Skagit County Monitoring Program

SCMP

Annual Report

2021 Water Year
(October 2020 – September 2021)

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This report is available online at www.skagitcounty.net/SCMP

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Definitions

Ag-CAO	-	Critical Areas Ordinance: Ongoing Agriculture
Ag-NRL	-	Agricultural Natural Resource Lands
BMP	-	Best Management Practice
County	-	Skagit County
CSI	-	Clean Samish Initiative
CV	-	Coefficient of Variation
DO	-	Dissolved Oxygen
Ecology	-	Washington State Department of Ecology
EPA	-	Environmental Protection Agency
FC	-	Fecal Coliform
GMHB	-	Growth Management Hearings Board
MPN	-	Most Probable Number
NH_3	-	Ammonia
NO_3+ NO_2	-	Nitrate + Nitrite
NTU	-	Nephelometric Turbidity Units
OP	-	Ortho-Phosphorous
pH	-	Power of Hydrogen
PIC	-	Pollution Identification and Correction
QAPP	-	Quality Assurance Project Plan
RR-NRL	-	Rural Resource Natural Resource Lands
RSD	-	Relative Standard Deviation
SCC	-	Skagit County Code
SCMP	-	Skagit County Monitoring Program
7-DADMax	-	7-Day Average of Daily Maximum Temperatures
SRC	-	Site Report Card
TKN	-	Total Kjeldahl Nitrogen
TMDL	-	Total Maximum Daily Load
TP	-	Total Phosphorous
TSS	-	Total Suspended Solids
VSP	-	Voluntary stewardship Program
WQI	-	Water Quality Index
WRC	-	State of Washington Water Research Center
WY	-	Water Year

Executive Summary

Skagit County Public Works has completed the eighteenth year of water quality monitoring under the Skagit County Water Quality Monitoring Program, and this is the eighteenth annual report, for the 2021 water year.

Data collected during this project indicates that many Skagit County streams, within and outside of the agricultural areas, do not meet state water quality standards for fecal coliform, *E. coli,* temperature, and/or dissolved oxygen. None of the 39 sites has met all water quality standards for the entire project, although some sites meet the standards most of the time. The standards are developed to protect salmonid populations, recreation, and downstream shellfish resources. Streams not meeting the standards represent less-than-ideal conditions for those uses. Conditions in Skagit County range from watercourses with occasional failures to continual inability to meet the standards. The Samish and Skagit Rivers have shown drastic improvement and a strong ratio of positive to negative trends over the course of this program. Most of the substandard water quality occurs in slow-moving agricultural sloughs and in creeks that have low flow in the warmer months. Further investigation is ongoing to determine the causes of poor water quality in each case. Some cases may represent natural conditions rather than human-caused problems.

Trends analyses of water temperature, dissolved oxygen, bacterial concentrations, and other metrics reveal strong differences between watersheds and timeframes across the county. Some watersheds have mostly negative trends across an eighteen-year period but show a majority of positive trends in a more recent timeframe, such as the last five years.

Most trends in fecal coliform reduction county-wide are positive over all three analyzed time periods. This is a result of the hard work and dedication of the residents, farmers, tribes, government, environmental groups, establishing and enforcing strong regulations, and continued vision for a clean and sustainable environment that the citizens of Skagit County and the state of Washington continually portray. These improvements in water quality will continue to shine as an example for other communities and states across the country. Most dissolved oxygen trends across all timeframes across the valley show a positive increase, despite an abundant increase in water temperatures. This may suggest reductions on biological oxygen demand in the watercourses, and it is great news for salmon.

The format of this report may be used as the means to form action plans to address trends in watercourses and sampling sites. The trends maps and tabled trends summaries can paint a picture of overall water quality at each site to inform future action and to efficiently direct public resources and efforts.

The Skagit County Water Quality Monitoring Program has now collected 18 years of high-quality data. Questions on the program can be addressed to Dan Sulak at dsulak@co.skagit.wa.us or 360-416-1443

Skagit County Monitoring Program Annual Report

2021 Water Year
(October 2020-September 2021)

Introduction

The Skagit County Monitoring Program (SCMP) began in October 2003 as part of Skagit County's (County) program to assess the effectiveness of Skagit County Code (SCC) Chapter 14.24.120: Critical Areas Ordinance for Areas of Ongoing Agriculture (Ag-CAO). The revised ordinance (Skagit County Ordinance O20030020) was passed by the Skagit County Board of Commissioners in June 2003 in response to a compliance order from the Western Washington Growth Management Hearings Board (GMHB).

The ordinance requires farmers to "do no harm" to adjacent watercourses and relies on specific watercourse protection measures and more generalized best management practices (BMPs) to protect the watercourses instead of requiring buffers. The associated Skagit County Resolution R20030210 committed the County to conduct water quality monitoring in the agricultural areas as one method of assessing if the ordinance was sufficient to protect the aquatic resources in agricultural areas. The resolution was subsequently amended in June 2004 as Resolution R20040211 in response to additional compliance orders from the Western Washington GMHB. This second resolution provided details about the water quality monitoring program in addition to other topics not associated with water quality. Included in R20040211 is the requirement for annual reporting on the water quality monitoring program. This document is intended to satisfy that requirement for the 2021 Water Year (WY). Results from the first seventeen years of this program have been reported previously (Skagit County 2004-2020). This current report contains data and analysis from water years 2004 – 2021.

R20040211 also required the County to conduct a triennial review of the Ag-CAO, including the water quality monitoring program, to seek public comment and to make changes if necessary. However, the State of Washington passed SSB 5248 in 2007, which placed a "time out" on changes to critical areas regulations impacting agriculture until 2010, while the statewide issues regarding agricultural regulation were studied. The legislature subsequently passed additional legislation to extend the "time out" to 2011. In 2011, the Washington State Legislature adopted the recommendations from one research group studying the critical areas regulations and created the Voluntary Stewardship Program (VSP). Skagit County enrolled in the program in 2012. Any county that enrolled agreed to maintain existing critical areas protections and ensure streams are protected using voluntary measures.

Sampling Locations

Figure 1 is a map with the sampling sites monitored by the SCMP, while **Table 1** and **Table 2** list the sampling site's names and their designations. Thirty-nine sites are currently included in the program. These sites are located primarily in agricultural zones, designated by the County as Agriculture-Natural Resource Lands (Ag-NRL) and Rural Resource-Natural Resource Lands (RR-NRL). Other sites were selected to provide context to, and comparisons with, the sites in the agricultural zones. These include sites located just upstream or downstream of agricultural areas or in streams draining suburban watersheds. The SCMP was designed to determine current conditions and long-term trends in water quality at these sampling locations. The data are also suitable for determining compliance with state water quality standards.

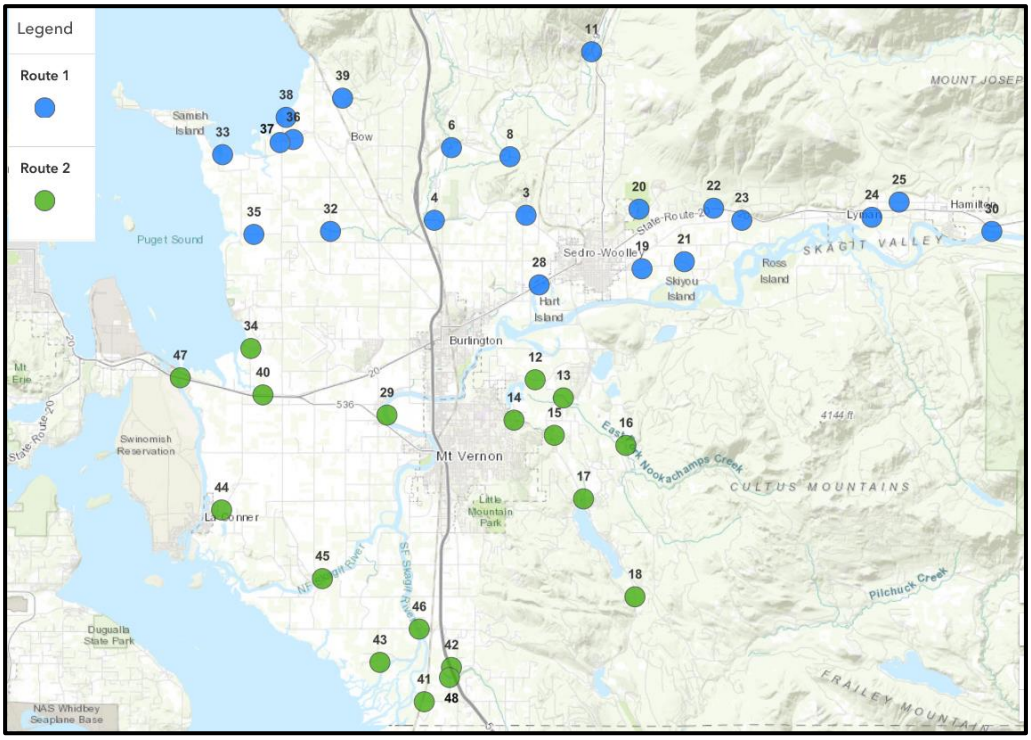


Figure 1 – Ambient sampling sites in the SCMP

A secondary purpose for some sites included in the SCMP is to provide data to the Washington State Department of Ecology (Ecology) in support of their Total Maximum Daily Load (TMDL) or water cleanup programs in Skagit County. The sites that provide TMDL data are in agricultural zones and are integral to the determination of trends and conditions in those areas. Active water cleanup plans in Skagit County include the Lower Skagit Tributaries Temperature TMDL, the Samish Bay Watershed Fecal Coliform TMDL, and the Lower Skagit River Fecal Coliform TMDL. Improvements made as a result of the

latter program indicate that the Lower Skagit River is a candidate for removal from Ecology's Impaired Waters list.

Table 1 - Sample site locations and types in the SCMP

Site Number	Watercourse	Location	Latitude	Longitude	Site Type[1]
3	Thomas Creek	Old Hwy 99 N	48.526	-122.339	3
4	Thomas Creek	F&S Grade Rd	48.528	-122.276	2
6	Friday Creek	Prairie Rd	48.559	-122.327	4
8	Swede Creek	Grip Rd	48.555	-122.287	3
11	Samish River	State Route 9	48.602	-122.231	1
12	Nookachamps Creek	Swan Rd	48.454	-122.270	3,6
13	E.F. Nookachamps Creek	State Route 9	48.446	-122.251	3,6
14	College Way Creek	College Way	48.436	-122.286	4
15	Nookachamps Creek	Knapp Rd	48.429	-122.258	2,6
16	E.F. Nookachamps Creek	Beaver Lake Rd	48.424	-122.208	2,6
17	Nookachamps Creek	Big Lake Outlet	48.400	-122.237	1,6
18	Lake Creek	State Route 9	48.356	-122.202	1,6
19	Hansen Creek	Hoehn Rd	48.504	-122.197	3,6
20	Hansen Creek	Northern State	48.531	-122.199	1,6
21	Coal Creek	Hoehn Rd	48.507	-122.169	3
22	Coal Creek	Hwy 20	48.531	-122.149	1
23	Wiseman Creek	Minkler Rd	48.526	-122.130	1
24	Mannser Creek	Lyman Hamilton Hwy	48.528	-122.041	2
25	Red Cabin Creek	Hamilton Cem. Rd	48.534	-122.023	1
28	Brickyard Creek	Hwy 20	48.497	-122.268	4
29	Skagit River	River Bend Rd	48.439	-122.372	5,6
30	Skagit River	Cape Horn Rd	48.521	-121.960	5
32	Samish River	Thomas Rd	48.521	-122.410	3
33	Alice Bay Pump Station	Samish Island Rd	48.555	-122.483	3
34	No Name Slough	Bayview-Edison Rd	48.468	-122.464	3
35	Joe Leary Slough	D'Arcy Rd	48.520	-122.462	3
36	Edison Slough at school	W. Bow Hill Rd	48.562	-122.436	3
37	Edison Pump Station	Farm to Market Rd	48.561	-122.444	3
38	North Edison Pump Station	North Edison Rd	48.572	-122.441	3
39	Colony Creek	Colony Rd	48.581	-122.401	2
40	Big Indian Slough	Bayview-Edison Rd	48.447	-122.457	3
41	Maddox Slough/Big Ditch	Milltown Rd	48.309	-122.346	3
42	Hill Ditch	Cedardale Rd	48.324	-122.327	3
43	Wiley Slough	Wylie Rd	48.326	-122.372	3
44	Sullivan Slough[2]	La Conner-Whitney	48.395	-122.485	3
45	Skagit River – North Fork	Moore Rd	48.364	-122.416	5,6
46	Skagit River – South Fork	Fir Island Rd	48.342	-122.349	5,6
47	Swinomish Channel	County Boat Launch	48.455	-122.512	7
48	Fisher Creek	Franklin Rd	48.320	-122.328	3,6

[1]See Table 2 for site type descriptions
[2]Site 44 was moved to its current location in June, 2005. See text for details

Table 2 - Sample site type descriptions for the SCMP

Site Type Number	Description	Number of Sites[1]
1	Ag-upstream: Located to determine status/trends at upstream end of agricultural areas.	6
2	Ag-midstream: Located to determine status/trends in the middle of agricultural areas.	6
3	Ag-downstream: Located to determine status/trends at downstream end of a watercourse in agricultural areas.	20
4	Reference: Located to determine status/trends in a non-agricultural area, such as urban/suburban or rural reserve, for comparison with agricultural area results.	3
5	Skagit River: Located to determine status/trends in the mainstem Skagit River or the forks. The Skagit may show effects from a wide variety of sources.	4
6	TMDL: Located to provide information for the Department of Ecology's TMDL efforts.	12
7	Swinomish Channel: Located to provide a water quality baseline for Swinomish Channel	1

[1]Some sites have more than one type designation

Sample Site Revisions

Nineteen of the thirty-nine sites (sites 3-25) are continued from the Skagit County Baseline Monitoring Project (Skagit County 2004a). The Baseline project used nearly identical methods to monitor water quality at 27 sites. Five additional sites were part of the Samish Bay Watershed Water Quality Monitoring Program (Skagit County 2003). The data from the Baseline and Samish Projects are used to help interpret trends in water quality for sites continued in the SCMP. Not all Baseline sites could be continued into the current program due to limited resources and the need to expand the current program into the Skagit Delta, where there were no Baseline sites. Several intermediate sites on the Samish River were discontinued, leaving one upstream and one downstream site on the Samish.

