an electronic YSI Data Probe. Field measurements and samples were taken just below the surface, in the deepest part of the stream that could be reached. Depth was measured for some sites using staff gages. Samples were tested for Fecal coliform either at the Padilla Bay volunteer lab (Padilla, Samish, Nookachamps samples), taken to Burlington Waste Water Treatment Plant (Gages Slough), taken to the Mount Vernon Wastewater Treatment Plant (Trumpeter Basin, Kulshan Creek) or the Anacortes Waste Water Treatment Plant (Ace of Hearts and Happy Valley Creeks) for analysis. Turbidity was measured either in Padilla Bay's lab or in the field. Volunteers also recorded water appearance and color. Quality procedures are outlined in more detail in Appendix C.

Quality control checks by staff were conducted periodically in the lab and in the field to assure that volunteers were using proper and consistent protocols.

The data was recorded on field sheets (See Appendix D) and transferred to a Microsoft Excel spreadsheet by a volunteer. Padilla Bay staff verified all data entries, making edits as appropriate. Any anomalies were recorded in the metadata.

In accordance with state standards, annual fecal coliform (FC) results were calculated using the geometric mean. "Too Numerous To Count" (TNTC) results were assigned a value of 1600 CFU/100 ml. Volunteers in Padilla Bay's lab ran two FC lab tests for each sample, generating a high and low reading, from which an average was calculated. Averages were calculated for dissolved oxygen, temperature and turbidity levels.

III. Padilla Bay Storm Team

In 2018-2019, Storm Team volunteers began monitoring sites in the Padilla Bay watershed. Some of these are new sites, and others were monitored by the Storm Team in 2010-2012. They include sites on Joe Leary Slough, No Name Slough, and Bay View drainages, and were selected to support a Department of Ecology water quality improvement project. Monitoring many sites throughout the drainage during storm events when high fecal coliform numbers are expected may detect priority areas for clean up. Special thanks to our Storm Team volunteers for their ongoing commitment – in the worst of weather. Complete data are found in Appendix B.

IV. Sites

Samish River Watershed

Figure 1. Map of Samish Sites



Table 1. Samish Sampling Locations

US1	Friday Creek @ Pomona Grange Park	N48°33'55.02 W122°20'49.49
US2	Swede Creek @ Grip Rd	N48°33'17.75 W122°17'16.23
US3	Thomas Creek @ F&S Grade Rd	N48°31'42.93 W122°16'44.69
US4	Willard Creek @ 8274 F & S Grade Rd	N48°31'13.65 W122°15'58.07
LS1	Hwy 99 Bridge over Samish River	N48°31'32.58 W122°20'24.78
LS2	Samish River @ Jolly Road	N48°32'25.47 W122°20'36.36
LS3	Thomas Road Bridge over Samish River	N48°31'0.69 W122°22'43.29
LS4	Mouth of the Samish River (boat dock)	N48°19'11 W122°19'47

Nookachamps Creek

Figure 2. Map of Nookachamps Creek Sites



Table 2. Nookachamps Creek Sampling Locations

UN1	Lake McMurray Estates	N48°19'37 W122°13'10
UN2	Big Lake Outflow	N48°23'57 W122°14'24
UN3	Otter Pond Road	N48°24'10 W122°13'44
UN4	Knapp Road	N48°25'43 W122°15'32
LN1	SR 538 and N Waugh Road	N48°26'10.14 W122°17'29.88
LN2	SR 9 and Babcock	N48°26'45.56 W122°15'8.65
LN3	Swan Road	N48°27'13.79 W122°16'17.84
LN4	Francis Road	N48°28'5.47 W122°17'38.72

No Name Slough

Figure 3. Map of No Name Slough Sites



Table 3. No Name Slough Sampling Locations

NN1	Marihugh Road Culvert	N48°17'53. W122°17'31
NN2	Bay View Road Ravine	N48°18'121 W122°17'41
NN3	Egber's Field Bridge	N48°18'30. W122°17'53
NN4	Field Culvert, Bay View-Edison Road	N48°19'11 W122°19'47

Bay View Drainage

Figure 4. Map of Bay View Sites

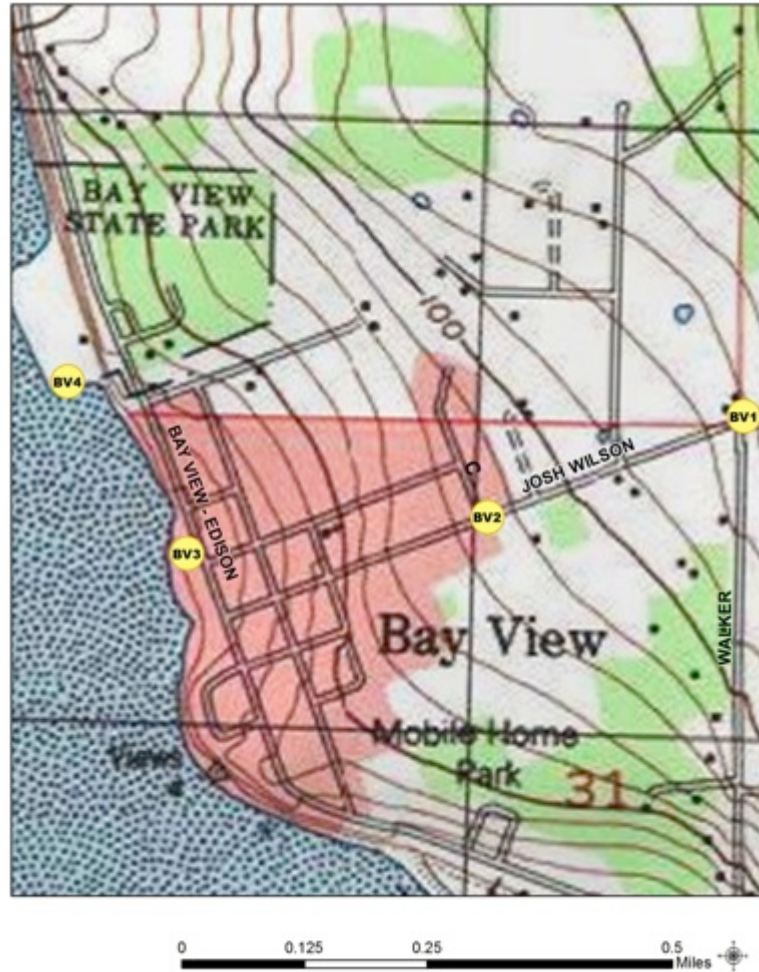


Table 4. Bay View Sampling Locations

BV1	Wilson Road and Walker Road	N48°29'11.94 W122°27'58.92
BV2	Wilson Road and C Street	N48°29'6.3 W122°28'19.26
BV3	Culvert at Boat Launch	N48°29'4.02 W122°28'43.2
BV4	N Beach at Bay View State Park	N48°29'13.02 W122°28'53.04

Joe Leary Slough

Figure 5. Map of Joe Leary Slough Sites



Table 5. Joe Leary Slough Sampling Locations

JL1	Dahlstedt Road	N48°30'53.35 W122°19'2.46
JL2	Hwy 99	N48°29'35.37 W122°20'6.61
JL3	Wilson Rd and Avon-Allen Rd.	N48°29'11.33 W122°22'41.96
JL4	Tide Gate	N48°31'4.90 W122°28'27.87

Trumpeter Basin

Figure 6. Map of Trumpeter Basin Sites

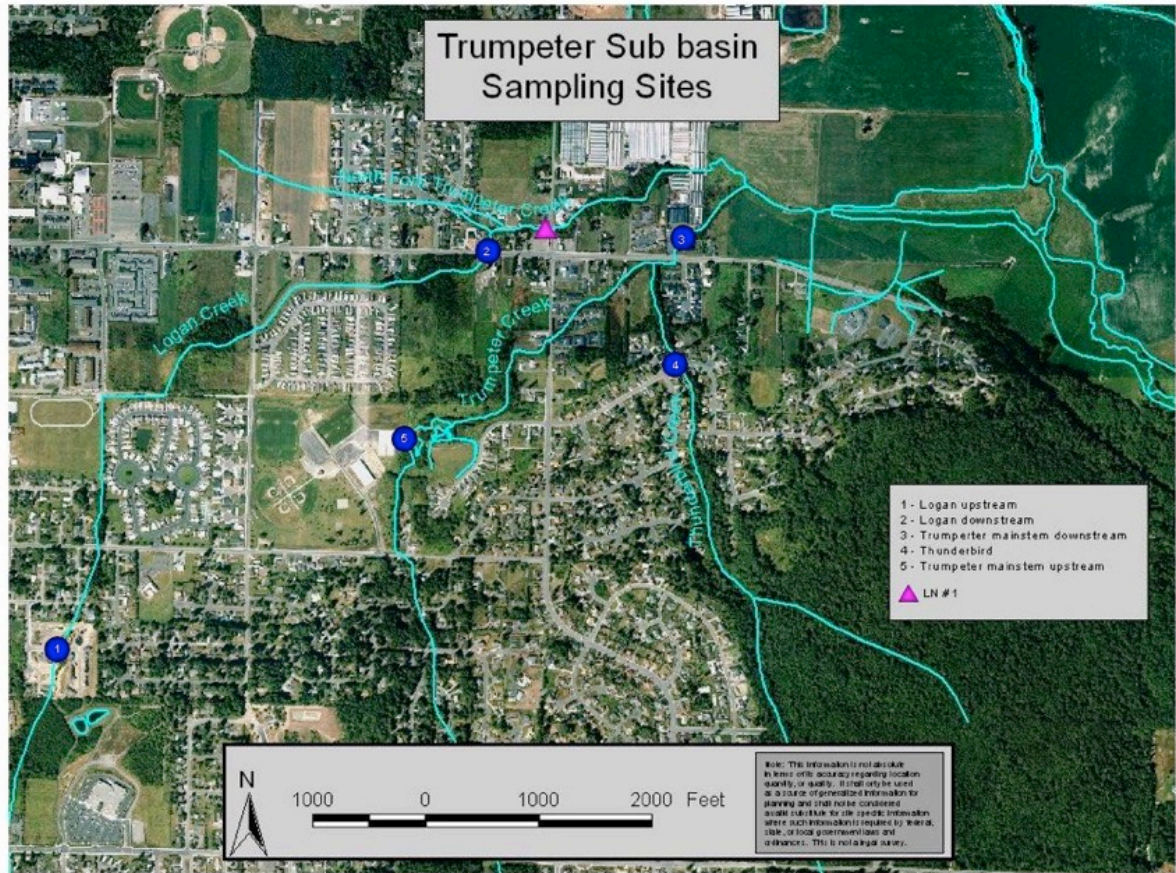


Table 6. Trumpeter Basin Sampling Locations

TB1	Stonebridge Adult Community, Logan Creek Bridge	N48°25'33 W122°18'32
TB2	College Way west of Martin .Vaugh Road, Logan Creek	N48°26'09 W122°17'12
TB3	College Way at Trumpeter/Thunderbird confluence	N48°26'07 W122°17'17
TB4	Culvert on Kiowa, Thunderbird	48°25'53 W122°17'12
TB5	Bakerview Park Footbridge, Trumpeter	N48°25'51 W122°17'48

Kulshan Creek

Figure 7. Map of Kulshan Creek Sites



Table 7. Kulshan Creek Sampling Locations

KC1	North end of S 14 th .Kulshan Trail	N48°25'59 W122°19'27
KC2	Parker Way	N48°25'59 W122°19'17
KC3	S side Roosevelt.1 blk W of Parker Way	N48°26'11 W122°19'25
KC4	E of Riverside - N of RR crossing	N48°25'54 W122°20'04
KC5	Freeway Drive at Lions Park	N48°25'43 W122°20'28

Figure 8. Map of Ace of Hearts/Happy Valley Sites



AH1	Heart Lake outlet	N48d28'42.56" W122d37'44.97"
AH2	41 st and H Ave	N48d29'16.62" W122d37'31.59"
AH3	Rotary Dog Park	N48d29'29.53" W122d37'25.27"
AH4	Happy Valley Creek	N48d29'37.28" W122d36'35.56"

Gages Slough

Figure 9. Map of Gages Slough Sites

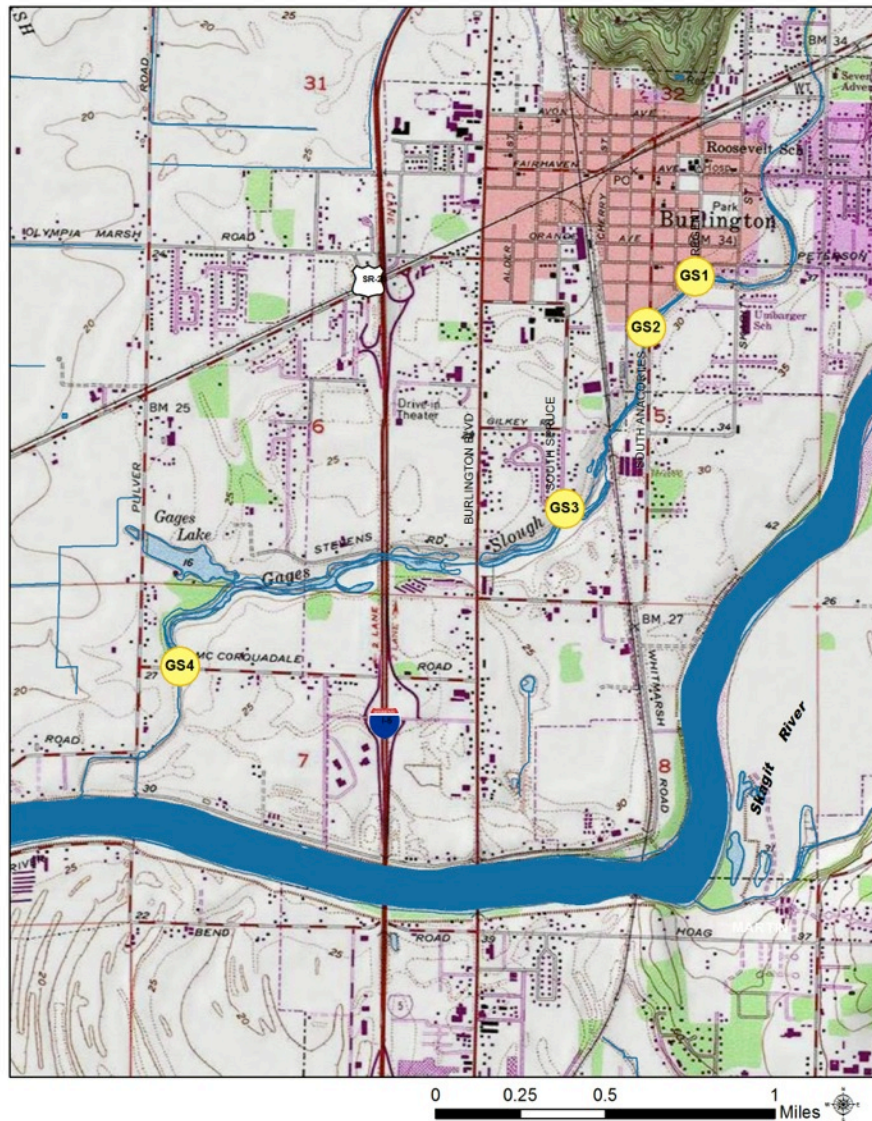


Table 9. Gages Slough Sampling Locations

GS1	Regent and East Rio Vista Streets	N48°28'16 W122°19'19
GS2	South Anacortes Street	N48°28'08 W122°19'30
GS3A	South Spruce Street	N48°27'40 W122°19'48
GS4A	McCorquedale Road	N48°27' 33 W122°20' 9

V. Results

This section presents the data collected during the 2018-2019 season. It provides a preliminary overview for each parameter followed by details for each watershed and a comparison of annual site averages for the past six sampling seasons. Complete data for all watersheds are provided in Appendix A.

Dissolved Oxygen Standards

Dissolved oxygen (DO) measurements determine how much oxygen is available in the water for fish and other organisms. The state water quality standards for dissolved oxygen are based on aquatic life uses. Streams in this program fall under three categories based on aquatic life use. For Nookachamps Creek, Trumpeter Basin, Kulshan Creek, and Upper Samish Site 2, the standard is a lowest 1 day minimum of 9.5 mg/l required for core summer salmonid habitat. (Higher dissolved oxygen levels are better.) For the lowland watercourses, Joe Leary Slough, No Name Slough, Bay View, Gages Slough and all Samish sites except Swede Creek (Upper Samish 2) the minimum standard is a lowest 1 day minimum of 8.0 mg/l for salmon spawning and rearing. Ace of Hearts and Happy Valley Creeks in Anacortes are classified for salmon rearing and migration, with the lower DO standard of a lowest 1 day minimum of 6.5 mg/l

Annual averages are presented for the purpose of comparison between sites and between years, but this data cannot determine whether the water body meets the standard. The standard is based on the lowest single-day measurement, not on the annual average. It is important to note that most of the teams do not monitor during the warmer summer months when DO would likely drop with warmer air and water temperatures.

Temperature Standards

Temperature is a water quality concern in part because warm water holds less dissolved oxygen than cool water. Many northwest fish species require cool temperatures and high oxygen levels at various stages in their life cycle. Warm water temperatures can cause stress to animals that lowers resistance to disease and infections. Many factors affect water temperature. These include large fluctuations in air temperature, changes in the shape of stream channel and lake margins, reductions in overhanging vegetation, turbidity, and reductions in water flow.

State standards for temperature are based on the 7-day average of the daily maximum temperatures (7-DADMax). For Nookachamps Creek, Trumpeter Basin, Kulshan Creek, and Upper Samish Site 2, that maximum is 16°C. All other sites must be less than 17.5°C to meet standards. (Lower temperatures are better.)

The average temperatures presented below are used for comparison, but this data cannot determine whether the water body meets the standard. Most sites were not monitored during the critical summer warm periods and none were monitored daily in order to obtain a 7-DADMax.

Turbidity Standards

Turbidity is a measurement of water clarity. Turbidity data in this report are not referenced to a state standard because that standard is relative to naturally occurring background levels and varies for each stream. For streams with background levels less than 50 NTU (all of the Stream Team sites), turbidity should not exceed 5 NTU above the background level. Short-term occurrences of high turbidity are not as harmful to aquatic animals as extended periods of moderately elevated turbidity.

Fecal Coliform Standards

Fecal coliform live in the digestive system of warm blooded animals, including birds, livestock, and humans. They are not directly harmful to humans or aquatic life, but their presence indicates the possible

presence of disease-causing microbes. To meet state standards, streams must meet two criteria. Part I: The geometric mean of fecal coliform bacteria levels cannot exceed 100 colony-forming units (CFU)/100 ml. A minimum of five samples in the database is needed to calculate the geometric mean. Part II: No more than 10% of the samples can exceed 200 CFU/100 ml.

State regulations for fecal coliform use the geometric mean, which reduces the weight of occasional extreme results or results that don't fall within a reasonable range of the overall sample database. This is helpful when analyzing bacteria concentrations, because levels may vary anywhere from 10 to 10,000 fold over a given period.

Upper Samish Results

Figures 10 through 17 below present results from Upper Samish sampling.

For dissolved oxygen, Sites 1 and 3 maintained levels above the state standard. As in past years, Site 4, the Willard Creek site had the lowest levels, with 4 occurrences below the state standard of 8.0 mg/l. Site 2, Swede Creek is considered core summer salmonid habitat, and should maintain DO levels above 9.5 mg/l. It dropped below 9.5mg/l twice in May and June.

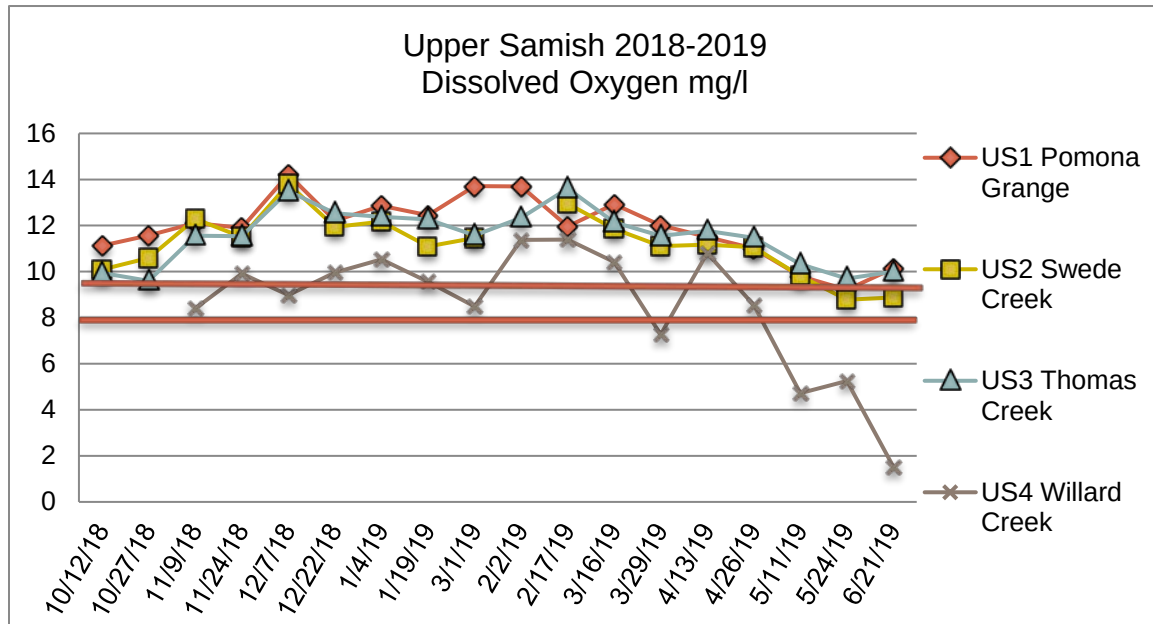


Figure 10. Upper Samish DO: 2018-2019

Figure 11 below shows a comparison of Upper Samish sites over the past 9 years.

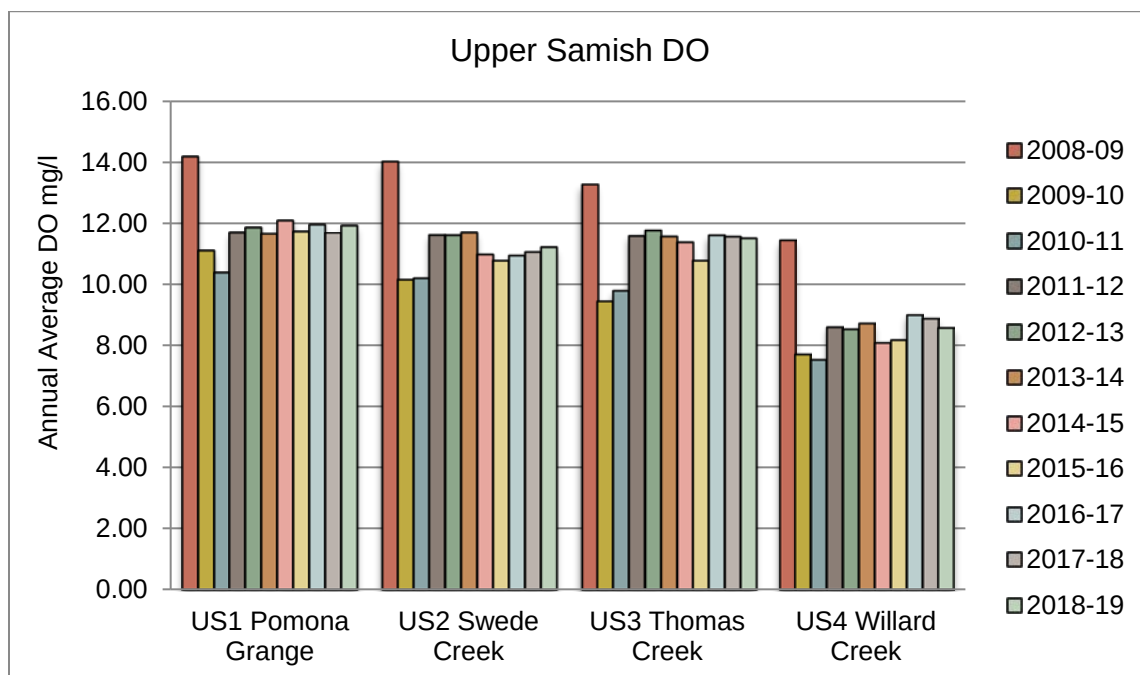


Figure 11. Upper Samish DO: Eleven-year comparison

Though all temperature readings during the sampling season fell within state standard temperatures, sampling stopped before the warm season. Temperatures were similar for all Upper Samish sites. Average temperatures have steadily decreased from their 2014-2015 high.

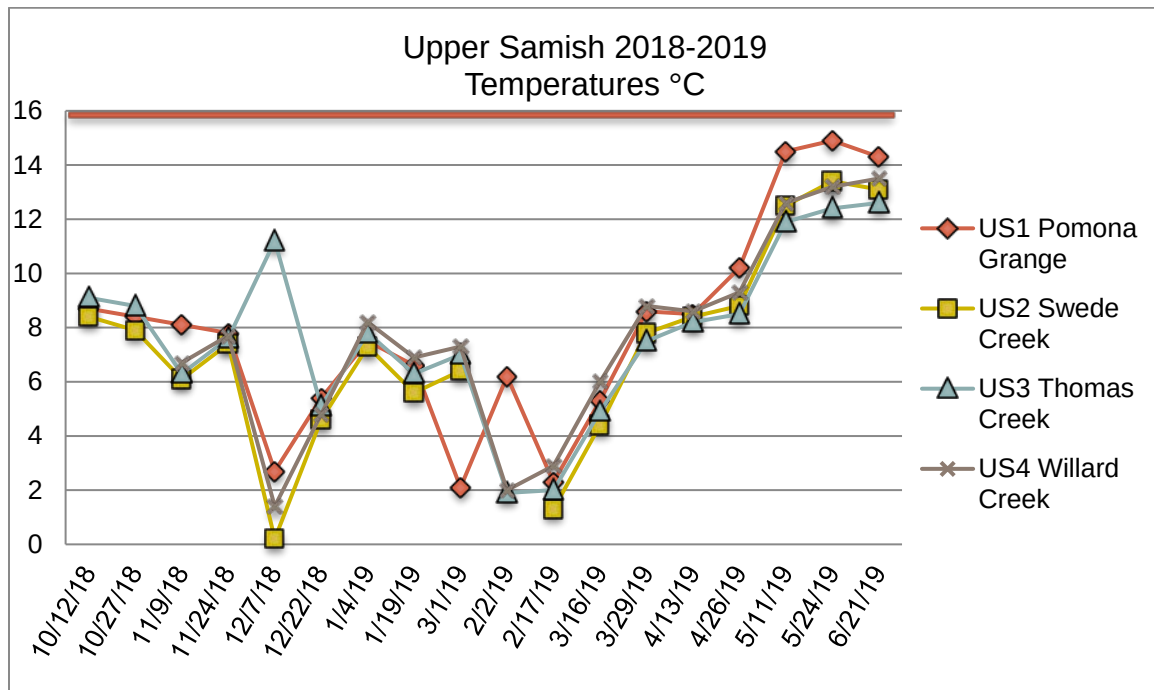


Figure 12. Upper Samish Temperature: 2018-2019

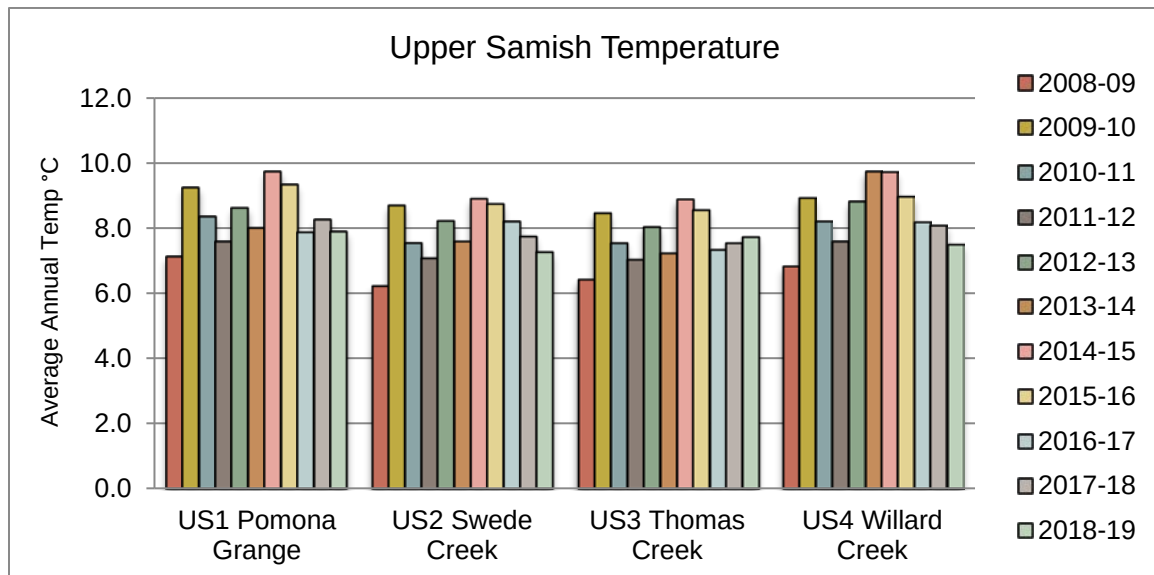


Figure 13. Upper Samish Temperature: Eleven-year comparison

Turbidity levels in the Upper Samish (Figure 15) were slightly higher at Site 3, Thomas Creek, and lowest at Site 1, Pomona Grange. The high turbidity levels on 6/21/2019 corresponded to a large rise in fecal coliform levels. (See figure 16.)

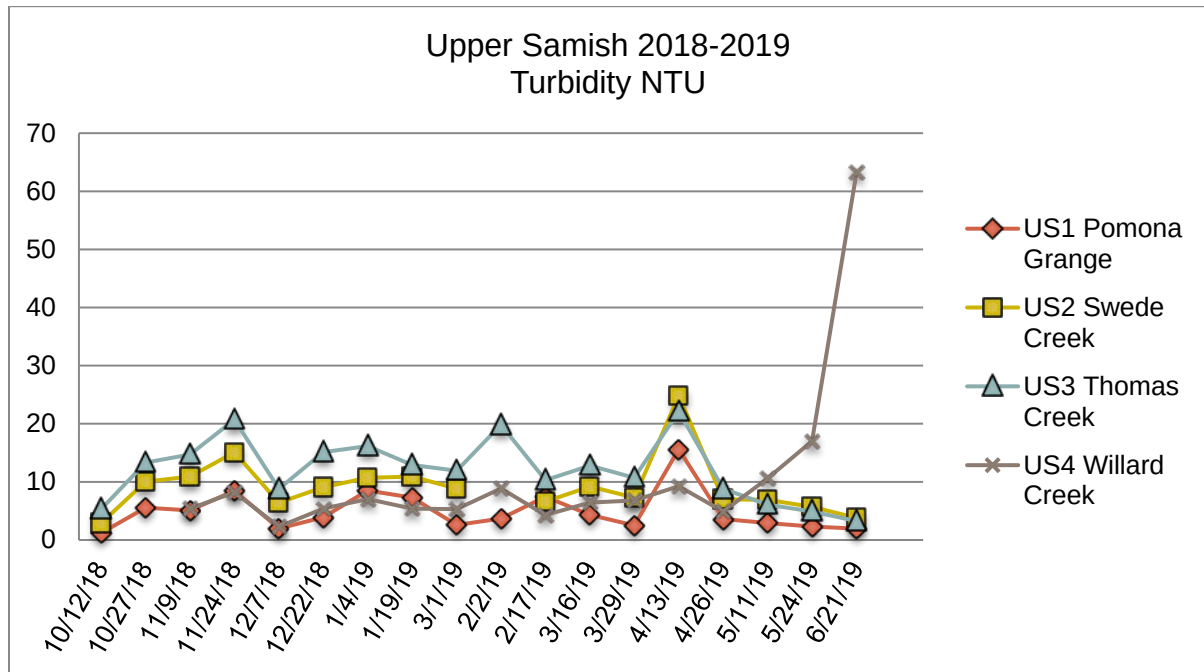


Figure 14. Upper Samish Turbidity: 2018-2019

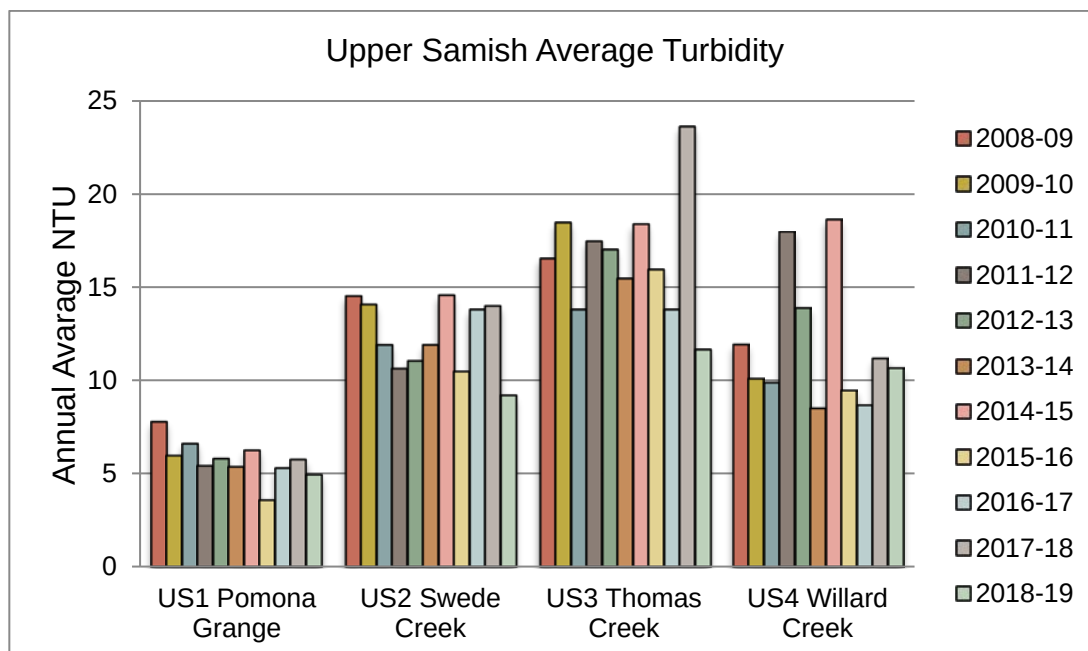


Figure 15. Upper Samish Turbidity: Eleven-year comparison

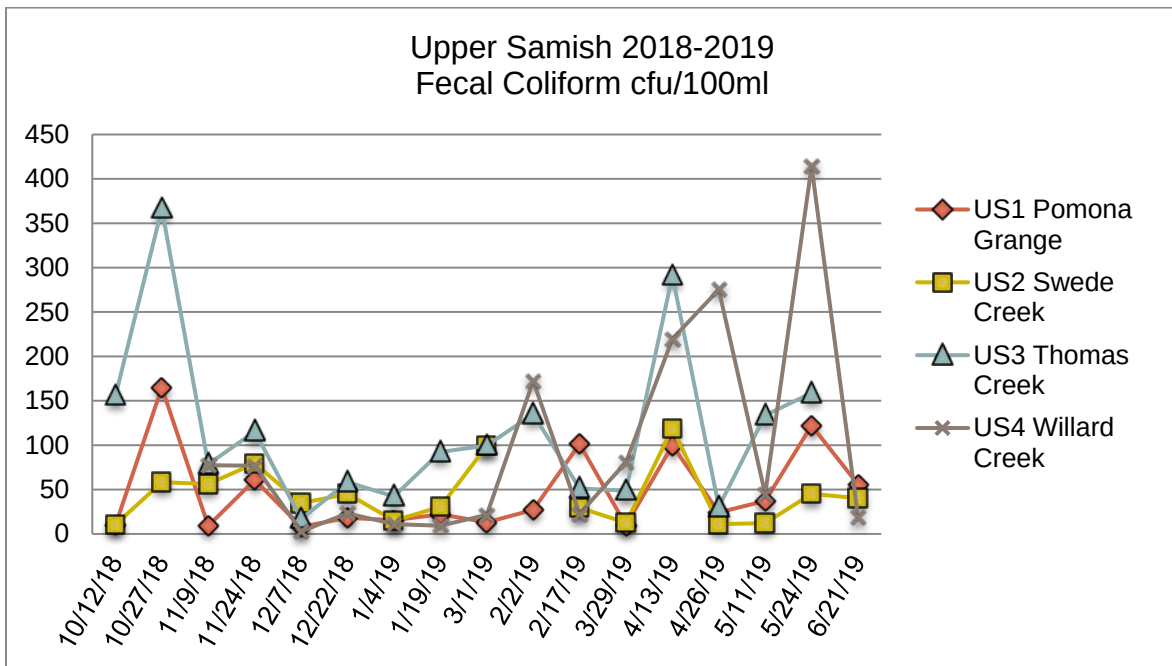


Figure 16. Upper Samish Fecal Coliform: 2018-2019

Fecal coliform levels in the Upper Samish watershed were highest at Site 3. All sites met the state standard of 100CFU/100ml. Sites 1 and 2 had fewer than 10% of the samples over 200 CFU/100ml and therefore met both standards.

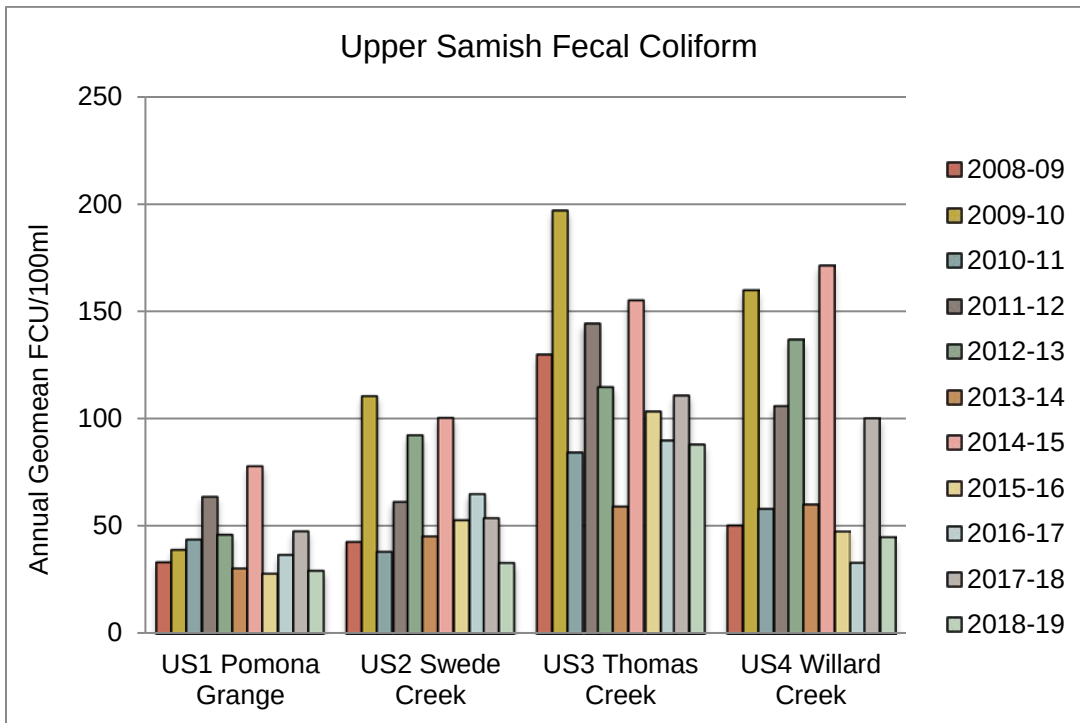


Figure 17. Upper Samish Fecal Coliform: Eleven-year comparison

Lower Samish Results

Figures 18 through 25 below present results from Lower Samish sampling.

Dissolved oxygen levels were similar for all sites, staying above 8mg/l through the sampling season with one exception at Site 4. Sites were not sampled during the warmest summer months when dissolved oxygen is likely to be lowest.

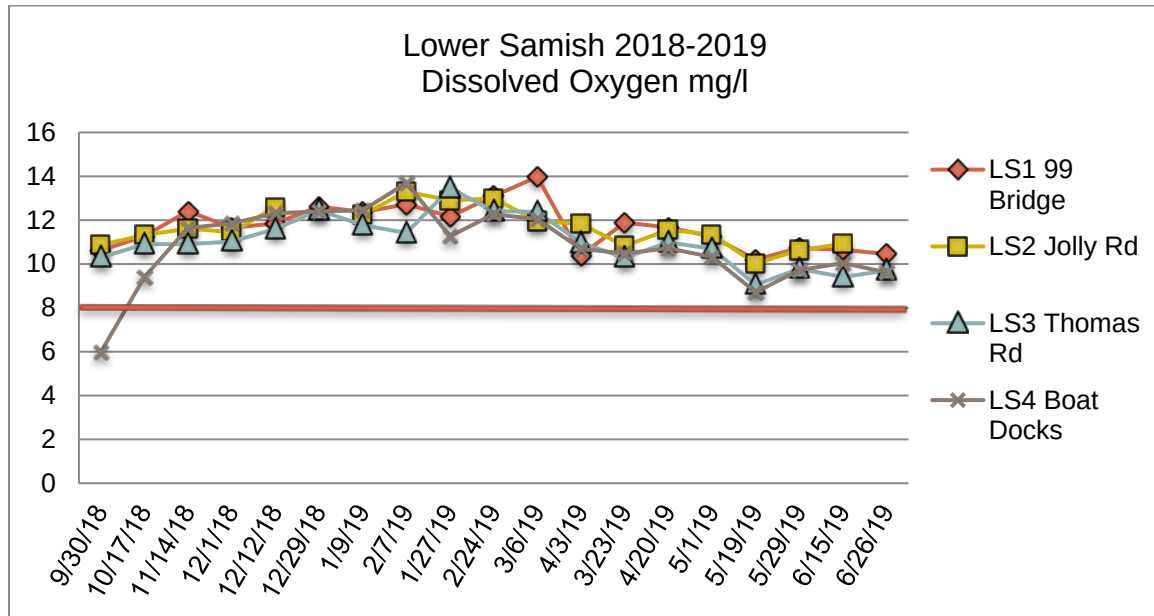


Figure 18. Lower Samish DO: 2018-2019

Average dissolved oxygen levels (Figure 19) have been consistent over ten years at sites 1-3. The standard is based on the lowest single day, not on an annual average.

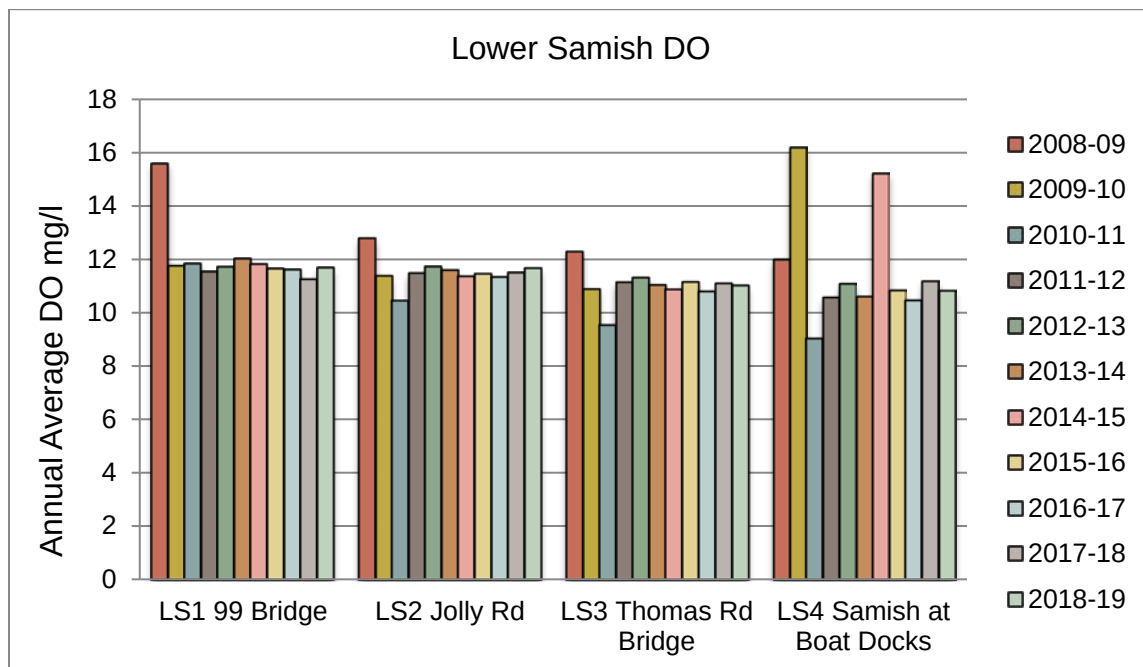


Figure 19. Lower Samish DO: Eleven-year comparison

Temperatures went above 16 °C in June at sites 3 and 4. Sampling stopped before the warmest months.

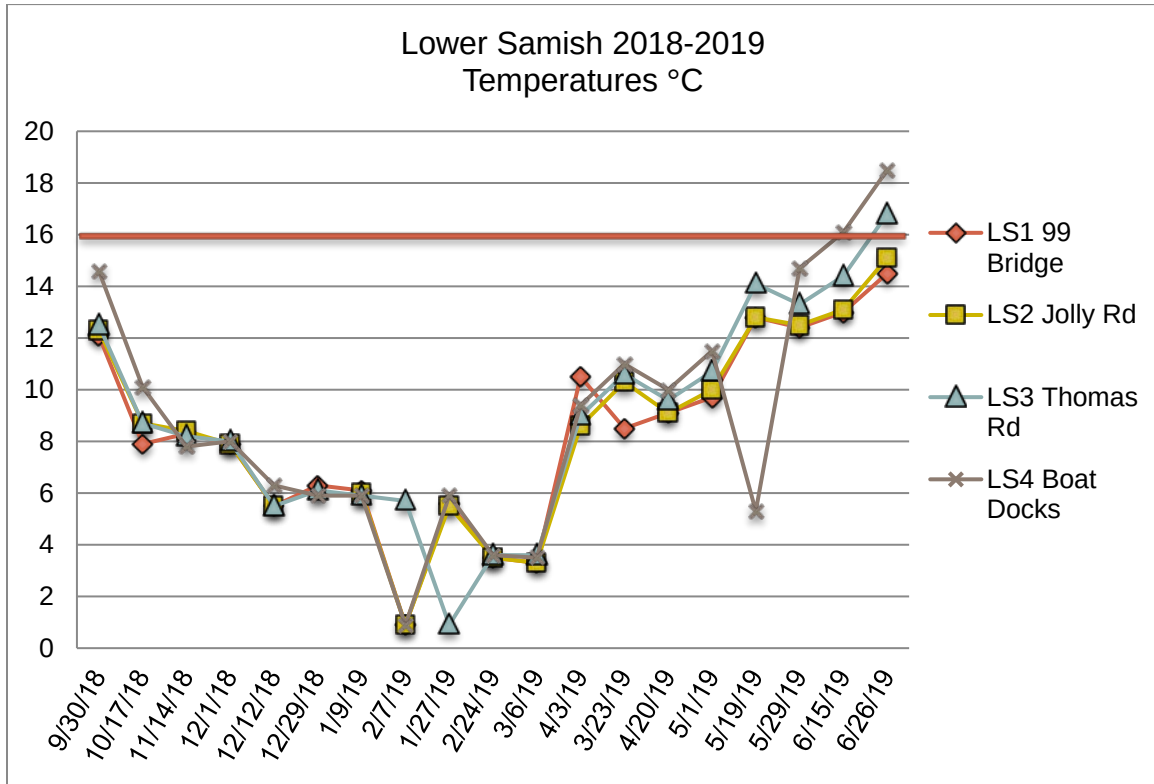


Figure 20. Lower Samish Temperature: 2018-2019

Average temperatures stayed below the high temperatures of 2014-2016. Standards are not based on average temperatures.

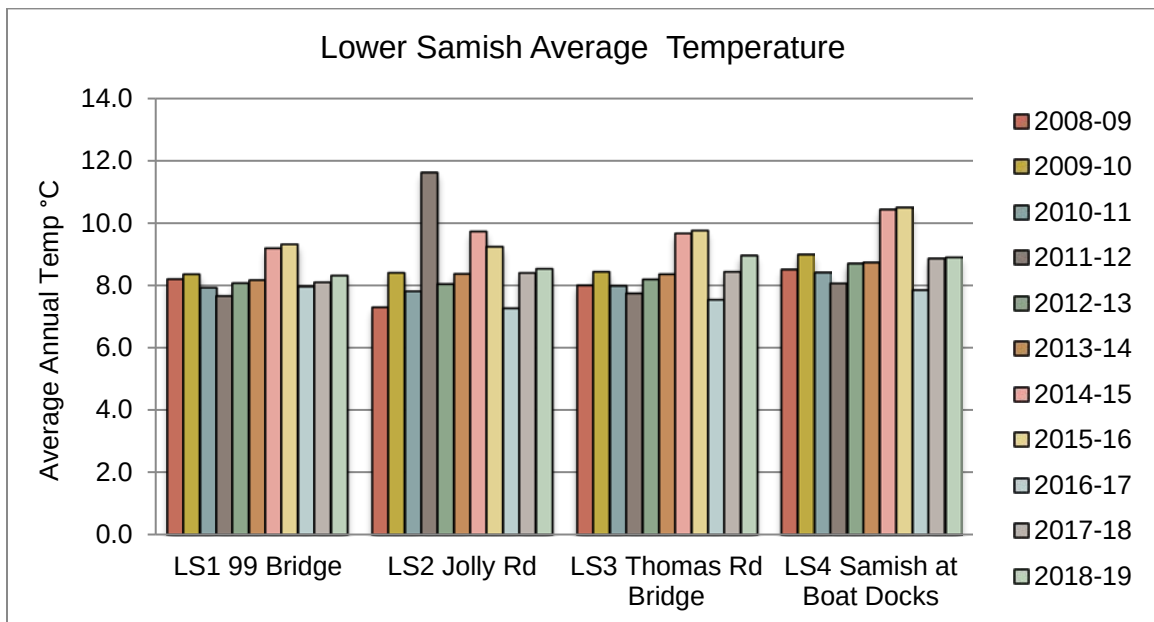


Figure 21. Lower Samish Temperature: Eleven-year comparison

The spike in turbidity 12/29/2018 corresponds to an inch of rainfall the previous 24 hours.

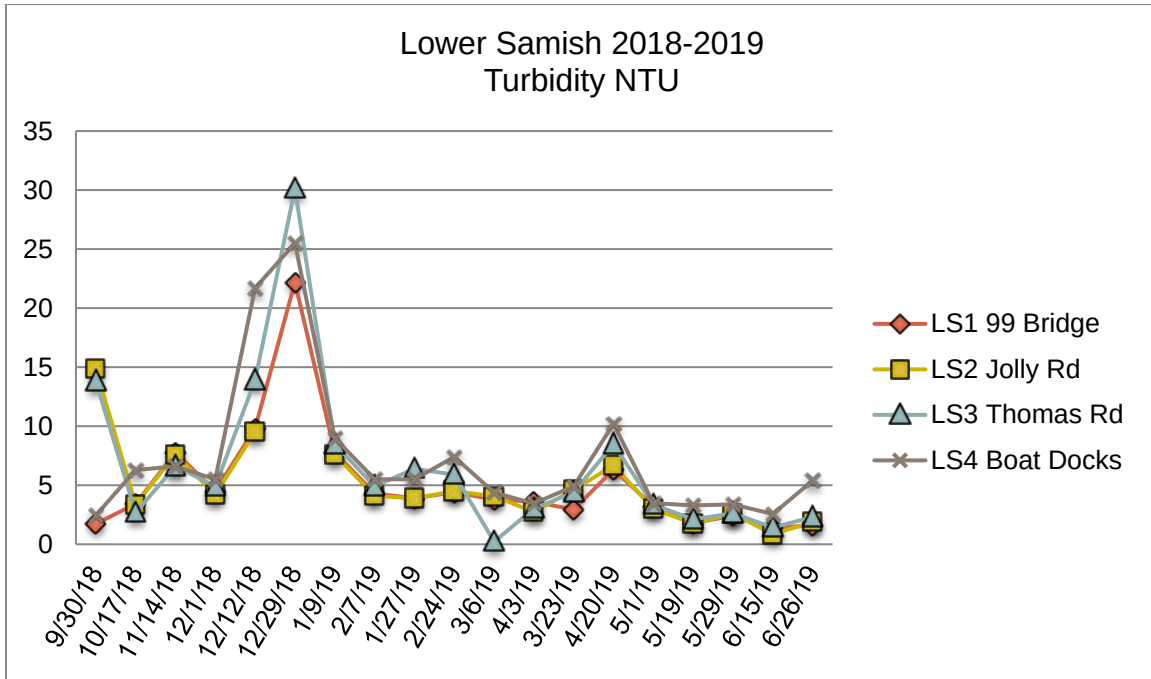


Figure 22. Lower Samish Turbidity: 2018-2019

Turbidity levels have trended downward over the past ten years.

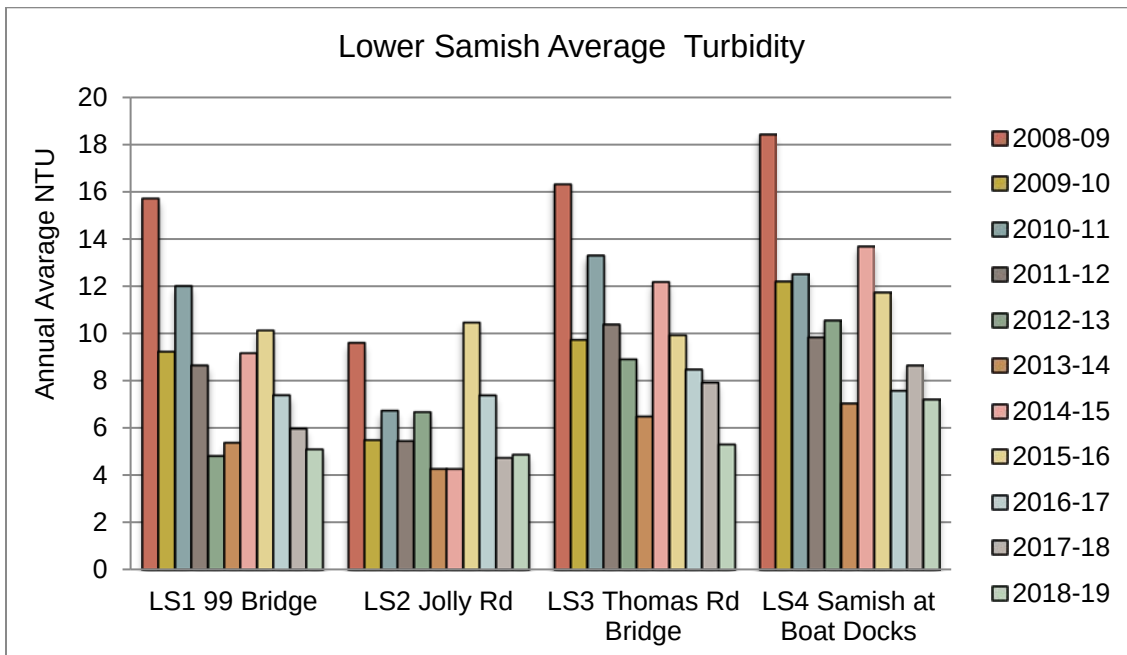


Figure 23. Lower Samish Turbidity: Eleven-year comparison

Fecal Coliform levels for the Lower Samish were higher than last year at sites 3-5, with multiple incidents of high counts throughout the spring.

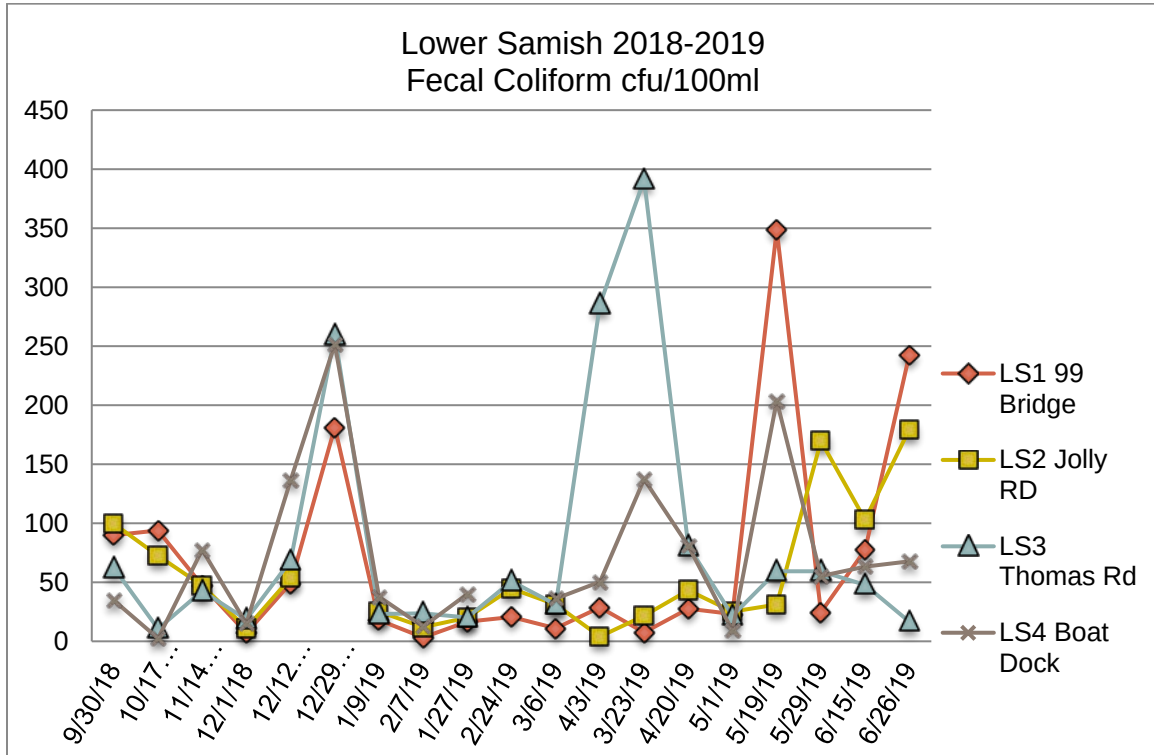


Figure 24. Lower Samish Fecal Coliform: 2018-2019

Geometric mean averages for fecal coliform (Figure 26) for all four sites were well below 100 CFU/100 ml. Last year, all four sites had fewer than 10% of the samples over 200 CFU.100 ml. This year, only site 2 met that standard.

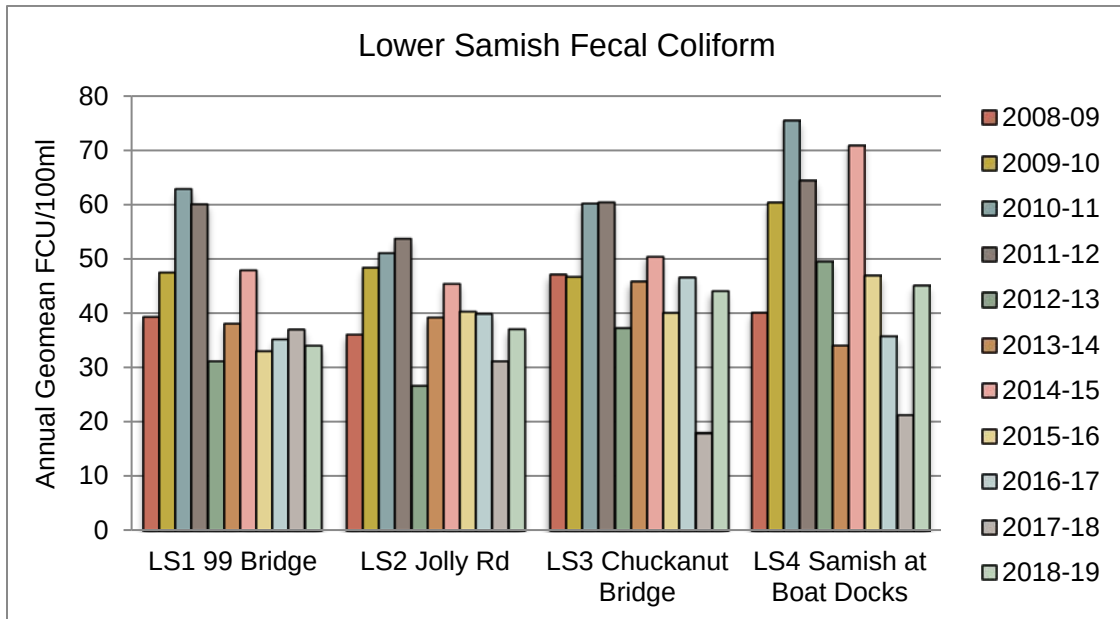


Figure 25. Lower Samish Fecal Coliform: Eleven-year comparison

Upper Nookachamps Results

Figures 26 through 33 below present results from Upper Nookachamps Creek sampling.

All four sites had DO levels below 9.5 mg/l multiple times. Once again, Site 1 was below 9.5^o much of the season, and was usually the lowest of the four sites.

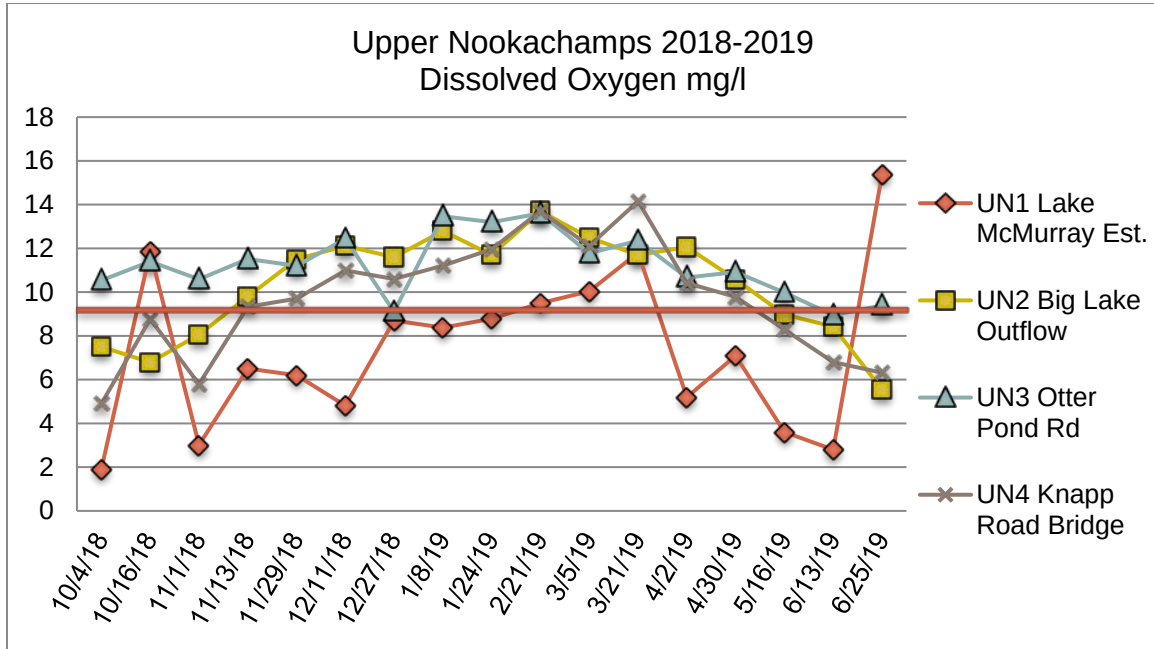


Figure 26. Upper Nookachamps DO: 2018-2019

Site 4 average DO was the highest in nine years. State standards are based on the single lowest measurement, not on annual averages, so to see averages below 9.5°C indicates a serious, long-term problem.

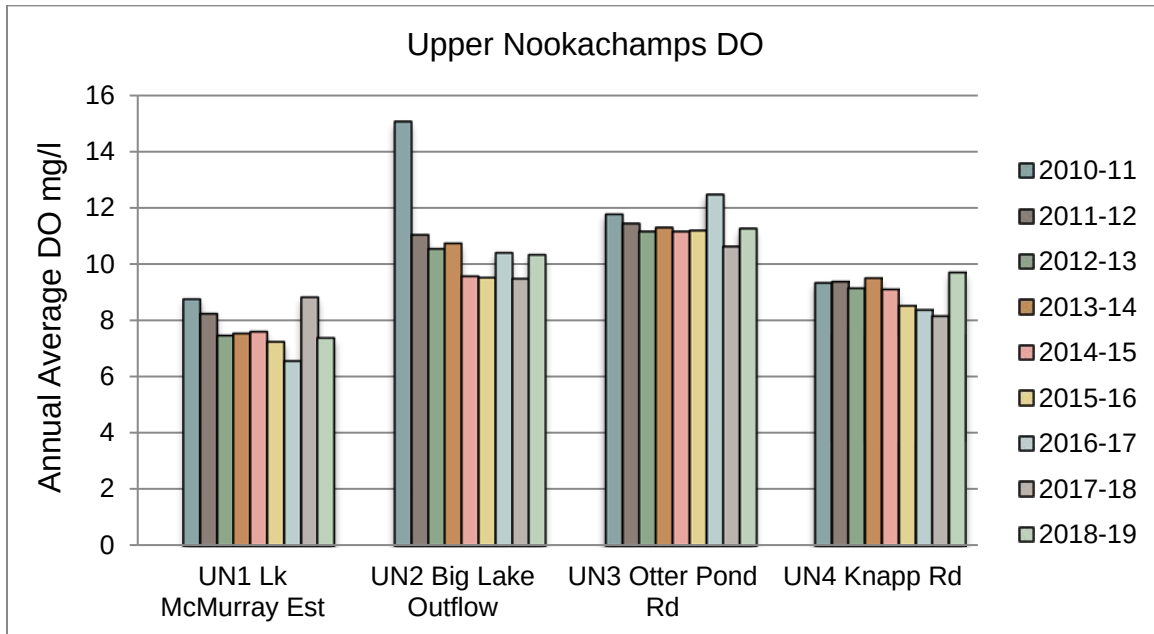


Figure 27. Upper Nookachamps DO: Nine-year comparison

Temperatures for Upper Nookachamps sites went above the standard of 16° in June.

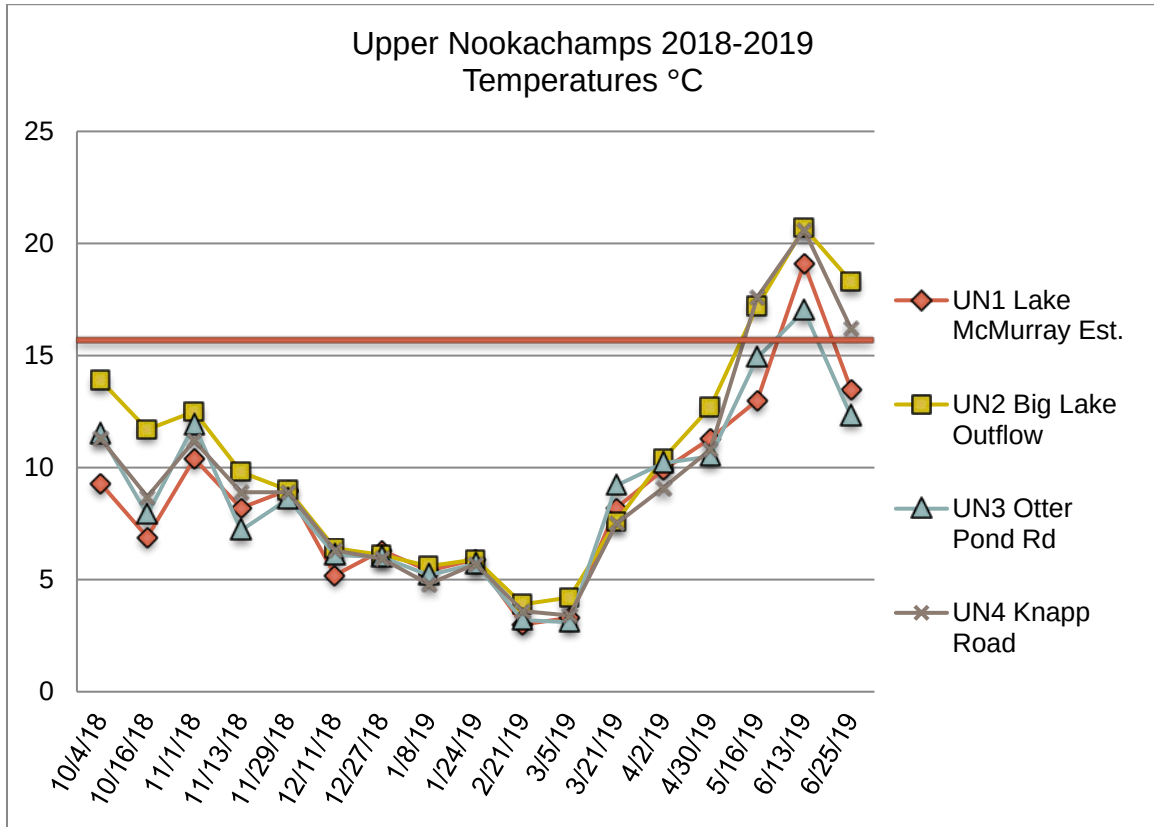


Figure 28. Upper Nookachamps Temperature: 2018-2019

Average temperatures for all Upper Nookachamps sites were comparable to the previous year, and lower than the highest temperatures in 2014-15. State standards are not based on average annual temperature.

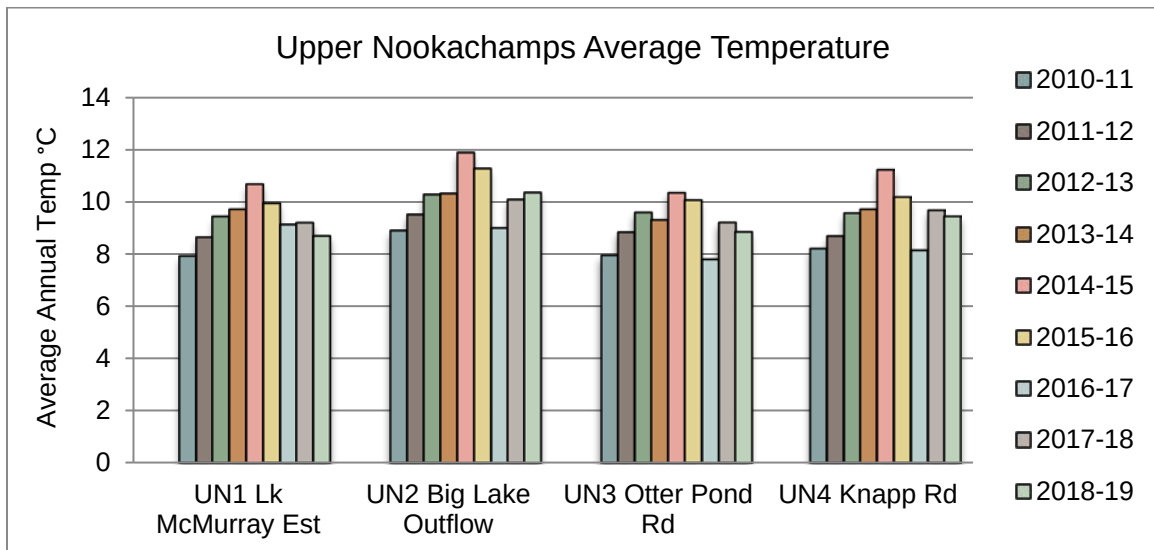


Figure 29. Upper Nookachamps Temperature: Nine-year comparison

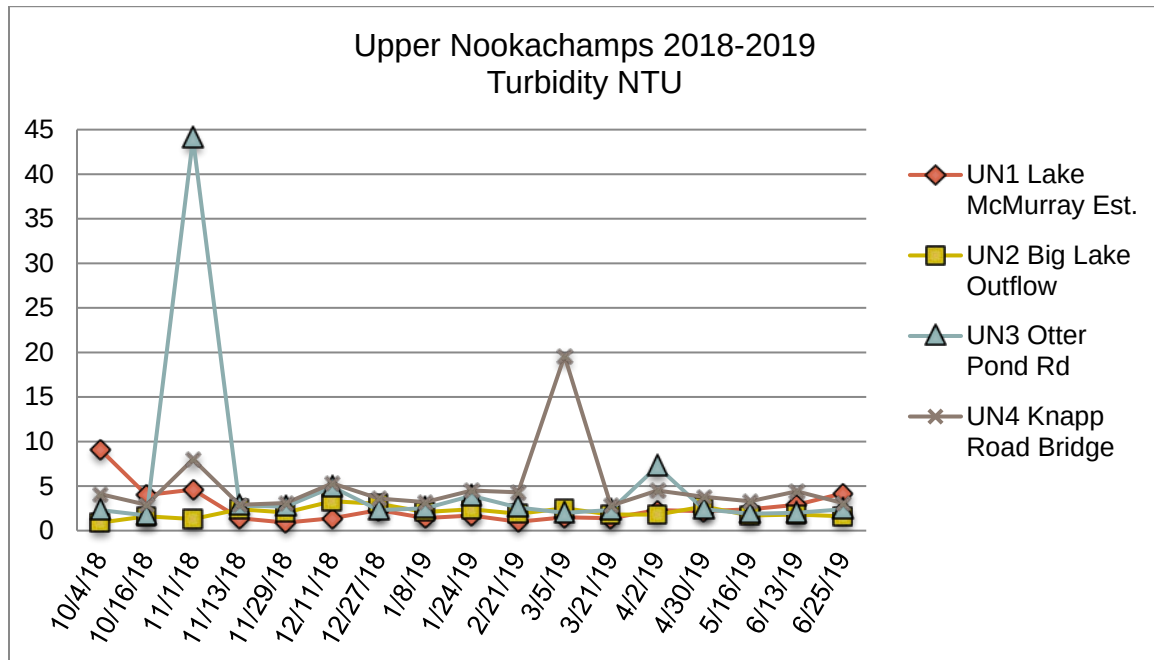


Figure 30. Upper Nookachamps Turbidity: 2018-2019

Site 3 had higher average turbidity levels than site 4, due to an abnormally high event on November 1.

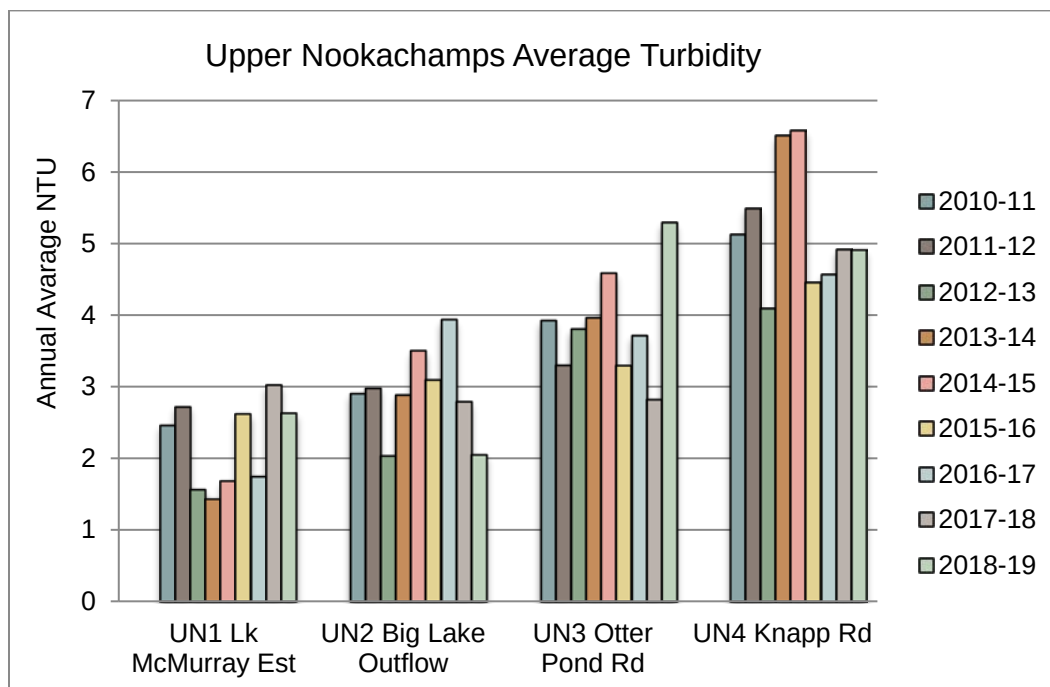


Figure 31. Upper Nookachamps Turbidity: Nine-year comparison

Fecal coliform levels (Figure 32 below) stayed relatively low through the season for Sites 1-3. Site 4 was more variable, with several very high counts.

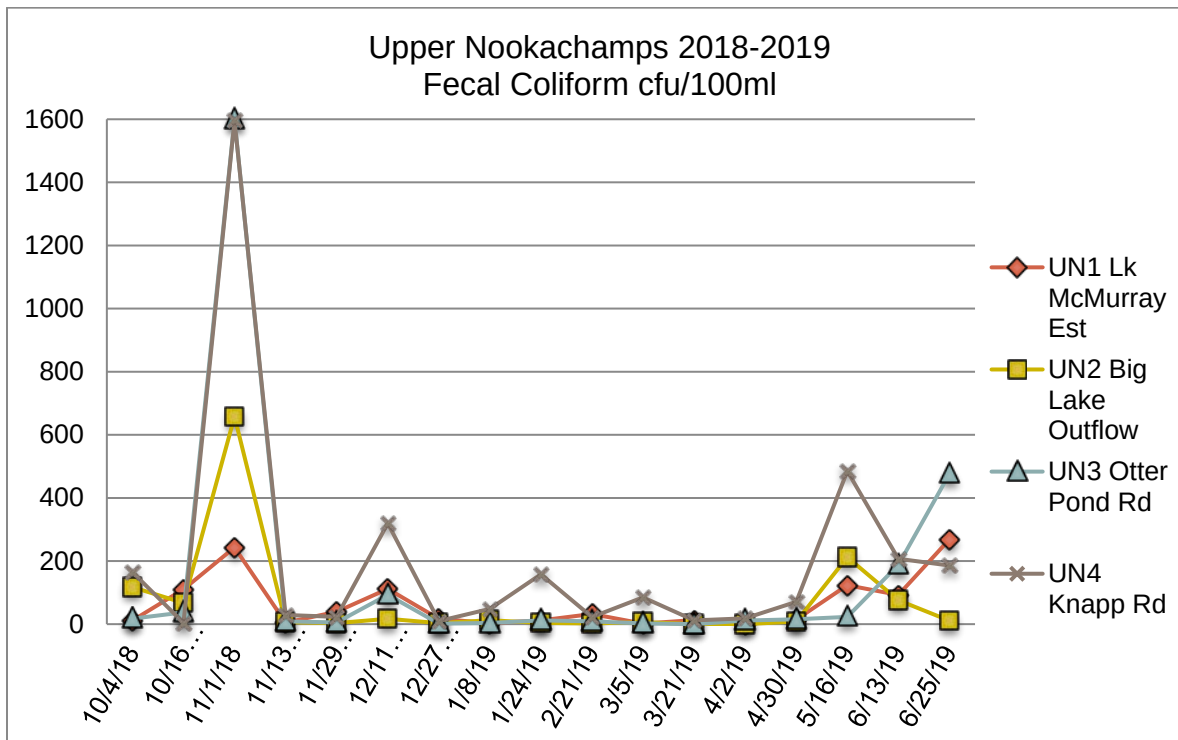


Figure 32. Upper Nookachamps Fecal Coliform: 2018-2019

Annual geometric means for fecal coliform for all Sites (Figure 33 below) met part 1 of the state standard (100 CFU/100ml). None of the sites met part 2 with <10% of samples below 200 CFU/100ml, though site 2 came very close with 2 out of 20 samples above 200CFU/100ml.

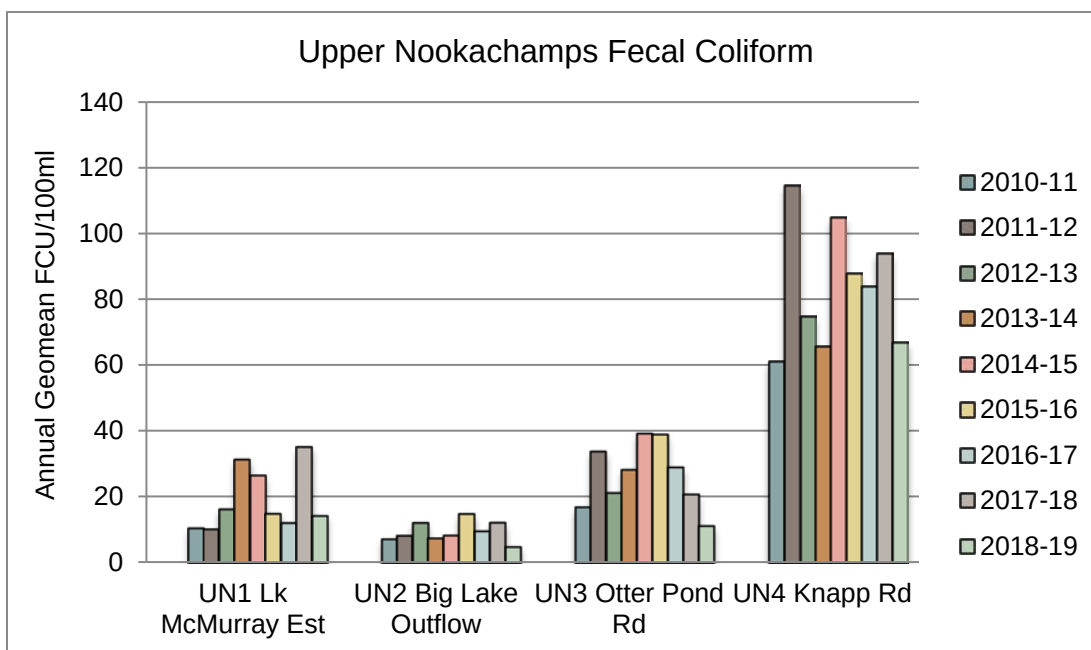


Figure 33. Upper Nookachamps Fecal Coliform: Nine-year comparison

Lower Nookachamps Results

Figures 34 through 41 below present results from Lower Nookachamps Creek sampling.

All Lower Nookachamps sites had similar dissolved oxygen levels. All sites dropped below the state standard of 9.5°C during the year.

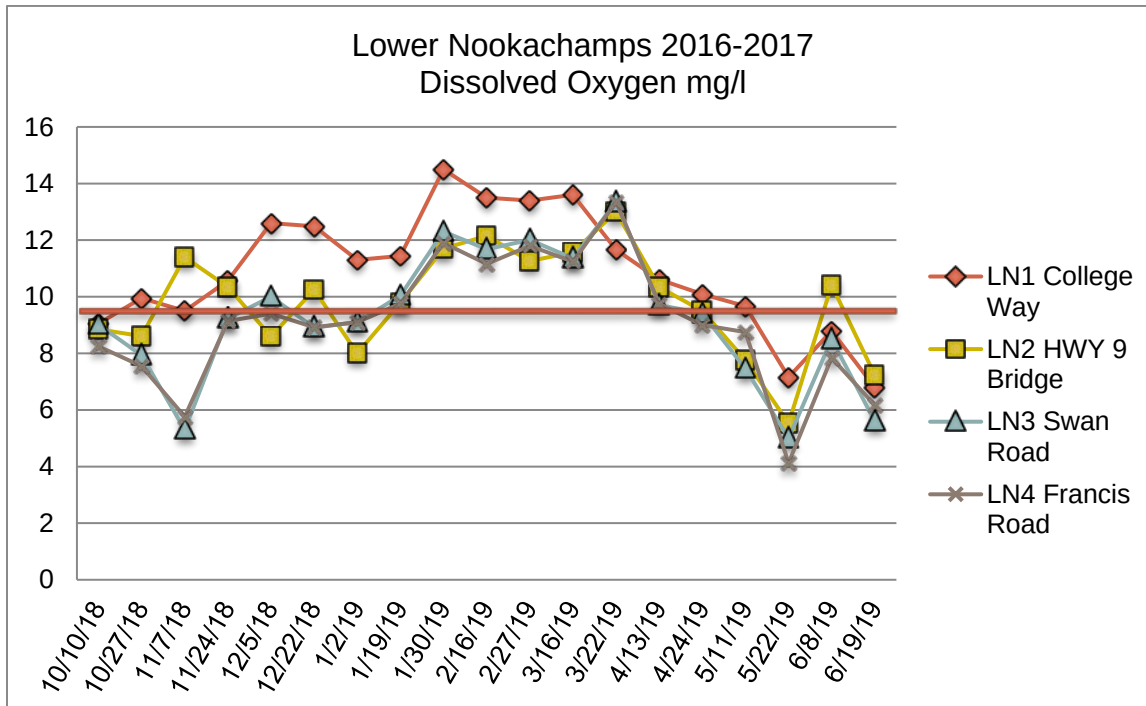


Figure 34. Lower Nookachamps DO: 2018-2019

Average dissolved oxygen levels were low relative to the standard of 9.5°C at all sites. Averages are shown below for comparing sites and years, and are not relevant to state standards.