Three sample sites were moved from their original locations as delineated in the Quality assurance Project Plan (QAPP). Site 35 on Joe Leary Slough was moved approximately 3,500 feet upstream from Bayview-Edison Road to D'Arcy Road to solve right-of-entry problems. Site 40 on Big Indian Slough was moved approximately 2,800 feet upstream to solve right-of-entry problems and to move away from the tide gate and associated saltwater intrusion. These two changes were made prior to any sampling. Site 42 on Hill Ditch/Carpenter Creek was moved approximately 4,300 feet upstream because the original site at Pioneer Highway was subject to backwater from the Skagit River, and in early samples it was determined that

primarily Skagit River water was being sampled instead of Hill Ditch/Carpenter Creek water. These changes were approved by Ecology as revisions to the QAPP in 2003 and 2004.

In June 2005, the sample site at Rexville Pump Station (Site 44), at the east end of the Sullivan Slough watershed, was moved to the west end of Sullivan Slough, at La Conner-Whitney Road. This move was made in consultation with Ecology and the Western Washington Agricultural Association. Most of the flow from that system discharges through the west end into Swinomish Channel. The Rexville Pump Station site was initially chosen because it was cited as a possible fecal coliform source in the Lower Skagit Fecal Coliform TMDL (Pickett 1997). However, fecal coliform (FC) readings at the site during this study were generally low. Because of the low FC readings, coupled with the infrequent discharges from the pump station, it was determined that sampling efforts would be better spent nearer the outlet of the slough.

For the 2017 season, Skagit County re-designated two sites to better reflect current land use patterns: Site 16 (East Fork Nookachamps Creek) was moved from Ag-Upstream to Ag-Midstream due to some agricultural activity directly upstream of the sample location. Site 23 (Wiseman Creek) was moved from Ag-Midstream to Ag-Upstream due to the cessation of agricultural activities upstream of the sample location.

Sampling Frequency

For the Skagit County ambient sampling program, samples are taken bi-weekly. Sites are sampled on one of two routes, with each route being completed every other week. All ambient sampling trips were conducted on schedule during the 2021 water year, beginning in October 2020. Sampling may have taken place on different days each week, depending on scheduling and logistics.

Clean Samish Initiative

The Clean Samish Initiative (CSI) was established by Ecology in fall 2008 to foster cooperation between local, state, tribal, and federal agencies, non-governmental groups, and citizens to address FC pollution in the Samish Bay Watershed. Excess FC pollution in the Samish River and other bay tributaries has resulted in numerous closures of the commercial shellfish beds in Samish Bay. The CSI participants (over 20 organizations) developed a work plan that included education and outreach, detailed water quality sampling to locate pollution sources, referrals of landowners to resource agencies for pollution abatement, and enforcement of water quality and land use regulations if necessary. Skagit County applied for and received EPA funding in 2010 to conduct a PIC project in the Samish Basin, incorporating CSI work plan elements into a program designed to locate and eliminate FC pollution in the Samish Basin.

The CSI grew out of Ecology's TMDL activities in the Samish Basin. Ecology's sampling demonstrated that the Samish River was the largest source of FC bacteria to Samish Bay. While some of the independent Samish Bay tributaries (e.g. Edison Slough and Colony

Creek) and agricultural drainages also contribute bacterial pollution to Samish Bay, the comparatively high discharge rate of the river combined with occasional high coliform counts determined that the river was, and continues to be, the most important pollution source for Samish Bay.

2008 Review by the State of Washington Water Research Center

Skagit County contracted with the State of Washington Water Research Center (WRC) for a review of its water quality program. The WRC Review Report draft was received in March 2008, and the final report was received in June 2008. The report is available at: www.skagitcounty.net/SCMP.

Skagit County is implementing the report recommendations as the budget allows. Recommendations that have already been incorporated into the program include expansion of the sampling program to better identify pollution source locations (through the PIC program), increased use of stream discharge information, and some statistical analysis recommendations.

Funding

A proposal was submitted in February 2003 to Ecology for consideration in its FY 2004 Centennial Clean Water Grants program. The proposal was accepted and a grant of nearly $500,000 was awarded to support five years of the monitoring program, fiscal year 2004 through fiscal year 2008.

The Centennial Clean Water Grant, that funded the program at 75%, ended in December 2008, with the remaining 25% having come from County funds. Work since that date has been funded by Skagit County's Clean Water Program (CWP). Skagit County has received some EPA funding to address Samish Bay watershed FC issues, but the core activities of the SCMP will continue to be funded out of the CWP.

Methods

Standard water quality monitoring methods are used in the SCMP. The methods are derived from several sources, including guidance from Ecology and the EPA. A brief description of monitoring procedures follows, and detailed monitoring procedures can be found in the QAPP developed for the program (Skagit County 2004b).

Each site in the monitoring program is visited once every two weeks. At each visit, dissolved oxygen (DO), temperature, pH, turbidity, conductivity, and salinity are measured, and samples are obtained for FC determinations. Additional water samples are obtained for laboratory quantification of nutrients (total Kjeldahl nitrogen (TKN), ammonia (NH_3), nitrate (NO_3), nitrite (NO_2), total phosphorus (TP), orthophosphate (OP)), and total suspended solids

(TSS) on a quarterly basis. Stream discharge was measured at selected sites as time and staffing permitted through 2008.

The sample routes are designed so that each station is visited at approximately the same time of day on each visit to minimize the effects of diurnal variation in water quality parameters on overall data variability through the length of the program.

Data are collected on paper field sheets and later entered in an electronic database which is then checked for accuracy against the original data sheets. Microsoft Excel spreadsheets are used for data summary and analysis. These spreadsheets are appendices to this report and are published on the County's web site: http://www.skagitcounty.net/SCMP

Data Analysis

Summary statistics for all measured parameters at each sampling site can be found in **Appendix B**. These statistics can be used as a general indication of water quality at each station. However, water quality conditions vary greatly at each station over time and the summary statistics should not be used as a sole indicator of water quality.

A primary goal of the SCMP is to detect trends in water quality over time. The purpose of the trends analysis is to provide indications of whether water quality in agricultural areas is improving, staying the same, or deteriorating. Once trends are detected, efforts should be undertaken to determine if they are caused by local activities or by regional conditions such as changes in climate. By comparing trends at stations inside and outside of the agricultural areas and by monitoring climate conditions, it should be possible to determine conditions that are likely caused by local circumstances.

One statistical tool in trends monitoring is the Seasonal Kendall's Test. This test is designed to determine overall trends in water quality for parameters that vary seasonally, such as temperature and DO. The Seasonal Kendall's Test has been widely employed for similar purposes in Washington, Oregon, and throughout the country (e.g. Cude 2002, Ehinger 1993, Holdeman et al 2003). Most parameters measured in the SCMP have seasonal variation, caused by our local climate, which produces comparatively high-water flows and low temperatures in the winter and spring, and lower flows with higher temperatures in the summer and early fall.

The Seasonal Kendall's Test for this report was computed using Sanitas software (Intelligent Design Technologies, 1998). For most analyses, twelve seasons were designated, starting with the beginning of each month. This approach was recommended in the review of the SCMP by the WRC. Observations below detection limits were replaced with one-half of the detection limit per the software user manual. The software was able to ignore missing data, so no accommodation for missing data was necessary.

The SCMP completed trends analysis via the Seasonal Kendall's Test for 18 key parameters at each sampling location. The parameters tested include pH, DO, DO% saturation,

temperature, turbidity, FC, NH_3, NO_3+NO_2, TP, OP, TKN, and TSS. Temperature data from biweekly sampling visits were used for this analysis instead of continuous data collected during the summer months because the test is not designed for summer-only data. Skagit County continues to examine methods for determining trends in the continuous temperature data. Since the temperature data from bi-weekly visits were collected at the same time of day for any individual station, the trends analysis should not be biased by differences caused by sampling time of day.

Three periods were analyzed for trends in this report: The 18 full years of SCMP data, the most recent ten years of data, and the most recent five years of data. Analyzing trends over three different timeframes allows a more detailed picture of what changes have been occurring across the county. For example, a creek may exhibit a small trend in increasing DO from 18 years ago as compared to now, but it may also show a strong trend in decreasing DO from five years ago as compared to now. Analyzing a combination of time periods reveals a clearer picture of what is happening than can be ascertained from a single trend over the course of 18 years.

Several sites have extended dry periods during most summers and/or are flooded during high water events and not sampled. The Sanitas trends analysis program was unable to compute trends based on 12 seasons for those sites due to the consistent lack of data for the dry or flooded periods. For those sites, trends were calculated based on four seasons, beginning in January, April, July, and October. All trends analyses on nutrient data mentioned above are also performed using four seasons, as these are only sampled quarterly.

Data used for the Seasonal Kendall's Test can be subject to autocorrelation, where each successive datum is correlated with the previous point. This situation usually occurs when samples are collected more frequently than monthly. For the SCMP, DO, temperature, and FC data are collected biweekly. Tests are available to detect autocorrelation, but in some cases may be confounded by the very seasonality we are trying to accommodate. Our approach for these parameters has been to conduct the analysis using all data and repeat the analysis using monthly averages to avoid autocorrelation. In the cases where there are differences, it would probably be prudent to use the monthly averages. A summary of Seasonal Kendall's Test results for all parameters, significant or not, can be found in Appendix C.

Data Quality

Quality Assurance Project Plan (QAPP)

The SCMP operates under a QAPP that was approved by Ecology in 2003. This plan details sampling strategies, equipment to be used, and all other aspects of the sampling program. Ecology approval of the QAPP was required for Skagit County to be eligible for grant funds.

Equipment Calibration and Maintenance

The turbidity meter (Lamotte Model 2020we) is calibrated the afternoon before or the morning of each sampling trip, and the reading before calibration is recorded.

The pH meter (Hanna Instruments Model 8314) is calibrated on the morning of each sampling trip. The pH meter is recalibrated during the trip if questionable results are obtained.

The DO/temperature/conductivity meter (YSI Model 2030 Pro) is calibrated for DO using the built-in calibration chamber (water-saturated air). The meter is recalibrated to local elevation at each sample site prior to sampling.

The DO meter probe is deployed in areas with sufficient current (> 0.5 fps) to produce reliable results, or the probe is stirred to produce adequate velocity across the membrane. Samples for pH and turbidity are obtained from the thalweg of the stream whenever possible with sample containers rinsed at least three times with sample water and are analyzed immediately.

Lab Samples

Laboratory samples for nutrients are collected using clean equipment and proper procedures, collected with a sampling wand from as close as possible to the the thalweg of the watercourse, and care is taken to prevent oversampling of the surface film or disturbing the bottom. For nutrient and TSS samples the sampling container is rinsed at least three times with the water to be sampled. The sample is then poured into the bottles provided by the contract lab, Edge Analytical of Burlington, WA, an Ecology-certified laboratory. Samples are capped and placed in a cooler with ice until they are delivered to the lab on the same day.