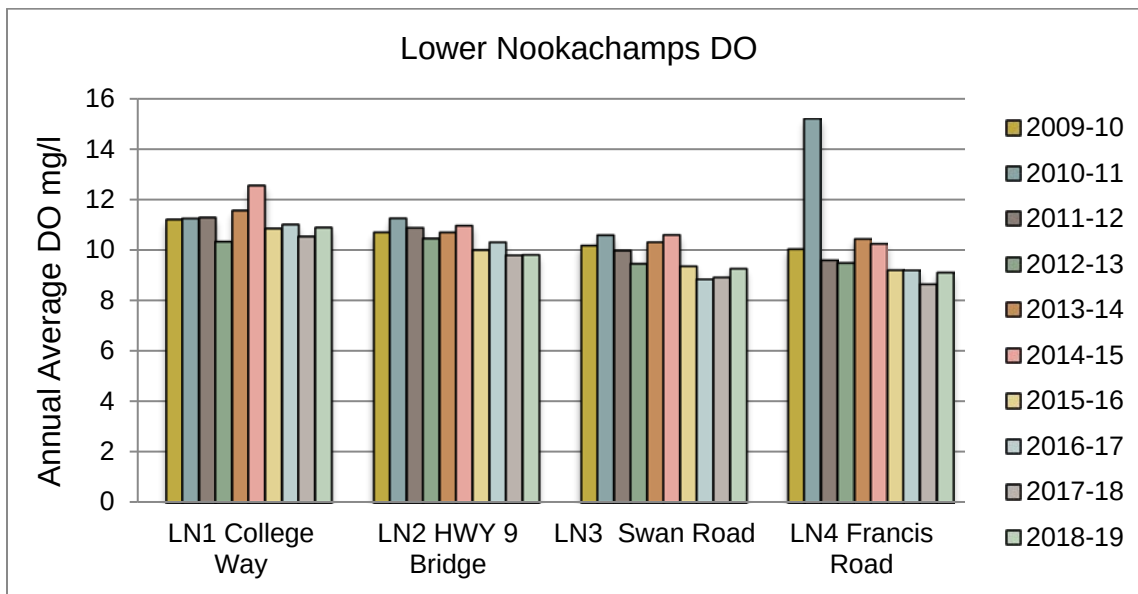


Figure 35. Lower Nookachamps DO: Eleven-year comparison

Temperatures for sites 3 and 4 went above the state standard of 16°C in May and June. No samples were taken during the warmest summer months.

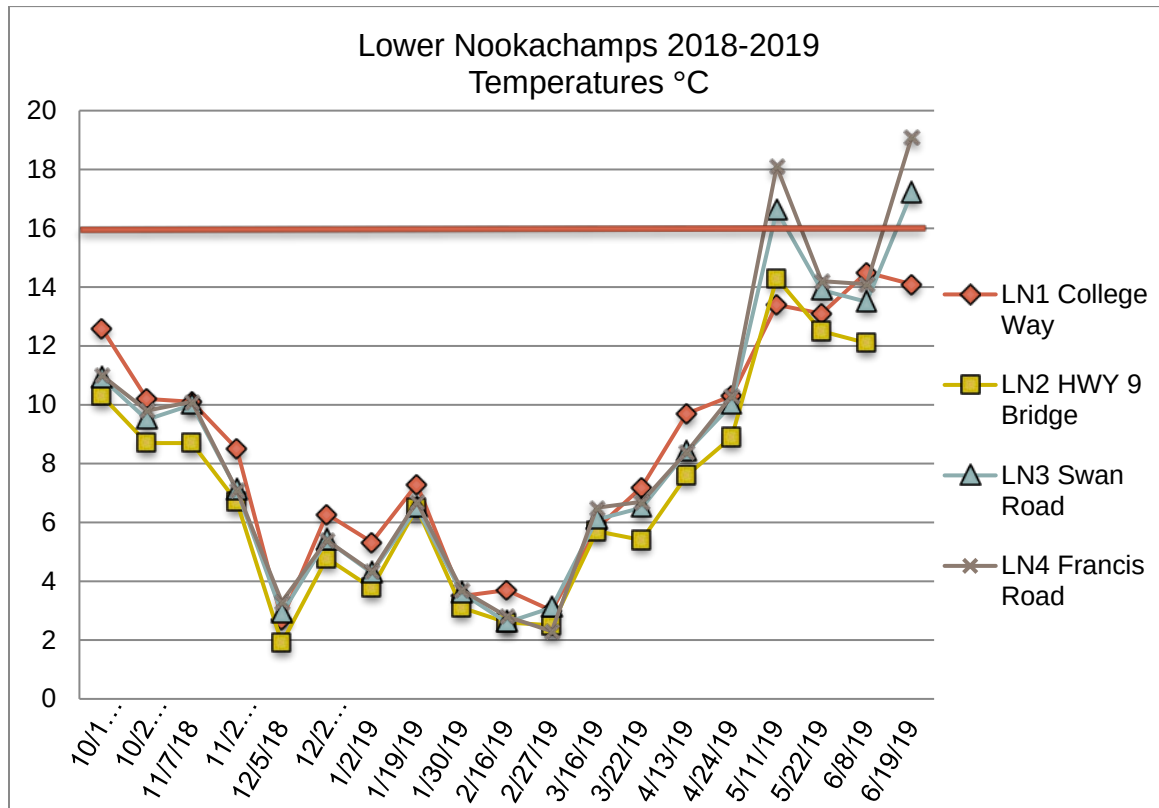


Figure 36. Lower Nookachamps Temperature: 2018-2019

Annual average temperatures for all Lower Nookachamps Sites (Figure 37 below) improved from last year's high. State standards are not based on the annual average

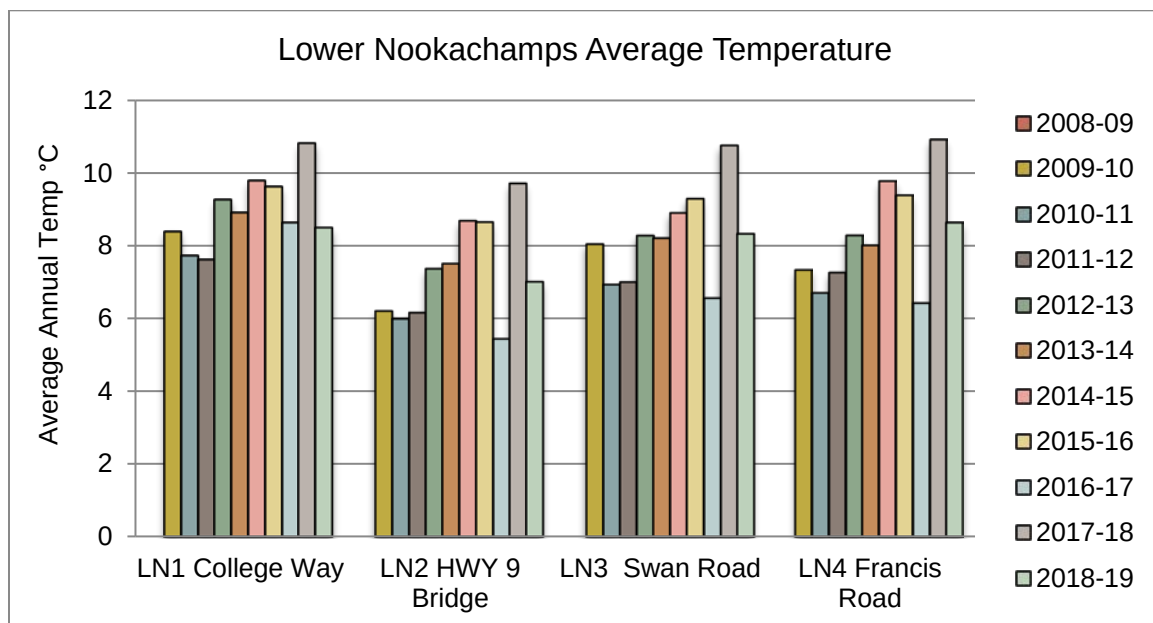


Figure 37. Lower Nookachamps Temperature: Eleven-year comparison

Turbidity levels were the lowest since sampling began in 2009.

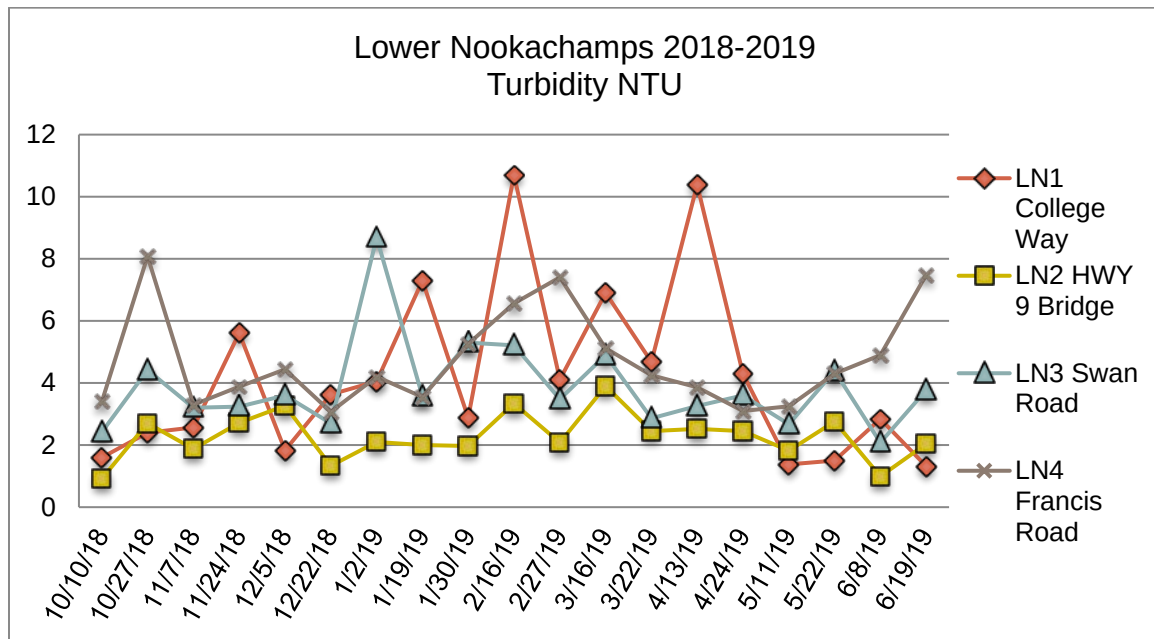


Figure 38. Lower Nookachamps Turbidity: 2018-2019

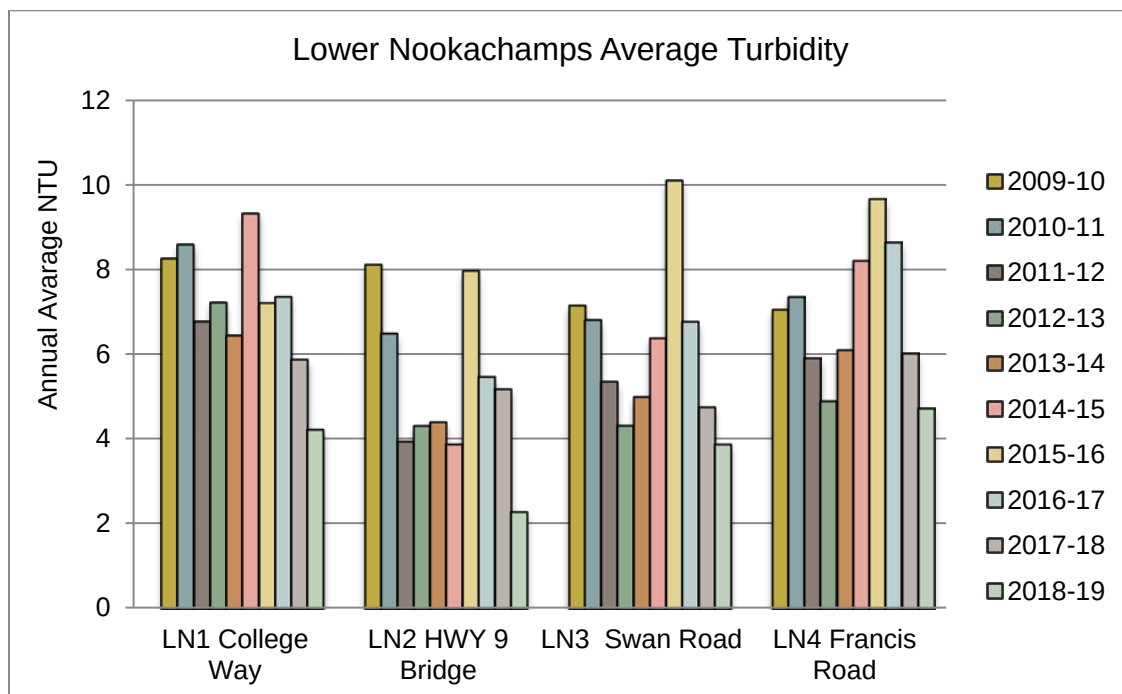


Figure 39. Lower Nookachamps Turbidity: Eleven-year comparison

Site 1, College Way again saw periodic high fecal coliform levels while other sites were relatively low.

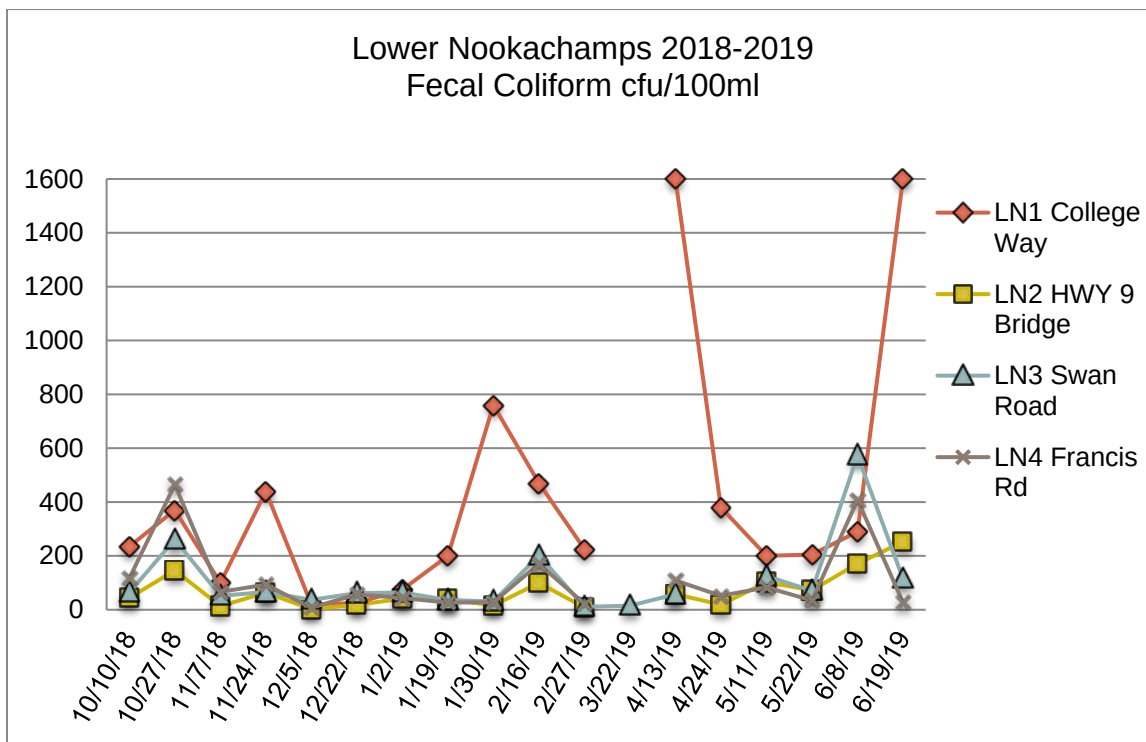


Figure 40. Lower Nookachamps Fecal Coliform: 2018-2019

Site 1 fecal coliform has been highly variable over the past 10 years, and was very high again this year. Sites 2-4 met the first part of the standard (<100 CFU/100ml). None of the sites also met the <10% over 200 CFU/100ml standard.

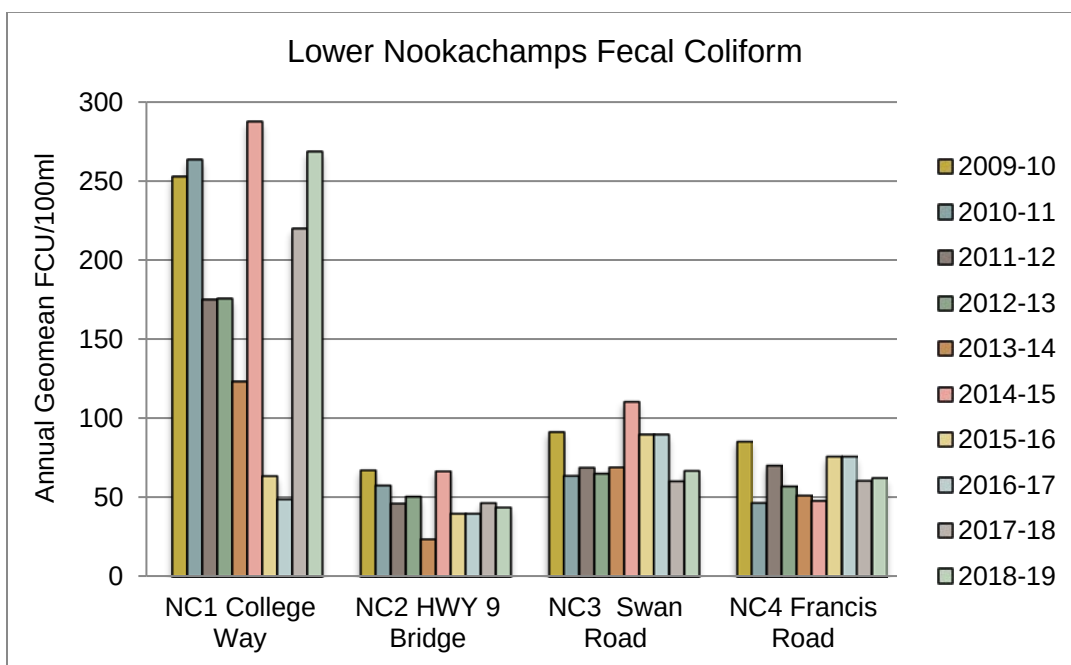


Figure 41. Lower Nookachamps Fecal Coliform: Eleven-year comparison

No Name Slough Results

Figures 42 through 49 below present results from No Name Slough sampling.

Dissolved oxygen levels fell below the state standard of 8mg/l at sites 1, 3, and 4 during the sampling season. The upper stream dries up in early summer.

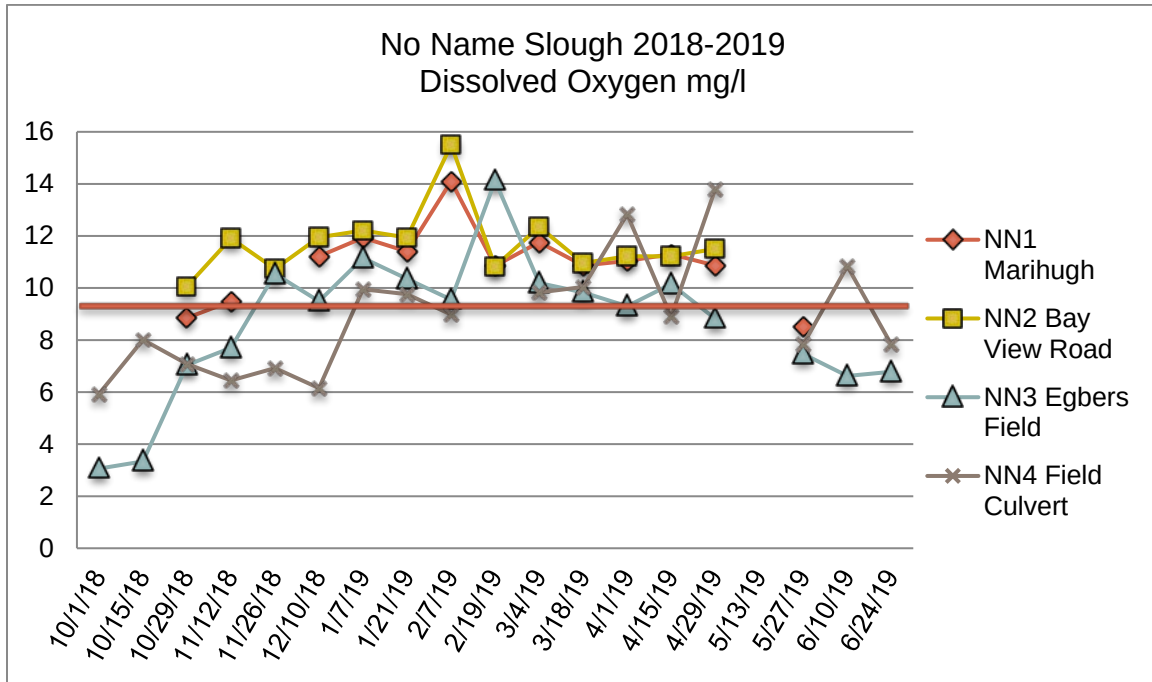


Figure 42. No Name Slough DO: 2018-2019

Average DO were lowest at site 1 since sampling began. State standards are not based on the annual average.

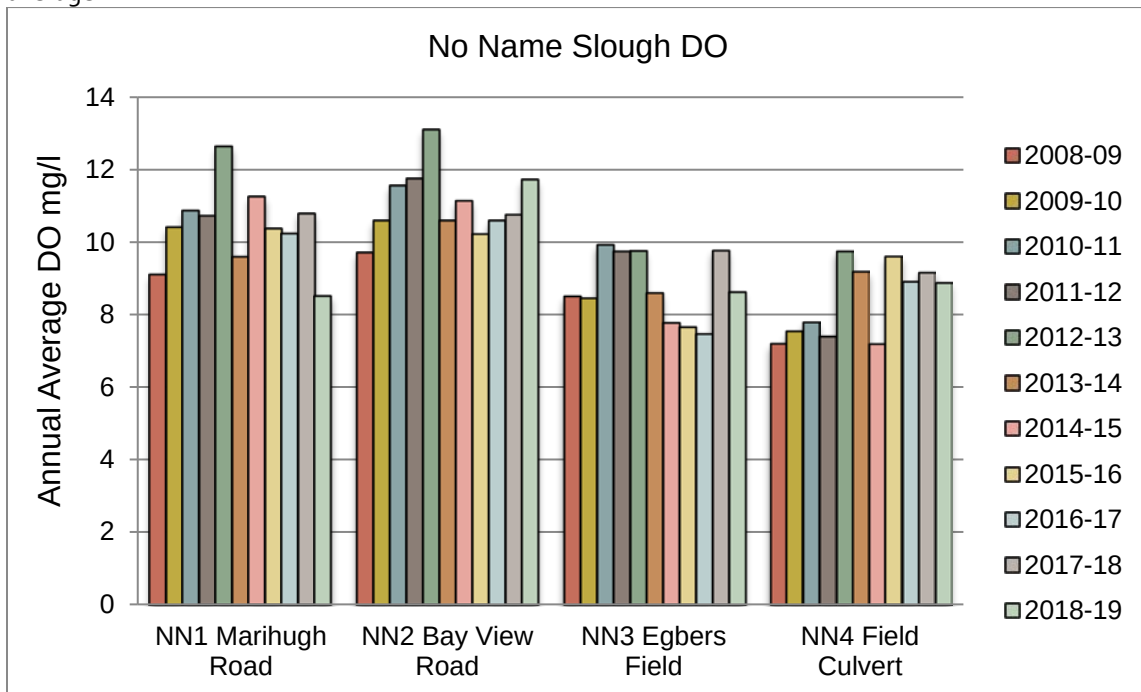


Figure 43. No Name Slough DO: Eleven-year comparison

Temperatures at No Name Sites 1-3 were within the optimum range of $<17.5^{\circ}\text{C}$ throughout the sampling period. Site 4 was above this temperature in May and June. No samples were taken during the warmest summer season when temperatures were most likely to be warmer than the state standard.

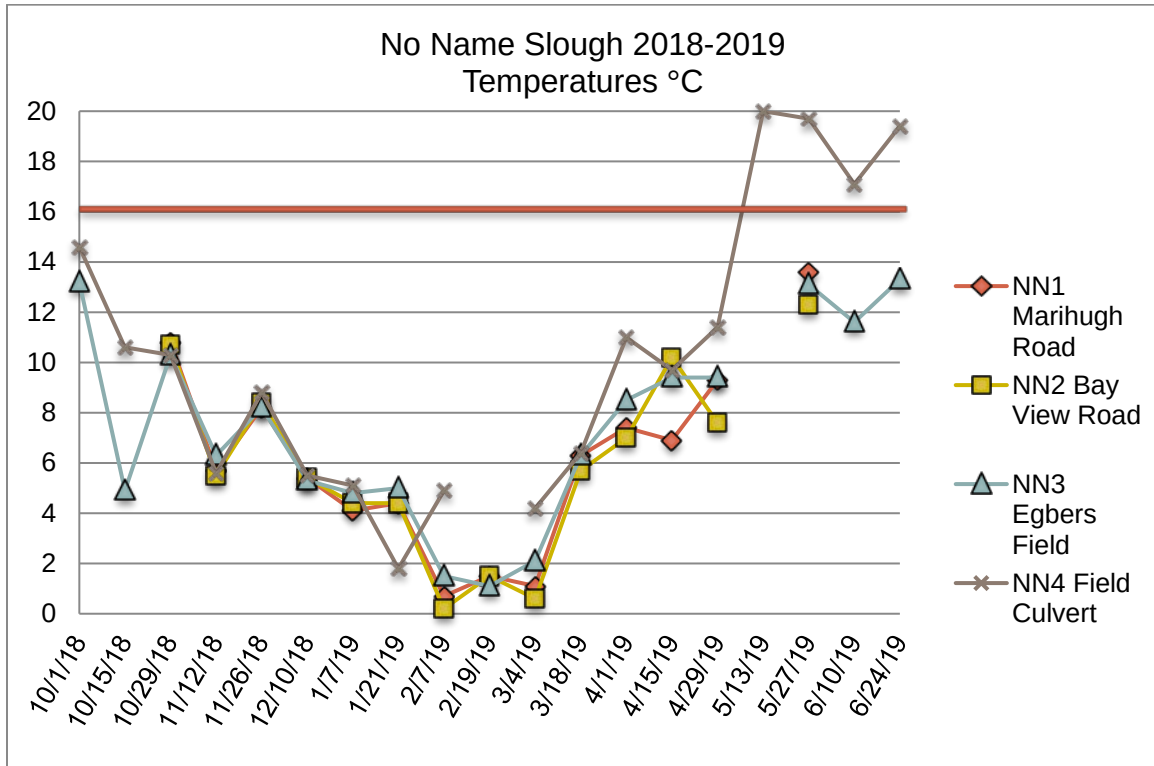


Figure 44 No Name Slough Temperature: 2018-2019

Average temperatures are shown for comparison. State standards are not based on the annual average.

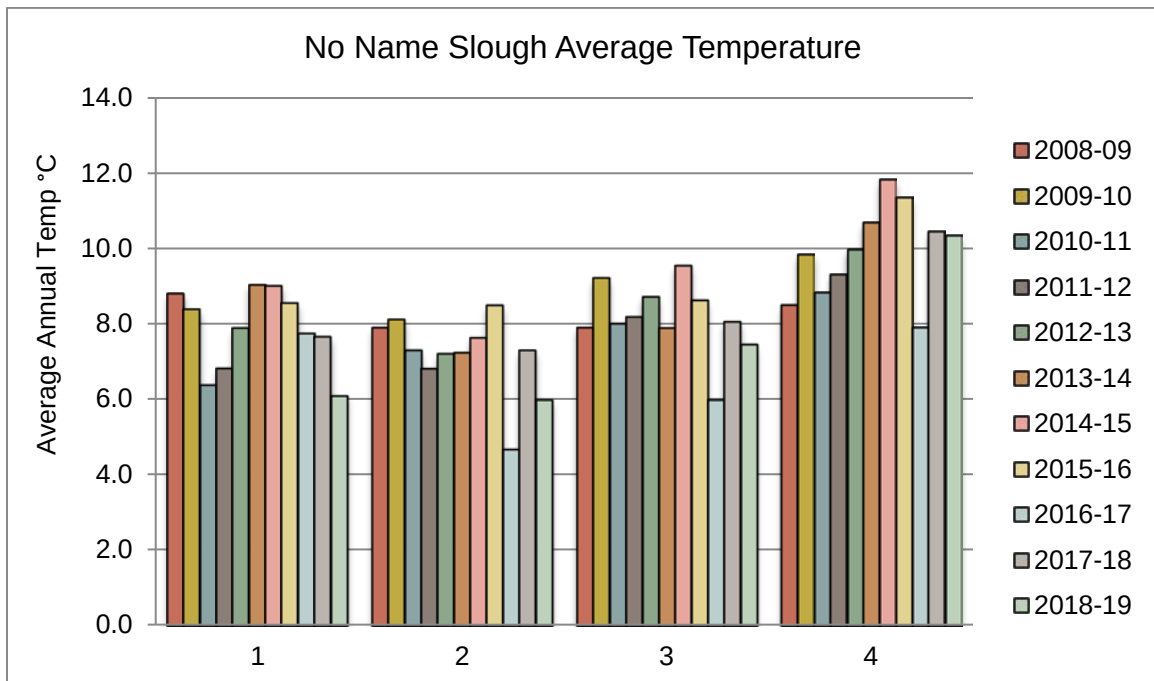


Figure 45. No Name Slough Temperature: Eleven-year comparison

Turbidity levels were generally low during 2018-2019 .

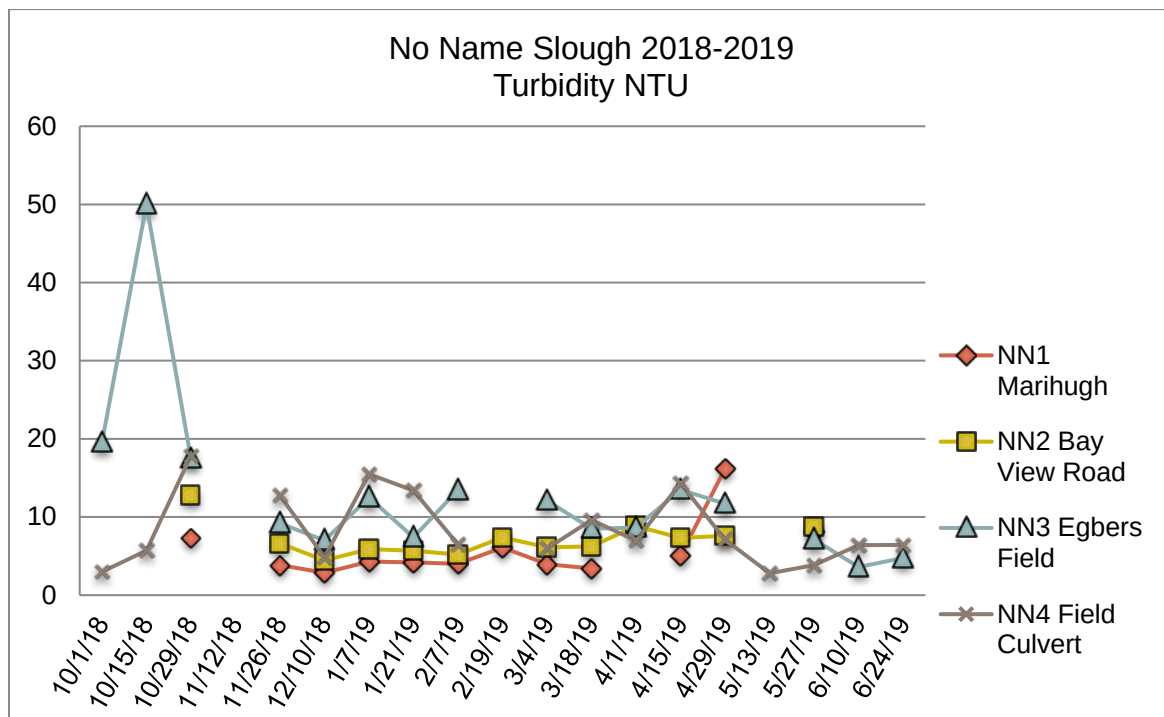


Figure 46. No Name Slough Turbidity: 2018-2019

Figure 47 below shows average turbidity levels that are comparatively low. Sites 3 and 4 have benefitted from extensive plantings along the slough.

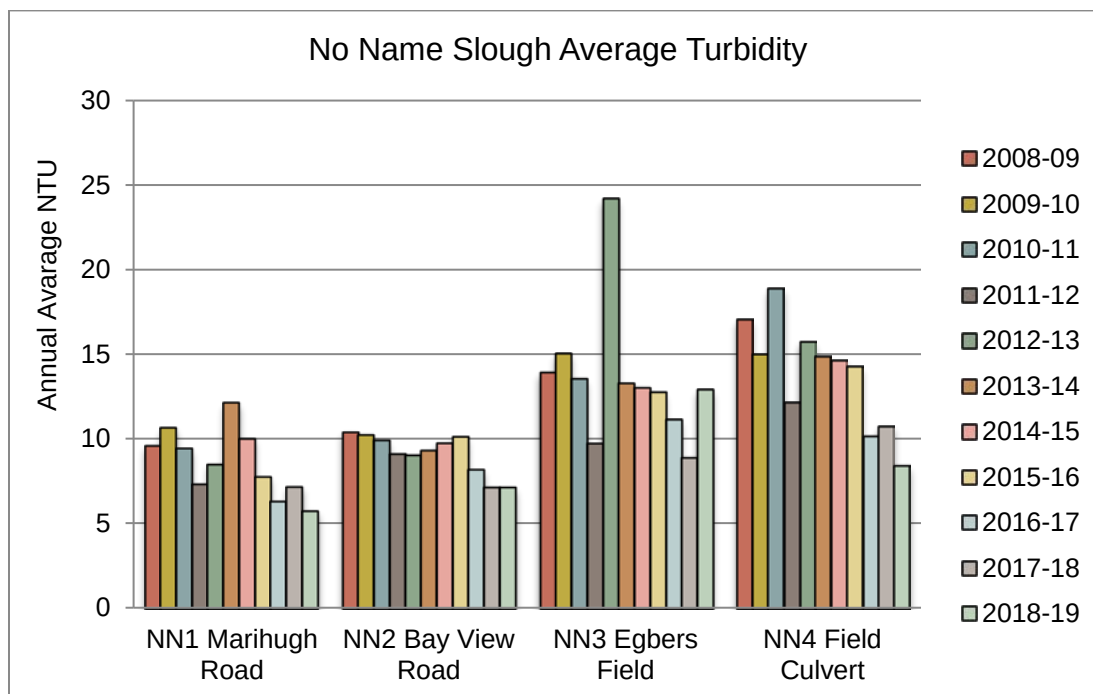


Figure 47. No Name Slough Turbidity: Eleven-year comparison

All No Name Slough sites had instances of very high fecal coliform levels in 2018-2019, with lowest numbers at site 2. None of the sites met the <10% over 200 CFU/100ml standard.

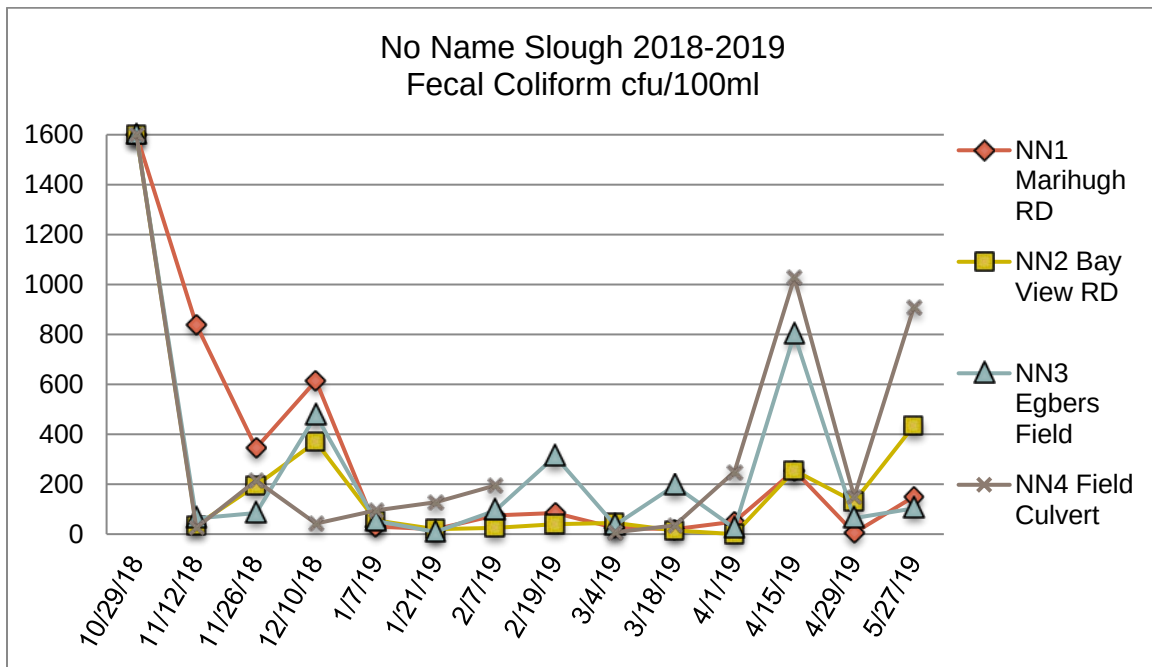


Figure 48. No Name Slough Fecal Coliform: 2018-2019

Sites 1 and 2 met the standard of <100CFU/100ml.

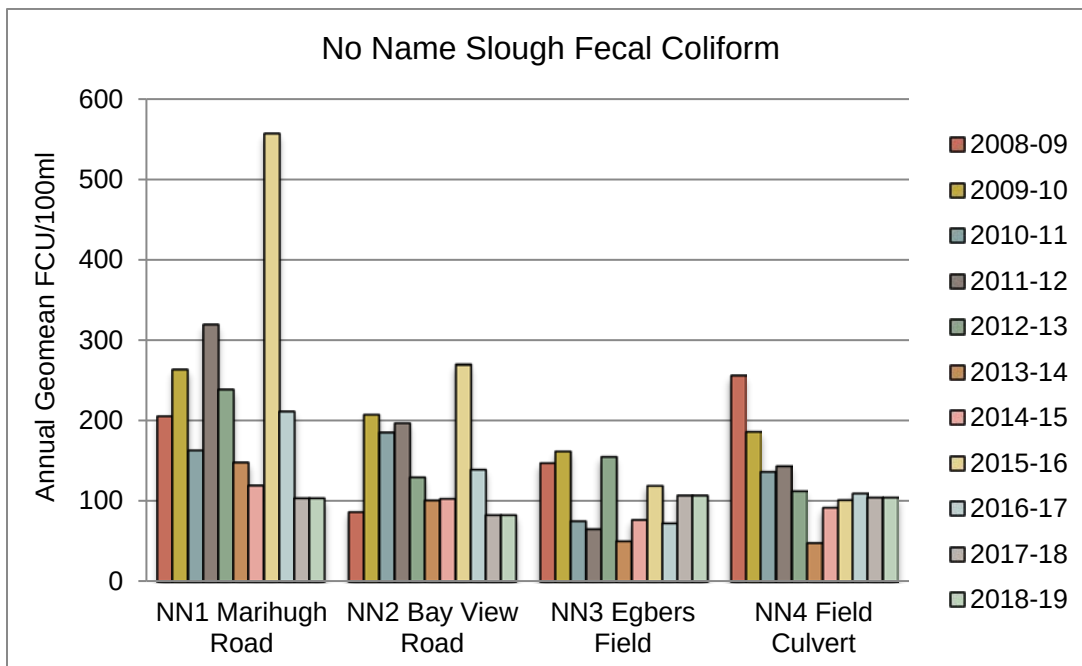


Figure 49. No Name Slough Fecal Coliform: Eleven-year comparison

Bay View Drainage Results

Figures 50 through 57 below present results from Bay View Drainage sampling. Sites 1-3 are roadside ditches that dry up between rainy periods. Site 4 is often without water due to low tide.

Dissolved oxygen measurements are limited for Bay View.