Samples for FC are collected directly into sterile bottles and transported under ice to the laboratory within eight hours of collection.

Personnel

The project manager performs most samplings that generate data for this report. Any other staff that perform samplings and collections are adequately trained by the project manager according to EPA-approved sampling methods prior to sampling. Due to regular staff turnover and availability of assisting staff members, some staff may collect sample data only once, though repeated participation and experience with the project manager is preferred when possible.

Duplicate Analysis

Duplicate samples are collected for FC at a 20% rate and for selected nutrients at a 10% rate. Selected nutrient duplicates (TP, OP, NO_3, and/or NH_3) are intended to provide a precision estimate for all the nutrient analyses.

Table 3 summarizes the results of the duplicate analyses for the 2021 water year, using the coefficient of variation (CV) statistic. Variability in FC for the 2021 water year was 41.5, above

the original target level set out in the 2003 QAPP of 33. However, the annual average across this program is 44, with a very small annual standard deviation of 3. A score of 41 is on the very lowest end of this program's history. In this report, coefficient of variation is considered synonymous with relative standard deviation (RSD).

The high variability of the FC results may be partially due to the use of the Most Probable Number (MPN) analysis technique. This method was chosen for the SCMP because the Skagit County Health Department laboratory was certified for the method, and because it is reportedly more reliable for samples with high turbidity, which are often encountered in the SCMP (Michaud 1991). The program continued using MPN when it switched to Edge Analytical in 2009 to maintain data comparability. Fecal coliform variability in the SCMP, although higher than the initial target level, is similar to that seen in other monitoring programs in Washington.

Table 3 - Data quality duplicate analysis for 2021 Water Year

		Coefficient of Variation (RSD)	
Parameter	**n**	**2021 Results**	**Target**
Fecal Coliform	208	41.5	33[1]
E. coli	207	50.3	33
Total Phosphorus	8	6.5	10 [2]
Orthophosphate	8	0.0	10 [2]
Nitrate	8	1.1	10 [2]
Ammonia	8	23.7	10 [2]

[1] Target precision as listed in 2003 QAPP
[2] 10% CV target was listed for all nutrients

Data Summaries and Trends Analysis

Trends were calculated for 30 measured or calculated parameters (such as monthly averages) at each of 39 sites, for a total of 1,170 tests. Of those, 399 tests showed a statistically significant trend at the 95% confidence level. Trends judged as improving or positive (e.g., increased dissolved oxygen, reduced temperature) made up 217 of the significant trends, or 54 percent. Negative or deleterious trends (e.g., reduced dissolved oxygen, increased nutrients) accounted for the remaining 182, or 46 percent of the significant trends. In relation to the global trend in acidification of surface waters, declining pH was considered a negative trend for this report. There were also statistically significant nutrient trends where the slope was zero, and these are not included in the above counts. The statistical analysis used was very sensitive, and a

slope of zero simply means that the slope was less than 0.0001 units, though the directionality as positive or negative was still given.

All trends can be found in the tables in **Appendix C**. Positive significant trends are shaded green and negative are shaded red. Trends that achieved 95% confidence in statistical significance are shaded the darkest blue in the confidence column. Some trends were very close to achieving 95% confidence but fell short. Trends that achieved 90% confidence are shaded in a slightly lighter blue, and trends that achieved 80% confidence in even lighter blue. This helps to inform the reader of all changes that may be occurring at the sampling site, even if they are not statistically significant at a 95% confidence level. Any parameters that showed a significant trend with a slope of 0 are highlighted in yellow in the slope column.

Trend statistics are tools to help us understand changing conditions in our watercourses, but do not completely describe the condition of a watercourse. Many of the sites with no significant trends or improving trends in water quality parameters still do not meet state water quality standards, and therefore still qualify as areas of concern. Many Skagit County sites remain on Ecology's Impaired Waters list. As previously discussed, high fecal coliform levels in the Samish Bay watershed have led to closures of shellfish beds and loss of revenue for shellfish growers. Dissolved oxygen and temperature conditions are still substandard in many watercourses, resulting in less-than-ideal rearing conditions for salmonids and other aquatic life.

Gaps in the data represent streams that were either flooded or dry at sampling time or may represent equipment malfunctions.

Site Sampling Times

The SCMP maintains sampling times as a temporal control for data analysis. The higher the precision of sampling time each week, the better. This is an exceptionally difficult task over such a long period. It is common to experience equipment problems, staff availability issues, bad weather, injuries, flat tires, closed roads, and inaccessible watercourses. Despite these obstacles, the SCMP has maintained remarkably small sampling windows across 18 years.

Route 1 - All 18 years combined					
Site	Mean	Min	Max	Range (hrs)	n
28	8:19	7:30	9:40	2:10	205
22	8:36	7:28	10:05	2:37	256
25	8:54	7:48	10:20	2:32	224
30	9:06	8:00	10:30	2:30	256
24	9:23	8:15	10:50	2:35	254
23	9:41	8:27	11:00	2:33	233
21	9:56	8:38	11:20	2:42	230
19	10:08	8:50	11:30	2:40	238
20	10:22	9:06	12:00	2:54	255
11	10:46	9:27	12:05	2:38	256
8	11:24	9:49	12:55	3:06	255
4	11:48	10:05	13:35	3:30	254
3	12:03	10:20	13:50	3:30	254
6	12:17	10:41	14:05	3:24	255
39	12:38	11:00	14:20	3:20	253
36	12:53	11:13	14:35	3:22	255
38	13:08	11:30	14:50	3:20	252
37	13:24	11:44	15:05	3:21	254
33	13:38	11:55	15:20	3:25	252
35	13:54	12:10	15:40	3:30	255
32	14:07	12:20	15:50	3:30	256

Table 4 – Historical sampling times for Route 1, which primarily samples the northern half of Skagit County. The table on the left includes all years of the program that sampling times were recorded. The table on the right is from the most recent water year.

Route 1 - Water Year 2021					
Site	Mean	Min	Max	Range (hrs)	n
28	7:52	7:35	8:20	0:45	15
22	8:08	7:28	8:40	1:12	26
25	8:28	7:48	9:00	1:12	21
30	8:42	8:00	9:20	1:20	26
24	9:00	8:15	9:40	1:25	26
23	9:20	8:27	10:00	1:33	22
21	9:37	8:38	10:20	1:42	22
19	9:50	8:50	10:30	1:40	22
20	10:04	9:06	10:50	1:44	26
11	10:29	9:27	11:15	1:48	26
8	10:50	9:49	11:40	1:51	26
4	11:10	10:05	12:05	2:00	26
3	11:32	10:20	12:45	2:25	26
6	11:44	10:41	12:30	1:49	25
39	12:02	11:00	12:50	1:50	26
36	12:19	11:13	13:05	1:52	26
38	12:34	11:30	13:20	1:50	25
37	12:54	11:44	13:50	2:06	26
33	13:12	11:55	14:00	2:05	26
35	13:28	12:10	14:15	2:05	26
32	13:42	12:20	14:25	2:05	26

Route 1 primarily samples the northern half of the county, while Route 2 primarily covers the southern half. Throughout the years, some short-term project-oriented sites were added into the sampling days, and those contributed to wider variation in sampling times for certain sites on the routes over the years.

Route 2 - All 18 years combined					
Site	Mean	Min	Max	Range (hrs)	n
29	8:19	7:00	9:44	2:44	253
40	8:47	7:35	10:13	2:38	251
34	9:01	7:50	10:26	2:36	250
47	9:15	8:05	10:40	2:35	256
44	9:33	8:30	11:00	2:30	255
45	9:58	8:55	11:40	2:45	253
43	10:18	9:00	11:56	2:56	255
46	10:33	9:10	12:07	2:57	255
41	10:48	9:25	12:30	3:05	257
48	11:01	9:35	12:47	3:12	257
42	11:16	9:45	13:04	3:19	255
18	11:45	10:10	13:40	3:30	255
17	12:01	10:25	14:00	3:35	255
16	12:23	10:40	14:19	3:39	255
15	12:43	10:55	14:46	3:51	254
13	12:57	11:05	15:01	3:56	254
12	13:11	11:20	15:30	4:10	252
14	13:30	11:30	15:30	4:00	251

Table 5 - Historical sampling times for Route 2, which primarily samples the southern half of Skagit County. The table on the left includes all years of the program that sampling times were recorded. The table on the right is from the most recent water year.

Route 2 - Water Year 2021					
Site	Mean	Min	Max	Range (hrs)	n
29	7:41	7:00	8:00	1:00	25
40	8:15	7:35	8:35	1:00	26
34	8:30	7:50	8:55	1:05	26
47	8:47	8:05	9:15	1:10	25
44	9:06	8:30	9:40	1:10	26
45	9:37	9:00	10:15	1:15	25
43	9:58	9:20	10:35	1:15	24
46	10:17	9:25	10:50	1:25	26
41	10:34	9:35	11:05	1:30	26
48	10:46	9:45	11:20	1:35	26
42	11:03	10:00	11:35	1:35	26
18	11:32	10:20	12:10	1:50	26
17	11:49	10:35	12:35	2:00	26
16	12:13	11:00	13:00	2:00	26
15	12:35	11:15	13:30	2:15	25
13	12:48	11:25	13:45	2:20	26
12	13:02	11:40	14:05	2:25	26
14	13:39	11:50	14:55	3:05	24

Annual Rainfall and Air Temperatures

Monthly precipitation totals and average air temperatures were collected from the Washington State University AgWeatherNet Mount Vernon station for the entire 18 water years of this program **(Tables 6, 7)**. Summary statistics are calculated on the right for each month and below for each year.

The 2021 water year had the third lowest recorded rainfall in the programs 18-year history. Total rainfall was 28.00 inches, 4.47 inches, or 1.14 standard deviations, below the 18-year mean of 32.47 inches. The period from March through July was particularly dry, with each of those months seeing at least 0.5 inches less rain than the average for the month.

	WY 2004	WY 2005	WY 2006	WY 2007	WY 2008	WY 2009	WY 2010	WY 2011	WY 2012	WY 2013	WY 2014	WY 2015	WY 2016	WY 2017	WY 2018	WY 2019	WY 2020	WY2021
October	5.34	2.71	4.01	1.98	4.82	1.37	5.67	1.76	1.96	3.87	1.51	6.07	3.39	5.26	5.39	2.32	4.21	3.54
November	4.66	6.84	4.20	5.61	2.68	5.55	5.31	3.74	4.67	3.89	3.48	3.90	7.85	5.99	6.22	4.20	2.14	2.92
December	2.87	4.36	3.42	3.05	3.71	3.18	1.25	3.26	1.25	3.52	2.34	3.73	7.05	3.21	3.76	3.79	3.50	4.25
January	4.01	4.11	6.54	5.47	2.75	3.79	2.81	6.01	2.92	5.13	4.70	4.69	3.21	1.62	4.79	1.81	5.90	3.71
February	1.35	3.15	3.2	2.96	2.91	1.25	1.25	1.72	4.49	2.02	3.89	2.97	4.63	3.18	5.78	2.27	4.82	4.89
March	3.44	2.77	1.51	4.52	4.36	2.24	2.16	3.37	3.77	2.10	4.45	2.51	3.88	5.01	2.79	1.35	2.84	1.61
April	0.28	4.11	3.16	0.89	2.40	2.71	2.53	3.90	4.31	4.60	3.26	1.48	2.17	3.00	4.73	2.45	1.61	1.16
May	3.65	1.73	2.24	1.09	2.09	2.22	4.57	4.17	2.4	2.58	3.68	0.60	1.27	2.36	0.35	0.88	3.13	0.87
June	1.80	1.90	1.10	1.58	2.25	0.16	1.66	0.91	3.14	1.27	1.14	0.61	2.78	0.94	1.52	1.42	3.07	0.91
July	0.61	0.74	0.82	1.27	0.64	0.51	0.05	1.39	1.3	0.00	1.29	0.11	0.59	0.01	0.04	0.83	0.83	0.00
August	6.29	2.22	0.23	0.81	2.23	0.52	1.17	0.42	0.01	1.34	0.88	1.46	2.88	0.04	0.17	0.86	0.64	0.96
September	3.27	1.96	1.78	2.36	0.50	1.31	2.87	0.87	0.14	4.10	2.64	2.12	1.32	1.59	1.36	5.24	1.07	3.18
Annual	37.57	36.6	32.21	31.59	31.34	24.81	31.30	31.52	30.36	34.42	33.26	30.25	41.02	32.21	36.90	27.42	33.76	28.00
Low	0.28	0.74	0.23	0.81	0.5	0.16	0.05	0.42	0.01	0.00	0.88	0.11	0.59	0.01	0.04	0.83	0.64	0.00
High	6.29	6.84	6.54	5.61	4.82	5.55	5.67	6.01	4.67	5.13	4.7	6.07	7.85	5.99	6.22	5.24	5.9	4.89
Mean	3.13	3.05	2.68	2.63	2.61	2.07	2.61	2.63	2.53	2.87	2.77	2.52	3.42	2.68	3.08	2.29	2.81	2.33
Mean Wet (Oct-Apr)	3.14	4.01	3.72	3.50	3.38	2.87	3.00	3.39	3.34	3.59	3.38	3.62	4.60	3.90	4.78	2.60	3.57	3.15
Mean Dry (May-Sep)	3.12	1.71	1.23	1.42	1.54	0.94	2.06	1.55	1.40	1.86	1.93	0.98	1.77	0.99	0.69	1.85	1.75	1.18
Seasonal Extremes*	1.00	2.34	3.01	2.46	2.19	3.04	1.45	2.19	2.39	1.93	1.75	3.70	2.60	3.94	6.95	1.41	2.04	2.66