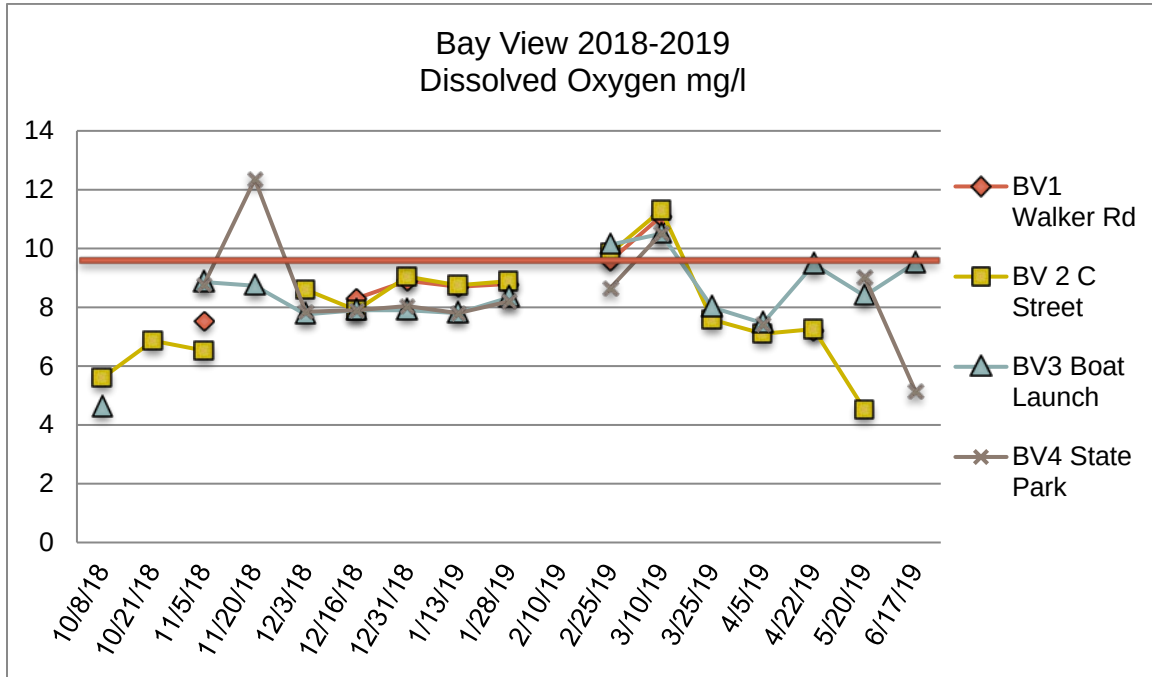


Figure 50. Bay View Drainage DO: 2018-2019

Average dissolved oxygen levels were notably lower at all sites. State standards are not based on averages.

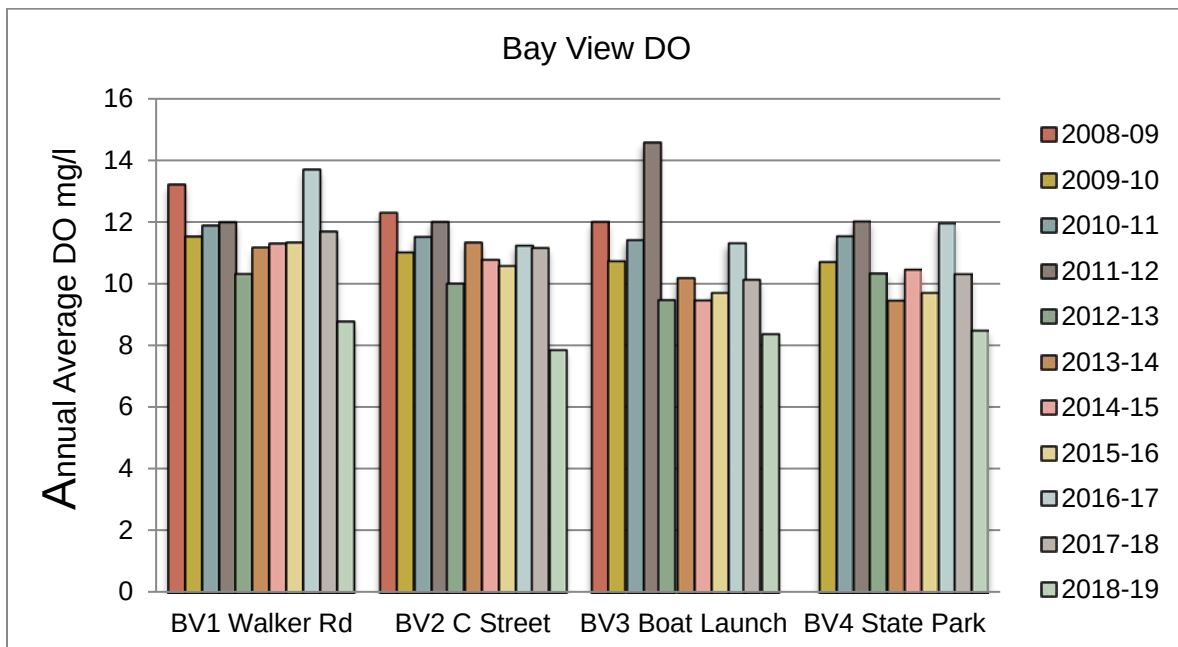


Figure 51. Bay View Drainage DO: Eleven-year comparison

Temperatures in 2018-2019 went above the maximum of 17.5°C at sites 3 and 4. Sites dry up during the dry season.

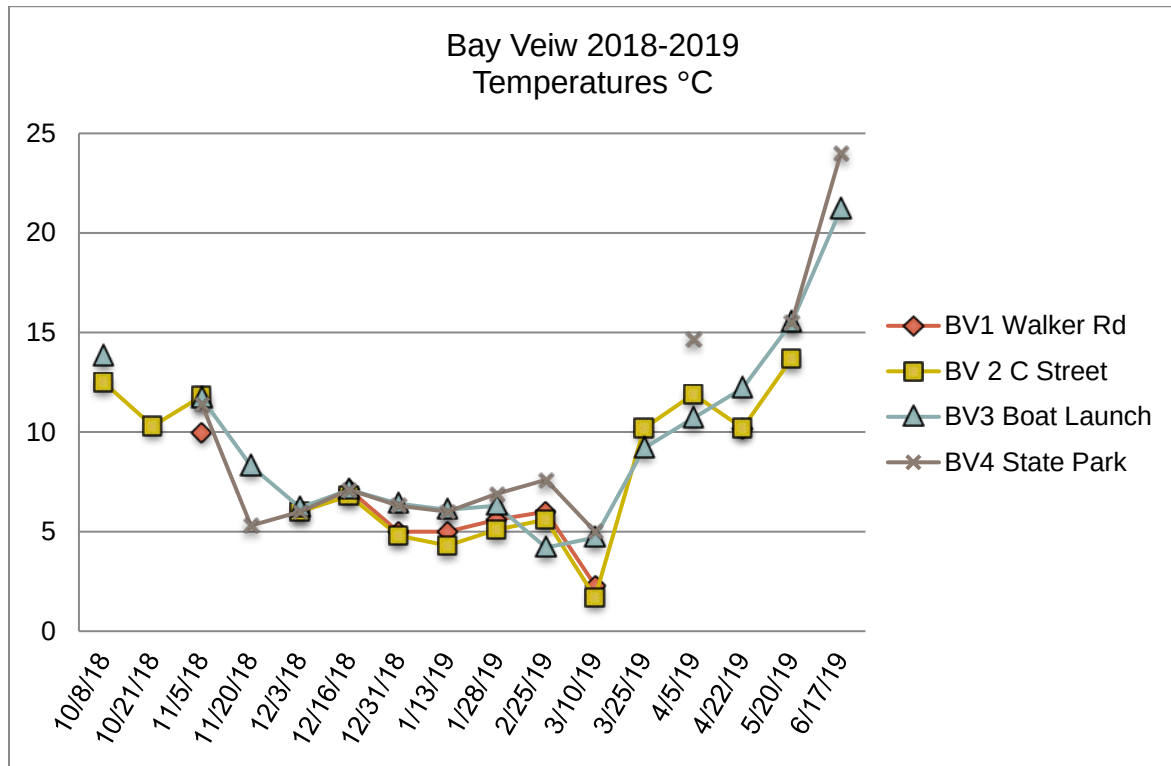


Figure 52. Bay View Drainage Temperature: 2018-2019

Average annual temperatures are shown for comparison.

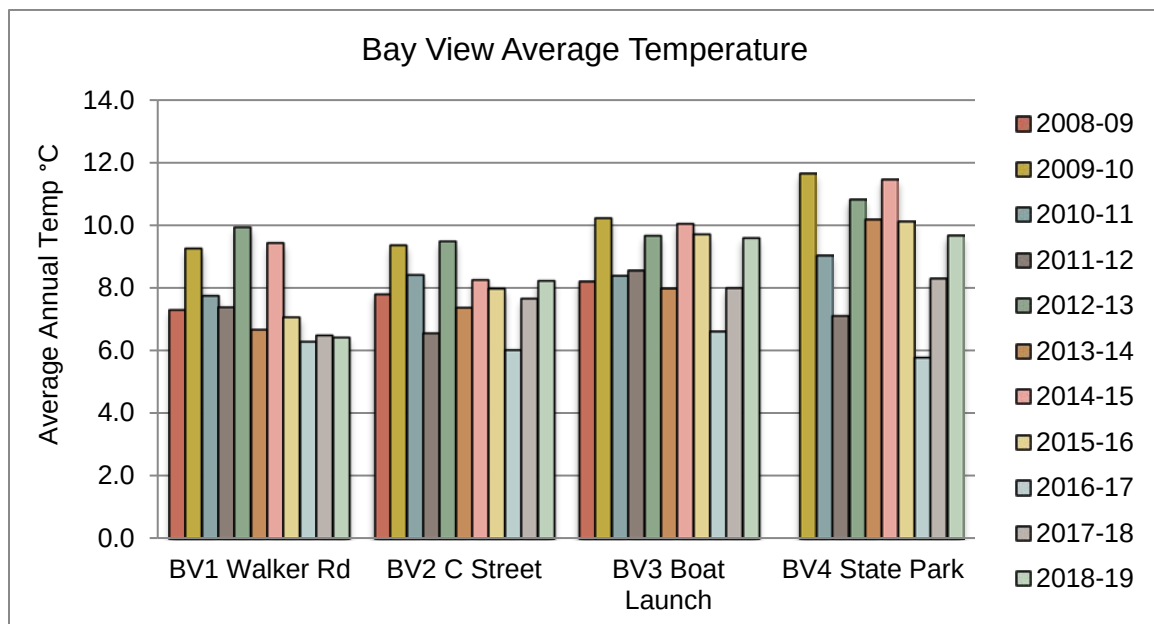


Figure 53. Bay View Drainage Temperature: Eleven-year comparison

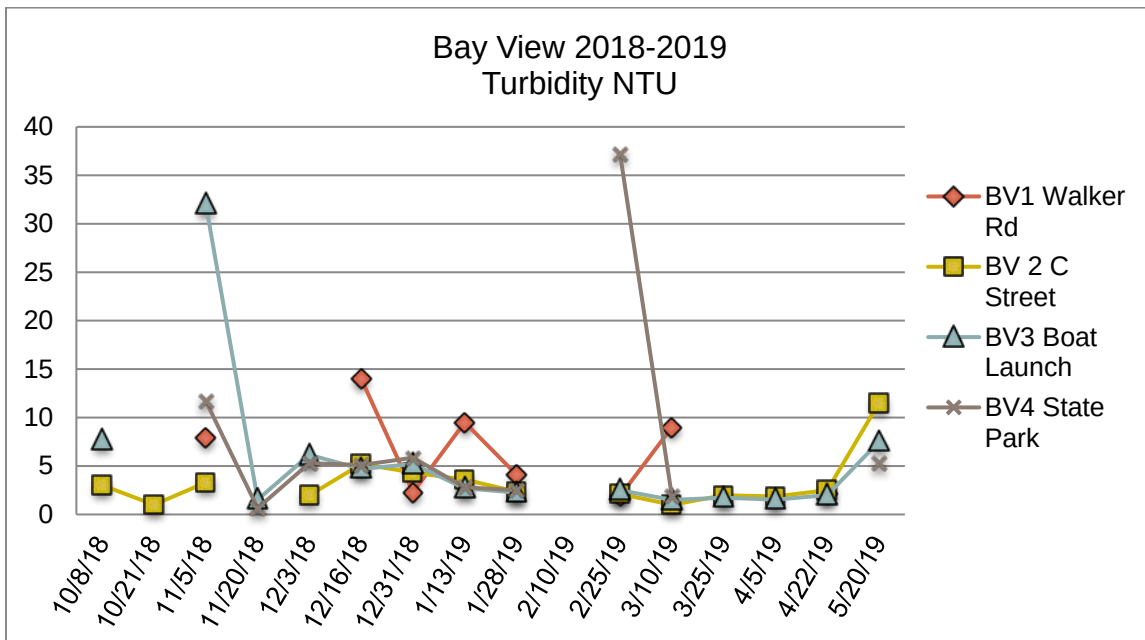


Figure 54. Bay View Turbidity: 2018-2019

Average turbidity levels (Figure 55 below) were low at all sites, and at site 2 were the lowest in eleven years.

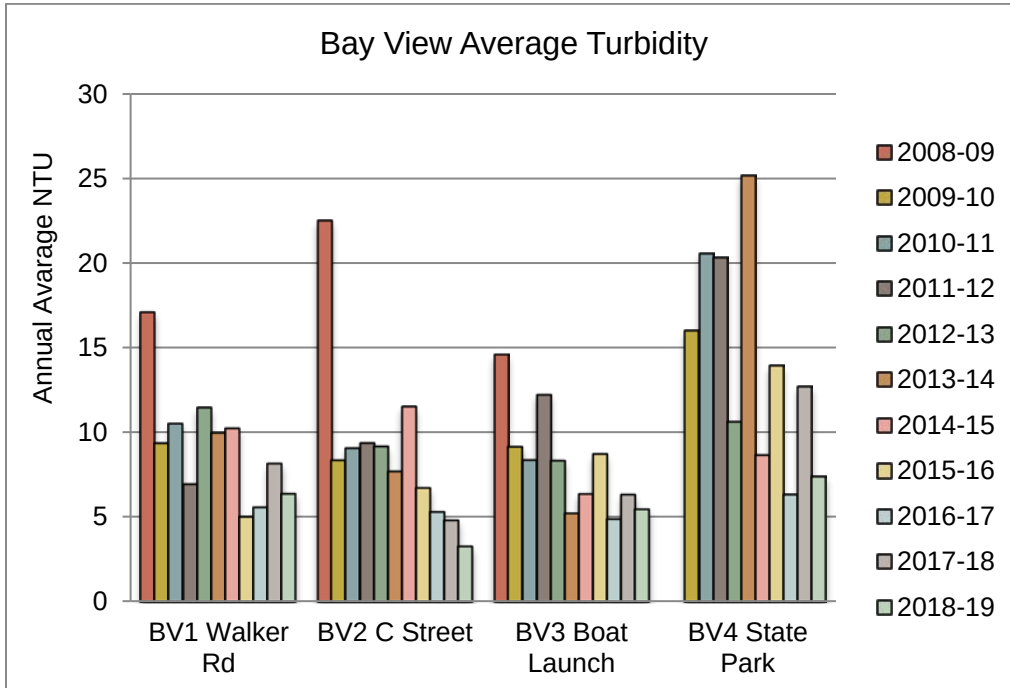


Figure 55. Bay View Drainage Turbidity: Eleven-year comparison

All Bay View sites met part 1 of the state standards for fecal coliform, and met part 2 at sites 1 and 4.

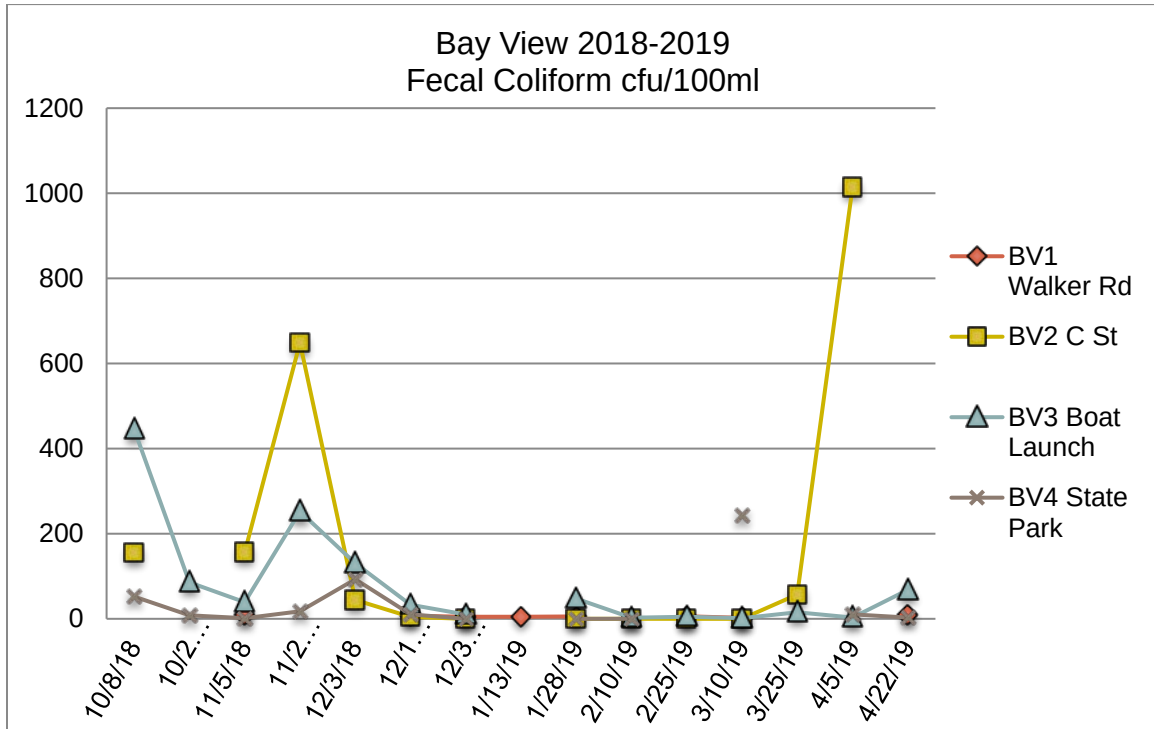


Figure 56. Bay View Drainage Fecal Coliform: 2018-2019

Annual geometric means for Bay View fecal coliform (Figure 57 below) were very low in 2018-2019.

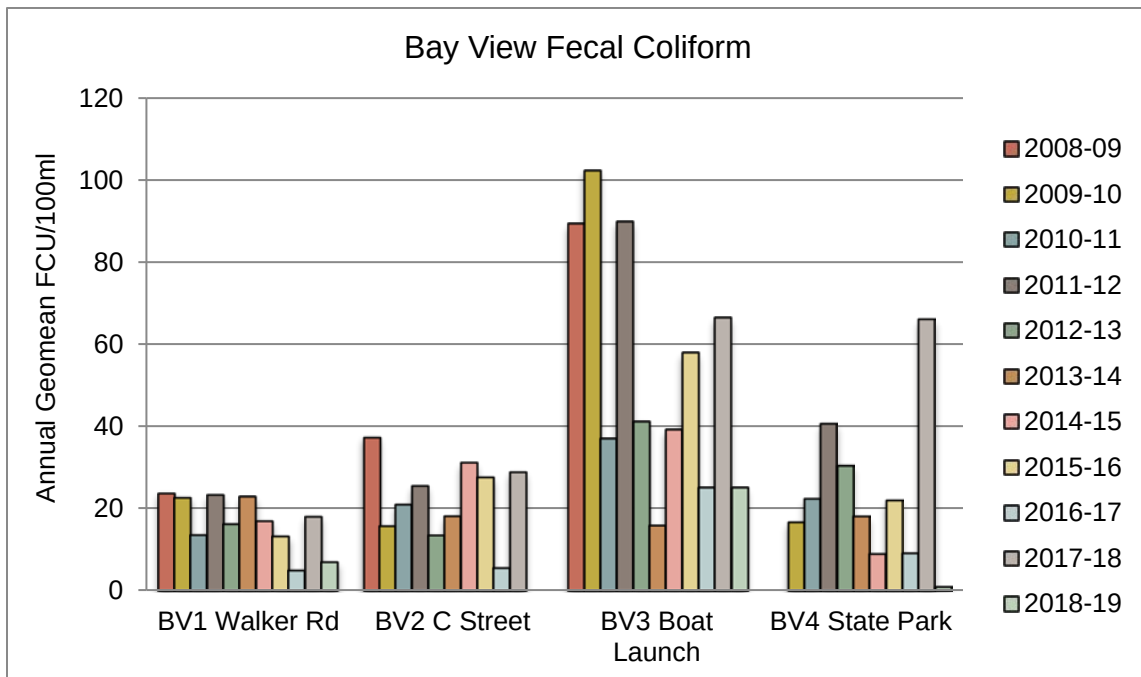


Figure 57. Bay View Drainage Fecal Coliform: Eleven-year comparison

Joe Leary Slough Results

Figures 58 through 65 below present results from Joe Leary Slough sampling.

Once again, dissolved oxygen levels were consistently below standards for all sites, even during the cold winter months.

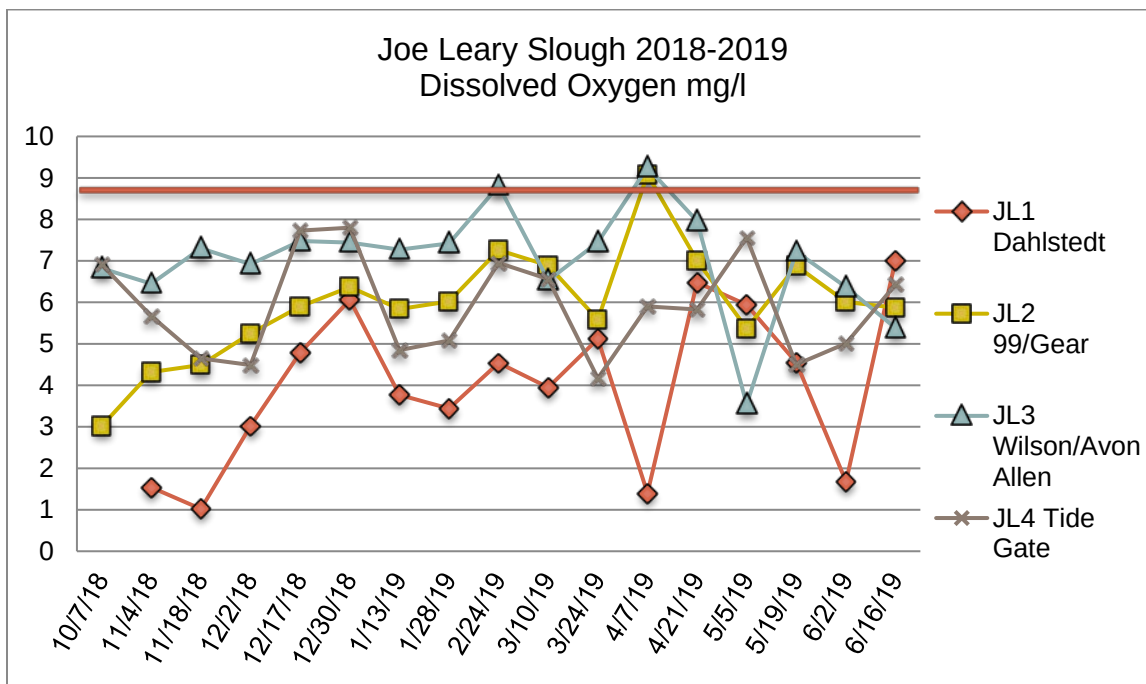


Figure 58. Joe Leary Slough DO: 2018-2019

Dissolved oxygen levels for all sites over the past ten years have been very low, with averages below the state standard of 8 mg/l. Standards are not based on average levels.

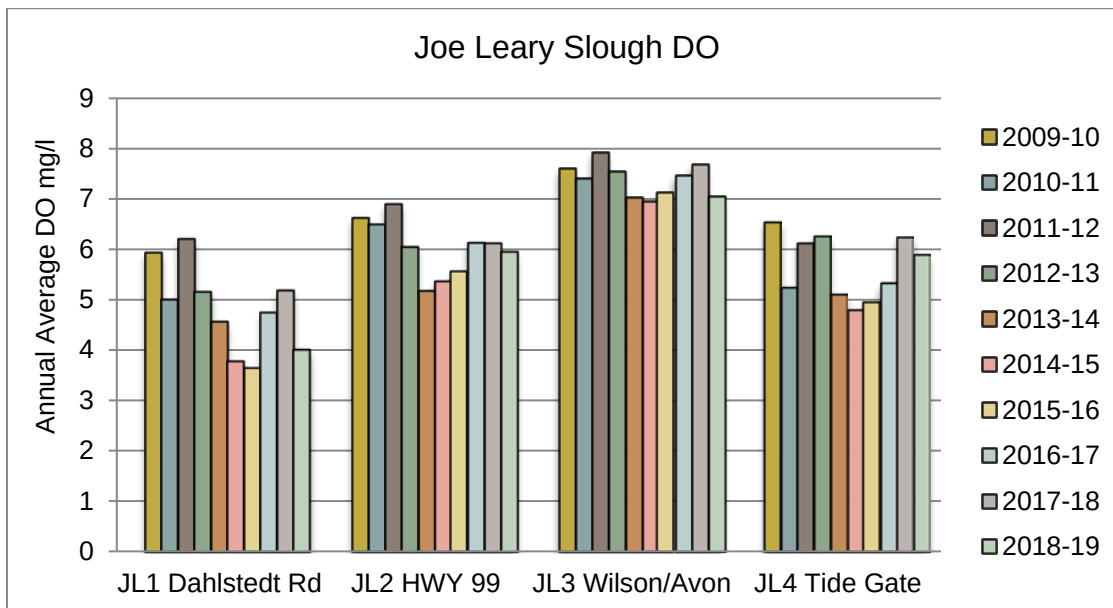


Figure 59. Joe Leary Slough DO: Eleven-year comparison

Sites 1, 3 and 4 temperatures were above 17.5 °C in June. No samples were taken during the warmest summer season when temperatures may have risen above the standard.

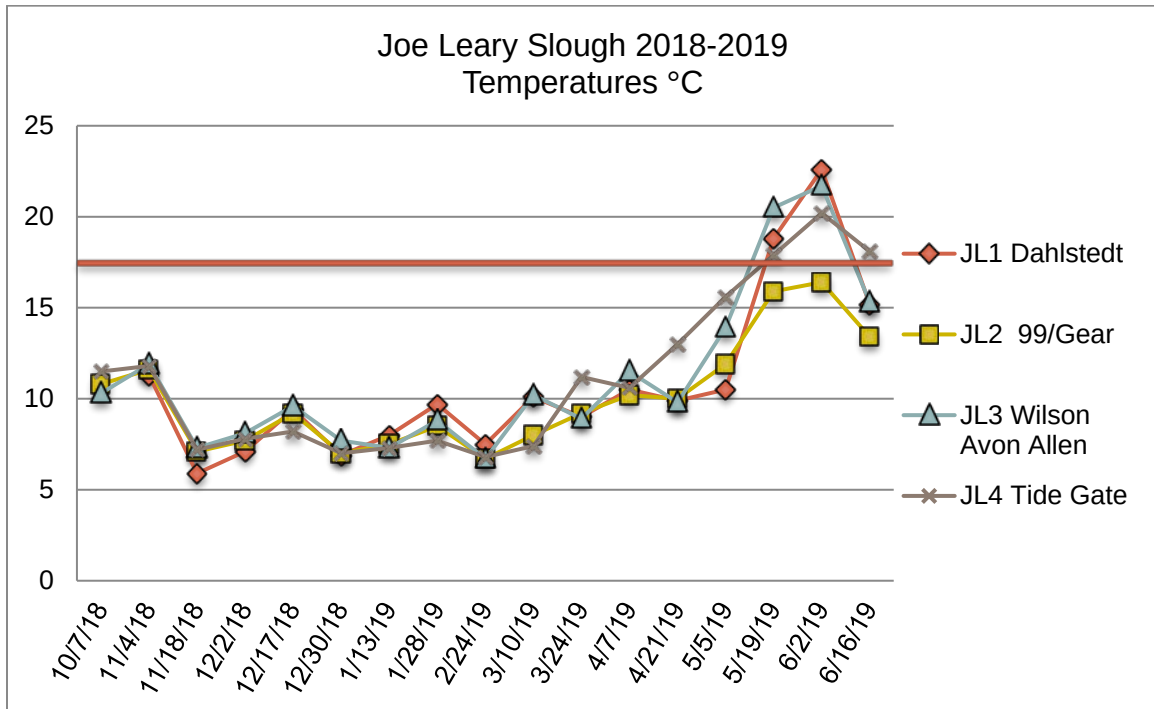


Figure 60. Joe Leary Slough Temperature: 2018-2019

Average annual temperatures (Figure 61 below) for all sites were similar to past years. Standards are not based on average temperature.

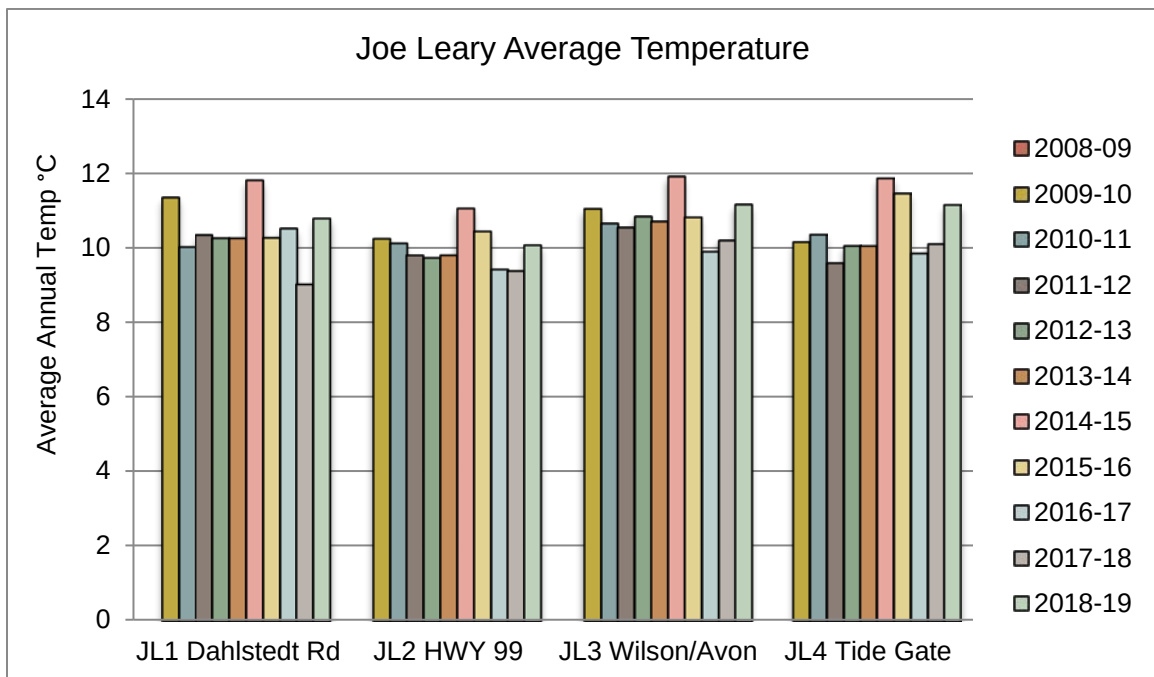


Figure 61. Joe Leary Slough Temperature: Eleven-year comparison

Joe Leary Slough maintains its distinction of having the highest turbidity of all the stream team sites.

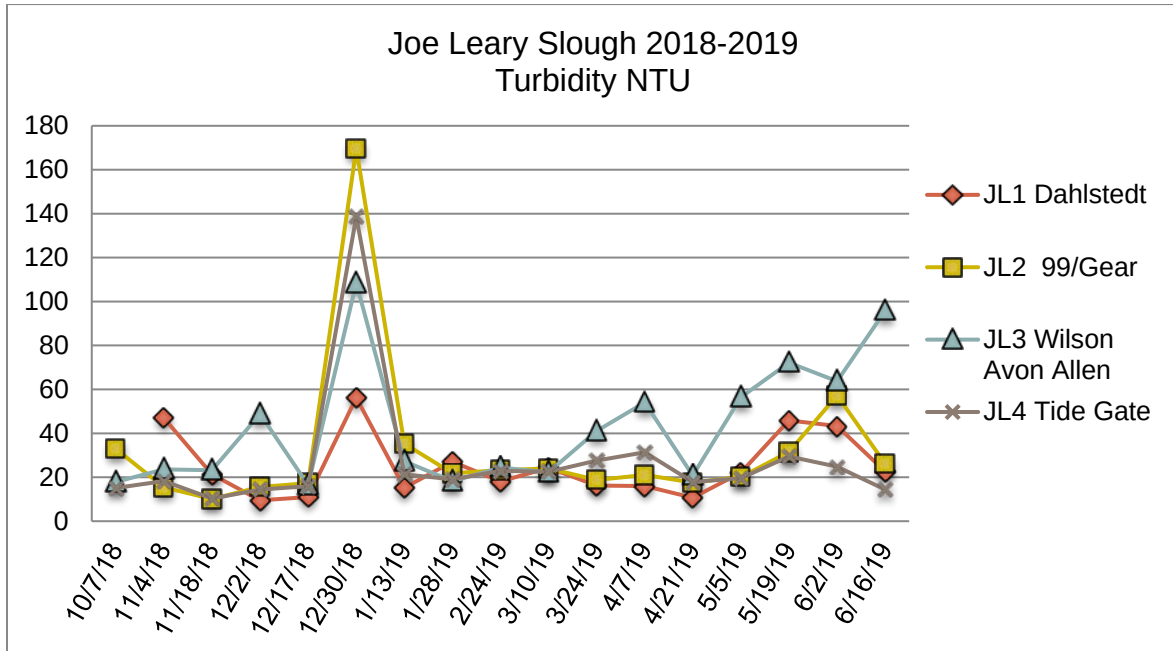


Figure 62. Joe Leary Slough Turbidity: 2018-2019

Average turbidity in Joe Leary Slough was lower than past years, but still very high relative to other streams.

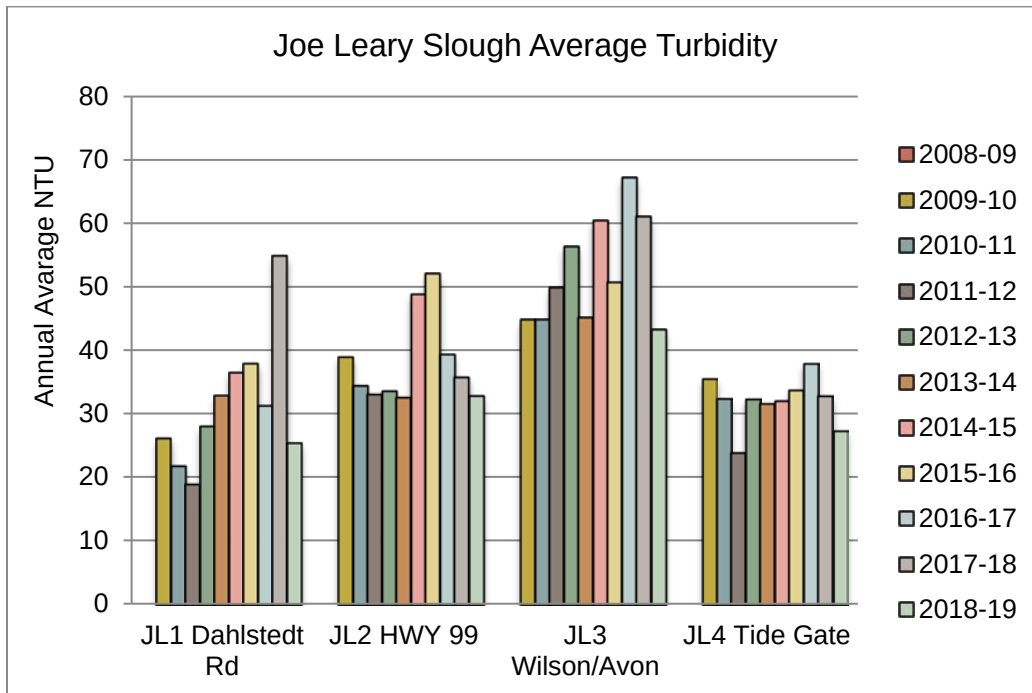


Figure 63. Joe Leary Slough Turbidity: Eleven-year comparison

In 2018-2019, as in the previous year, none of the Joe Leary Slough sites met Part II of the state standard for fecal coliform: more than 10% of the samples were higher than 200CFU/100ml. At Site 3, over half of the samples were higher than 200CFU/100ml.

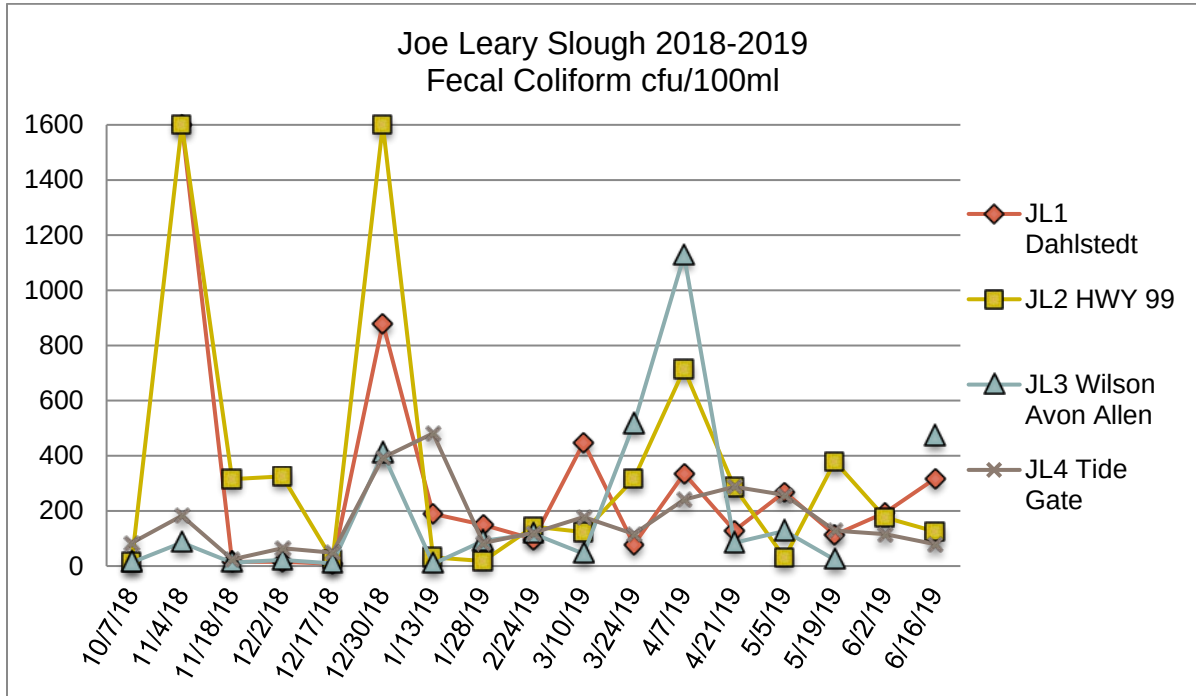


Figure 64. Joe Leary Slough Fecal Coliform: 2018-2019

Site 3 had an annual geomean of 70, and was the only site to meet this part of the standard.

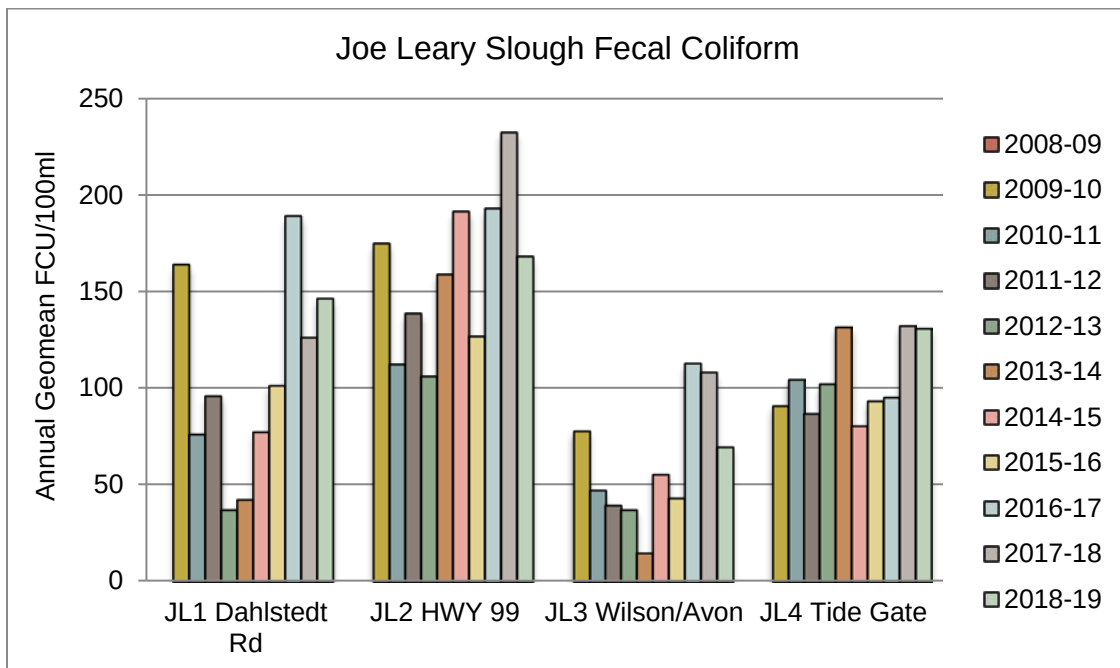


Figure 65. Joe Leary Slough Fecal Coliform: Eleven-year comparison

Trumpeter Basin Results

Figures 66 through 73 below present results from Trumpeter Basin sampling.

Dissolved oxygen levels dropped below the standard of 9.5mg/l at all sites.