Raw Data Source: WSU AgWeather Net Mount Vernon Station

	Mean	Low	High
Annual	32.47	24.81	41.02
Low	0.35	0.00	0.88
High	5.78	4.67	7.85
Mean	2.71	2.07	3.42
Mean Wet (Oct-Apr)	3.53	2.60	4.78
Mean Dry (May-Sep)	1.55	0.69	3.12
Seasonal Extremes*	2.61	1.00	6.95

	Low	High	Mean
October	1.37	6.07	3.62
November	2.14	7.85	4.66
December	1.25	7.05	3.42
January	1.62	6.54	4.11
February	1.25	5.78	3.15
March	1.35	5.01	3.04
April	0.28	4.73	2.71
May	0.35	4.57	2.22
June	0.16	3.14	1.56
July	0.00	1.39	0.61
August	0.01	6.29	1.29
September	0.14	5.24	2.09
Annual	0.00	7.85	2.76

No data, filled in with mean value

Neutral value is within +- 0.5 of mean

Greater than 0.5 below mean

Greater than 0.5 above mean

Table 6 - Monthly precipitation totals for the history of the Skagit County Monitoring Program. Cells are shaded blue or red to illustrate above and below average rainfall for a month, respectively. The threshold of 0.5 inches of rain to constitute an "average" shading of grey is arbitrarily chosen and does not constitute an authoritative metric. * Seasonal Extremes in the ratio of average monthly rainfall for the wet to the dry season for each year.

Some of the most interesting statistics on **Table 6** are at the bottom: The monthly mean wet and dry seasonal rainfall, and the seasonal extremes category, which divides the wet by the dry. This creates a ratio that can illustrate extremes in seasonal rainfall. Monitoring these ratios across a changing climate can be informative in monitoring changes in water quality. You can see that some years you may get a near equivalent amount of total precipitation in the wet season as the dry season, whereas a year can be as extreme as nearly seven times as much precipitation in the wet season as occurs in the dry.

Monthly temperature statistics are summarized in **Table 7.** Mean monthly temperatures for each year that are greater than 0.9°F different from the full period average are highlighted in red or blue for above or below, respectively. In the lower section of the table, the full years' average temperatures are shown and compared to the 18-year mean. Differences exceeding 0.9°F above or below the mean are again highlighted. Seven out of the 18 years exceed this difference from the average.

The Seasonal Extremes in the bottom row is the ratio of average monthly wet season temperature to average monthly dry season temperature. It is lower if the wet and dry seasons are more disparate in average temperatures, or higher if the two seasons are more alike in that year.

	WY 2004	WY 2005	WY 2006	WY 2007	WY 2008	WY 2009	WY 2010	WY 2011	WY 2012	WY 2013	WY 2014	WY 2015	WY 2016	WY 2017	WY 2018	WY 2019	WY 2020	WY 2021
October	54.3	50.6	46.8	47.2	48.0	50.0	50.6	51.9	50.7	51.3	49.1	56.8	54.4	53.5	49.6	49.8	47.9	50.4
November	44.0	43.2	34.4	42.8	41.1	47.8	47.1	42.5	42.5	46.4	43.7	43.9	41.7	51.0	46.4	46.1	42.9	44.7
December	41.9	41.1	39.9	39.5	38.3	35.9	36.4	42.8	39.6	41.2	37.1	43.1	42.4	36.2	37.4	41.4	42.3	42.3
January	41.9	41.0	43.6	36.2	36.7	38.2	46.7	40.7	40.1	37.2	41.0	43.5	42.6	36.4	44.1	41.7	43.7	42.5
February	43.5	41.1	39.1	41.5	40.0	39.9	45.6	38.0	42.2	43.0	38.7	47.5	46.5	40.1	39.3	33.5	40.9	39.1
March	47.5	46.7	44.0	45.3	40.8	41.4	46.1	45.2	43.1	45.7	46.8	49.3	48.7	45.8	43.6	43.1	42.4	43.5
April	52.4	49.4	46.8	47.4	45.4	49.2	49.2	45.1	49.8	48.6	50.5	49.6	53.4	50.5	49.3	49.8	49.7	49.1
May	56.3	56.2	55.0	52.3	53.7	55.0	52.1	51.6	53.2	55.4	57.1	56.3	56.9	55.4	57.1	56.6	56.0	53.7
June	61.3	57.1	58.6	56.0	55.6	60.0	56.8	57.4	56.1	60.5	59.2	62.8	59.6	59.8	58.9	59.2	58.2	62.8
July	62.4	61.4	61.1	62.0	59.7	64.4	60.7	60.1	60.6	62.5	64.1	65.9	63.1	62.5	64.5	63.0	61.7	62.8
August	65.4	61.5	59.2	59.9	61.9	61.7	60.8	61.1	62.9	63.9	64.4	64.3	63.8	63.7	62.6	64.0	61.9	62.6
September	57.0	54.7	56.0	54.6	57.0	59.2	58.8	60.4	57.1	59.7	60.4	57.2	57.6	59.7	57.5	59.1	60.2	58.1
Low	41.9	41	34.4	36.2	36.7	35.9	36.4	38	39.6	37.2	37.1	43.1	41.7	36.2	37.4	33.5	40.9	39.1
High	65.4	61.5	61.1	62	61.9	64.4	60.8	61.1	62.9	63.9	64.4	65.9	63.8	63.7	64.5	64	61.9	62.8
Mean	52.3	49.9	48.0	48.2	47.4	49.4	50.2	48.8	49.2	50.5	50.2	53.0	52.1	50.4	50.3	49.8	49.8	50.3
Mean Wet (Oct-Apr)	45.5	44.0	41.3	42.1	40.8	42.2	45.4	43.5	43.0	44.1	42.7	47.4	46.1	43.8	43.4	42.6	43.4	43.8
Mean Dry (May-Sep)	59.1	56.7	56.1	55.4	55.6	58.3	56.4	56.0	56.6	58.4	59.3	59.4	59.1	58.6	58.3	58.6	58.0	58.2
Seasonal Extremes	0.77	0.77	0.74	0.76	0.73	0.72	0.81	0.78	0.76	0.76	0.72	0.80	0.78	0.75	0.74	0.73	0.75	0.75

Raw Data Source: WSU AgWeatherNet Mount Vernon Station

	Mean	Low	High
	63.11	60.80	65.90
	49.99	47.38	53.00
	43.61	40.82	47.35
	57.66	55.37	59.35
	0.76	0.72	0.81

	Low	High	Mean
October	46.8	56.8	50.7
November	34.4	51.0	44.0
December	35.9	43.1	39.9
January	36.2	46.7	41.0
February	33.5	47.5	41.1
March	40.8	49.3	44.9
April	45.1	53.4	49.2
May	51.6	57.1	55.0
June	55.6	62.8	58.9
July	59.7	65.9	62.4
August	59.2	65.4	62.5
September	54.6	60.4	58.0
	33.5	65.9	50.6

No data, filled in with mean value
Neutral value is within +- 0.9 of mean
Greater than 0.9 above mean
Greater than 0.9 below mean

Table 7 - Monthly air temperature averages for the entire history of the Skagit County Monitoring Program. Cells are shaded red or blue to illustrate above and below average temperature for a month, respectively. The threshold of 0.9 degrees Fahrenheit to constitute an "average" shading of grey is arbitrarily chosen and does not constitute an authoritative metric.

Water Temperature

Water temperature governs the metabolic rate of aquatic organisms. Excessive temperature can serve as a stress on fish and other cold-water organisms, and extreme temperatures can be lethal.

Background

For the water years 2004-2007 and 2009-2021, temperatures were measured with Stowaway Tidbit® data loggers from Onset Computer Company. These devices were set to measure water temperature every half hour. They are normally deployed in late June and retrieved in early September. During those years, several of the data loggers went missing by the end of each monitoring period. Some may have been lost due to channel changes associated with heavy rains in late summer, while others may have been vandalized. For the 2008 water year, a computer programming error resulted in the data loggers measuring temperature for only two weeks in late June and early July. Since annual peak temperatures occur later in the summer, the 2008 data logger data were not very useful. Readers interested in the continuous temperature data collected in 2004-2007 can access those graphs in the 2007 Water Year Annual Report at this web address: www.skagitcounty.net/scmp.

In the fall of 2006, Ecology revised its water quality standards (WAC 173-201a) to comply with a request from the EPA. Included in this revision were several changes to temperature and DO standards for Skagit County watercourses. In particular, the lower Skagit River, Hansen, Nookachamps, Fisher, and Carpenter Creeks, and the upper Samish River and its tributaries were placed in the "Core salmonid spawning and rearing" use category. This change had the effect of imposing more stringent temperature and DO standards on these streams. Formerly, each of these streams was held to a 7-day average of the daily maximum temperatures (7-DADMax) standard of 17.5ºC, but with the revised standards, these streams must now meet a 7-DADMax standard of 16ºC. There were no changes to other streams in the county. Currently, Sites 3-4, 28, 32-44, and 48 are held to the 17.5 ºC standard, while all other sites are held to the 16ºC standard, including marine Site 47.

In addition to changes in the general standard, the revisions to the state temperature standards in 2006 also added spawning period temperature standards to some streams in the county. Portions of the Samish River, Friday Creek, Hansen Creek, Lake Creek, and East Fork Nookachamps Creek have a 13ºC limit from February 15 to June 15 to protect steelhead spawning and egg incubation. The Skagit River upstream from Sedro-Woolley has a 13ºC limit from September 1 through May 15 to protect spawning and egg incubation for several salmonids.

Results

Table 8 shows the daily maximum temperatures for the last five years of the study, based on data collected at bi-weekly samplings. Because the state water quality standards are based on 7-DADMax, the maximums reported on **Table 8** are not directly comparable to the state

temperature standard but are displayed here as an indication of the relative condition of each stream and for comparison of the temperature conditions from year to year.

Table 9 contains the 7-DADMax values for those sample sites where continuous temperature data is available. These data are directly comparable to the state water quality standards as described on the table and in the text above.

Twenty-three dataloggers were deployed for the summer of 2021. Of these, two went missing and were not recovered. The remaining 21 dataloggers were retrieved and their data analyzed.

Trends analyses reveal that in comparison to 18 years ago, at the start of this program, nine sites have shown an increase in temperature and one site has shown a decrease (**Figure 2**). Looking at the map of trends from the most recent ten years (**Figure 3**), three sites show an increase while one shows a decrease. All the sites with increasing temperatures are in the northern half of the county.

Trends from the most recent five years of data (**Figure 4**) show one significantly increasing in temperature, with no sites showing a significant decrease.

A major heat wave across the western United States in June 2021 led to high water temperatures. Out of 15 sites where data loggers were deployed at that time and subsequently recovered, 13 recorded their 7-DADMax in a span that included the dates of June 26th, 27th, and 28th, when daily high temperature records were set at the Mount Vernon AgWeatherNet station. The 7-DADMax temperature that was recorded at those sites was the highest on record for at least the last 5 years. These data contributed to more increasing and fewer decreasing trends in the 10- and 5-year time frames than were seen in the analyses done in the 2020 water year.

Ecology has developed temperature remediation plans (TMDLs) for Fisher, Carpenter, Nookachamps, and Hansen Creeks, but many other Skagit County streams also exceed temperature standards.

Table 8 - Maximum watercourse temperatures recorded from bi-weekly sampling. Cells shaded green pass state standard. There is a 0.2 allowance in the standard for variation in equipment calibration. These samplings are taken at nearly the same time of day, each week they are sampled, and do not represent the hottest temperature that each site may have reached on a given day.