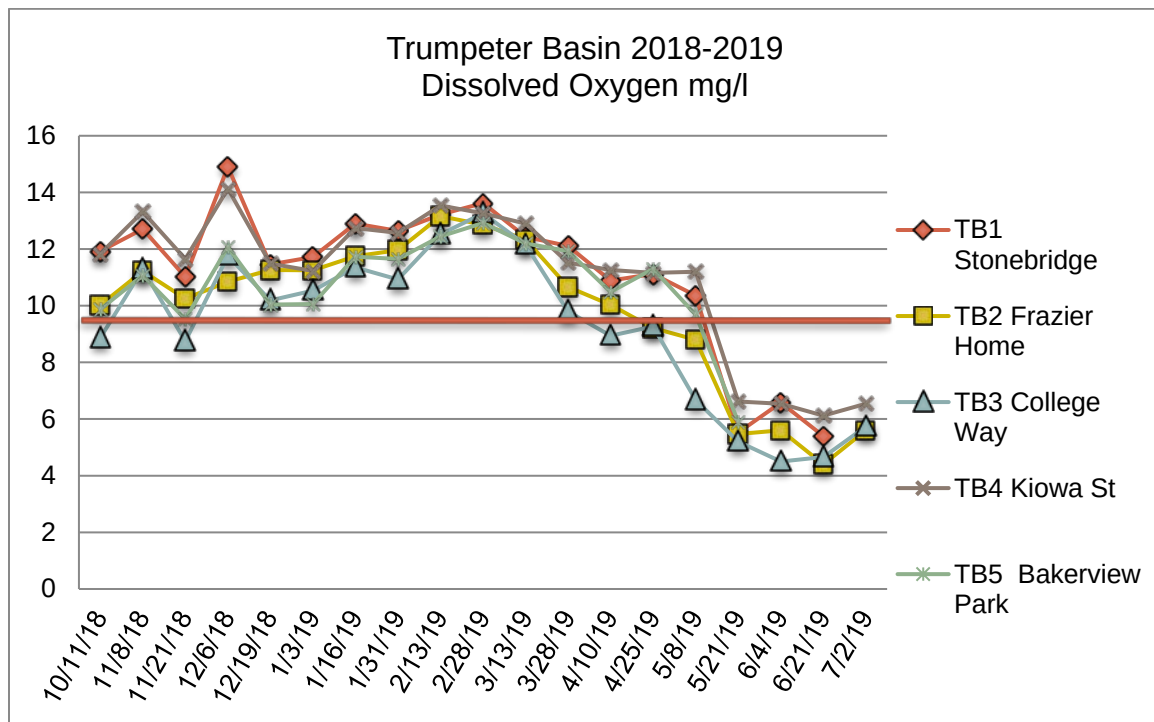


Figure 66. Trumpeter Basin DO: 2018-2019

Average annual dissolved oxygen levels (Figure 67 below) were similar lower at sites 1 and 3 than past years. State standards are not based on annual averages.

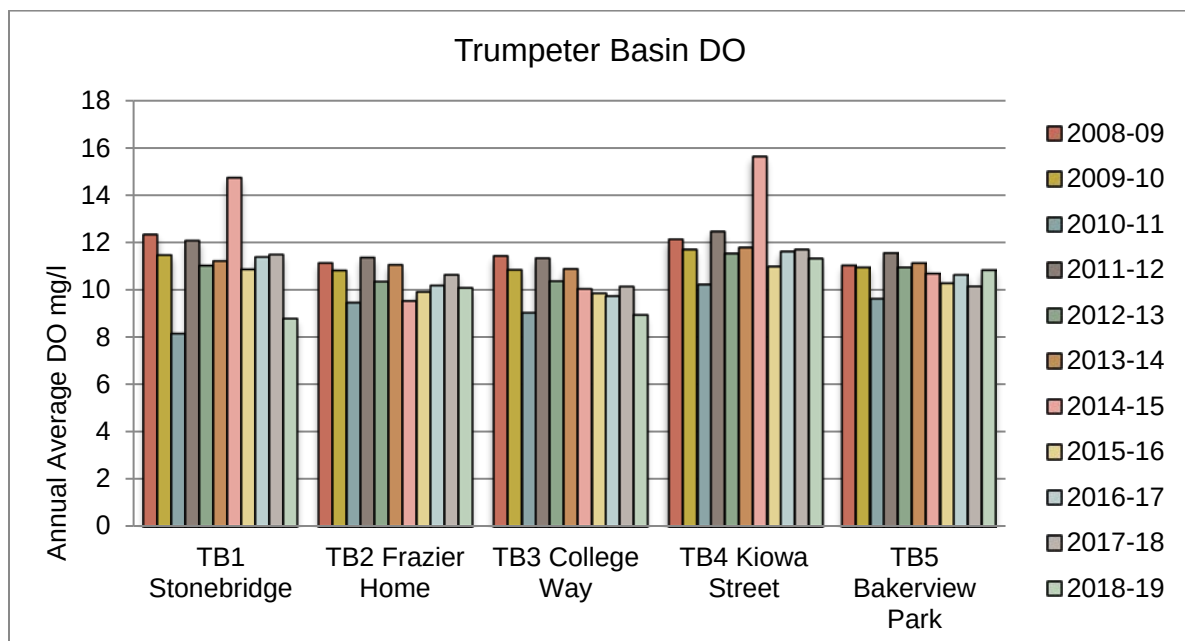


Figure 67. Trumpeter Basin DO: Eleven-year comparison

Temperature at Sites 2 went above the standard of 16°C at site 2 in June.

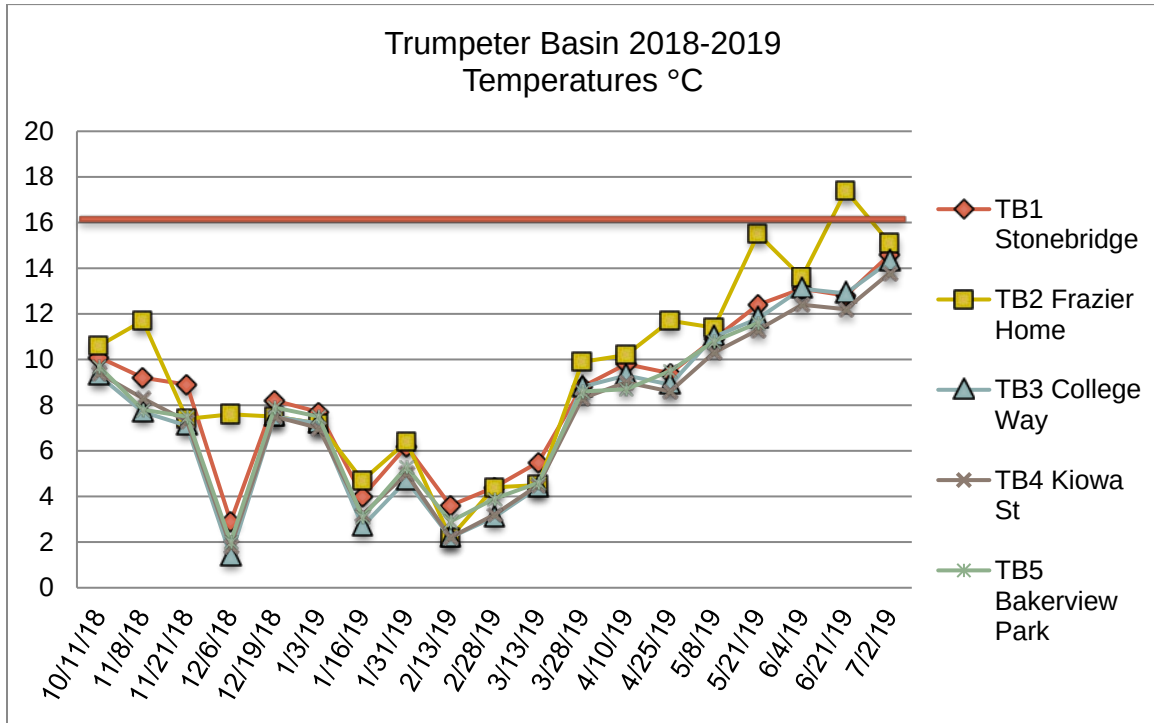


Figure 68. Trumpeter Basin Temperature: 2018-2019

Average temperatures were nearly the same as last year. State standards are not based on the annual averages.

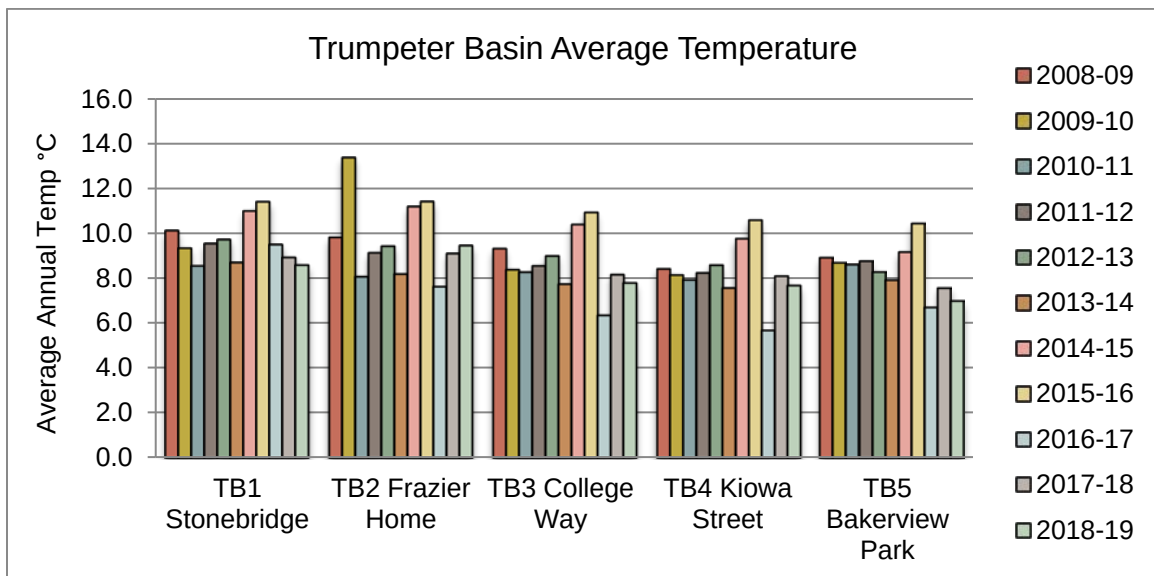


Figure 69. Trumpeter Basin Temperature: Eleven-year comparison

Turbidity levels for Trumpeter Basin were again highest at site 2.

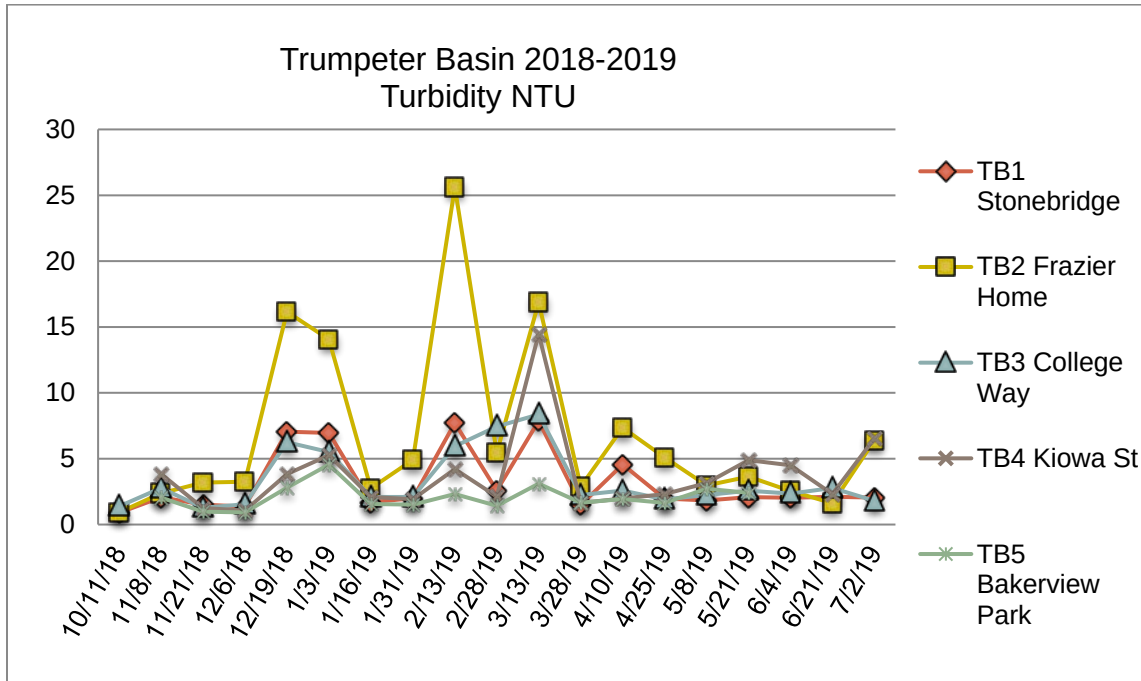


Figure 70. Trumpeter Basin Turbidity: 2018-2019

Turbidity levels in Trumpeter Basin (Figure 71 below) continued to drop compared with past years.

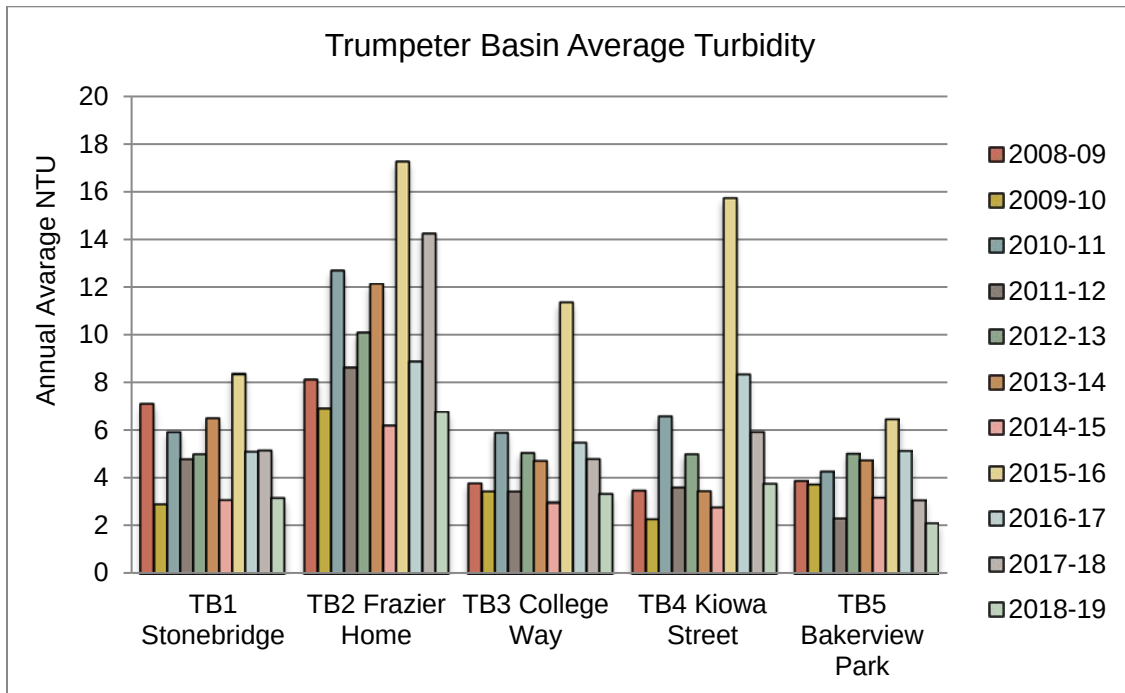


Figure 71. Trumpeter Basin Turbidity: Eleven-year comparison

While last year, all sites passed the standard of <10% of counts under 200 CFU/100ml, this year none of them passed.

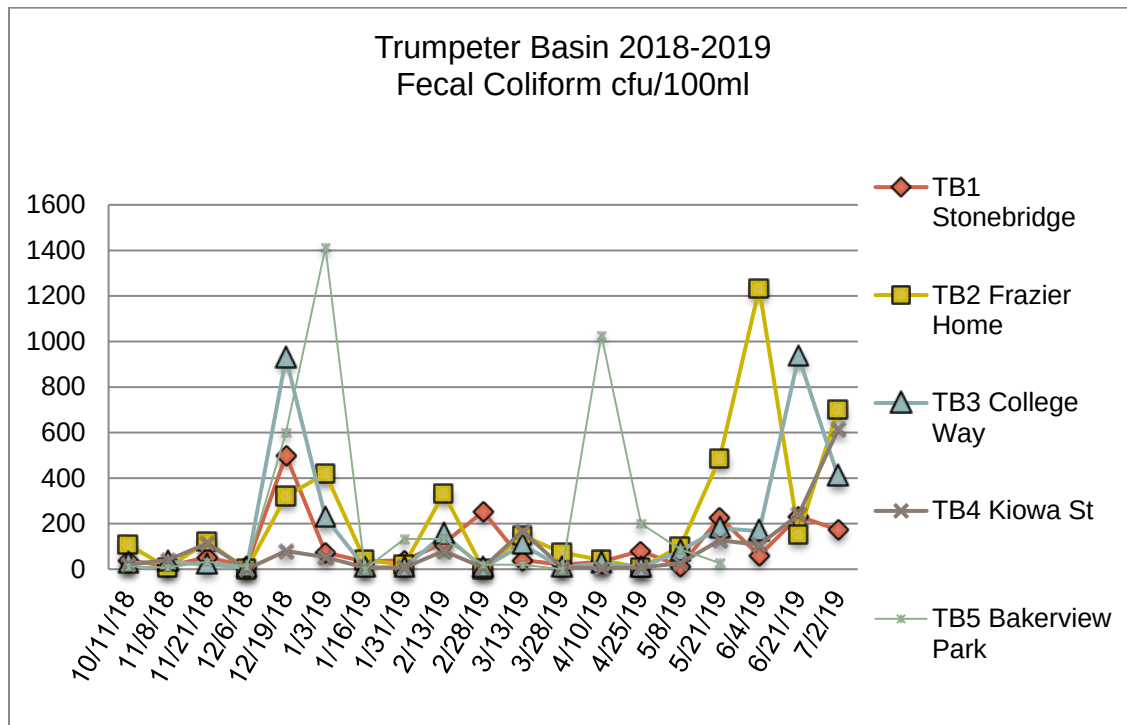


Figure 72. Trumpeter Basin Fecal Coliform: 2018-2019

Fecal coliform geometric means for 2018-2019 were again lower than the high numbers in the past. (Figure 73 below) All Sites met Part I of the state standard: geometric mean <100CFU/100ml.

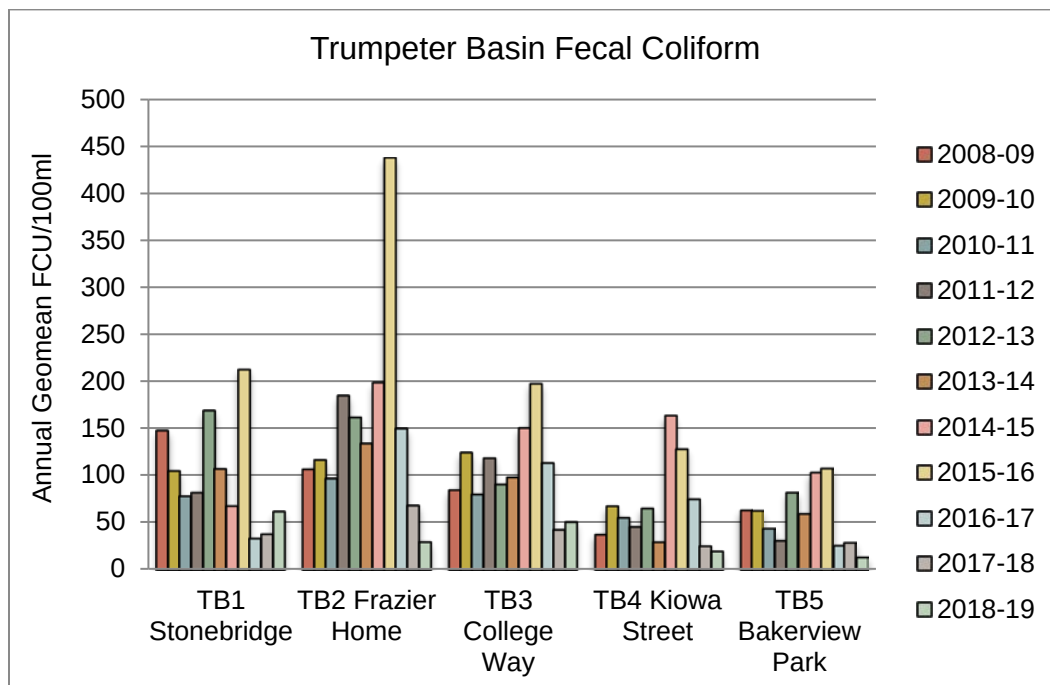


Figure 73. Trumpeter Basin Fecal Coliform: Eleven-year comparison

Kulshan Creek Results

Figures 74 through 81 below present results from Kulshan Creek sampling.

As in past years, dissolved oxygen in all Kulshan Creek sites went below the state standard of 9.5mg/l during this sampling season. Site 3 was never above the standard.

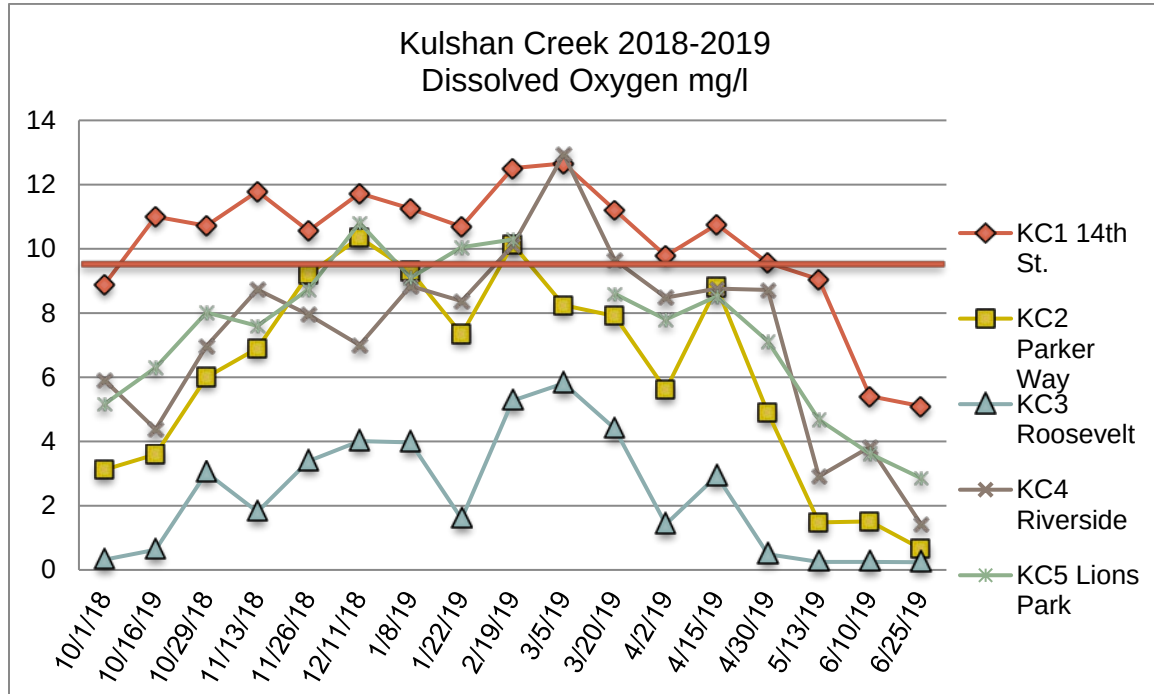


Figure 74. Kulshan Creek DO: 2018-2019

Average dissolved oxygen levels show how big this problem is. Dissolved oxygen should not drop below 9.5 mg/l even once. Standards are not based on annual average measurements.

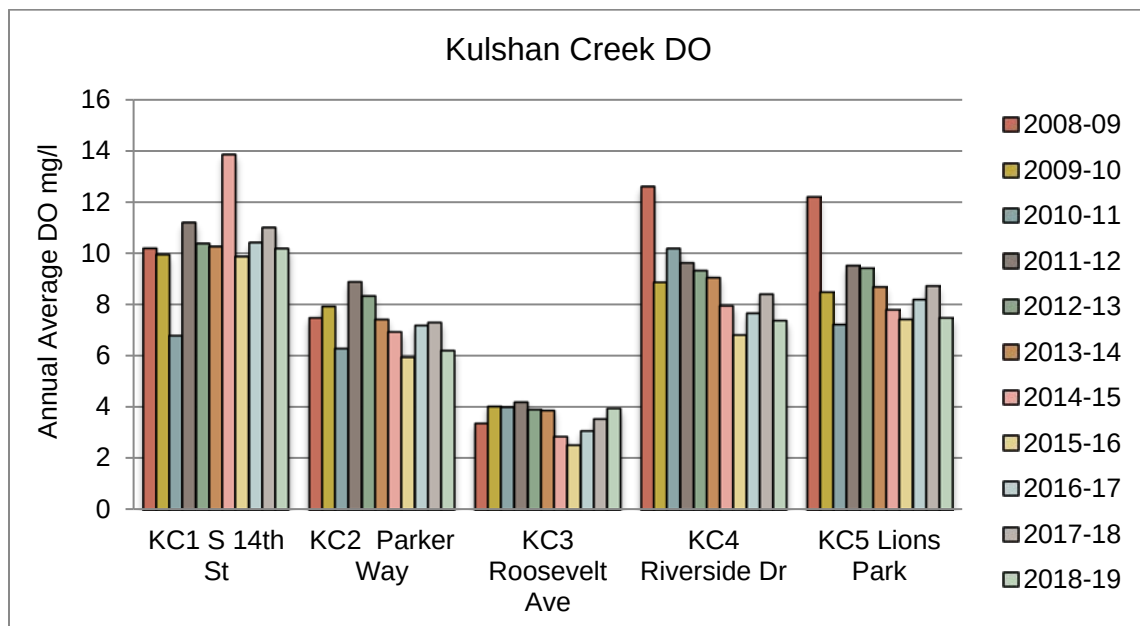


Figure 75. Kulshan Creek DO: Eleven-year comparison

All sites started the year above 16°C and rose again in May. Kulshan Creek was not monitored after July 10 when temperatures may have been even warmer.

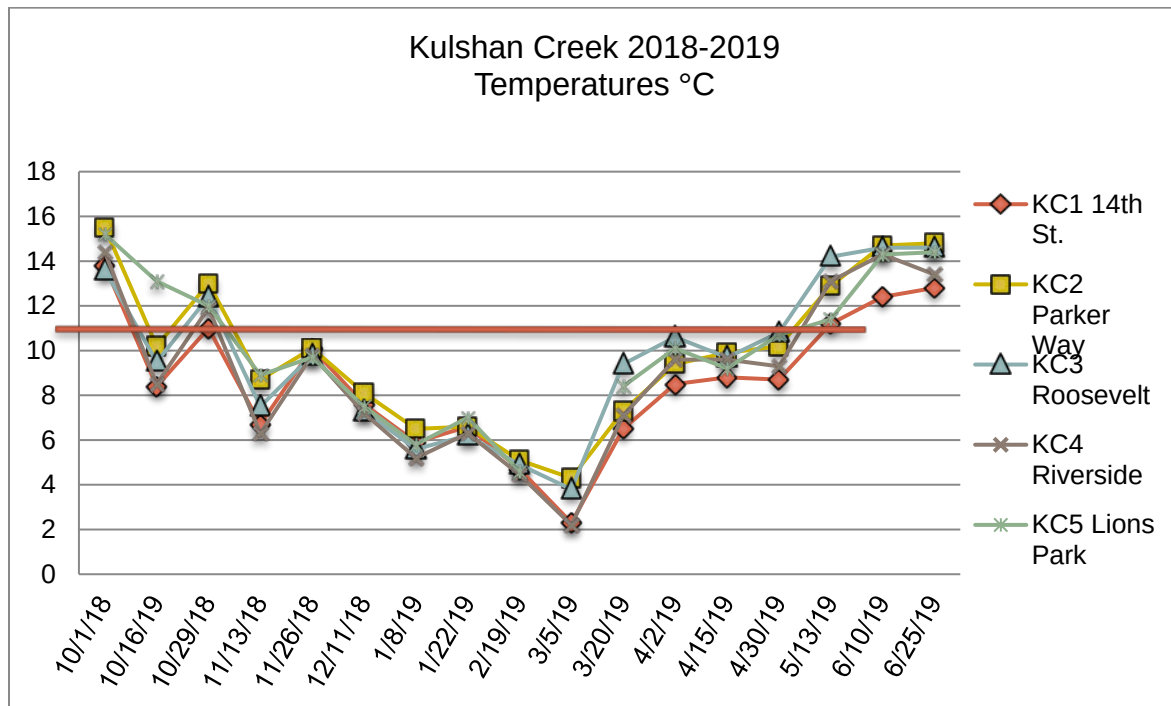


Figure 76. Kulshan Creek Temperature: 2018-2019

Average temperatures are shown for comparison.

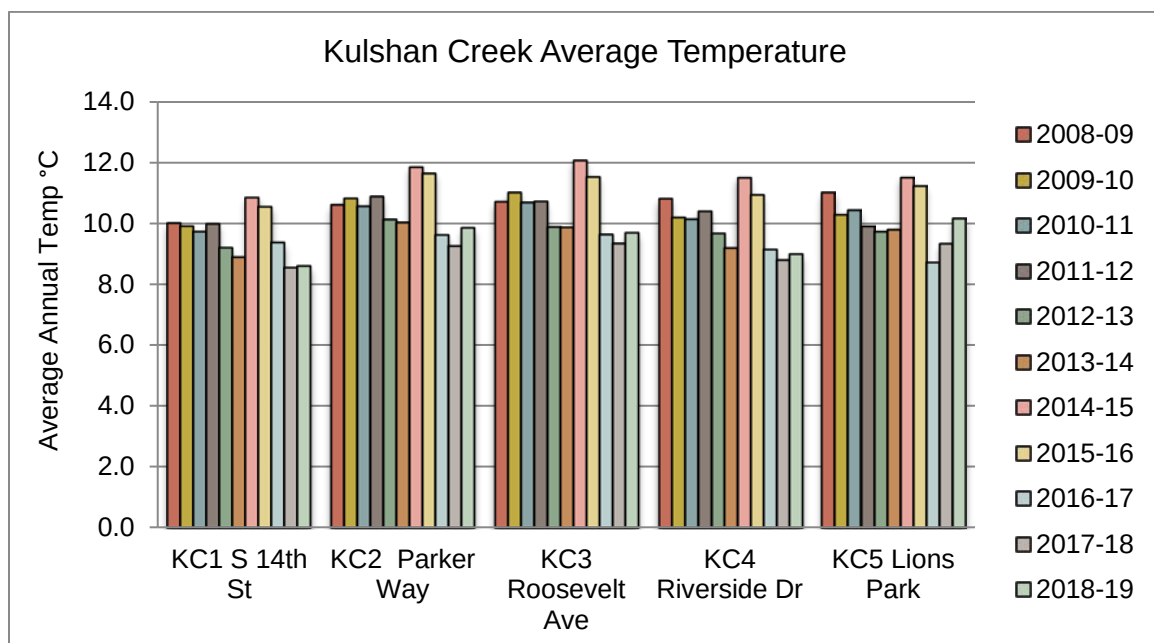


Figure 77. Kulshan Creek Temperature: Eleven-year comparison

Turbidity for Kulshan Creek was generally lower than most streams, with just one December spike.

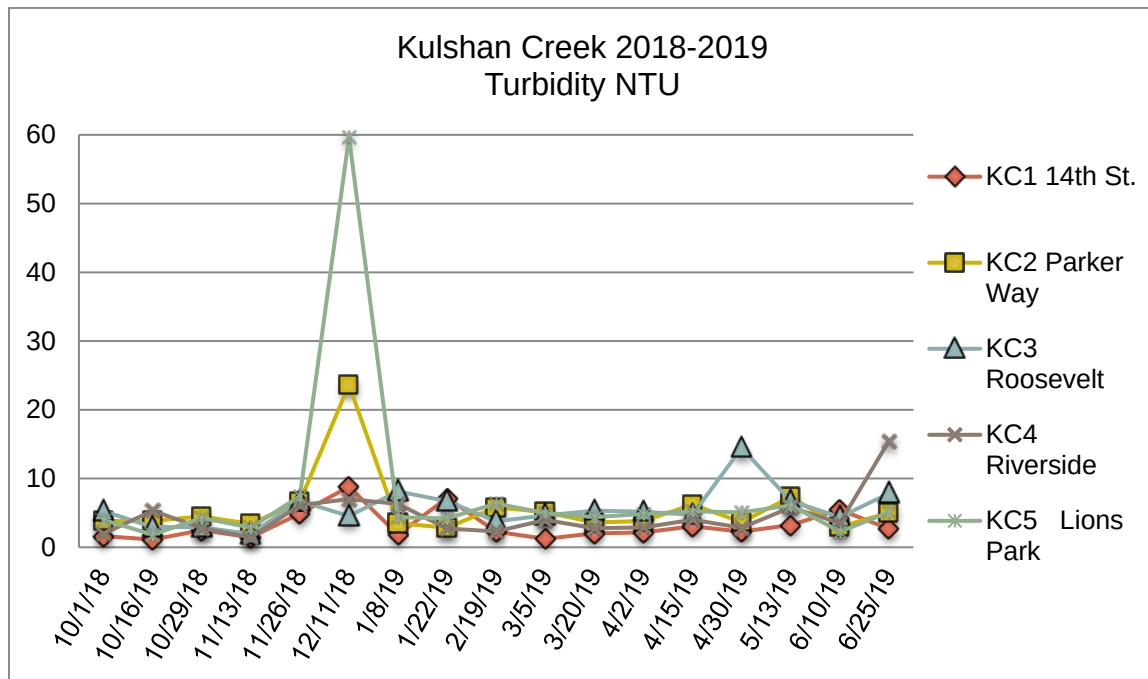


Figure 78. Kulshan Creek Turbidity: 2018-2019

Average turbidity in Kulshan Creek (Figure 79 below) was very low.

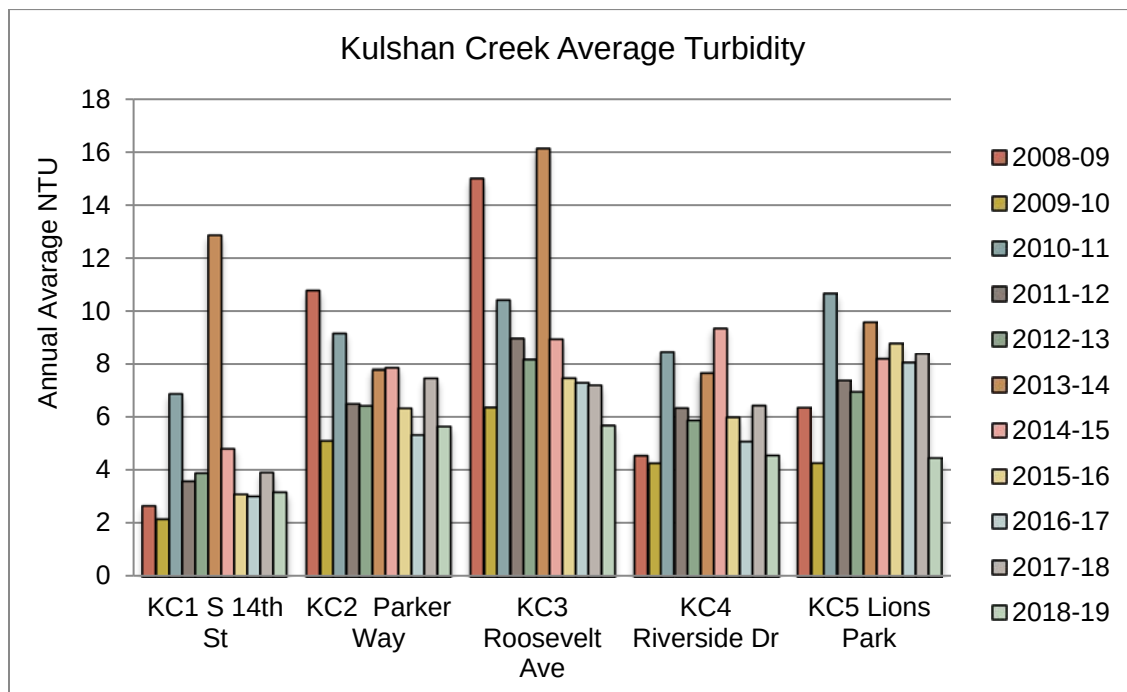


Figure 79. Kulshan Creek Turbidity: Eleven-year comparison

As in previous years, fecal coliform counts in Kulshan Creek were highly variable throughout the year. Site 4 had no samples over 200 CFU/100ml.

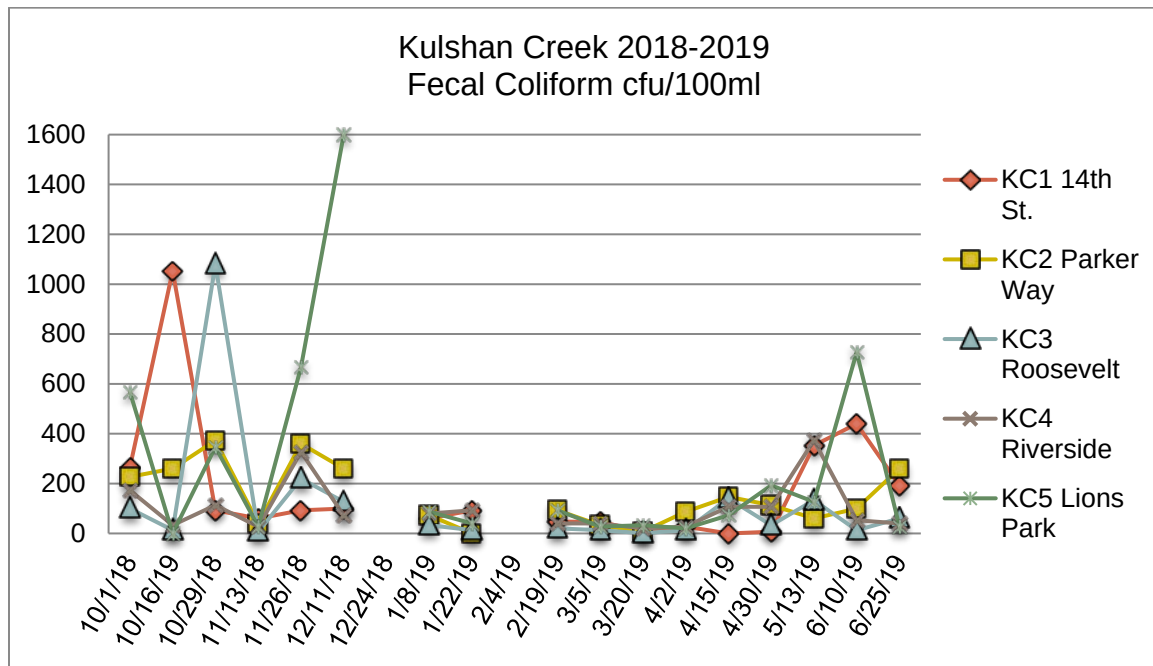


Figure 80. Kulshan Creek Fecal Coliform: 2018-2019

All sites met the standard of <100 CFU/100ml.

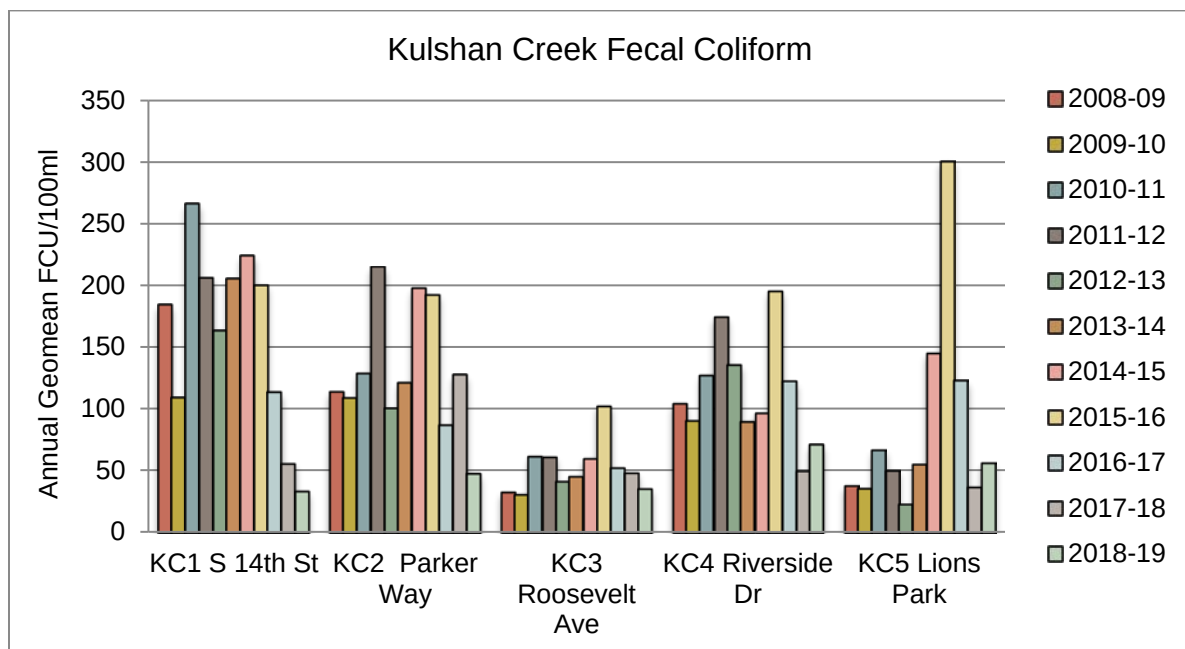


Figure 81. Kulshan Creek Fecal Coliform: Eleven-year comparison

Ace of Hearts/Happy Valley Creeks

Figures 82 through 91 below present results from Ace of Hearts and Happy Valley Creek sampling. This was the third year of sampling these sites.

Dissolved oxygen for all sites was above the standard throughout the sampling season, but it was not monitored during the warmest months.

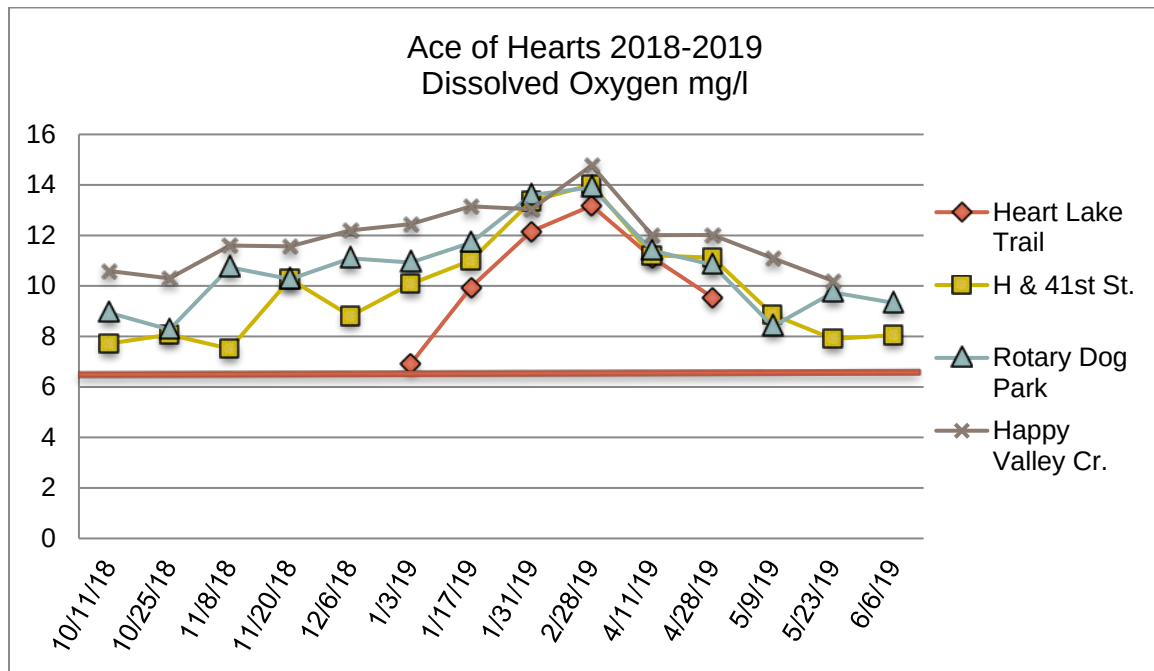


Figure 82. Ace of Hearts DO: 2018-2019

Average dissolved oxygen levels were lower than the past 2 years.

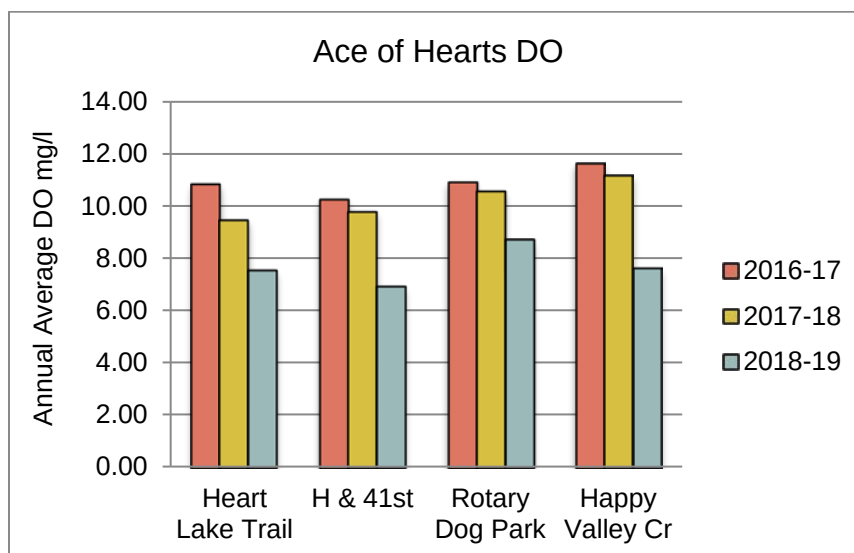


Figure 83. Ace of Hearts Average DO

Temperatures at all sites stayed below 17.5 °. Ace of Hearts sites were not sampled in summer months because water dries up completely.

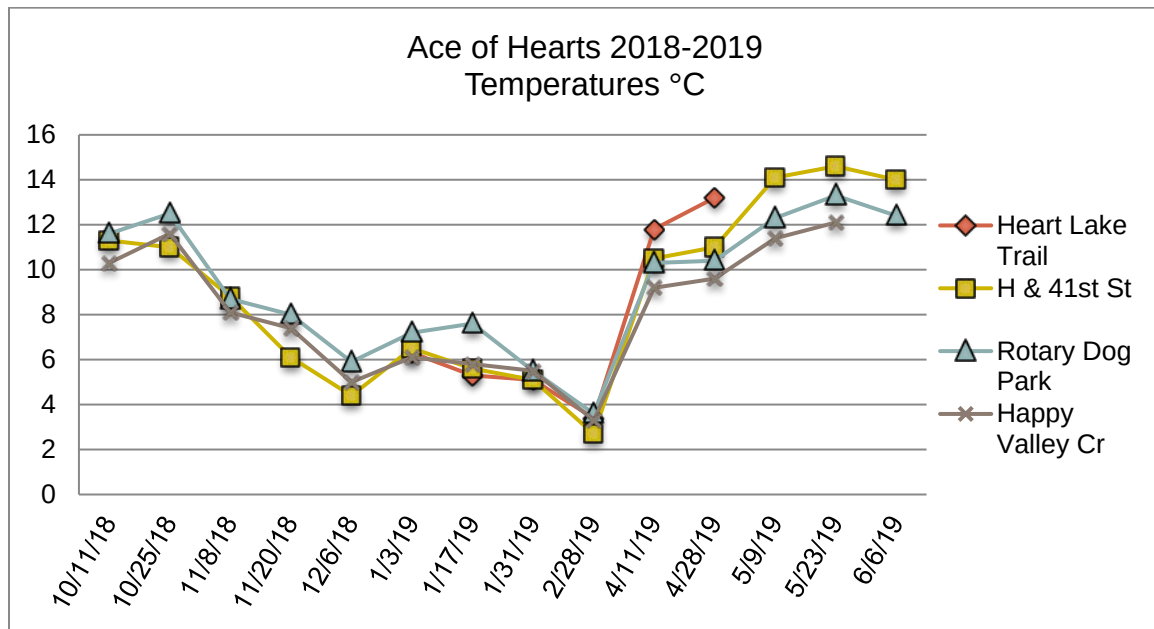


Figure 84. Ace of Hearts Temperature: 2018-2019

Average annual temperatures (Figure 85 below) are shown for comparison, and are not related to state standards.

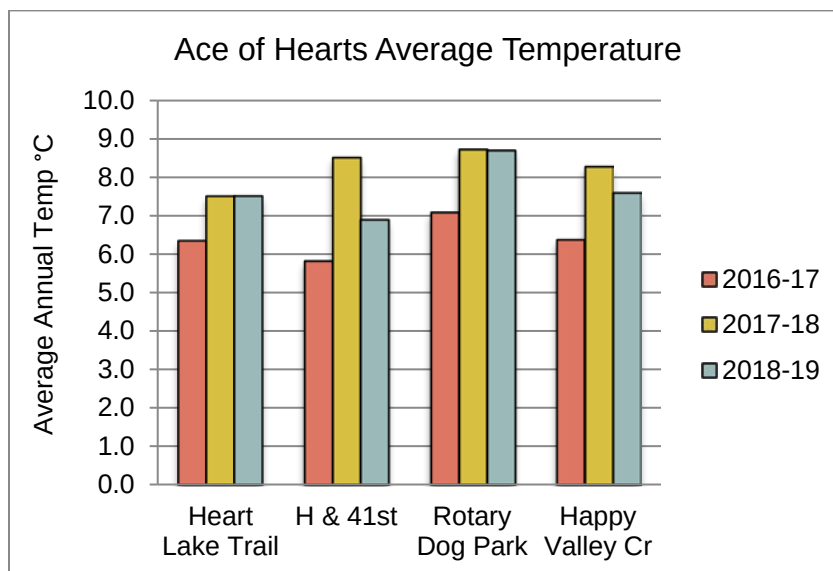


Figure 85. Ace of Hearts Average Temperature

Turbidity levels for Ace of Heart and Happy Valley Creeks were relatively low at all sites.

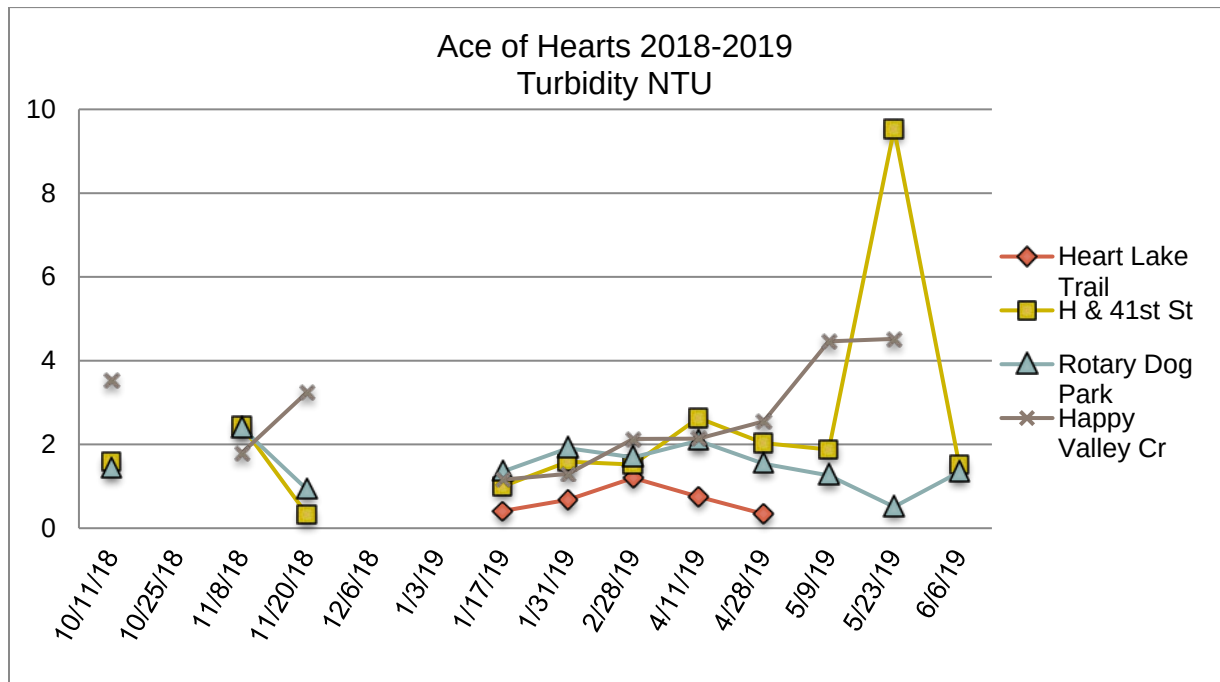


Figure 86. Ace of Hearts Turbidity: 2018-2019

Average turbidity levels were the lowest in three years.(Figure 87 below)

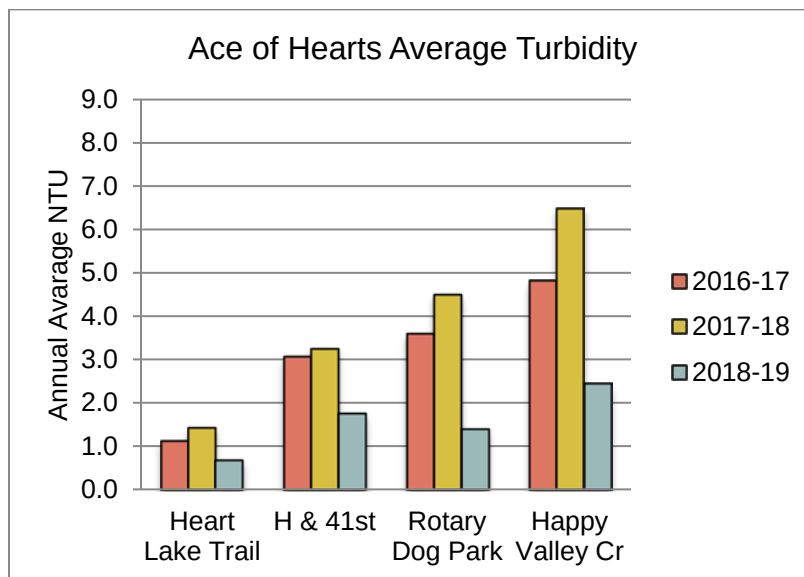


Figure 87. Ace of Hearts Average Turbidity

Sites 1 and 2 met Part II of the standard, with fewer than 10% of the counts higher than 200CFU/100ml.

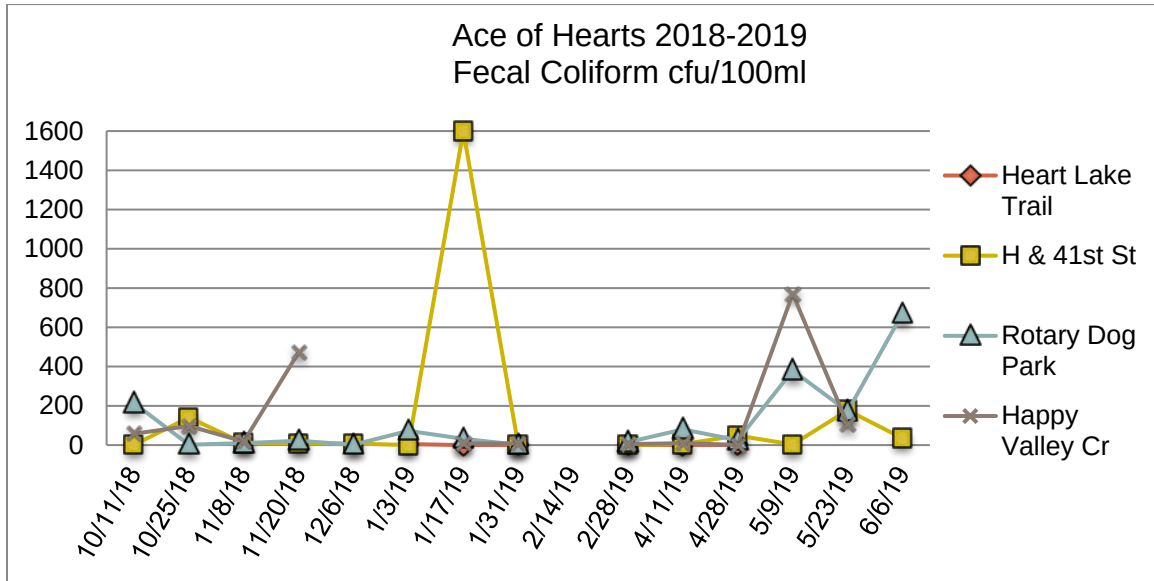


Figure 88. Ace of Hearts Fecal Coliform: 2018-2019

Geometric means (Figure 89 below) for all Ace of Hearts sites were lower than the 100 CFU/100ml standard.

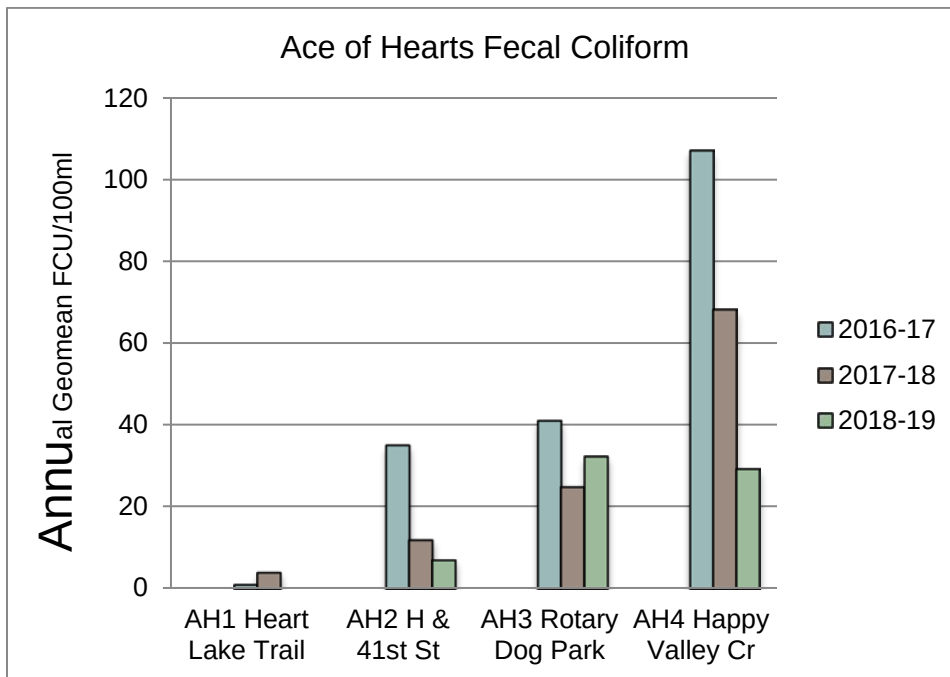


Figure 89. Ace of Hearts Fecal Coliform: Annual Geomean

Gages Slough Results

Figures 90 through 104 below present results from Gages Slough sampling. Site GS4 was moved in 2013-14 because of changes to public access, and was renamed GS4A. This stream is monitored every four weeks.

Dissolved oxygen at all Gages Slough sites was below the standard throughout the year, including December and January when cold water temperatures usually increase DO.

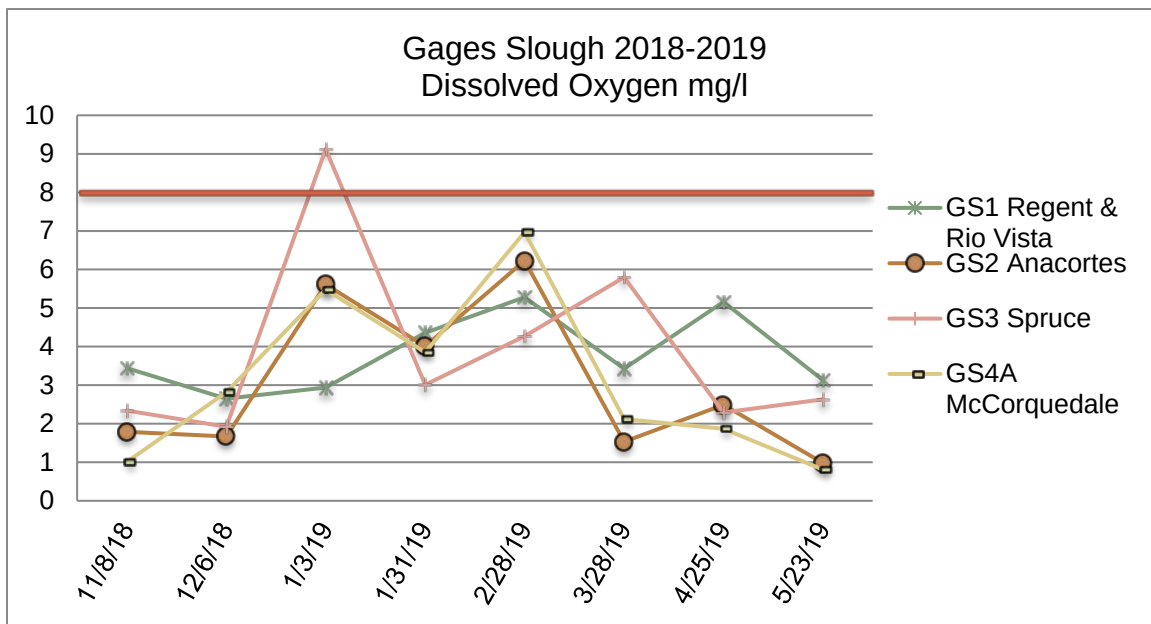


Figure 90. Gages Slough DO: 2018-2019

Dissolved oxygen levels have been decreasing steadily in the ten years of monitoring, and are well below the standard. This is a slow moving stream that dries up completely in summer.

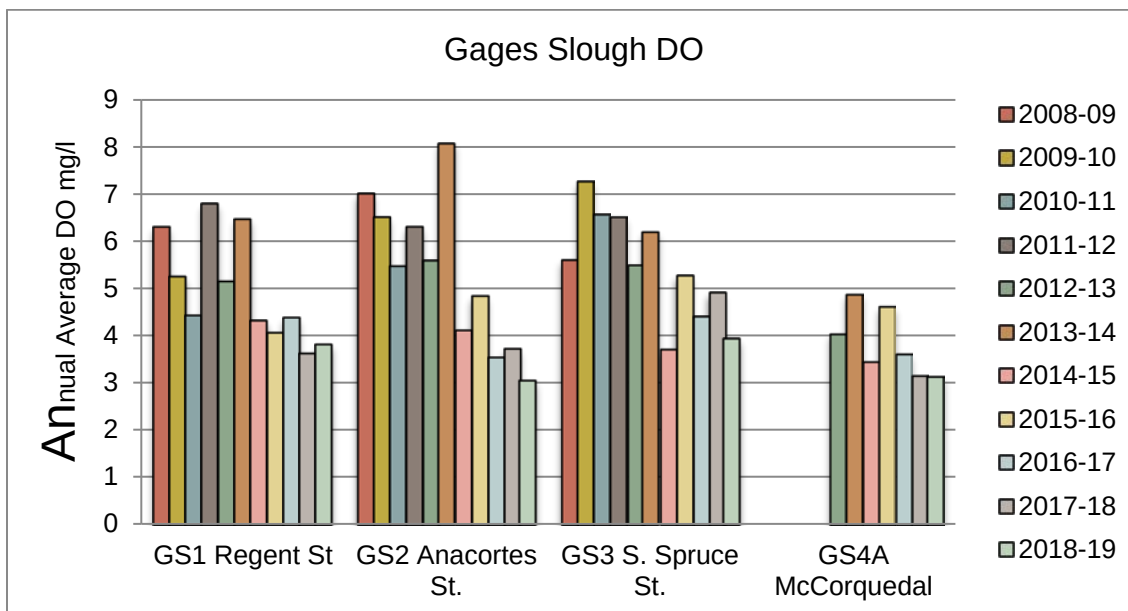


Figure 91. Gages Slough DO: Eleven-year comparison

All Gages Slough sites were cooler than 17.5°C throughout the sampling period, with a single exception at Site 3. Sites were not sampled in the warmest months.

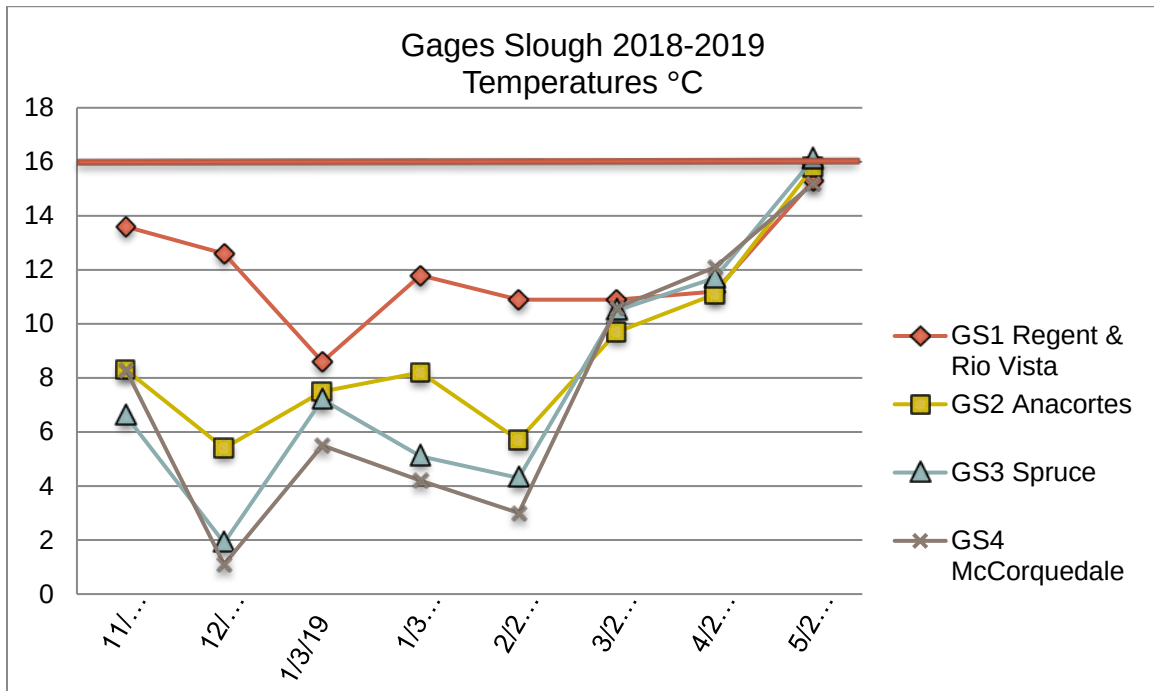


Figure 92. Gages Slough Temperature: 2018-2019

Average temperatures in Gages Slough were cooler than last year. The state standard is not based on average temperature.

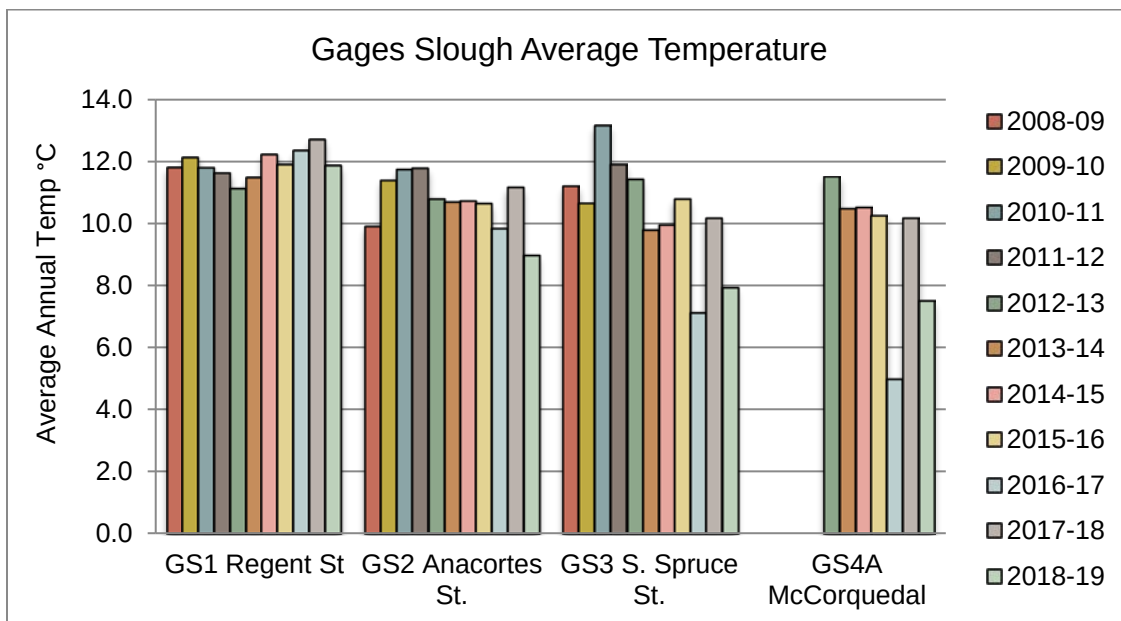


Figure 93. Gages Slough Temperature: Eleven-year comparison

Site 2 again had the highest turbidity levels.

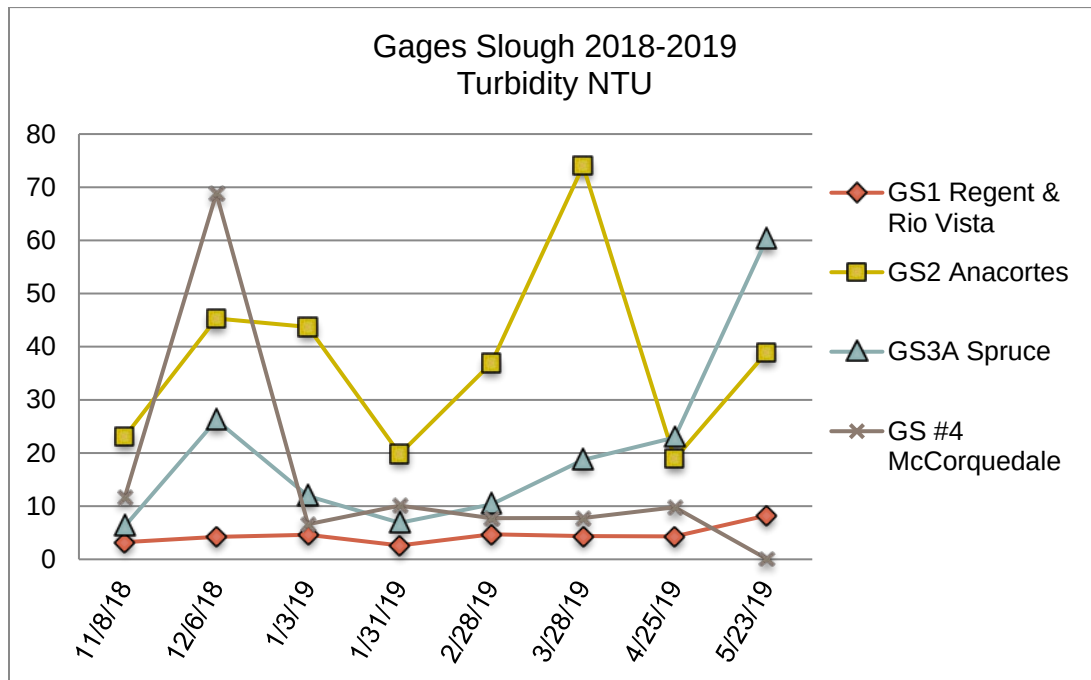


Figure 94. Gages Slough Turbidity: 2018-2019

Sites 2-4 remained high in 2018-2019.

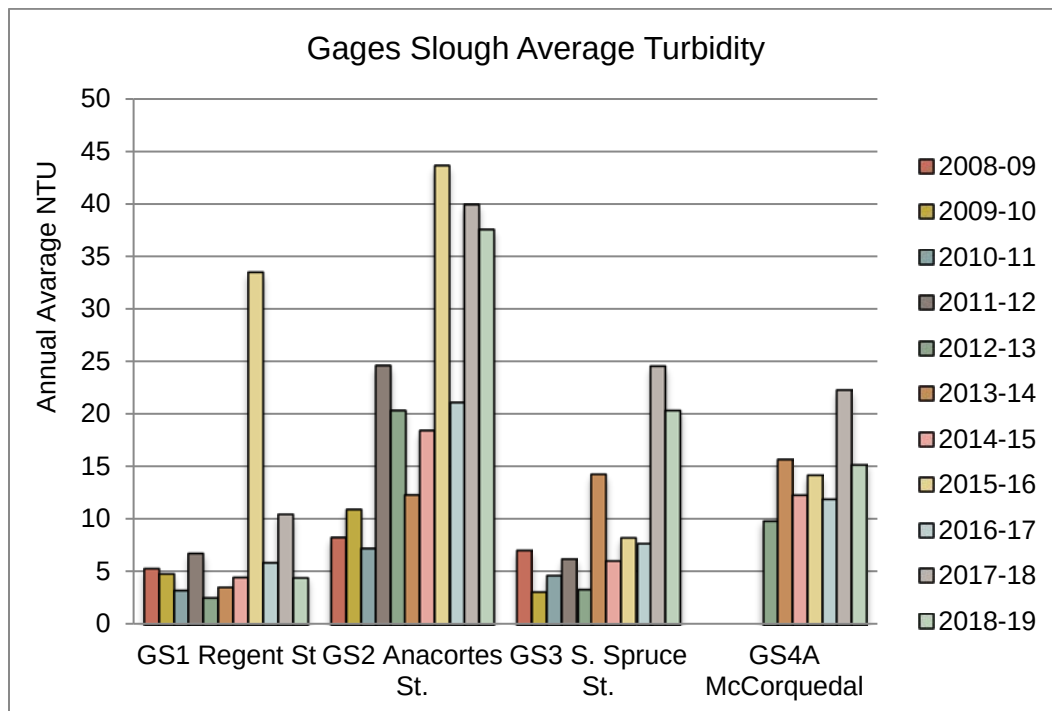


Figure 95. Gages Slough Turbidity: Eleven-year comparison

All sites had more than 10% of the samples >200CFU.100 ml. Note that there were just 8 samples taken this year.

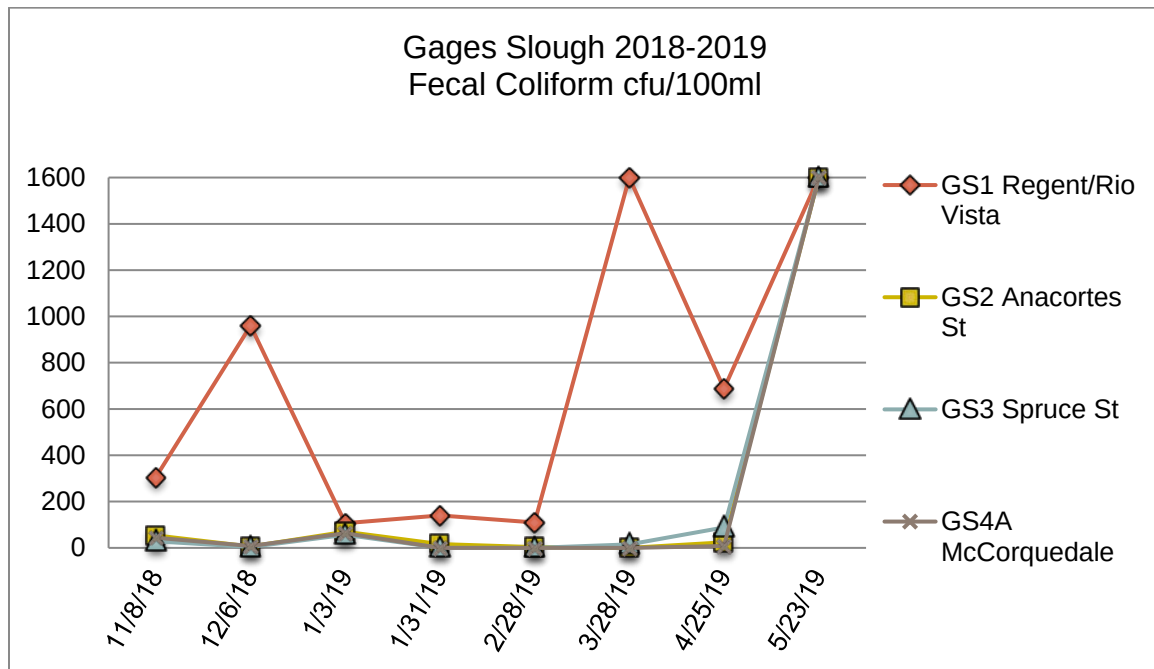


Figure 96. Gages Slough Fecal Coliform: 2018-2019

In spite of very high numbers in May, Sites 2-4 met Part 1 standard with annual geometric mean less than 100CFU 100ml, though the standard requires at least 10 samples.

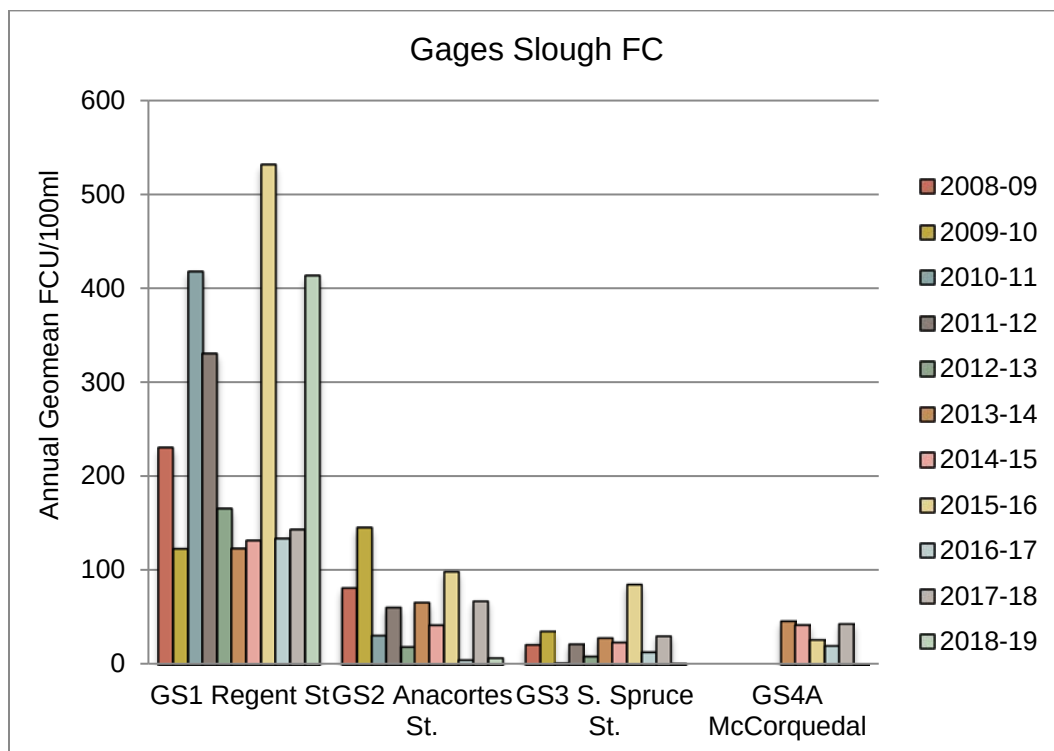


Figure 97. Gages Slough Fecal Coliform: Eleven-year comparison

Stream Team 2018-2019 Summary

Figures 98-101 below show annual averages for each parameter at all sites. While it is interesting to compare watersheds, it is important to note that each water body has unique characteristics that naturally influence water quality. Variation is normal, and what might be considered "healthy" for water backed up behind a tide gate might not be healthy for a small wooded stream in the Upper Nookachamps.

For dissolved oxygen, (Figure 98) a number of sites have annual averages below 8mg/l. Considering regulations do not allow even one occurrence of levels below the standard, it is clear that these sites are in need of attention. Upper Nookachamps 1, all Joe Leary sites, Kulshan Creek 2 and all Gages Slough sites have low DO levels.

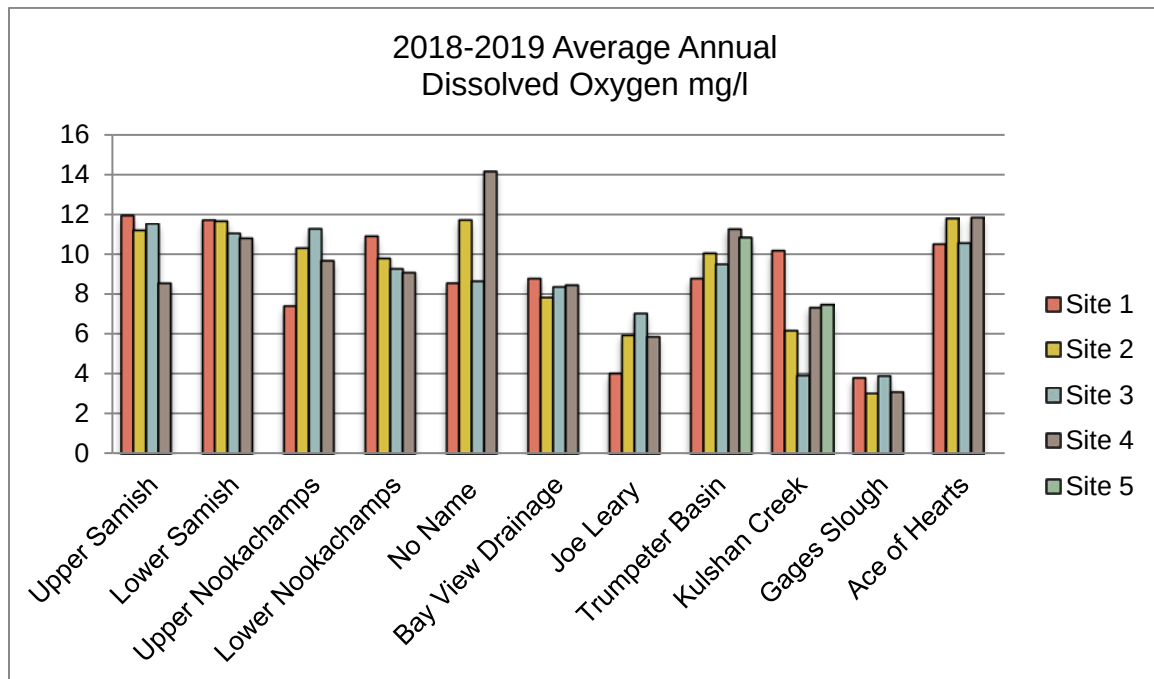


Figure 98. Annual Average Dissolved Oxygen: All sites

Figure 99 (next page) shows average temperature. State standards are not based on annual average temperatures, but on the average 7-day maximum. Most sites were not sampled during the warm summer season.

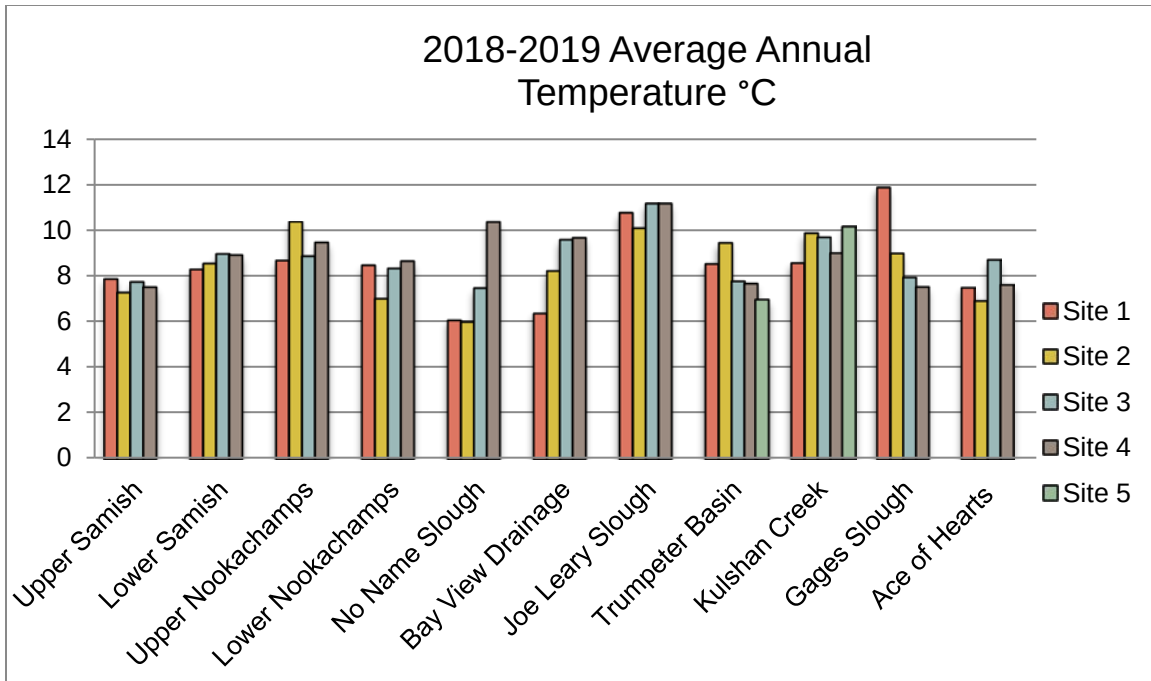


Figure 99. Annual Average Temperature: All sites

Turbidity is the parameter with the greatest naturally occurring variability. Comparing all streams, Gages Slough Site 2, and Joe Leary Slough stand out. All Joe Leary sites are 2-3 times higher than most other sites. Along much of Joe Leary's course, it drains cultivated cropland and is periodically dredged to improve drainage.