Site Number	Watercourse	Location	Highest daily temperature (°C)				
			2017	2018	2019	2020	2021
3	Thomas Creek	Old Hwy 99 North	19.2	18.4	17.8	18.4	18.7
4	Thomas Creek	F&S Grade Rd	15.3	14.9	14.8	14.7	15.2
6	Friday Creek	Prairie Rd	18.6	19.2	18.0	17.8	18.8
8	Swede Creek	Grip Rd	17.8	16.9	16.5	16.2	16.2
11	Samish River	State Route 9	13.5	13.2	13.6	15.2	12.6
12	Nookachamps Creek	Swan Rd	21.1	22.5	21.0	20.1	21.8
13	E.F. Nookachamps Creek	State Route 9	19.6	21.9	19.4	18.6	24.0
14	College Way Creek	College Way	17.3	19.0	16.7	17.0	20.0
15	Nookachamps Creek	Knapp Rd	22.0	22.7	20.1	22.1	25.3
16	E.F. Nookachamps Creek	Beaver Lake Rd	18.1	19.8	17.5	17.0	20.4
17	Nookachamps Creek	Big Lake Outlet	22.8	23.6	21.3	22.5	26.9
18	Lake Creek	State Route 9	16.3	18.1	16.4	16.3	21.9
19	Hansen Creek	Hoehn Rd	17.3	17.6	18.1	18.5	18.0
20	Hansen Creek	Northern State	15.3	15.4	14.9	14.8	14.7
21	Coal Creek	Hoehn Rd	15.7	15.2	15.6	16.5	14.9
22	Coal Creek	Hwy 20	15.3	15.2	15.3	15.1	14.5
23	Wiseman Creek	Minkler Rd	15.0	14.1	14.2	15.5	15.8
24	Mannser Creek	Lyman Ham. Hwy	12.5	11.9	12.5	12.9	15.3
25	Red Cabin Creek	Hamilton Cem. Rd	11.7	11.2	11.9	12.4	11.5
28	Brickyard Creek	Hwy 20	14.5	14.3	14.7	16.2	12.1*
29	Skagit River	River Bend Rd	15.9	16.2	16.0	14.7	15.7
30	Skagit River	Cape Horn Rd	15.3	15.4	15.6	15.0	15.0
32	Samish River	Thomas Rd	20.1	19.3	18.8	18.2	19.4
33	Alice Bay Pump Station	Samish Island Rd	22.7	25.0	22.1	22.9	22.6
34	No Name Slough	Bayview-Edison Rd	21.5	27.0	25.3	24.8	25.7
35	Joe Leary Slough	D'Arcy Rd	20.3	21.3	21.4	18.9	21.2
36	Edison Slough at school	W. Bow Hill Rd	27.0	30.2	28.3	27.0	29.5
37	Edison Pump Station	Farm to Market Rd	23.6	25.5	23.3	25.8	26.6
38	North Edison Pump Sta.	North Edison Rd	22.2	24.4	22.3	20.9	23.8
39	Colony Creek	Colony Rd	16.6	17.4	15.3	20.5	16.1
40	Big Indian Slough	Bayview-Edison Rd	19.4	19.5	18.3	17.7	20.6
41	Maddox/Big Ditch	Milltown Rd	22.4	21.7	21.4	20.8	21.3
42	Hill Ditch	Cedardale Rd	22.0	20.8	20.9	21.2	21.9
43	Wiley Slough	Wylie Rd	19.6	27.2	20.2	19.3	19.2
44	Sullivan Slough	La Conner-Whitney	20.0	18.3	16.7	20.1	14.7
45	Skagit River – N. Fork	Moore Rd	16.4	16.4	17.0	15.6	16.5
46	Skagit River – S. Fork	Fir Island Rd	16.7	16.7	17.0	15.9	16.9
47	Swinomish Channel	County Boat Launch	18.5	16.1	16.2	17.0	16.3
48	Fisher Creek	Franklin Rd	13.5	15.3	14.0	14.0	15.8

*only sampled November 11 – May 11

Table 9 - Maximum seven-day average of the daily maximum temperatures (Max 7-DADMax). This data is from continuous temperature loggers (TidbiTs), with measurements taken every 30 minutes. Cells shaded green pass state standard. There is a 0.2 allowance in the standard for variation in equipment calibration.

Site Number	Watercourse	Location	Max 7-DADMax (°C)				
			2017	2018	2019	2020	2021
3	Thomas Creek	Old Hwy 99 North	20.2	20.2	n/a	19.9	22.4
4	Thomas Creek	F&S Grade Rd	16.1	17.0	16.5	16.2	n/a+
6	Friday Creek	Prairie Rd	n/a	22.6	21.3	20.0	23.95
8	Swede Creek	Grip Rd	17.6	19.0	17.8	17.4	19.0◊
11	Samish River	State Route 9	14.8	14.8	n/a	15.1	15.6
12	Nookachamps Creek	Swan Rd	22.9	23.5	23.5	21.0*	22.0◊
13	E.F. Nookachamps Creek	State Route 9	20.5	21.7	n/a	20.7	24.1
15	Nookachamps Creek	Knapp Rd	22.3	23.8	n/a	23.0	27.3
16	E.F. Nookachamps Creek	Beaver Lake Rd	20.8	22.2	20.1	n/a	23.5
17	Nookachamps Creek	Big Lake Outlet	25.5	26.5	n/a	25.6	27.8
18	Lake Creek	State Route 9	18.0	19.5	19.2	18.6	23.1*
19	Hansen Creek	Hoehn Rd	19.0	20.1	19.7	20.3	23.1*
20	Hansen Creek	Northern State	17.1	17.8	n/a	16.5	18.9
21	Coal Creek	Hoehn Rd	15.9	18.6	20.3	17.8	20.8*
22	Coal Creek	Hwy 20	n/a	17.5	16.8	16.7	18.9
24	Mannser Creek	Lyman Hamilton Hwy	13.9	13.7	13.4	14.0	16.8
30	Skagit River	Cape Horn Rd	11.9	n/a	17.1	14.8**	n/a+
32	Samish River	Thomas Rd	20.2	21.2	20.6	n/a	22.1
39	Colony Creek	Colony Rd	17.3	18.4	17.5	17.4	19.6
41	Maddox Creek/Big Ditch	Milltown Rd	24.9	25.9	25.0	24.4	22.9
42	Hill Ditch	Cedardale Rd	25.7	25.9	24.9	24.6	24.0
45	Skagit River – North Fork	Moore Rd	17.7	19.4	n/a	17.2*	n/a+
48	Fisher Creek	Franklin Rd	14.8	16.8	16.5	16.1	17.2

*Incomplete dataset, as the TidbiT probe was out of the water for some of the summer measurement period. It is possible that this value could have been higher.

**TidbiT out of water for part of season. Analysis of USGS temperature monitoring station 12200500 near Mount Vernon, in comparison to the incomplete data from SCMP site 30 infers that the actual 7-DADMax likely occurred near 16.0 °C.

+ TidbiT data logger was not recovered

◊ TidbiT not deployed until mid-July. Likely missed actual max as most other loggers recorded their maximum 7-DADMax during the final week of June into the first few days of July.

Figure 2 – Eighteen-year trends in watercourse temperatures

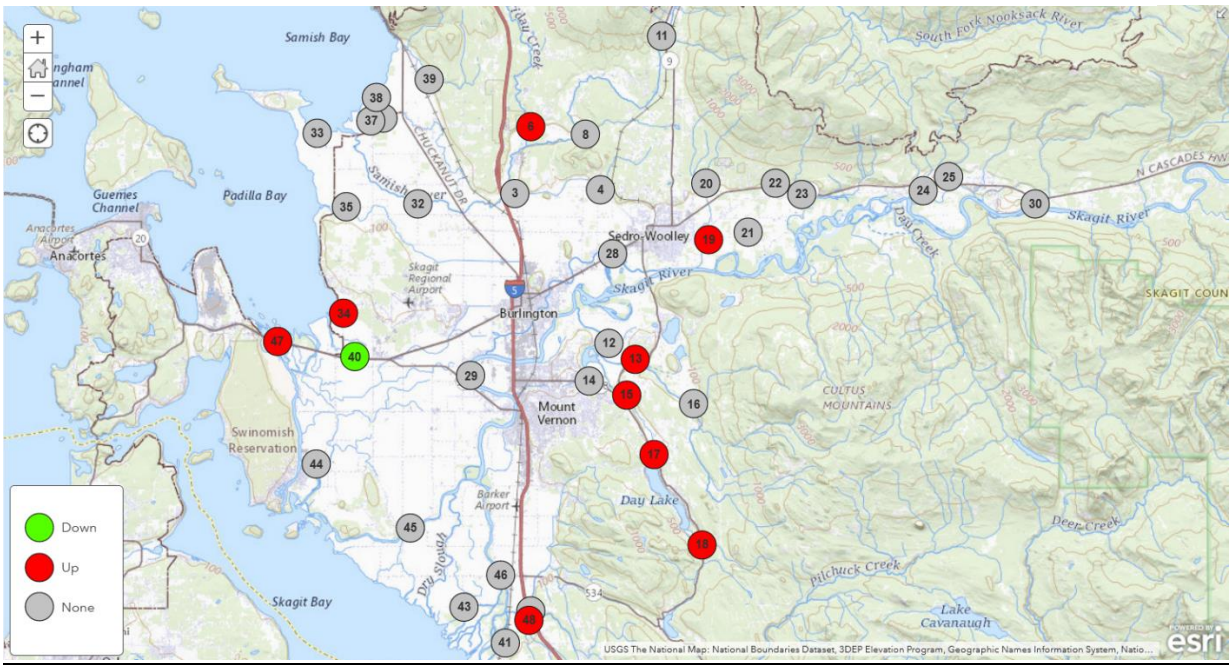


Figure 3 - Ten-year trends in watercourse temperatures

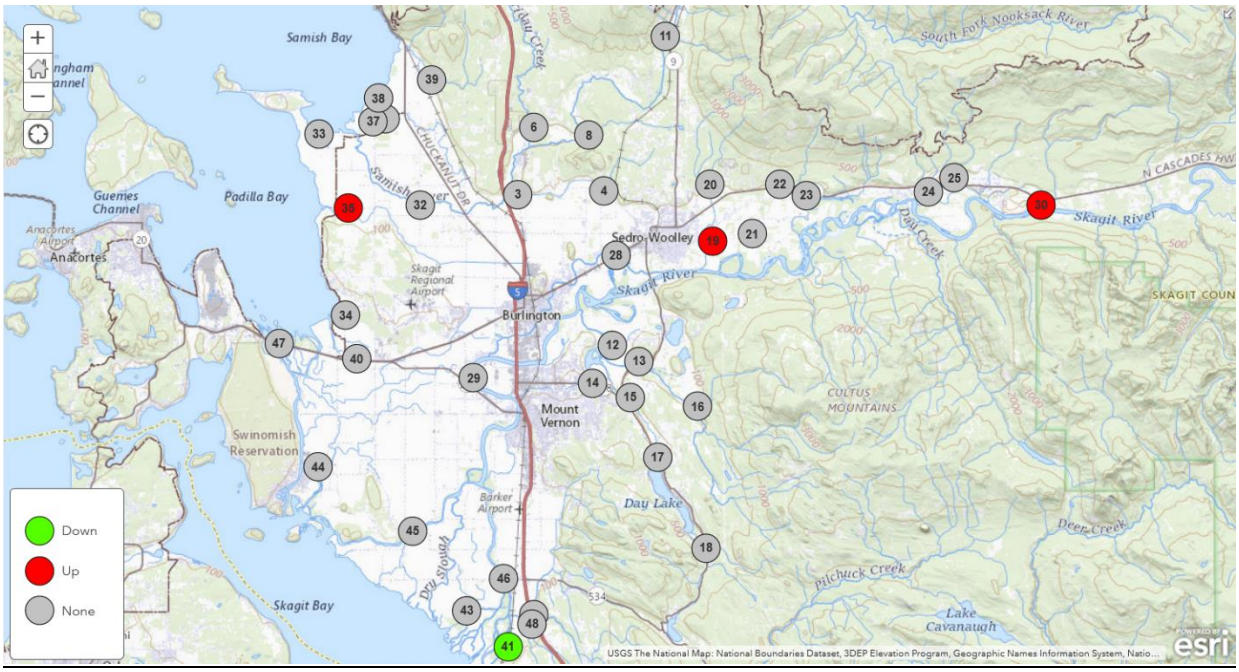
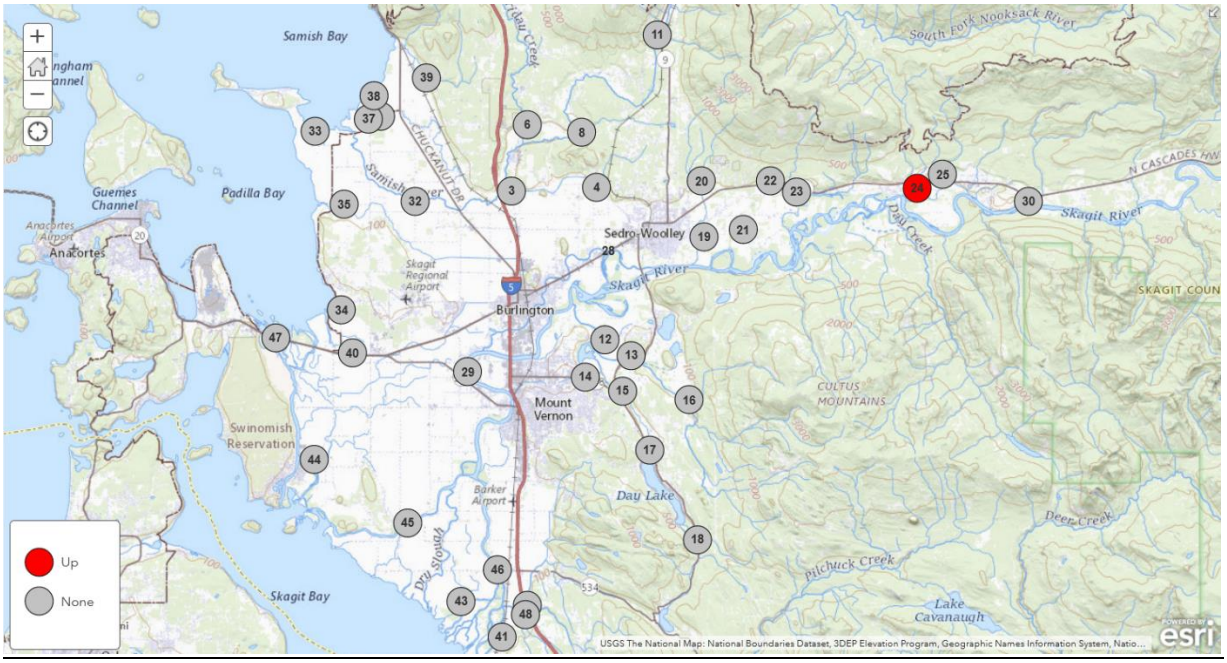