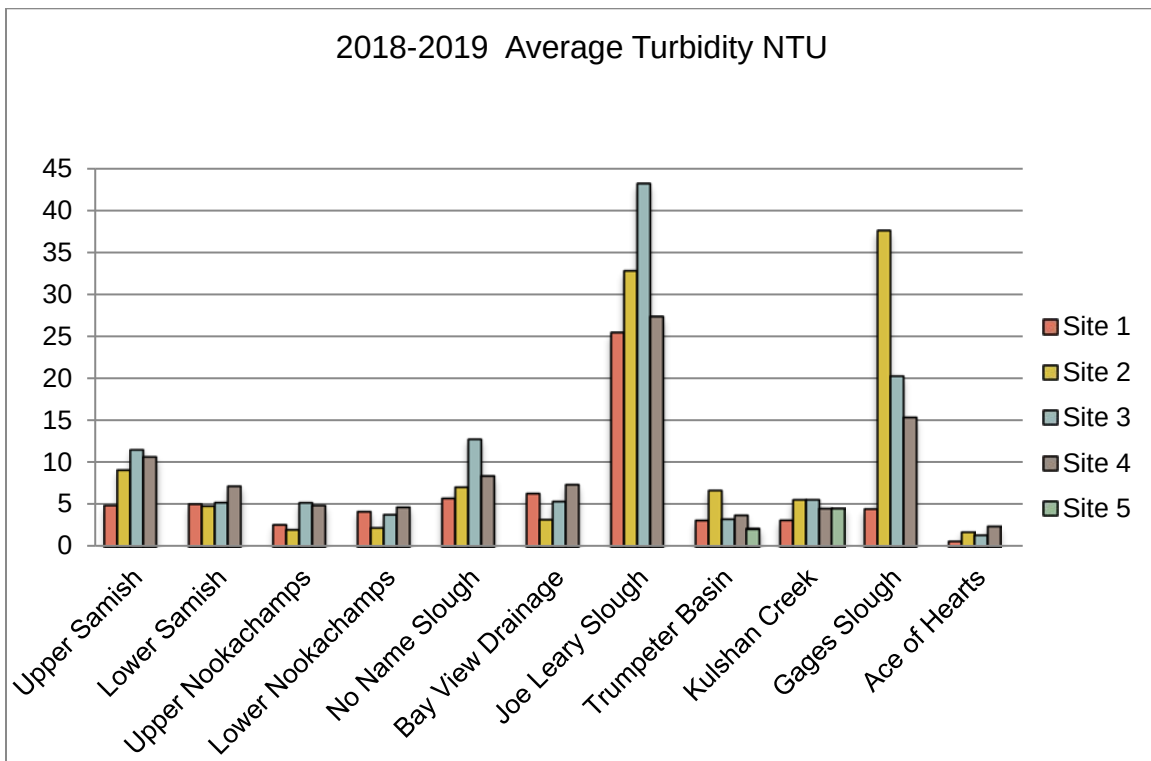


Figure 100. Annual Average Turbidity: All sites

Fecal coliform (Figure 101) is the parameter of greatest interest to regulators, health officials, and shellfish growers. In 2015-2016, 18 out of 46 sites did not meet Part I of the standard. In 2016-2017, 13 out of 46 sites averaged above 100CFU/100ml. In 2017-2018 only 9 out of 46 sites did not meet the standard. This year, 2018-2019, 10 out of 46 sites did not meet Part 1. No Name Slough has historically had very high fecal coliform numbers, and hovered close to the standard this year. Like last year, Upper Samish 3, all Joe Leary Slough sites, Kulshan Creek Site 2, and Gages Slough Site 1 all failed to meet Part 1 of the State Standard.

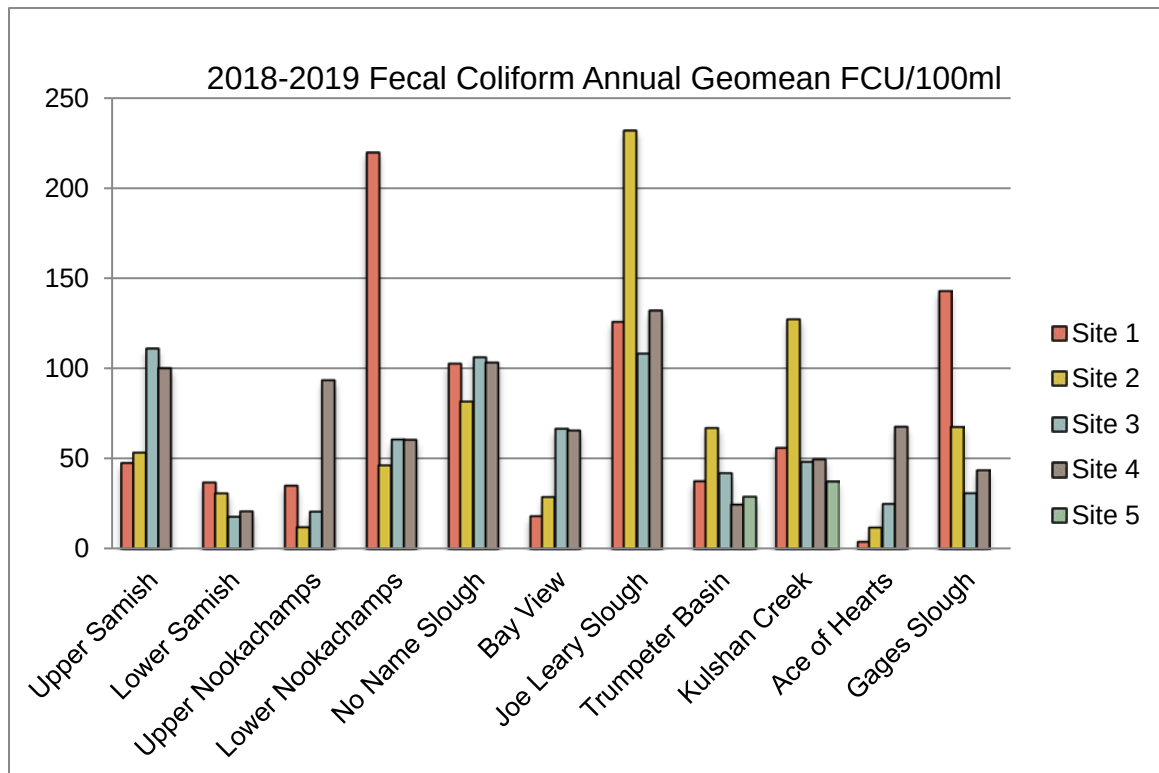


Figure 101. Fecal Coliform Annual Geomean: All sites

Table 11 below shows each site and whether it met Part 1 (geomean <100CFU/100ml) and Part 2 (<10% of samples under 200CFU/100ml) of the state standard for fecal coliform. Bold text denotes sites that met both parts of the standard. Three years ago, in 2014-2015, fifteen sites met both standards. The following two years, 13 out of 46 sites met both standards. In 2017-2018, only 10 of 46 sites met both standards. In 2018-2019, 7 out of 46 sites met both standards– shown in bold below.

Table 11. Fecal Coliform Results Compared to State Standards

	Site 1		Site 2		Site 3		Site 4		Site 5	
	Part 1	Part 2	Part 1	Part 2	Part 1	Part 2	Part 1	Part 2	Part 1	Part 2
Upper Samish	yes	yes	yes	yes	no	no	yes	no		
Lower Samish	yes	no	yes	yes	yes	no	yes	no		
Upper Nookachamps	yes	no	yes	no	yes	no	yes	no		
Lower Nookachamps	no	no	yes	no	no	yes	no	no		
No Name Slough	no	no	yes	no	yes	no	no	no		
Bay View	yes	yes	yes	no	yes	no	yes	yes		
Joe Leary Slough	no	no	no	no	no	no	no	no		
Trumpeter Basin	yes	no	yes	no	yes	no	yes	no	yes	no
Kulshan Creek	yes	no	no	no	yes	no	yes	no	yes	no
Ace of Hearts Creek	yes	yes	yes	yes	yes	no	yes	no		
Gages Slough	no	no	yes	no	yes	no	yes	no		

Storm Team Results

2018-2019 the Storm Team completed a third year of sampling in the Padilla Baywatershed. Volunteers sampled 12 sites. Four sites were on Joe Leary Slough, the largest fresh water input to Padilla Bay. Other sites were on No Name Slough, Little Indian Slough, and in the village of Bay View. Volunteers sampled 12 sites during just 4 rain events, the fewest number of events since Storm Team began. Storm team data should be viewed differently from the rest of the stream team data. They do not represent typical conditions. Even a healthy stream can have occasional high fecal coliform levels during rain events. Standards are based on an average of multiple samples taken over time and in a variety of conditions, with at least 10 samples during a year.

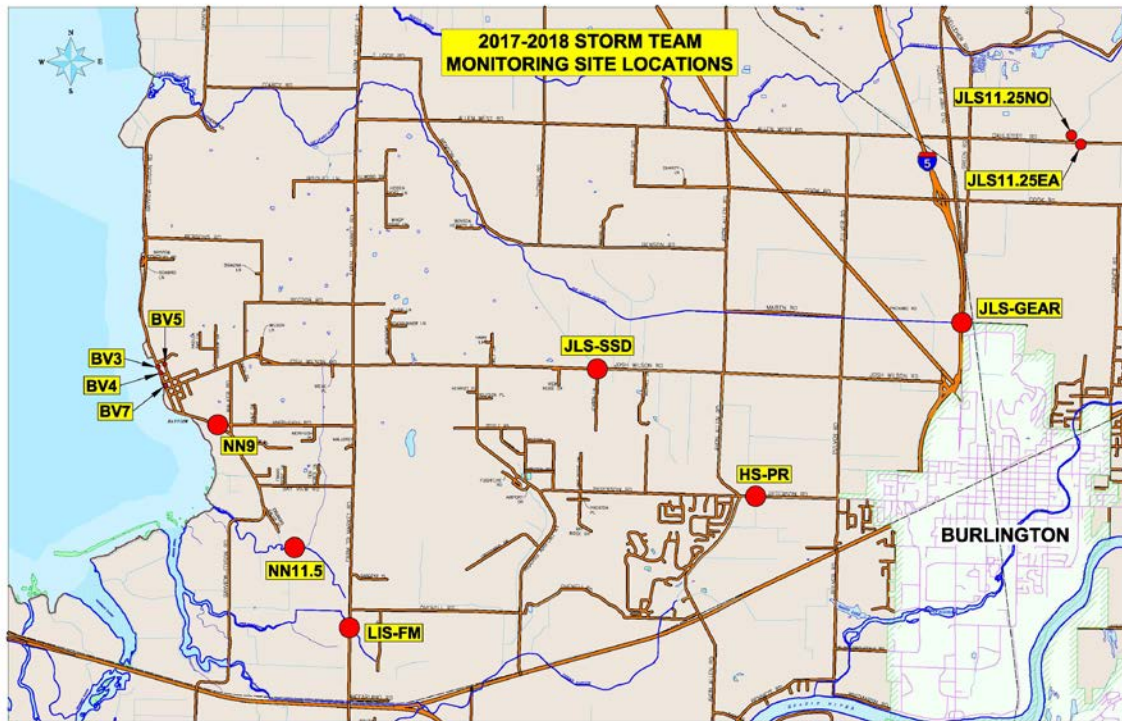


Figure 102. Padilla Bay Storm Team Sampling Sites 2018-2019

Table 12. Storm Team Site Names and Location

Site ID	Location	Lat	Long
JLS-SSD	South Spur Ditch (JLS) at Josh Wilson Rd	48.486785	-122.400550
JLS11.25NO	Joe Leary Slough N side of Dahlstedt Rd at v-ditch	48.515290	-122.316760
JLS11.25EA	Joe Leary Slough S side of Dahlstedt Rd , E of culvert	48.514820	-122.316120
JLS-GEAR	Joe Leary Slough at Gear Rd (car lots)	48.493169	-122.334936
HS-PR	Higgins Slough at Peterson Road	48.471939	-122.372181
LIS-FM	Little Indian Slough at Farm-Market Road	48.455794	-122.444279
NN9	Marihugh and Bayview-Edison Road	48.479283	-122.468683
NN11.5	No Name Slough at end of Egbers-Kalso Road	48.465098	-122.455329
BV3	Culvert South of Bay View State Park	48.485931	-122.479358

BV4	B Street Culvert (Bay View)	48.485154	-122.478814
BV5	Second St at south end of board fence (Bay View)	48.486494	-122.478086
BV7	Boat Launch Culvert (Bay View)	48.484440	-122.478754

Figures 103-105 below show actual fecal coliform counts for all sites. Each graph shows 5 sites.

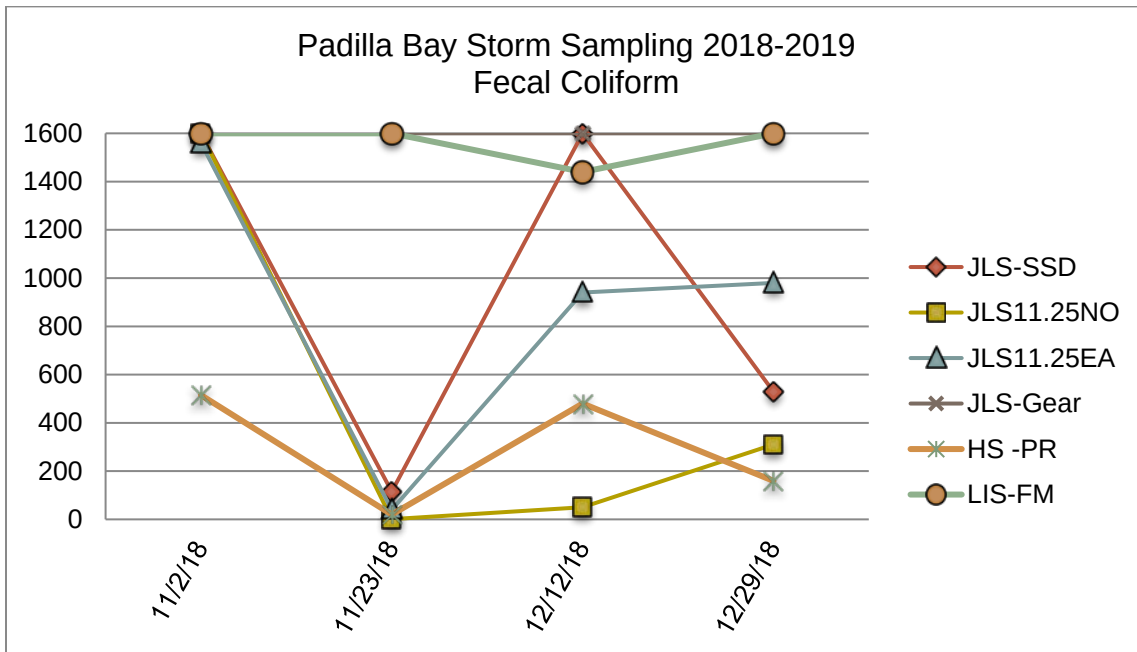


Figure 103. Storm Team: Padilla Bay Fecal Coliform, Joe Leary/Little Indian Slough Sites

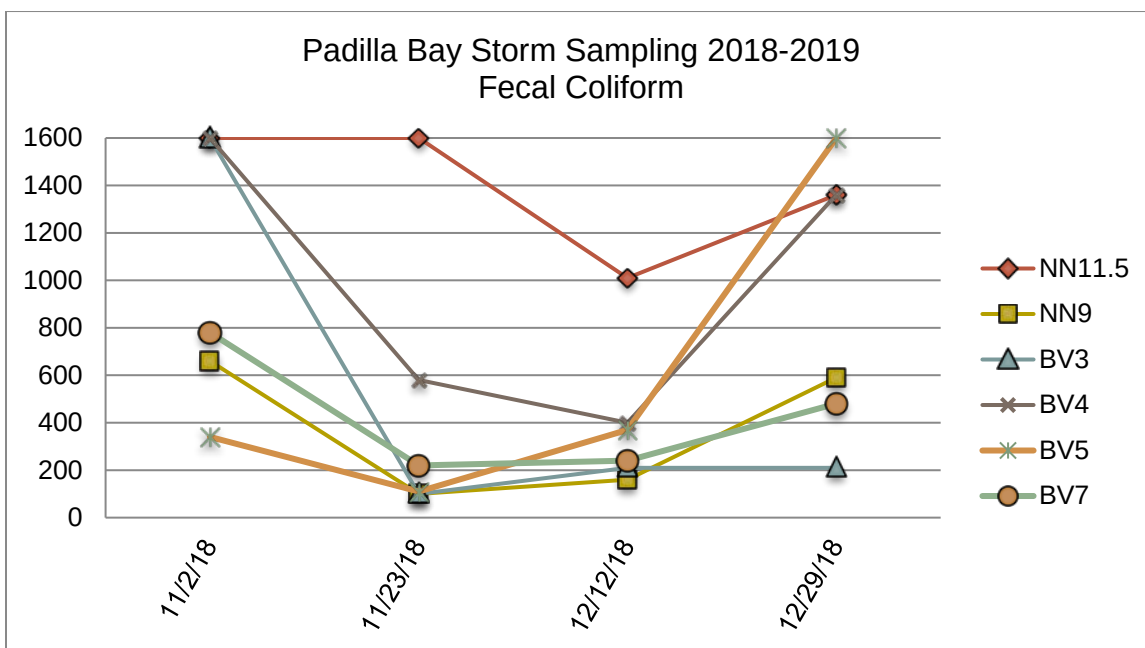


Figure 104. Storm Team: Padilla Bay Fecal Coliform, No Name Slough and Bay View Sites

Figure 105 (below) shows geometric means for the 2018-2019 sampling season. Only 2 sites were below the state standard of 100cfu/100ml of water. It is important to remember that sampling only occurred during heavy rain events. In Bay View, the B Street culvert (BV 4) continued to have higher counts than nearby Bay View sites. Like last year, two other sites stand out with extremely high counts, Joe Leary Slough at Gear Road and Little Indian Slough at Farm-to-Market Road. State standards require at least 10 samples over the course of a year.

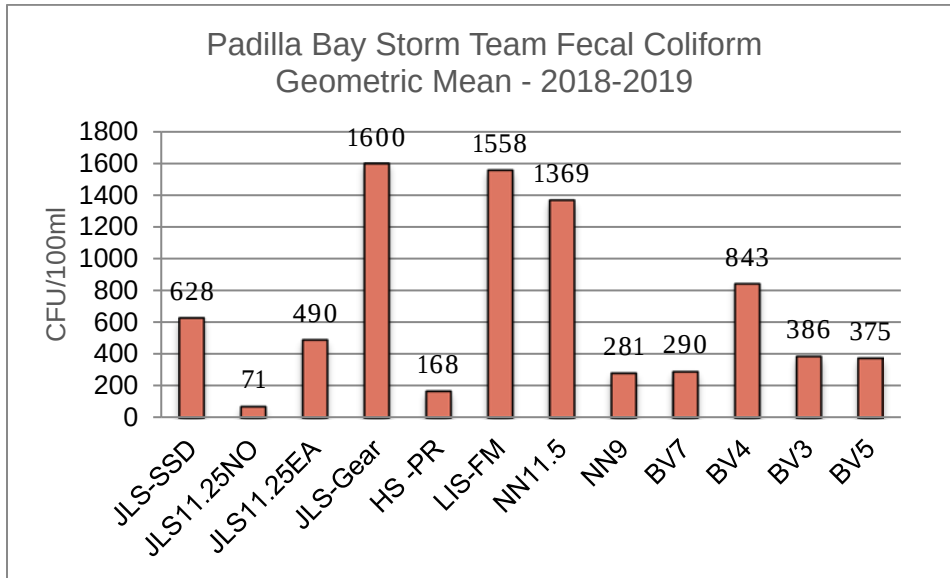


Figure 105. Storm Team: All Sites, Fecal Coliform Annual Geometric Means

Figure 106 (below) compares sites over the past three years. Again, this year volunteers only sampled during four events. Four sites were much higher in 2018-2019 than in the previous years: two on Joe Leary Slough, the Little Indian Slough site, and No Name slough at Egbers Road.

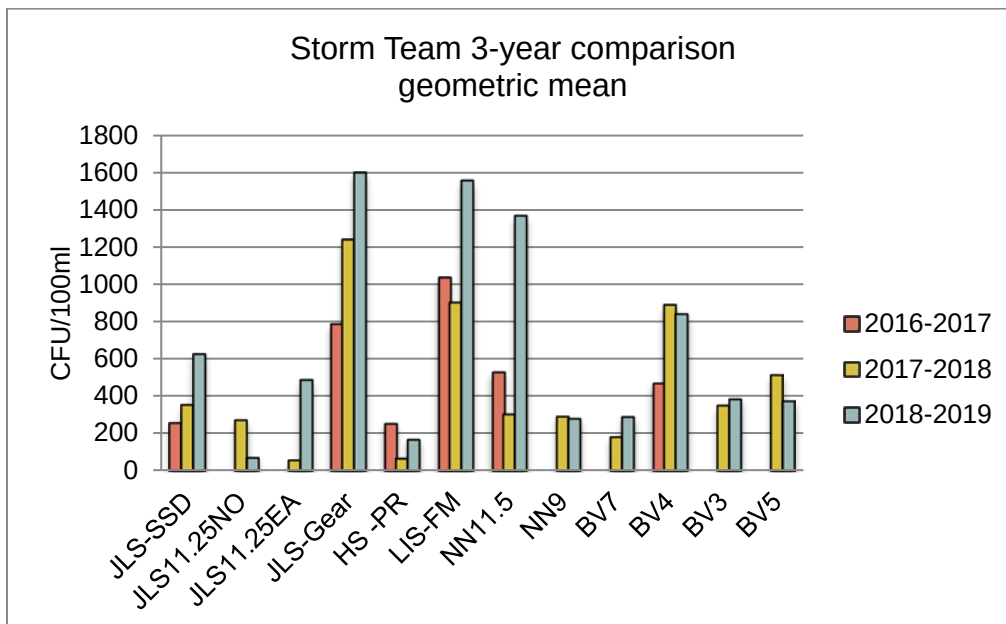


Figure 106. Storm Team: Three-year annual geometric mean comparison

VI. Conclusion

The 2018-2019 Stream Team volunteers built upon the success of previous years, and provided the twentieth year of WQ data for Skagit County's priority watersheds. This year saw the continued monitoring of 46 sites, and fearless Storm Team sampling of the Padilla Bay watershed during heavy rain events.

Sixty-eight adult volunteers were exposed to a firsthand view of the impact that non-point source pollution has on local water quality. Along the way they experienced sampling techniques used by environmental professionals, learned the importance of establishing a long-term, routine sampling program, formed lasting friendships and enriched their own lives through volunteering.

Thanks to 1,190 volunteer hours, this program has provided valuable data to citizens and agencies, assessing current conditions so water quality improvements can be made and documented in the future. This is key data for the long-term protection of our water resources. We hope that our data is useful in identifying trends, improvements, and problem areas for the attention of the appropriate agencies and local citizens.

Appendix A - Data

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)
No Name Slough						
NN1 Marihugh Road	Average/Geomean	6.10	5.79	81.29	8.53	98
-	10/1/18	-	-	-	-	-
-	10/15/18	-	-	-	-	-
-	10/29/18	10.80	7.32	78.80	8.85	2218
-	11/12/18	5.70	-	77.00	9.49	840
-	11/26/18	8.20	3.84	78.70		345
-	12/10/18	5.40	2.87	89.20	11.22	615
-	1/7/19	4.10	4.30	91.50	11.93	30
-	1/21/19	4.40	4.20	92.50	11.40	20
-	2/7/19	0.70	4.00	100.70	14.10	75
-	2/19/19	1.50	6.10	82.20	10.85	85
-	3/4/19	1.10	3.96	80.00	11.76	25
-	3/18/19	6.30	3.41	87.70	10.86	20
-	4/1/19	7.40	-	92.90	11.04	50
-	4/15/19	6.90	5.05	91.10	11.30	255
-	4/29/19	9.30	16.20	87.60	10.86	5
-	5/13/19	-	-	-	-	-
-	5/27/19	13.60	8.17	8.19	8.53	150
	6/10/19	-	-	-	-	-
	6/24/19	-	-	-	-	-
NN2 Bay View Road	Average/Geomean	5.99	7.14	89.78	11.72	36
-	10/1/18	-	-	-	-	-
-	10/15/18	-	-	-	-	-
-	10/29/18	10.70	12.78	89.60	10.06	2200
-	11/12/18	5.50	-	94.60	11.91	35
-	11/26/18	8.40	6.62	90.80	10.73	195
-	12/10/18	5.40	4.45	94.10	11.95	370
-	1/7/19	4.40	5.90	95.20	12.21	55
-	1/21/19	4.40	5.68	90.90	11.94	20
	2/7/19	0.20	5.20	105.70	15.50	25
-	2/19/19	1.50	7.38	83.10	10.83	40
-	3/4/19	0.60	6.12	65.00	12.35	45
-	3/18/19	5.70	6.24	88.10	10.96	15
	4/1/19	7.00	8.84	93.50	11.22	0
-	4/15/19	10.20	7.32	92.20	11.22	255
-	4/29/19	7.60	7.60	84.30	11.50	130

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)
NN2 Bay View Road	5/13/19	-	-	-	-	-
	5/27/19	12.30	8.73	-	-	435
	6/10/19	-	-	-	-	-
	6/24/19	-	-	-	-	-
NN3 Egbers Field	Average/Geomean	7.46	12.90	72.58	8.64	120
-	10/1/18	13.20	19.50	30.50	3.06	-
-	10/15/18	4.90	50.00	25.10	3.34	-
-	10/29/18	10.30	17.45	63.40	7.04	3913
-	11/12/18	6.30	-	62.40	7.70	63
-	11/26/18	8.20	9.18	81.30	10.54	85
-	12/10/18	5.30	7.00	76.00	9.49	476
-	1/7/19	4.80	12.50	88.00	11.15	53
-	1/21/19	5.00	7.38	79.60	10.35	9
-	2/19/19	1.50	13.46	75.60	9.55	95
-	2/7/19	1.10	-	105.20	14.12	312
-	3/4/19	2.10	12.09	81.30	10.19	36
-	3/18/19	6.30	8.52	78.20	9.83	195
-	4/1/19	8.50	8.63	80.20	9.30	24
-	4/15/19	9.40	13.49	81.20	10.15	800
-	4/29/19	9.40	11.70	77.80	8.82	64
-	5/13/19	-	-	-	-	-
-	5/27/19	13.10	7.13	72.50	7.46	104
-	6/10/19	11.60	3.60	64.50	6.62	-
-	6/24/19	13.30	4.76	83.60	6.78	-
NN4 Field Culvert	Average/Geomean	10.4	10.7	83.2	8.89	109
-	10/1/18	14.60	2.99	69.80	5.93	-
-	10/15/18	10.60	5.70	87.10	8.01	-
-	10/29/18	10.30	17.83	63.60	7.08	6627
-	11/12/18	5.60	-	53.00	6.45	26
-	11/26/18	8.80	12.74	60.20	6.92	215
-	12/10/18	5.50	4.85	54.30	6.15	43
-	1/7/19	5.10	15.50	78.10	9.95	95
-	2/19/19	1.80	13.38	75.50	9.76	128
-	1/21/19	4.90	6.48	68.20	8.98	195
-	2/7/19	-	-	-	-	-
-	3/4/19	4.20	5.98	88.10	9.83	8
-	3/18/19	6.40	9.62	81.90	10.04	35
-	4/1/19	11.00	6.97	130.00	12.83	250
-	4/15/19	9.70	14.32	75.90	8.90	1028

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)
NN4 Field Culvert	4/29/19	11.40	7.10	134.30	13.79	150
-	5/13/19	20.00	2.80	145.00	-	-
-	5/24/19	19.70	3.84	71.50	7.84	910
-	6/10/19	17.10	6.40	125.10	10.84	-
	6/24/19	19.40	6.42	95.30	7.83	-
Upper Samish						
US1 PomonaGrange	Average/Geomean	7.89	4.94	100.46	11.91	29
-	10/12/18	8.70	1.20	95.80	11.13	10
-	10/27/18	8.40	5.56	99.10	11.57	165
-	11/9/18	8.10	5.10	103.50	12.11	9
-	11/24/18	7.80	8.48	100.40	11.90	61
-	12/7/18	2.70	1.98	105.00	14.22	8
-	12/22/18	5.40	3.92	96.30	12.21	18
-	1/4/19	7.50	8.50	106.00	12.86	16
-	1/19/19	6.60	7.29	102.90	12.45	22
-	3/1/19	2.10	2.60	100.00	13.71	13
-	2/2/19	6.20	3.70	112.00	13.70	27
-	2/17/19	2.30	7.43	97.40	11.96	101
-	3/16/19	5.30	4.32	102.20	12.93	-
-	3/29/19	8.60	2.50	104.00	12.01	10
-	4/13/19	8.50	15.61	99.50	11.50	100
-	4/26/19	10.20	3.60	97.70	11.00	24
-	5/11/19	14.50	2.93	96.50	9.80	37
-	5/24/19	14.90	2.30	90.70	9.21	122
-	6/21/19	14.30	1.96	99.20	10.14	56
-	-	-	-	-	-	-
US2 Swede Creek	Average/Geomean	7.27	9.19	87.33	11.21	33
-	10/12/18	8.40	2.90	86.00	10.09	11
-	10/27/18	7.90	10.05	89.40	10.59	58
-	11/9/18	6.10	10.90	99.30	12.29	56
-	11/24/18	7.40	15.08	96.20	11.50	79
-	12/7/18	0.20	6.40	95.30	13.80	35
-	12/22/18	4.60	9.08	92.70	11.94	45
-	1/4/19	7.30	10.72	101.40	12.17	15
-	2/2/19	5.60	10.90	88.30	11.09	31
-	1/19/19	6.40	8.83	93.30	11.46	99
-	2/17/19	-	-	-	-	-
-	3/1/19	1.30	6.60	92.20	12.95	30
-	3/16/19	4.40	9.20	91.50	11.86	-

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)
US2 Swede Creek	3/29/19	7.80	7.30	93.50	11.11	13
-	4/13/19	8.40	24.80	9.58	11.17	119
-	4/26/19	8.80	7.00	95.30	11.06	11
-	5/11/19	12.50	6.90	92.10	9.81	12
-	5/24/19	13.40	5.70	84.00	8.78	45
-	6/21/19	13.10	3.80	84.50	8.88	40
US3 Thomas Creek	Average/Geomean	7.73	11.64	95.22	11.50	88
-	10/12/18	9.10	5.30	86.30	9.94	156
-	10/27/18	8.80	13.32	82.70	9.60	366
-	11/9/18	6.30	14.70	93.70	11.56	78
-	11/24/18	7.60	20.70	96.70	11.54	115
-	12/7/18	11.20	8.80	95.40	13.50	17
-	12/22/18	5.10	15.10	98.10	12.53	58
-	1/4/19	7.80	16.15	102.60	12.38	42
-	2/2/19	6.30	12.90	99.40	12.27	92
-	1/19/19	7.00	11.92	95.40	11.57	100
-	2/17/19	1.90	19.82	100.20	12.34	135
-	3/1/19	2.00	10.30	98.50	13.61	51
-	3/16/19	4.90	12.80	95.10	12.14	-
-	3/29/19	7.50	10.70	96.10	11.55	49
-	4/13/19	8.20	22.10	99.30	11.77	291
-	4/26/19	8.50	8.80	98.20	11.47	31
-	5/11/19	11.90	6.08	95.90	10.32	134
-	5/24/19	12.40	4.90	90.90	9.70	159
-	6/21/19	12.60	3.26	94.50	10.00	-
US4 Willard Creek	Average/Geomean	7.49	10.65	70.53	8.57	45
-	10/12/18	-	-	-	-	-
-	10/27/18	-	-	-	-	-
-	11/9/18	6.70	5.40	69.00	8.40	77
-	11/24/18	7.70	8.20	83.80	9.91	77
-	12/7/18	1.40	2.30	65.10	8.98	3
-	12/22/18	4.80	5.39	77.70	9.96	23
-	1/4/19	8.20	7.05	89.60	10.53	11
-	2/2/19	6.90	5.40	78.80	9.56	9
-	1/19/19	7.30	5.30	70.60	8.49	22
-	2/17/19	2.00	8.87	92.00	11.38	172
-	3/1/19	2.90	4.30	84.70	11.39	23
-	3/16/19	6.00	6.43	83.70	10.42	-
-	3/29/19	8.80	6.80	62.90	7.27	81
-	4/13/19	8.60	9.24	86.10	10.80	220

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)
US4 Willard Creek	4/26/214	9.30	4.90	74.60	8.54	275
-	5/11/19	12.60	10.60	44.50	4.72	45
-	5/24/19	13.20	17.00	50.30	5.25	414
-	6/21/19	13.50	63.20	15.00	1.52	19

Lower Samish

LS1 99 Bridge	Average/Geomean	8.31	5.10	100.22	11.68	34
-	9/30/18	12.10	1.74	98.90	10.62	90
-	10/17/18	7.90	3.42	96.00	11.27	94
-	11/14/18	8.30	7.80	105.70	12.41	47
-	12/1/18	7.90	4.50	98.30	11.65	7
-	12/12/18	5.50	9.83	95.50	11.86	49
-	12/29/18	6.30	22.20	102.70	12.62	181
-	1/9/19	6.10	7.80	100.20	12.37	18
-	2/7/19	0.90	4.30	100.50	12.72	3
-	1/27/19	5.60	3.90	97.80	12.17	17
-	2/24/19	3.50	4.40	100.00	13.10	21
-	3/6/19	3.30	3.80	106.10	13.97	11
-	4/3/19	10.50	3.60	98.60	10.40	29
-	3/23/19	8.50	2.94	100.90	11.89	8
-	4/20/19	9.10	6.33	101.60	11.67	28
-	5/1/19	9.70	3.22	99.30	11.25	23
-	5/19/19	12.80	1.80	95.20	10.20	349
-	5/29/19	12.40	2.41	102.90	10.73	25
	6/15/19	13.00	1.39	100.80	10.65	77
	6/26/19	14.50	1.60	103.10	10.46	243

LS2 Jolly Rd	Average/Geomean	8.53	4.88	98.72	11.67	37
-	9/30/18	12.30	14.90	101.60	10.87	100
-	10/17/18	8.70	3.38	97.50	11.32	73
-	11/14/18	8.40	7.60	99.40	11.61	47
-	12/1/18	7.90	4.20	97.00	11.46	11
-	12/12/18	5.50	9.54	100.30	12.58	54
-	12/29/18	-	-	-	-	-
-	1/9/19	6.00	7.60	99.10	12.25	25
-	2/7/19	0.90	4.10	96.00	13.30	12
-	1/27/19	5.50	3.90	95.40	12.90	20
-	2/24/19	3.50	4.50	98.70	12.99	45
-	3/6/19	3.30	4.06	90.00	11.95	31
-	3/23/19	8.60	2.75	100.90	11.83	4

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)
LS2 Jolly Rd	4/3/19	10.30	4.60	97.50	10.82	22
-	4/20/19	9.10	6.69	100.40	11.56	43
-	5/1/19	10.00	2.99	100.40	11.33	25
-	5/19/19	12.80	1.76	94.30	10.02	31
-	5/29/19	12.50	2.59	99.50	10.63	170
-	6/15/19	13.10	0.85	103.90	10.91	103
-	6/26/19	15.10	1.90	105.10	-	179
LS3 Thomas Rd	Average/Geomean	8.95	5.31	94.27	11.02	44
Bridge	9/30/18	12.50	13.80	97.00	10.30	62
-	10/17/18	8.70	2.68	95.00	10.90	11
-	11/14/18	8.20	6.60	92.60	10.91	43
-	12/1/18	8.00	4.90	93.30	11.02	19
-	12/12/18	5.50	13.90	92.10	11.60	68
-	12/29/18	6.10	30.10	99.30	12.45	259
-	1/9/19	5.90	8.50	95.50	11.77	23
-	1/27/19	5.70	4.90	91.40	11.41	24
-	2/7/19	0.90	6.40	96.50	13.45	20
-	2/24/19	3.60	5.90	94.60	12.41	51
-	3/6/19	3.60	0.22	93.80	12.38	31
-	3/23/19	9.00	3.02	95.20	10.96	285
-	4/3/19	10.60	4.40	92.80	10.29	391
-	4/20/19	9.60	8.48	96.50	10.98	81
-	5/1/19	10.70	3.35	96.30	10.70	22
-	5/19/19	14.10	2.12	87.20	9.05	59
-	5/29/19	13.30	2.62	93.80	9.78	59
-	6/15/19	14.40	1.43	92.80	9.41	48
-	6/26/19	16.80	2.30	100.50	9.70	17
LS4 Samish at Boat	Average/Geomean	8.89	7.18	93.39	10.82	45
Docks	9/30/18	14.60	2.45	58.80	5.98	35
-	10/17/18	10.10	6.29	83.80	9.40	3
-	11/14/18	7.80	6.60	98.30	11.65	78
-	12/1/18	8.00	5.50	91.30	11.85	15
-	12/12/18	6.30	21.70	100.40	12.31	137
-	12/29/18	5.90	25.50	100.00	12.40	252
-	1/9/19	5.90	9.00	100.50	12.45	38
-	2/7/19	0.90	5.50	95.00	13.69	12
-	1/27/19	5.90	5.50	90.40	11.27	40
-	2/24/19	3.60	7.40	93.30	12.27	-
-	3/6/19	3.50	4.38	92.40	12.05	36

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)
LS4 Samish at Boat	3/23/19	9.40	3.45	93.70	10.69	50
Docks	4/3/19	11.00	4.90	95.10	10.48	137
-	4/20/19	10.00	10.21	94.60	10.71	81
-	5/1/19	11.50	3.48	94.80	10.32	9
-	5/19/19	5.30	3.29	86.50	8.71	204
-	5/29/19	14.70	3.38	97.00	9.72	55
-	6/15/19	16.10	2.56	101.50	10.04	63
-	6/26/19	18.50	5.40	107.00	9.62	68

Gages Slough

GS1 Regent St. & E Rio Vista St.	Average/Geomean	11.86	4.54	37.76	3.80	413
-	11/8/18	13.60	3.24	37.00	3.44	306
-	12/6/18	12.60	4.22	26.10	2.65	960
-	1/3/19	8.60	4.61	25.50	2.94	107
-	1/31/19	11.80	2.61	45.30	4.36	140
-	2/28/19	10.90	4.71	49.60	5.28	110
-	3/28/19	10.90	4.36	39.80	3.43	1600
-	4/25/19	11.20	4.30	48.30	5.16	688
-	5/23/19	15.30	8.24	30.50	3.13	1600
GS2 Anacortes St.	Average/Geomean	8.96	37.58	30.11	3.04	8
-	11/8/18	8.30	23.10	11.10	1.79	54
-	12/6/18	5.40	45.30	12.00	1.67	6
-	1/3/19	7.50	43.70	46.90	5.61	70
-	1/31/19	8.20	19.80	37.90	4.01	17
-	2/28/19	5.70	36.90	50.50	6.23	3
-	3/28/19	9.70	74.00	48.10	1.53	0
-	4/25/19	11.10	18.90	24.10	2.49	24
-	5/23/19	15.80	38.90	10.30	0.98	1600
GS3 S. Spruce St.	Average/Geomean	7.93	20.42	30.49	3.92	2
-	11/8/18	6.60	6.23	19.20	2.34	28
-	12/6/18	1.90	26.20	14.10	1.92	4
-	1/3/19	7.20	11.90	48.60	9.12	57
-	1/31/19	5.10	6.86	23.10	3.01	0
-	2/28/19	4.30	10.34	37.30	4.27	0
-	3/28/19	10.50	18.70	62.40	5.80	15
-	4/25/19	11.70	22.90	21.50	2.29	88
-	5/23/19	16.10	60.20	17.70	2.63	1600

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)
GS4 McCorquedale	Average/Geomean	7.50	15.33	25.30	3.12	1
-	11/8/18	8.30	11.70	9.60	1.01	44
-	12/6/18	1.10	68.80	20.40	2.82	8
-	1/3/19	5.50	6.59	43.80	5.48	63
-	1/31/19	4.20	10.10	29.80	3.85	0
-	2/28/19	3.00	7.74	52.50	6.97	0
-	3/28/19	10.60	7.78	20.10	2.12	0
-	4/25/19	12.10	9.78	17.40	1.87	8
-	5/23/19	15.20	0.12	8.80	0.81	1600

Bay View

BV1 Walker Rd	Average/Geomean	6.40	6.36	76.85	8.76	7
-	10/8/18	-	-	-	-	-
-	10/21/18	-	-	-	-	-
-	11/5/18	10.00	7.90	69.60	7.53	43
-	11/20/18	-	-	-	-	-
-	12/3/18	-	-	-	-	-
-	12/16/18	7.10	14.00	75.50	8.30	2
-	12/31/18	5.00	2.30	77.00	8.90	30
-	1/13/19	5.00	9.50	77.00	8.70	2
-	1/28/19	5.60	4.10	76.00	8.79	16
-	2/10/19	-	-	-	-	-
-	2/25/19	6.00	1.90	84.10	9.59	3
-	3/10/19	2.30	9.00	89.00	11.10	13
-	3/25/19	-	-	-	-	-
-	4/5/19	-	-	-	-	-
-	4/22/19	10.20	2.20	66.60	7.20	3
-	5/20/19	-	-	-	-	-
-	6/17/19	-	-	-	-	-
BV2 C Street	Average/Geomean	8.21	3.27	68.94	7.84	0
-	10/8/18	12.50	3.01	49.40	5.60	22
-	10/21/18	10.30	1.00	61.50	6.86	0
-	11/5/18	11.80	3.30	62.10	6.53	156
-	11/20/18	-	-	-	-	-
-	12/3/18	6.00	1.98	68.00	8.60	157
-	12/16/18	6.80	5.20	70.10	7.90	649
-	12/31/18	4.80	4.34	75.50	9.04	44
-	1/13/19	4.30	3.60	73.20	8.75	5
-	1/28/19	5.10	2.36	75.50	8.89	0