Figure 4 - Five-year trends in watercourse temperatures



Dissolved Oxygen (DO)

Dissolved oxygen measurements determine how much oxygen is available in the water for fish and other organisms.

Background

The state water quality standards for DO are based on single-day minimum measurements. For some lowland watercourses in the SCMP (Sites 3-4, 28, 31-44, and 48), the minimum standard is 8.0 mg/L. For the marine site (Site 47), the standard is 6.0 mg/L. For all other sites, the standard is 9.5 mg/L. The solubility of oxygen in water is inversely related to temperature, so that higher temperatures frequently result in lower dissolved oxygen values.

Results

A summary of DO readings (in mg/L) obtained during the 2021 water year is provided in **Table 10**. A summary of data from the most recent five years of this program can be found in **Table 11**.

Seven sites met the oxygen standards for the entire 2021 water year, compared to ten in 2020. Others met the oxygen standard for most of the year. In a few streams, oxygen levels show steep declines in summer. These declines are usually associated with very low flows, less velocity, and higher temperatures.

In the drainage infrastructure and lower sloughs, DO levels can be greatly influenced by algal activity. During large algae blooms, the oxygen produced during photosynthesis can lead to very high oxygen levels during the day. However, night-time oxygen levels can be very low, as the large populations of algae turn from producing oxygen to consuming it. Because our oxygen readings are taken during the day, the monitoring program does not account for these night-time oxygen reductions. During times when algae blooms are dying off, the decomposition of the dying algae can lead to very low oxygen levels, both day and night. The results are widely fluctuating DO levels, depending on the state of the algal blooms at sampling time. These fluctuations are very extreme, and data has been recorded from as low as 0% to as high as 300% typical oxygen saturation.

Trends analysis shows that in the 18 years since the program began, twelve sites have shown an increase in DO levels, while five have shown a decrease (**Figure 5**). There is a clustering of improved sites in the Samish and South Skagit watersheds. In the most recent ten years (**Figure 6**), trends show 17 sites increasing DO levels, while two are decreasing. These sites appear to be spread county-wide. In the most recent five years (**Figure 7**), trends show one site increasing DO levels, while eight sites are decreasing. These sites appear to also be spread county-wide. This decrease of sites with rising DO levels in the 5-year trends are likely influenced by the June 2021 heat wave, when high water temperatures led to low DO levels. Otherwise generally increasing DO levels are great news for water quality across the county, and possible contributions could be from lower biological oxygen demand (BOD), which can be a result of a decrease in pollution.

Table 10 - Dissolved oxygen (DO) measurements for 2021 water year. Cells shaded green pass state standard. A margin of error allowance is given at 0.2 mg/L.

Site Number	Watercourse	Location	Mean DO (mg/L)	Minimum DO (mg/L)	St. Std[1]
3	Thomas Creek	Old Hwy 99 N	6.83	6.28	8.0
4	Thomas Creek	F&S Grade Rd	11.17	7.55	8.0
6	Friday Creek	Prairie Rd	11.70	9.40	9.5
8	Swede Creek	Grip Rd	10.86	6.70	9.5
11	Samish River	State Route 9	9.12	7.13	9.5
12	Nookachamps Creek	Swan Rd	9.39	4.59	9.5
13	E.F. Nookachamps Creek	State Route 9	8.99	2.37	9.5
14	College Way Creek	College Way	9.38	5.75	9.5
15	Nookachamps Creek	Knapp Rd	7.63	0.63	9.5
16	E.F. Nookachamps Creek	Beaver Lake Rd	11.67	8.88	9.5
17	Nookachamps Creek	Big Lake Outlet	10.08	6.90	9.5
18	Lake Creek	State Route 9	11.12	8.32	9.5
19	Hansen Creek	Hoehn Rd	10.22	4.71	9.5
20	Hansen Creek	Northern State	11.48	8.81	9.5
21	Coal Creek	Hoehn Rd	11.86	8.67	9.5
22	Coal Creek	Hwy 20	12.02	10.23	9.5
23	Wiseman Creek	Minkler Rd	12.28	10.43	9.5
24	Mannser Creek	Lyman Hamilton Hwy	7.49	5.63	9.5
25	Red Cabin Creek	Hamilton Cem. Rd	11.86	9.38	9.5
28	Brickyard Creek	Hwy 20	9.65	6.52	8.0
29	Skagit River	River Bend Rd	11.30	8.96	9.5
30	Skagit River	Cape Horn Rd	11.37	9.45	9.5
32	Samish River	Thomas Rd	11.22	8.80	8.0
33	Alice Bay Pump Station	Samish Island Rd	8.80	0.41	8.0
34	No Name Slough	Bayview-Edison Rd	6.54	0.15	8.0
35	Joe Leary Slough	D'Arcy Rd	6.36	2.32	8.0
36	Edison Slough at school	West Bow Hill Rd	9.72	5.46	8.0
37	Edison Pump Station	Farm to Market Rd	6.63	0.07	8.0
38	North Edison Pump Station	North Edison Rd	3.99	0.00	8.0
39	Colony Creek	Colony Rd	10.64	6.49	9.5
40	Big Indian Slough	Bayview-Edison Rd	5.21	0.33	8.0
41	Maddox Slough/Big Ditch	Milltown Rd	5.14	0.15	8.0
42	Hill Ditch	Cedardale Rd	7.86	3.24	9.5
43	Wiley Slough	Wylie Rd	3.54	0.25	8.0
44	Sullivan Slough	La Conner-Whitney	5.41	2.09	8.0
45	Skagit River – North Fork	Moore Rd	11.37	8.56	9.5
46	Skagit River – South Fork	Fir Island Rd	11.29	9.16	9.5
47	Swinomish Channel	County Boat Launch	8.64	6.87	6.0
48	Fisher Creek	Franklin Rd	11.36	9.10	9.5

[1]Washington State Water Quality Standard per WAC 173-201A

Table 11 - Mean dissolved oxygen (DO) levels for the most recent five years. Cells shaded green pass state standard. A margin of error allowance is given at 0.2 mg/L.

Site Number	Watercourse	Location	Mean Dissolved Oxygen (mg/L)				
			2017	2018	2019	2020	2021
3	Thomas Creek	Old Hwy 99 North	6.6	6.1	5.8	6.5	6.83
4	Thomas Creek	F&S Grade Rd	11.5	11.6	11.5	11.4	11.17
6	Friday Creek	Prairie Rd	11.8	11.6	11.6	11.4	11.70
8	Swede Creek	Grip Rd	10.6	10.8	10.7	11.0	10.86
11	Samish River	State Route 9	9.4	9.4	9.0	9.30	9.12
12	Nookachamps Creek	Swan Rd	8.4	9.0	9.4	8.5	9.39
13	E.F. Nookachamps Creek	State Route 9	10.0	10.0	9.6	8.9	8.99
14	College Way Creek	College Way	9.7	9.9	9.8	9.5	9.38
15	Nookachamps Creek	Knapp Rd	8.4	8.6	8.3	8.1	7.63
16	E.F. Nookachamps Creek	Beaver Lake Rd	11.7	11.7	12.0	11.7	11.67
17	Nookachamps Creek	Big Lake Outlet	10.2	10.4	10.2	9.7	10.08
18	Lake Creek	State Route 9	11.2	11.1	11.3	11.3	11.12
19	Hansen Creek	Hoehn Rd	10.4	10.3	10.3	10.3	10.22
20	Hansen Creek	Northern State	11.6	11.6	11.5	11.5	11.48
21	Coal Creek	Hoehn Rd	11.7	11.8	11.6	11.2	11.86
22	Coal Creek	Hwy 20	11.9	12.1	11.8	11.8	12.02
23	Wiseman Creek	Minkler Rd	12.3	12.2	12.2	11.8	12.28
24	Mannser Creek	Lyman Ham. Hwy	7.5	7.9	7.9	7.9	7.49
25	Red Cabin Creek	Hamilton Cem. Rd	12.3	12.2	12.2	11.8	11.86
28	Brickyard Creek	Hwy 20	10.2	10.4	9.5	8.3	9.65
29	Skagit River	River Bend Rd	11.4	11.4	11.1	11.4	11.30
30	Skagit River	Cape Horn Rd	11.7	11.5	11.3	11.4	11.37
32	Samish River	Thomas Rd	11.4	10.9	11.2	11.3	11.22
33	Alice Bay Pump Station	Samish Island Rd	8.2	11.1	9.2	8.6	8.80
34	No Name Slough	Bayview-Edison Rd	7.8	8.0	7.0	7.4	6.54
35	Joe Leary Slough	D'Arcy Rd	5.0	5.6	5.6	6.4	6.36
36	Edison Slough at school	W. Bow Hill Rd	10.4	11.2	8.9	8.0	9.72
37	Edison Pump Station	Farm to Market Rd	8.3	7.9	8.2	4.8	6.63
38	N. Edison Pump Station	North Edison Rd	8.4	7.5	7.4	4.0	3.99
39	Colony Creek	Colony Rd	11.0	11.0	11.1	11.0	10.64
40	Big Indian Slough	Bayview-Edison Rd	4.7	5.4	5.1	5.1	5.21
41	Maddox/Big Ditch	Milltown Rd	6.6	7.1	7.4	6.4	5.14
42	Hill Ditch	Cedardale Rd	8.3	8.9	8.5	7.9	7.86
43	Wiley Slough	Wylie Rd	4.5	5.0	4.8	4.1	3.54
44	Sullivan Slough	La Conner-Whitney	7.5	6.3	6.3	7.3	5.41
45	Skagit River – North Fork	Moore Rd	11.5	11.6	11.3	11.5	11.37
46	Skagit River – South Fork	Fir Island Rd	11.4	11.6	11.4	11.6	11.29
47	Swinomish Channel	County Boat Launch	9.0	8.8	8.8	8.7	8.64
48	Fisher Creek	Franklin Rd	11.6	11.4	11.6	11.4	11.36

Figure 5 - Eighteen-year trends in dissolved oxygen (DO)

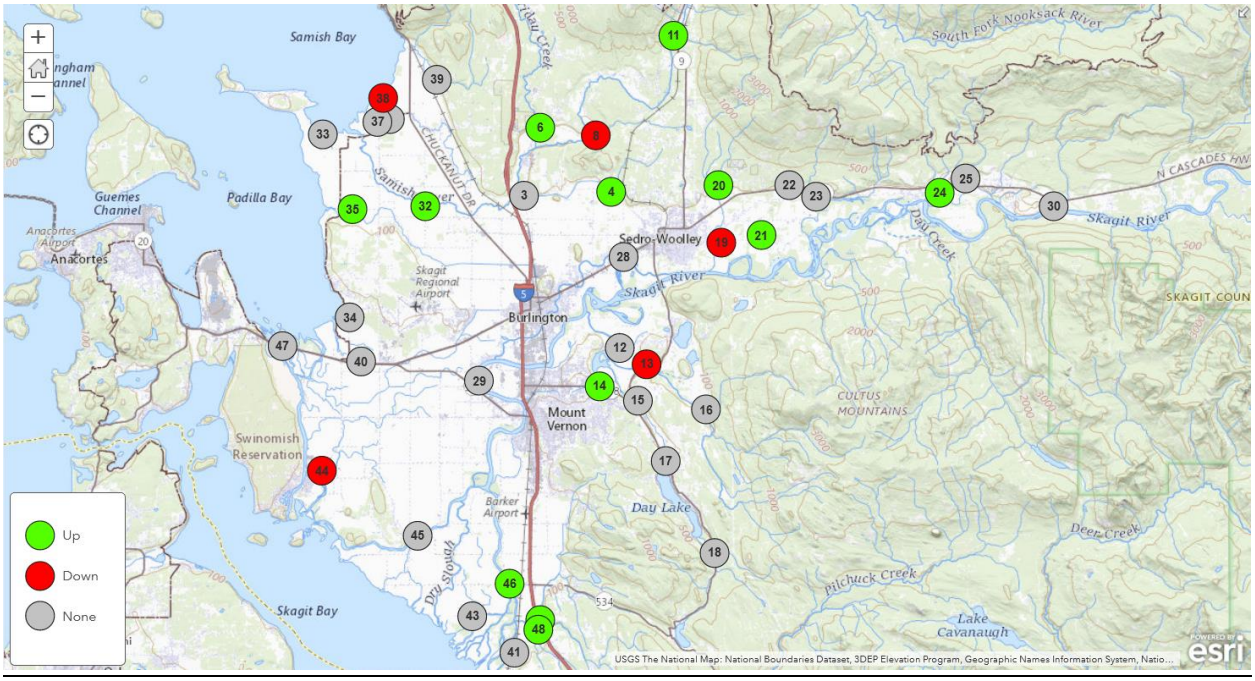


Figure 6 - Ten-year trends in dissolved oxygen (DO)

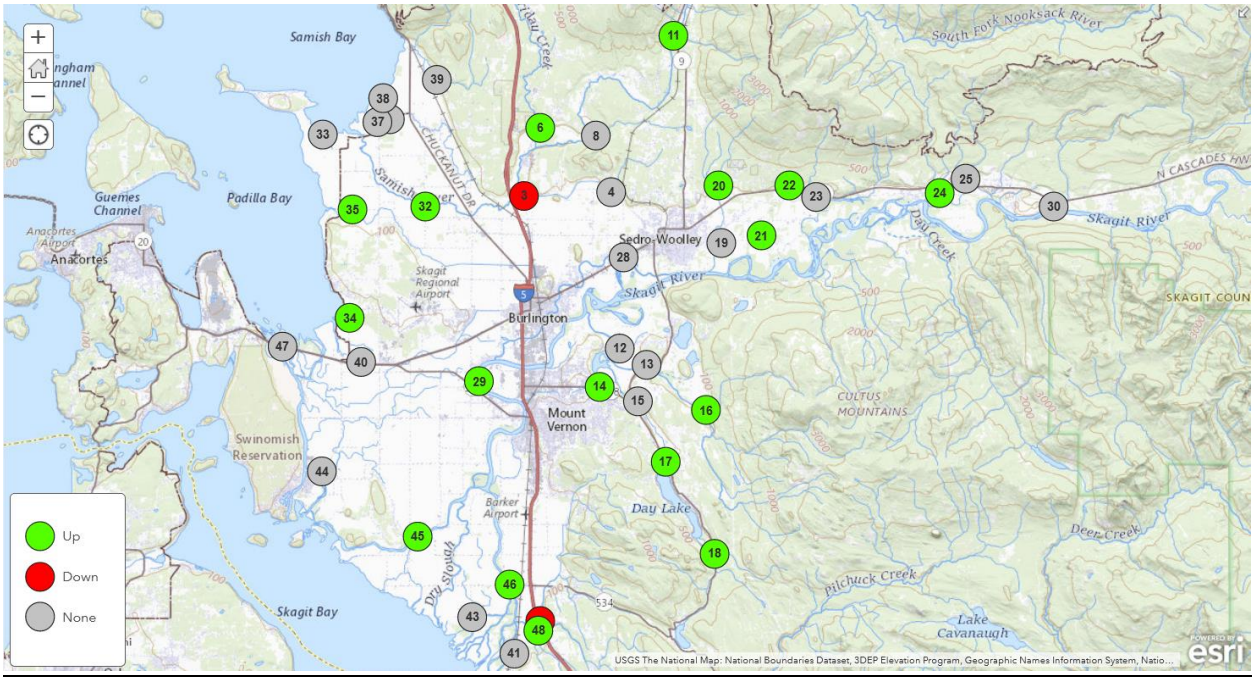
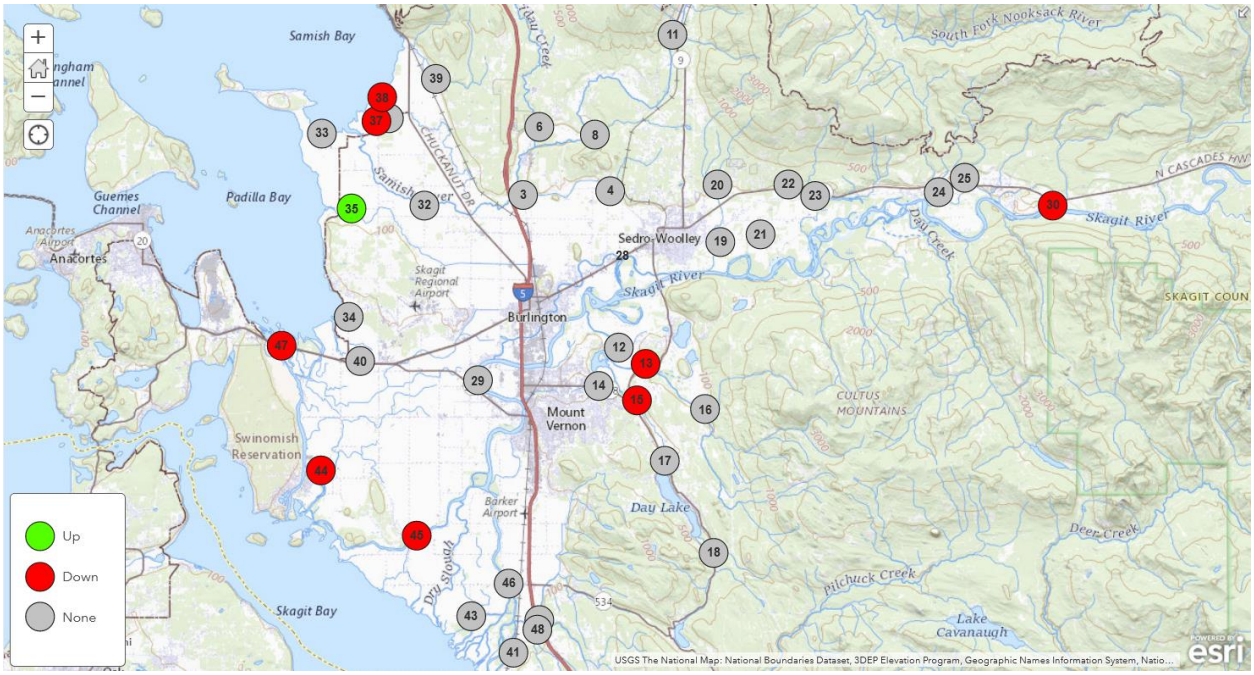


Figure 7 - Five-year trends in dissolved oxygen (DO)



Fecal Coliform (FC) and *Escherichia (E.) coli* (EC)

Fecal coliform is a group of enteric bacteria from warm-blooded animals. *E. coli* is one of the specific bacteria species within that group. Although FC and EC measurements do not directly quantify disease-causing organisms, they serve as an indicator of the possible presence of such bacteria, viruses, and protozoa. The sources of FC and EC organisms reaching the watercourses of Skagit County may include runoff from failing septic tanks, livestock operations, wildlife, recreationists, and pets.

Background

Samples for FC measurements were taken at each site during each visit and were submitted to the Skagit County Health Department Water Lab (2003-2008) or Edge Analytical (2009-2021) for analysis by the most probable number (MPN) method. Beginning in the 2021 water year, samples submitted to Edge Analytical were also analyzed for EC by the MPN method.

State standards for these bacteria are based on the geometric mean of the samples as well as the percent of the samples that exceed given criteria. Prior to 2020, state standards for recreational water contact of fresh water were set for FC as follows. For most of the watercourses in the SCMP (sites 3-20, 28-29, 31-46, 48), FC was not to exceed a geometric mean of 100 MPN per 100mL, with no more than 10% of the measurements exceeding 200 MPN per 100 mL. For the upriver sites (sites 21-25, 30), the standard was a geometric mean of 50 MPN, with no more than 10% of the measurements exceeding 100 MPN. Those standards expired on December 31, 2020. Primary contact recreation bacteria criteria are now

based on EC. For all freshwater sites, EC must not exceed a geometric mean of 100 MPN per 100 mL, with not more than 10% of all samples exceeding 320 MPN per 100 mL. For the marine site (site 47), a more stringent standard of 14 MPN with no more than 10% exceeding 41 MPN is enforced to protect shellfish beds.

The SCMP now collects and reports data for both FC and EC. FC measurements allow for comparison to historic data and assessment of progress on TMDLs that were written based on the now expired FC standards. EC results allow for determination of whether sites are meeting current water quality criteria.

Results

For the 2021 water year, 14 sites met the old FC standard based on ambient sampling for the entire water year (**Table 12**), compared to 19 sites in 2020. Meanwhile, 24 sites met the new EC standard for the 2021 water year (**Table 13**). Most sites that did not meet the standards did so due to having more than 10% of samples with FC counts over 200 MPN and/or with EC counts greater than 320 MPN. Over the past five years, the particular sites meeting and exceeding standards has been fairly consistent (**Table 14**). The new state standards are designed to better indicate when contact with the water may pose a threat to human health, and seeing that more sites meet those criteria is a positive sign for assessing Skagit County's water quality.

Trends analysis shows that in the 18 years since the program began, eight sites have shown improvement through a decline in FC counts, while four sites have shown deterioration through an increase in FC counts (**Figure 8**). There is a clear clustering of improved sites in the Samish Bay watershed, relative to the rest of the county. In the most recent ten years, two sites have shown improvement, while two sites have shown deterioration (**Figure 9**). In the most recent five years, one site has shown improvement, while two sites have shown significantly increased FC counts (**Figure 10**).

Table 12 - Fecal coliform (FC) results (MPN/100ml) for 2021 water year. Cells shaded green pass state standard.

Site Number	Watercourse	Location	n	Geometric mean (MPN)[1]	% > 100 or 200[1]
3	Thomas Creek	Old Hwy 99 N	26	64	27
4	Thomas Creek	F&S Grade Rd	26	169	42
6	Friday Creek	Prairie Rd	25	29	0
8	Swede Creek	Grip Rd	26	51	12
11	Samish River	State Route 9	26	23	8
12	Nookachamps Creek	Swan Rd	26	77	19
13	E.F. Nookachamps Creek	State Route 9	26	51	23
14	College Way Creek	College Way	24	214	63
15	Nookachamps Creek	Knapp Rd	25	57	16
16	E.F. Nookachamps Creek	Beaver Lake Rd	26	37	19
17	Nookachamps Creek	Big Lake Outlet	26	22	4
18	Lake Creek	State Route 9	26	51	27
19	Hansen Creek	Hoehn Rd	21	65	10
20	Hansen Creek	Northern State	26	60	15
21	Coal Creek	Hoehn Rd	20	90	40
22	Coal Creek	Hwy 20	26	9	8
23	Wiseman Creek	Minkler Rd	22	17	9
24	Mannser Creek	Lyman Hamilton Hwy	26	19	4
25	Red Cabin Creek	Hamilton Cemetery Rd	20	7	5
28	Brickyard Creek	Hwy 20	14	50	7
29	Skagit River	River Bend Rd	25	13	12
30	Skagit River	Cape Horn Rd	26	4	0
32	Samish River	Thomas Rd	26	41	4
33	Alice Bay Pump Station	Samish Island Rd	26	63	19
34	No Name Slough	Bayview-Edison Rd	26	113	38
35	Joe Leary Slough	D'Arcy Rd	26	100	19
36	Edison Slough at school	W. Bow Hill Rd	26	68	23
37	Edison Pump Station	Farm to Market Rd	26	154	50
38	N. Edison Pump Station	North Edison Rd	25	198	44
39	Colony Creek	Colony Rd	26	55	31
40	Big Indian Slough	Bayview-Edison Rd	26	125	27
41	Maddox/Big Ditch	Milltown Rd	26	85	19
42	Hill Ditch	Cedardale Rd	26	121	31
43	Wiley Slough	Wylie Rd	25	112	20
44	Sullivan Slough	La Conner-Whitney Rd	26	123	35
45	Skagit River – North Fork	Moore Rd	25	9	0
46	Skagit River – South Fork	Fir Island Rd	26	13	0
47	Swinomish Channel	County Boat Launch	25	6	0
48	Fisher Creek	Franklin Rd	26	82	23

[1] Now expired state water quality standards for fecal coliform required water bodies to have a geometric mean of less than 50 (sites 21-25, 30) or 100 (sites 3-20, 28-29, 31-46, 48) colony forming units (CFU) or Most Probable Number (MPN) per 100 ml and less than 10% of the samples >100 (sites 21-25,30) or >200 cfu (sites 3-20,28-29, 31-46, 48). Marine locations (site 47) are required to be <14 cfu with no more than 10% >41 cfu. Cells shaded green represent sites that pass state standards.