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)
BV2 C Street	2/10/19	-	-	-	-	-
-	2/25/19	5.60	2.13	84.20	9.85	0
-	3/10/19	1.70	1.00	86.30	11.30	0
-	3/25/19	10.20	1.97	75.20	7.58	0
-	4/5/19	11.90	1.86	67.20	7.10	0
-	4/22/19	10.20	2.50	72.00	7.26	57
-	5/20/19	13.70	11.50	45.00	4.52	1015
-	6/17/19	-	-	-	-	-
BV3 Boat Launch	Average/Geomean	9.57	5.45	72.38	8.36	25
-	10/8/18	13.80	7.69	41.00	4.60	-
-	10/21/18	-	-	-	-	-
-	11/5/18	11.70	32.00	8.14	8.86	445
-	11/20/18	8.30	1.53	74.40	8.73	86
-	12/3/18	6.20	6.15	64.60	7.76	39
-	12/16/18	7.10	4.70	70.00	7.90	252
-	12/31/18	6.40	5.20	69.30	7.90	131
-	1/13/19	6.10	2.70	68.00	7.80	33
-	1/28/19	6.30	2.25	71.90	8.33	10
-	2/10/19	-	-	-	-	-
-	2/25/19	4.20	2.50	84.50	10.13	47
-	3/10/19	4.70	1.50	90.00	10.50	3
-	3/25/19	9.20	1.72	74.30	8.00	5
-	4/5/19	10.70	1.53	73.10	7.46	2
-	4/22/19	12.20	2.00	94.50	9.46	16
-	5/20/19	15.50	7.50	87.00	8.39	3
-	6/17/19	21.20	2.80	114.90	9.51	68
BV4 Bay View State Park	Average/Geomean	9.65	13.14	70.89	8.47	1
-	10/8/18	-	-	-	-	-
-	10/21/18	-	-	-	-	-
-	11/5/18	11.40	11.70	8.03	8.77	52
-	11/20/18	5.30	0.65	97.50	12.35	8
-	12/3/18	6.00	5.30	66.50	7.85	2
-	12/16/18	7.10	5.10	71.00	7.90	18
-	12/31/18	6.30	5.85	70.50	8.04	93
-	1/13/19	6.00	2.80	68.70	7.80	11
-	1/28/19	6.90	2.50	74.00	8.20	0
-	2/10/19	-	-	-	-	-
-	2/25/19	7.60	37.20	79.90	8.66	0
-	3/10/19	5.00	1.90	89.00	10.51	0

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)
-	3/25/19	-	-	-	-	-
-	4/5/19	14.70	76.60	76.90	7.42	244
-	4/22/19	-	-	-	-	-
-	5/20/19	15.50	5.30	95.90	9.03	11
-	6/17/19	24.00	2.80	52.70	5.15	3

Trumpeter Basin

TB1 Stonebridge Adult Community	Average/Geomean	8.55	3.15	98.37	11.14	61
-	10/11/18	10.10	0.89	105.20	11.92	40
-	10/24/18	-	-	-	-	-
-	11/8/18	9.20	2.07	111.50	12.71	13
-	11/21/18	8.90	1.51	95.80	11.02	53
-	12/6/18	2.90	1.37	109.40	14.90	13
-	12/19/18	8.20	7.05	97.3	11.46	500
-	1/3/19	7.70	6.96	98.70	11.72	73
-	1/16/19	4.00	1.69	98.50	12.90	33
-	1/31/19	6.20	2.00	103.40	12.64	40
-	2/13/19	3.60	7.71	99.70	13.22	113
-	2/28/19	4.40	2.58	106.10	13.62	253
-	3/13/19	5.50	7.87	98.60	12.43	40
-	3/28/19	8.80	1.49	106.00	12.11	20
-	4/10/19	9.80	4.56	96.20	10.89	33
-	4/25/19	9.40	1.97	95.60	11.12	80
-	5/8/19	10.90	1.83	93.70	10.36	13
-	5/21/19	12.40	2.08	77.70	5.52	227
-	6/4/19	13.10	2.03	97.90	6.58	60
-	6/21/19	12.80	2.11	78.30	5.40	233
-	7/2/19	14.60	2.05	-	-	173

TB2 Frazier Home on College Way	Average/Geomean	9.42	6.74	90.36	10.06	29
-	10/11/18	10.60	0.92	91.30	10.02	107
-	10/24/18	-	-	-	-	-
-	11/8/18	11.70	2.38	103.10	11.22	7
-	11/21/18	7.40	3.19	85.60	10.25	120
-	12/6/18	7.60	3.25	90.40	10.85	0
-	12/19/18	7.50	16.15	94.20	11.26	320
-	1/3/19	7.20	14.06	92.40	11.25	420
-	1/16/19	4.70	2.75	92.00	11.75	40
-	1/31/19	6.40	4.91	97.00	11.96	20

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)	
TB2 Frazier Home on College Way	2/13/19	2.20	25.62	96.00	13.16	333	
	2/28/19	4.40	5.45	98.80	12.86	0	
	-	3/13/19	4.50	16.88	95.30	12.34	147
	-	3/28/19	9.90	2.88	93.40	10.66	73
	-	4/10/19	10.20	7.36	89.80	10.03	40
	-	4/25/19	11.70	5.10	86.10	9.21	7
	-	5/8/19	11.40	2.97	81.20	8.80	100
	-	5/21/19	15.50	3.64	84.40	5.47	487
		6/4/19	13.60	2.54	84.00	5.60	1233
		6/21/19	17.40	1.62	71.50	4.40	153
		7/2/19	15.10	6.39	85.00	5.60	700
TB3 College Way	Average/Geomean	7.76	3.32	80.31	9.48	50	
Trumpeter/Thunderbird Confluence	10/11/18	9.30	1.38	77.00	8.86	27	
	10/24/18	-	-	-	-	-	
	-	11/8/18	7.70	2.77	94.20	11.29	33
	-	11/21/18	7.10	1.28	71.60	8.75	20
	-	12/6/18	1.40	1.53	83.20	11.76	7
	-	12/19/18	7.50	6.25	85.60	10.19	927
	-	1/3/19	7.20	5.51	87.70	10.53	227
	-	1/16/19	2.70	2.09	83.30	11.35	7
	-	1/31/19	4.70	2.09	86.00	10.93	7
	-	2/13/19	2.20	5.94	91.00	12.52	153
	-	2/28/19	3.10	7.44	99..4	13.26	7
	-	3/13/19	4.40	8.36	94.20	12.15	107
	-	3/28/19	8.80	2.24	87.50	9.80	7
	-	4/10/19	9.30	2.58	78.00	8.94	27
	-	4/25/19	8.90	1.91	79.80	9.27	7
	-	5/8/19	11.00	2.24	61.00	6.67	80
	-	5/21/19	11.80	2.57	72.70	5.20	180
	-	6/4/19	13.10	2.35	67.10	4.50	167
	-	6/21/19	12.90	2.78	65.30	4.66	933
	-	7/2/19	14.30	1.80	85.00	5.73	407
TB4 Kiowa Street	Average/Geomean	7.65	3.75	97.90	11.28	19	
-	10/11/18	9.40	-	103.60	11.83	20	
-	10/24/18	-	-	-	-	-	
-	11/8/18	8.30	3.85	113.00	13.32	40	
-	11/21/18	7.30	1.26	96.70	11.65	113	
-	12/6/18	1.80	1.06	101.10	14.13	0	
-	12/19/18	7.50	3.83	95.70	11.49	80	

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)
Ace of Hearts						
AH1 Heart Lake	Average/Geomean	7.52	0.68	86.73	10.48	5
Trail	10/11/18	-	-	-	-	-
-	10/25/18	-	-	-	-	-
-	11/8/18	-	-	-	-	-
-	11/20/18	-	-	-	-	-
-	12/6/18	-	-	-	-	-
-	1/3/19	6.30	-	55.50	6.92	5
-	1/17/19	5.30	0.41	78.10	9.95	<1
-	1/31/19	5.10	0.68	95.50	12.16	<2
-	2/14/19	-	-	-	-	-
-	2/28/19	3.40	1.20	98.80	13.18	<2
-	4/11/19	11.80	0.75	102.30	11.13	<1
-	4/28/19	13.20	0.34	90.20	9.55	<2
-	5/9/19	-	-	-	-	-
-	5/23/19	-	-	-	-	-
-	6/6/19	-	-	-	-	-
AH2 H & 41st St	Average/Geomean	6.90	4.49	84.52	11.80	21
-	10/11/18	11.30	1.59	70.80	7.72	2
-	10/25/18	11.00	-	74.70	8.07	140
-	11/8/18	8.80	2.44	66.10	7.51	10
-	11/20/18	6.10	0.32	68.50	10.27	8
-	12/6/18	4.40	-	66.90	8.81	8
-	1/3/19	6.50	-	8.73	10.08	4852
-	1/17/19	5.60	1.00	88.50	11.01	<1
-	1/31/19	5.10	1.59	104.80	13.36	2
-	2/14/19	-	-	-	-	-
-	2/28/19	2.70	15.18	103.40	14.01	<2
-	4/11/19	10.50	2.63	100.70	11.21	5
-	4/28/19	11.00	2.03	101.00	11.12	48
-	5/9/19	14.10	1.88	85.60	8.86	3
-	5/23/19	14.60	9.53	78.40	7.90	177
-	6/6/19	14.00	1.51	74.60	8.05	35
AH3 Rotary Dog	Average/Geomean	8.69	1.39	91.17	10.53	32
Park	10/11/18	11.60	1.42	82.60	8.94	214
-	10/25/18	12.50	-	77.30	8.27	2
-	11/8/18	8.70	2.39	89.50	10.74	10
-	11/20/18	8.00	0.92	88.80	10.27	22
-	12/6/18	5.90	-	88.80	11.09	2

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)	
AH3 Rotary Dog Park	1/3/19	7.20	-	89.93	10.93	73	
	1/17/19	7.60	1.35	97.50	11.71	32	
	-	1/31/19	5.50	1.91	107.10	13.60	2
	-	2/14/19	-	-	-	-	-
	-	2/28/19	3.60	1.69	104.60	13.90	15
	-	4/11/19	10.30	2.09	100.50	11.40	80
	-	4/28/19	10.40	1.54	97.10	10.84	25
	-	5/9/19	12.30	1.26	89.10	8.40	380
	-	5/23/19	13.30	0.51	77.00	9.74	172
	-	6/6/19	12.40	1.34	92.50	9.33	670

AH4 Happy Valley	Average/Geomean	7.60	2.43	99.91	11.86	41
Creek	10/11/18	10.30	3.53	94.60	10.59	58
-	10/25/18	11.60	-	93.90	10.30	97
-	11/8/18	8.10	1.80	89.40	11.60	18
-	11/20/18	7.40	3.25	97.70	11.57	472
-	12/6/18	5.00	-	95.50	12.20	-
-	1/3/19	6.10	-	100.40	12.45	-
-	1/17/19	5.80	1.16	104.50	13.15	8
-	1/31/19	5.50	1.30	102.90	13.04	8
-	2/14/19	-	-	-	-	-
-	2/28/19	3.30	2.13	111.10	14.77	5
-	4/11/19	9.20	2.14	104.50	12.01	10
-	4/28/19	9.60	2.55	106.00	12.02	<2
-	5/9/19	11.40	4.46	100.40	11.10	770
-	5/23/19	12.10	4.52	100.00	10.20	107
-	6/6/19	-	-	-	-	-

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Kulshan Creek

KC1 S 14th St.	Average/Geomean	8.59	3.17	89.29	10.16	33
-	10/1/18	13.80	1.63	86.00	8.89	266
-	10/16/19	8.40	1.12	93.50	11.00	1053
-	10/29/18	11.00	2.49	97.50	10.72	93
-	11/13/18	6.70	1.44	96.50	11.79	60
-	11/26/18	10.10	4.91	93.80	10.56	93
-	12/11/18	7.60	8.81	98.00	11.73	100
-	12/24/18	-	-	-	-	-
-	1/8/19	5.90	1.83	90.50	11.25	60
-	1/22/19	6.60	7.17	87.00	10.69	93

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)
KC1 S 14th St	2/4/19	-	-	-	-	-
-	2/19/19	4.70	2.27	96.90	12.51	47
-	3/5/19	2.3	1.24	94.10	12.66	47
-	3/20/19	6.50	2.03	90.90	11.21	7
-	4/2/19	8.50	2.17	83.70	9.78	27
-	4/15/19	8.80	3.06	92.70	10.76	0
-	4/30/19	8.70	2.28	81.60	9.56	7
-	5/13/19	11.20	3.23	82.40	9.05	353
-	6/10/19	12.40	5.48	79.00	5.41	440
-	6/25/19	12.80	2.68	73.90	5.10	193
KC2 Parker Way	Average/Geomean	9.84	5.63	52.30	6.18	47
-	10/1/18	15.50	3.84	31.60	3.12	227
-	10/16/19	10.20	3.81	32.60	3.60	260
-	10/29/18	13.00	4.49	56.40	6.00	373
-	11/13/18	8.70	3.41	56.30	6.90	40
-	11/26/18	10.10	6.65	82.10	9.21	360
-	12/11/18	8.10	23.63	-	10.35	260
-	12/24/18	-	-	-	-	-
-	1/8/19	6.50	3.50	77.10	9.30	73
-	1/22/19	6.60	2.85	60.60	7.34	0
-	2/4/19	-	-	-	-	-
-	2/19/19	5.10	5.82	85.00	10.14	93
-	3/5/19	4.30	5.09	63.20	8.24	33
-	3/20/19	7.30	3.61	66.10	7.91	7
-	4/2/19	9.40	3.81	50.30	5.61	87
-	4/15/19	9.90	6.20	79.60	8.80	147
-	4/30/19	10.20	3.68	41.20	4.90	113
-	5/13/19	12.90	7.30	23.00	1.48	60
-	6/10/19	14.70	2.97	22.30	1.51	100
-	6/25/19	14.80	5.04	9.40	0.66	260
KC3 Roosevelt Ave	Average/Geomean	9.68	5.66	19.98	2.34	35
-	10/1/18	13.60	5.27	3.10	0.32	100
-	10/16/19	9.50	2.96	5.50	0.63	13
-	10/29/18	12.40	2.90	29.80	3.03	1080
-	11/13/18	7.50	1.94	15.60	1.81	7
-	11/26/18	9.80	6.73	29.90	3.39	220
-	12/11/18	7.30	4.55	38.80	4.01	127
-	12/24/18	-	-	-	-	-
-	1/8/19	5.60	8.13	31.40	3.97	33

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)
KC3 Roosevelt Ave	1/22/19	6.20	6.71	12.60	1.59	13
-	2/4/19	-	-	-	-	-
-	2/19/19	4.90	3.80	40.10	5.27	20
-	3/5/19	3.80	4.64	41.60	5.81	13
-	3/20/19	9.40	5.32	38.60	4.40	1
-	4/2/19	10.60	5.17	11.20	1.42	13
-	4/15/19	9.70	4.73	25.80	2.93	140
-	4/30/19	10.80	14.46	4.90	0.49	33
-	5/13/19	14.20	6.73	4.00	0.25	133
-	6/10/19	14.60	4.41	3.80	0.25	13
-	6/25/19	14.60	7.83	2.90	0.24	60
KC4 Riverside Dr.	Average/Geomean	8.98	4.54	61.35	7.35	70
-	10/1/18	14.40	1.96	57.80	5.91	173
-	10/16/19	8.50	5.34	36.80	4.38	33
-	10/29/18	11.90	2.79	64.20	6.97	113
-	11/13/18	6.30	1.44	71.50	8.73	27
-	11/26/18	9.80	6.12	70.40	7.95	327
-	12/11/18	7.20	7.01	74.80	7.00	73
-	12/24/18	-	-	-	-	-
-	1/8/19	5.20	6.30	7.00	8.84	80
-	1/22/19	6.30	2.73	68.50	8.37	93
-	2/4/19	-	-	-	-	-
-	2/19/19	4.45	2.31	77.60	10.10	40
-	3/5/19	2.20	3.97	94.60	12.94	40
-	3/20/19	7.10	2.77	79.80	9.65	20
-	4/2/19	9.60	2.88	73.40	8.48	27
-	4/15/19	9.60	4.01	76.90	8.76	107
-	4/30/19	9.30	2.84	74.10	8.72	107
-	5/13/19	13.10	5.79	43.50	2.91	373
-	6/10/19	14.30	3.55	57.10	3.83	53
-	6/25/19	13.40	15.45	14.90	1.43	40
KC5 Lions Park	Average/Geomean	9.3	8.4	74.8	8.7	36.9
-	10/1/18	15.20	3.97	61.60	5.16	567
-	10/16/19	13.10	1.85	55.00	6.30	0
-	10/29/18	12.00	4.27	74.40	8.02	347
-	11/13/18	8.90	2.86	67.20	7.60	27
-	11/26/18	9.70	7.42	77.20	8.74	667
-	12/11/18	7.50	59.68	89.00	10.81	6280
-	12/24/18	-	-	-	-	-
-	1/8/19	5.80	4.38	72.50	9.10	87

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)
KC5 Lions Park	1/22/19	7.00	4.19	78.60	10.05	40
-	2/4/19	-	-	-	-	-
-	2/19/19	4.60	6.35	79.50	10.29	93
-	3/5/19	-	-	-	-	-
-	3/20/19	8.40	4.40	72.90	8.60	33
-	4/2/19	10.10	4.85	70.90	7.80	20
-	4/15/19	9.20	5.25	74.30	8.52	73
-	4/30/19	10.70	5.07	67.00	7.12	193
	5/13/19	11.40	6.09	67.50	4.68	127
	6/10/19	14.30	2.28	55.80	3.62	727
	6/25/19	14.40	5.10	45.80	2.86	27



Joe Leary Slough

JL1 Dahlstedt Road	Average/Geomean	10.78	25.41	35.73	4.02	146
-	10/7/18	-	-	-	-	-
-	11/4/18	11.30	47.00	14.20	1.54	3354
-	11/18/18	5.90	21.30	8.50	1.02	15
-	12/2/18	7.10	9.50	25.30	3.02	15
-	12/17/18	9.40	10.99	41.90	4.79	9
-	12/30/18	6.90	56.20	49.60	6.06	880
-	1/13/19	8.00	15.21	32.20	3.77	189
-	1/28/19	9.70	27.10	31.40	3.44	149
-	2/10/19	-	-	-	-	-
-	2/24/19	7.50	18.10	38.10	4.54	97
-	3/10/19	10.10	24.30	27.40	3.95	448
-	3/24/19	9.00	16.20	44.20	5.12	78
-	4/7/19	10.50	16.00	8.40	1.40	335
-	4/21/19	9.90	10.70	58.40	6.48	129
-	5/5/19	10.50	22.10	45.70	5.94	269
-	5/19/19	18.80	45.90	56.20	4.55	113
-	6/2/19	22.60	43.30	19.70	1.68	194
-	6/16/19	15.20	22.60	70.40	7.02	318

JL2 Hwy 99.Gear Rd	Average/Geomean	10.06	32.80	49.01	5.95	168
-	10/7/18	10.80	32.90	27.80	3.02	14
-	11/4/18	11.60	15.39	40.10	4.32	5240
-	11/18/18	7.10	10.10	37.30	4.49	315
-	12/2/18	7.70	15.60	44.30	5.25	325
-	12/17/18	9.20	17.29	51.50	5.90	22

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)
JL2 Hwy 99.Gear Rd	12/30/18	7.00	169.60	52.60	6.37	2485
-	1/13/19	7.50	35.30	46.20	5.84	32
-	1/28/19	8.50	21.80	52.10	6.02	18
-	2/10/19	-	-	-	-	-
-	2/24/19	6.70	23.20	60.90	7.26	143
-	3/10/19	8.00	24.00	58.10	6.89	123
-	3/24/19	9.20	18.80	49.00	5.58	316
-	4/7/19	10.20	21.00	8.10	9.08	714
-	4/21/19	10.00	17.60	62.70	7.01	286
-	5/5/19	11.90	20.10	48.40	5.37	30
-	5/19/19	15.90	31.50	70.50	6.88	379
-	6/2/19	16.40	57.20	66.30	6.01	176
-	6/16/19	13.40	26.20	57.30	5.87	125
JL3 Wilson.Avon	Average/Geomean	11.15	43.21	58.57	7.04	70
Allen	10/7/18	10.30	17.90	58.50	6.82	13
-	11/4/18	11.90	23.60	60.20	6.45	85
-	11/18/18	7.30	23.20	59.50	7.30	13
-	12/2/18	8.10	48.80	58.40	6.92	22
-	12/17/18	9.60	16.45	66.00	7.48	10
-	12/30/18	7.70	108.50	62.10	7.44	409
-	1/13/19	7.30	27.30	61.10	7.27	8
-	1/28/19	8.80	18.20	64.80	7.42	91
-	2/10/19	-	-	-	-	-
-	2/24/19	6.70	24.40	72.60	8.81	117
-	3/10/19	10.20	22.30	42.30	6.53	45
-	3/24/19	8.90	41.10	65.40	7.45	515
-	4/7/19	11.50	54.00	8.40	9.25	1126
-	4/21/19	9.80	20.80	72.40	7.96	84
-	5/5/19	13.90	56.40	32.80	3.54	127
-	5/19/19	20.50	72.20	83.10	7.22	23
-	6/2/19	21.70	63.70	72.80	6.37	-
-	6/16/19	15.30	95.80	55.30	5.38	471
JL4 Tide Gate	Average/Geomean	11.14	27.27	54.22	5.89	131
-	10/7/18	11.50	15.10	65.00	6.91	84
-	11/4/18	11.80	18.30	52.60	5.67	183
-	11/18/18	7.20	10.30	37.70	4.65	24
-	12/2/18	7.80	14.40	38.10	4.49	65
-	12/17/18	8.20	15.96	65.80	7.73	49
-	12/30/18	7.00	138.60	64.50	7.80	393
-	1/13/19	7.30	21.30	40.50	4.85	481

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)
JL4 Tide Gate	1/28/19	7.70	19.10	43.00	5.08	84
-	2/10/19	-	-	-	-	-
-	2/24/19	6.80	22.90	60.40	6.95	121
-	3/10/19	7.40	22.50	57.10	6.56	178
-	3/24/19	11.20	27.60	38.50	4.17	116
-	4/7/19	10.60	31.40	59.40	5.90	241
-	4/21/19	13.00	17.80	56.40	5.83	288
-	5/5/19	15.60	19.60	77.50	7.56	258
-	5/19/19	17.90	29.50	46.50	4.50	129
-	6/2/19	20.20	24.80	52.40	5.01	116
-	6/16/19	18.10	14.40	66.30	6.43	79

Upper Nookachamps

UN1 Lake McMurray	Average/Geomean	8.70	2.63	51.45	7.39	14
Estates	10/4/18	9.30	9.10	18.50	1.90	12
-	10/16/18	6.90	4.00	18.90	11.85	110
-	11/1/18	10.40	4.60	30.90	3.01	243
-	11/13/18	8.20	1.40	55.40	6.51	5
-	11/29/18	9.00	0.90	53.80	6.20	39
-	12/11/18	5.20	1.40	38.50	4.81	112
-	12/27/18	6.30	2.30	75.60	8.70	17
-	1/8/19	5.40	1.41	67.20	8.38	3
-	1/24/19	5.90	1.70	70.50	8.78	12
-	2/5/19	-	-	-	-	-
-	2/21/19	3.00	1.00	70.00	9.50	32
-	3/5/19	3.30	1.50	75.50	10.04	2
-	3/21/19	8.20	1.40	101.00	11.80	13
-	4/2/19	9.90	2.30	46.80	5.20	0
-	4/30/19	11.30	2.18	65.60	7.09	15
-	5/16/19	13.00	2.40	34.10	3.60	123
-	6/13/19	19.10	2.90	31.10	2.80	92
-	6/25/19	13.50	4.20	21.20	15.40	269
UN2 Big lake	Average/Geomean	10.35	2.05	86.22	10.31	5
Outflow	10/4/18	13.90	0.90	70.10	7.50	117
-	10/16/18	11.70	1.60	62.30	6.79	67
-	11/1/18	12.50	1.30	7.50	8.06	658
-	11/13/18	9.80	2.40	86.30	9.80	6
-	11/29/18	9.00	2.03	95.80	11.50	3
-	12/11/18	6.40	3.30	98.50	12.12	17

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)
UN2 Big lake Outflow	12/27/18	6.10	3.00	93.60	11.60	3
	1/8/19	5.60	2.10	102.30	12.80	13
	- 1/24/19	5.90	2.40	94.50	11.70	4
	- 2/5/19	-	-	-	-	-
	- 2/21/19	3.90	1.90	105.00	13.70	3
	- 3/5/19	4.20	2.50	95.90	12.49	7
	- 3/21/19	7.60	1.80	97.80	11.70	0
	- 4/2/19	10.40	1.80	107.30	12.06	0
	- 4/30/19	12.70	2.70	100.60	10.58	9
	- 5/16/19	17.20	1.70	93.60	8.98	212
	- 6/13/19	20.70	1.80	94.20	8.42	76
	- 6/25/19	18.30	1.60	60.50	5.54	11
UN3 Otter Pond Rd	Average/Geomean	8.85	5.29	96.89	11.24	11
-	10/4/18	11.50	2.30	100.80	10.54	18
-	10/16/18	7.90	1.70	95.50	11.40	37
-	11/1/18	11.90	44.00	98.10	10.59	2082
-	11/13/18	7.20	2.80	95.30	11.52	9
-	11/29/18	8.60	2.70	98.10	11.20	6
-	12/11/18	6.10	4.90	100.20	12.44	93
-	12/27/18	6.00	2.30	77.10	9.10	2
-	1/8/19	5.20	2.50	106.10	13.47	4
-	1/24/19	5.70	3.90	106.10	13.20	12
-	2/5/19	-	-	-	-	-
-	2/21/19	3.20	2.60	101.00	13.60	9
-	3/5/19	3.10	2.00	88.10	11.78	3
-	3/21/19	9.20	2.30	108.00	12.35	0
-	4/2/19	10.20	7.20	94.00	10.67	12
-	4/30/19	10.50	2.40	98.50	10.92	16
-	5/16/19	14.90	1.90	99.50	9.98	23
-	6/13/19	17.00	2.00	93.10	8.95	188
-	6/25/19	12.30	2.40	87.70	9.39	476
UN4 Knapp Road	Average/Geomean	9.44	4.91	75.32	9.70	67
Bridge	10/4/18	11.30	4.10	49.20	4.90	165
-	10/16/18	8.70	2.90	48.90	8.77	4
-	11/1/18	11.20	8.00	53.00	5.80	1596
-	11/13/18	8.90	2.90	79.90	9.33	29
-	11/29/18	8.90	3.10	83.60	9.70	23
-	12/11/18	6.30	5.30	90.10	10.99	319
-	12/27/18	5.94	3.60	89.50	10.60	10
-	1/8/19	4.80	3.20	89.60	11.21	48

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)
-	1/24/19	5.70	4.50	94.10	11.96	158
-	2/5/19	-	-	-	-	-
-	2/21/19	3.60	4.30	103.70	13.70	23
-	3/5/19	3.40	19.60	90.20	12.12	85
-	3/21/19	7.50	2.80	11.70	14.15	12
-	4/2/19	9.10	4.50	87.30	10.41	19
-	4/30/19	10.80	3.80	89.50	9.78	71
-	5/16/19	17.60	3.30	86.30	8.29	485
-	6/13/19	20.60	4.40	75.60	6.80	207
-	6/25/19	16.20	3.10	58.20	6.32	186

Lower Nookachamps

LN1 College Way	Average/Geomean	8.49	4.21	93.86	10.88	268
-	10/10/18	12.60	1.60	88.60	9.05	235
-	10/27/18	10.20	2.40	88.70	9.95	370
-	11/7/18	10.10	2.57	88.90	9.50	100
-	11/24/18	8.50	5.61	91.00	10.57	440
-	12/5/18	2.70	1.83	93.00	12.60	20
-	12/22/18	6.28	3.63	99.00	12.49	25
-	1/2/19	5.33	4.05	93.70	11.30	75
-	1/19/19	7.30	7.30	95.40	11.44	200
-	1/30/19	3.50	2.88	111.60	14.50	760
-	2/16/19	3.70	10.70	104.10	13.50	470
-	2/27/19	3.00	4.11	99.90	13.40	225
-	3/16/19	5.80	6.90	109.60	13.60	-
-	3/22/19	7.20	4.68	97.30	11.66	-
-	4/13/19	9.70	10.38	92.90	10.61	4250
-	4/24/19	10.30	4.30	97.30	10.09	380
-	5/11/19	13.40	1.38	92.40	9.67	200
-	5/22/19	13.10	1.50	87.60	7.16	205
-	6/8/19	14.50	2.84	86.10	8.79	290
-	6/19/19	14.10	1.32	66.20	6.80	4420
LN2 Hwy 9 Bridge	Average/Geomean	7.00	2.28	80.72	9.80	40
-	10/10/18	10.30	0.92	82.50	8.85	44
-	10/27/18	8.70	2.70	74.50	8.61	146
-	11/7/18	8.70	1.88	62.70	11.40	14
-	11/24/18	6.70	2.72	83.60	10.34	64
-	12/5/18	1.90	3.27	61.20	8.60	3

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)
LN2 Hwy 9 Bridge	12/22/18	4.78	1.33	80.40	10.25	18
-	1/2/19	3.77	2.10	63.90	8.00	41
-	1/19/19	6.50	2.00	79.40	9.79	39
-	1/30/19	3.10	1.97	82.80	11.70	16
-	2/16/19	2.60	3.34	89.30	12.15	100
-	2/27/19	2.50	2.08	81.90	11.26	8
-	3/16/19	5.70	3.90	93.00	11.57	-
-	3/22/19	5.40	2.45	104.00	13.00	-
-	4/13/19	7.60	2.52	86.80	10.34	58
-	4/24/19	8.90	2.45	82.60	9.50	19
-	5/11/19	14.30	1.82	77.70	7.76	102
-	5/22/19	12.50	2.76	78.70	5.53	72
-	6/8/19	12.10	0.99	96.70	10.41	171
-	6/19/19	-	2.04	72.00	7.23	253
LN3 Swan Road	Average/Geomean	8.32	3.86	78.24	9.26	67
-	10/10/18	10.90	2.42	81.40	9.01	64
-	10/27/18	9.50	4.42	69.60	7.93	261
-	11/7/18	10.00	3.20	48.00	5.30	52
-	11/24/18	7.10	3.24	75.90	9.23	66
-	12/5/18	2.90	3.60	74.90	10.00	37
-	12/22/18	5.39	2.70	71.10	8.91	62
-	1/2/19	4.28	8.68	72.90	9.10	64
-	1/19/19	6.50	3.57	82.40	10.04	36
-	1/30/19	3.60	5.30	93.8	12.30	31
-	2/16/19	2.60	5.21	86.90	11.68	201
-	2/27/19	3.10	3.48	89.50	12.01	11
-	3/16/19	6.10	4.90	91.60	11.36	-
-	3/22/19	6.50	2.86	106.90	13.34	15
-	4/13/19	8.40	3.26	82.60	9.71	57
-	4/24/19	10.00	3.60	83.10	9.40	-
-	5/11/19	16.60	2.67	76.90	7.46	125
-	5/22/19	13.90	4.39	74.60	5.00	71
-	6/8/19	13.50	2.08	82.00	8.50	573
-	6/19/19	17.20	3.77	58.10	5.60	116
LN4 Francis Road	Average/Geomean	8.63	4.71	79.04	9.10	62
-	10/10/18	11.00	3.40	74.90	8.25	117
-	10/27/18	9.80	8.08	66.80	7.55	464
-	11/7/18	10.10	3.30	55.70	5.76	66
-	11/24/18	7.10	3.88	75.50	9.14	93
-	12/5/18	3.30	4.44	70.70	9.40	8

Site	Date	Water Temp (° C)	Turbidity (NTU)	D.O. (% sat.)	D.O. (mg/l)	FC (CFU/100ml)
LN4 Francis Road	12/22/18	5.39	3.07	70.80	8.92	57
-	1/2/19	4.33	4.20	74.20	9.10	43
-	1/19/19	6.70	3.55	79.20	9.76	27
-	1/30/19	3.70	5.26	89.00	11.90	28
-	2/16/19	2.80	6.56	82.90	11.16	170
-	2/27/19	2.30	7.40	87.70	11.80	22
-	3/16/19	6.50	5.12	91.20	11.24	-
-	3/22/19	6.70	4.25	108.60	13.35	-
-	4/13/19	8.40	3.86	83.10	9.75	108
-	4/24/19	10.30	3.10	80.10	9.00	52
-	5/11/19	18.10	3.25	92.90	8.75	83
-	5/22/19	14.20	4.30	75.30	4.13	35
-	6/8/19	14.10	4.90	76.30	7.84	408
-	6/19/19	19.10	7.48	66.80	6.17	28

Appendix B – Storm Team Data

	11/2/2018	11/23/2018	12/12/2018	12/29/2018	Geomean
JLS-SSD	1600	115	1600	530	628
JLS11.25NO	1600	1	50	310	71
JLS11.25EA	1560	40	940	980	490
JLS-Gear	1600	1600	1600	1600	1600
HS -PR	515	20	480	160	168
LIS-FM	1600	1600	1440	1600	1558
NN11.5	1600	1600	1010	1360	1369
NN9	660	100	160	590	281
BV3	1600	100	210	210	290
BV4	1600	580	400	1360	843
BV5	340	110	370	1600	386
BV7	780	220	240	480	375

Site ID	Padilla Bay Storm Sites	Site ID	
JLS-SSD	South Spur Ditch (JLS) at Josh Wilson Rd	NN11.5	Little Indian Slough at Farm-to-Market Road
JLS11.25NO	Joe Leary Slough N side of Dahlstedt Rd at v-ditch	NN9	Marihugh and Bayview-Edison Road
JLS11.25EA	Joe Leary Sl S of Dahlstedt Rd , E of culvert	BV3	No Name Slough at end of Egbers-Kalso Road
JLS-Gear	Joe Leary Slough at Gear Rd (car lots)	BV4	Bay View - B Street Culvert
HS -PR	Higgins Slough at Peterson Road	BV5	Bay View - Boat Launch Culvert
LIS-FM	Little Indian Slough at Farm-Market Road	BV7	Blue beach cottage

Appendix C. Quality Objectives

parameter	method	precision (Rel. Std. Dev.)	accuracy	detection level
Dissolved Oxygen (DO)	YSI 55 Probe	Unavailable	± 0.3 mg/l	0-20 mg/l
Total depth	Fixed.hand- held Tape	± 20%	± 0.05 meters	0 - 1 cm
Turbidity	Turbidimeter	Unavailable	0.01 NTU	0-19.9 NTU 0-199.9 NTU
Temperature	YSI 55 Probe	Unavailable	0.2° C	°-5 to 45° C

parameter	method	test equipment	filter type	incubation
Fecal coliform bacteria	Membrane Filtration	Millipore sterifil aseptic system	47 mm membrane filter .45 um pore space	Millipore single chamber incubator Temp. range 30°C (±0.5) 44.5°C (±0.2)

Standard Operating Procedures (SOP's)

1. Dissolved Oxygen (DO)- Samples will be taken with a bottle placed in an extension pole and dipped using the Standard Methods. DO will be measured using a YSI 55 probe. Results will be recorded as DO mg/l.

DO testing procedure (YSI 55 Probe):

- i. Turn probe on and calibrate immediately when picking up equipment. Make sure sponge inside the calibration chamber is wet with distilled water.
- ii. Place probe in water below the surface of water and move probe back and forth until the reading stabilizes. Record the result in mg/l. Leave probe on for the rest of the sampling.

2. Temperature will be measured with a YSI probe and recorded in °C.

3. Total depth is measured using depth gauges installed at some sites.

4. Water clarity will be determined by placing a sample into a turbidimeter (EPA approved VWR 66120-200)

- i. Warm-up Turbidimeter 30 minutes and calibrates w. 0 NTU polymer standard using the "zero-adjustment".
- ii. Thoroughly shake the water sample in a clean sampling jar.
- iii. Pour sample into unscratched, clean, and Kim-wiped vial. Mix again
- iv. Place in turbidimeter w. index line facing directly out to the front.
- v. Read and record the steady reading after the highest readings settle.
- vi. If reading is greater than 200 NTU, dilute the sample by 50%. (x 2).

variable	sampling equipment	sample container	sample preservation	maximum holding time
fecal coliform	Pole w.glass bottle	glass bottle pre-sterilized	ice chest with ice pack	1 hr
d. oxygen	YSI probe	instream	none	immediately
total depth	Installed depth gauge	instream	none	immediately
temperature	YSI probe	instream	none	immediately
	thermometer	instream	none	immediately
turbidity	turbidimeter	glass bottle, wide-mouth	ice chest	2 hrs

Equipment calibration and maintenance

1. Millipore Sterifil Filtration System maintenance

Maintenance: Immediately after use disassemble the apparatus and clean the components to ensure optimum performance.

- i. Remove the cover from the funnel. Carefully remove the O-ring using forceps. Remove the support screen from the base by pushing a short blunt rod through the base outlet.
- ii. Clean all components with a sponge, hot water, and non-alkaline, non-abrasive cleanser (anti-bacterial soap). Remove stubborn residues on the insides of the holder, cover port, and flask side arms using a plastic bristle brush and pipe cleaner dipped in cleanser (do not use any steel wool or abrasive materials that can harm the components).
- iii. Rinse the components with lab water and sterilize.

2. Sample Containers and Equipment maintenance

Maintenance: Empty bottles and place in Liquinox and warm water. Wash with a bottlebrush. Double rinse with tap water and final rinse with distilled water. Autoclave all fecal coliform sample bottles and graduated cylinders.

3. Millipore Portable Single Chamber Incubator maintenance

Maintenance: Clean the exterior case and interior chamber with a damp cloth and warm water (anti-bacterial soap). Give final spray with rubbing alcohol.

4. VWR Turbidimeter

Calibration: Insert 0 NTU polymer standard with the range control set at "20". Set the "Zero Control" to 0. Set the coarse so that the meter reads as close to zero as possible. Calibrate turbidimeter annually.

5. YSI Meters (DO, Temp)

Calibration: Press and release UP ARROW and DOWN ARROW keys at the same time. Enter "0" for altitude and salinity, and ENTER afterwards. Instrument is calibrated.

Maintenance: Turn YSI 55 off and rinse probe with distilled water after each use. Replace membrane filters and Kim-wipe moisturizers monthly. Replace batteries as needed.

Appendix D. Sample Data Sheet

**Lower Samish Watershed
Skagit Stream Team
Water Quality Monitoring**

Date: _____

Field Work By: _____

Lab Work By: _____

Dupe Site: _____

FC Results: _____

Site LS1. Old Hwy. 99 Samish Bridge Water Appearance ☐ Scum/Film ☐ Foam ☐ Muddy Brown ☐ Milky ☐ Clear ☐ Oily Sheen ☐ Frozen ☐ Other _____ Field: Biological/Unusual Observations: _____	Time of Sample	Total Depth	Water Temp	Turbidity
		ft	°C	NTU's
	D.O. saturation	D.O.		Fecal Coliform
	%	mg/L		$\frac{\text{FC}}{\text{mL}} = \frac{\text{FC}}{\text{100 mL}}$
Lab metadata			Fecal Coliform $\frac{\text{FC}}{\text{mL}} = \frac{\text{FC}}{\text{100 mL}}$	

Site LS2. Samish River @ Jolly Road Water Appearance ☐ Scum/Film ☐ Foam ☐ Muddy Brown ☐ Milky ☐ Clear ☐ Oily Sheen ☐ Frozen ☐ Other _____ Field: Biological/Unusual Observations: _____	Time of Sample	Total Depth	Water Temp	Turbidity
		ft	°C	NTU's
	D.O. saturation	D.O.		Fecal Coliform
	%	mg/L		$\frac{\text{FC}}{\text{mL}} = \frac{\text{FC}}{\text{100 mL}}$
Lab metadata			Fecal Coliform $\frac{\text{FC}}{\text{mL}} = \frac{\text{FC}}{\text{100 mL}}$	

Site LS3. Samish River @ Thomas Road Bridge Water Appearance ☐ Scum/Film ☐ Foam ☐ Muddy Brown ☐ Milky ☐ Clear ☐ Oily Sheen ☐ Frozen ☐ Other _____ Field: Biological/Unusual Observations: _____	Time of Sample	Total Depth	Water Temp	Turbidity
		ft	°C	NTU's
	D.O. saturation	D.O.		Fecal Coliform
	%	mg/L		$\frac{\text{FC}}{\text{mL}} = \frac{\text{FC}}{\text{100 mL}}$
Lab metadata			Fecal Coliform $\frac{\text{FC}}{\text{mL}} = \frac{\text{FC}}{\text{100 mL}}$	

Site LS4. Samish River @ Mouth (Boat Dock) Water Appearance ☐ Scum/Film ☐ Foam ☐ Muddy Brown ☐ Milky ☐ Clear ☐ Oily Sheen ☐ Frozen ☐ Other _____ Field: Biological/Unusual Observations: _____	Time of Sample	Total Depth	Water Temp	Turbidity
		ft	°C	NTU's
	D.O. saturation	D.O.		Fecal Coliform
	%	mg/L		$\frac{\text{FC}}{\text{mL}} = \frac{\text{FC}}{\text{100 mL}}$
Lab metadata			Fecal Coliform $\frac{\text{FC}}{\text{mL}} = \frac{\text{FC}}{\text{100 mL}}$	

Additional notes or observations: _____