Table 13 – *E. coli* (EC) results (MPN/100ml) for 2021 water year. Cells shaded green pass state standard.

Site Number	Watercourse	Location	n	Geometric mean (MPN)	% > 320
3	Thomas Creek	Old Hwy 99 N	26	39	15
4	Thomas Creek	F&S Grade Rd	26	109	23
6	Friday Creek	Prairie Rd	25	16	0
8	Swede Creek	Grip Rd	26	29	4
11	Samish River	State Route 9	26	12	0
12	Nookachamps Creek	Swan Rd	26	52	4
13	E.F. Nookachamps Creek	State Route 9	26	35	15
14	College Way Creek	College Way	24	113	29
15	Nookachamps Creek	Knapp Rd	25	30	0
16	E.F. Nookachamps Creek	Beaver Lake Rd	26	27	12
17	Nookachamps Creek	Big Lake Outlet	26	16	4
18	Lake Creek	State Route 9	26	33	15
19	Hansen Creek	Hoehn Rd	21	40	5
20	Hansen Creek	Northern State	26	22	4
21	Coal Creek	Hoehn Rd	20	60	20
22	Coal Creek	Hwy 20	26	5	0
23	Wiseman Creek	Minkler Rd	22	10	0
24	Mannser Creek	Lyman Hamilton Hwy	26	12	0
25	Red Cabin Creek	Hamilton Cemetery Rd	20	4	0
28	Brickyard Creek	Hwy 20	14	30	0
29	Skagit River	River Bend Rd	25	9	4
30	Skagit River	Cape Horn Rd	26	4	0
32	Samish River	Thomas Rd	25	27	0
33	Alice Bay Pump Station	Samish Island Rd	26	24	0
34	No Name Slough	Bayview-Edison Rd	26	52	8
35	Joe Leary Slough	D'Arcy Rd	26	43	8
36	Edison Slough at school	W. Bow Hill Rd	26	33	15
37	Edison Pump Station	Farm to Market Rd	26	60	19
38	N. Edison Pump Station	North Edison Rd	25	113	36
39	Colony Creek	Colony Rd	26	36	15
40	Big Indian Slough	Bayview-Edison Rd	26	44	12
41	Maddox/Big Ditch	Milltown Rd	26	56	15
42	Hill Ditch	Cedardale Rd	26	52	15
43	Wiley Slough	Wylie Rd	24	65	4
44	Sullivan Slough	La Conner-Whitney Rd	26	52	8
45	Skagit River – North Fork	Moore Rd	25	7	0
46	Skagit River – South Fork	Fir Island Rd	26	9	0
47	Swinomish Channel	County Boat Launch	25	4	0
48	Fisher Creek	Franklin Rd	26	44	19

Table 14 - Geometric mean FC results for most recent five years (MPN/100ml). Cells shaded green pass state standard.

Site Number	Watercourse	Location	2017	2018	2019	2020	2021
3	Thomas Creek	Old Hwy 99 N	63	47	50	37	64
4	Thomas Creek	F&S Grade Rd	107	138	131	94	169
6	Friday Creek	Prairie Rd	29	39	28	26	29
8	Swede Creek	Grip Rd	40	53	29	54	51
11	Samish River	State Route 9	14	12	11	15	23
12	Nookachamps Creek	Swan Rd	79	56	45	56	77
13	E.F. Nookachamps Creek	State Route 9	41	22	38	42	51
14	College Way Creek	College Way	172	83	113	192	214
15	Nookachamps Creek	Knapp Rd	62	63	64	50	57
16	E.F. Nookachamps Creek	Beaver Lake Rd	28	22	22	19	37
17	Nookachamps Creek	Big Lake Outlet	12	14	17	10	22
18	Lake Creek	State Route 9	24	26	41	39	51
19	Hansen Creek	Hoehn Rd	53	57	62	29	65
20	Hansen Creek	Northern State	50	48	37	45	60
21	Coal Creek	Hoehn Rd	53	65	63	49	90
22	Coal Creek	Hwy 20	18	13	11	7	9
23	Wiseman Creek	Minkler Rd	10	18	10	14	17
24	Mannser Creek	Lyman Hamilton Hwy	15	13	14	12	19
25	Red Cabin Creek	Hamilton Cemetery Rd	12	5	6	10	7
28	Brickyard Creek	Hwy 20	42	45	53	13	50
29	Skagit River	River Bend Rd	9	9	7	9	13
30	Skagit River	Cape Horn Rd	3	5	4	4	4
32	Samish River	Thomas Rd	48	41	58	55	41
33	Alice Bay Pump Station	Samish Island Rd	30	24	33	42	63
34	No Name Slough	Bayview-Edison Rd	65	59	48	88	113
35	Joe Leary Slough	D'Arcy Rd	91	108	93	72	100
36	Edison Slough at school	W. Bow Hill Rd	97	56	49	106	68
37	Edison Pump Station	Farm to Market Rd	317	214	188	291	154
38	North Edison Pump Station	North Edison Rd	148	148	113	127	198
39	Colony Creek	Colony Rd	57	61	58	36	55
40	Big Indian Slough	Bayview-Edison Rd	43	81	47	92	125
41	Maddox Slough/Big Ditch	Milltown Rd	87	52	46	64	85
42	Hill Ditch	Cedardale Rd	42	51	48	111	121
43	Wiley Slough	Wylie Rd	68	82	74	56	112
44	Sullivan Slough	La Conner-Whitney Rd	127	67	45	107	123
45	Skagit River – North Fork	Moore Rd	7	8	4	6	9
46	Skagit River – South Fork	Fir Island Rd	13	13	9	11	13
47	Swinomish Channel	County Boat Launch	6	6	4	7	6
48	Fisher Creek	Franklin Rd	69	78	56	60	82

Figure 8 - Seventeen-year trends in fecal coliform (FC)

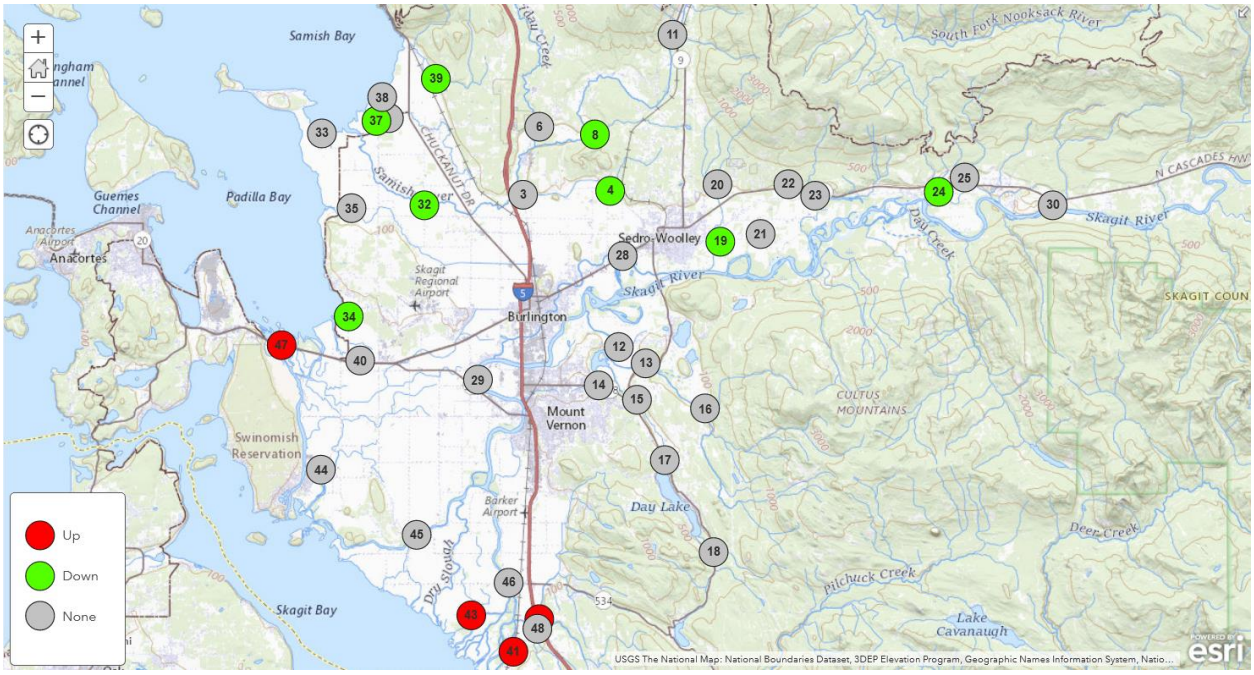


Figure 9 - Ten-year trends in fecal coliform (FC)

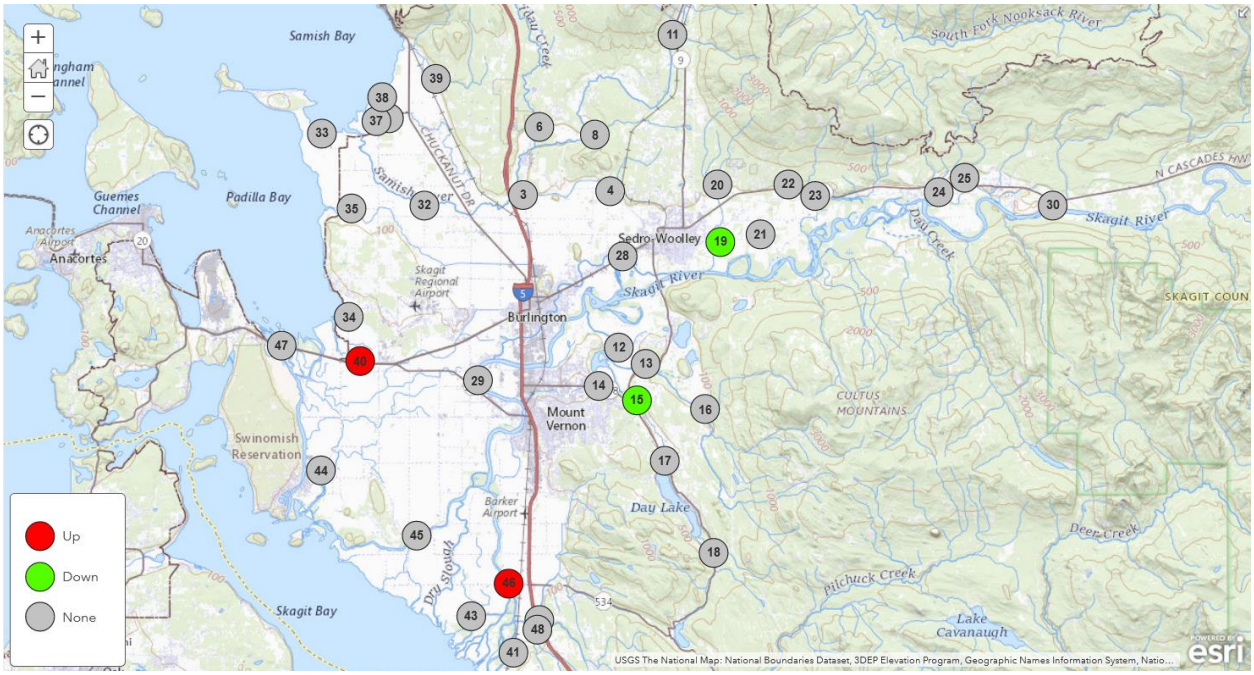
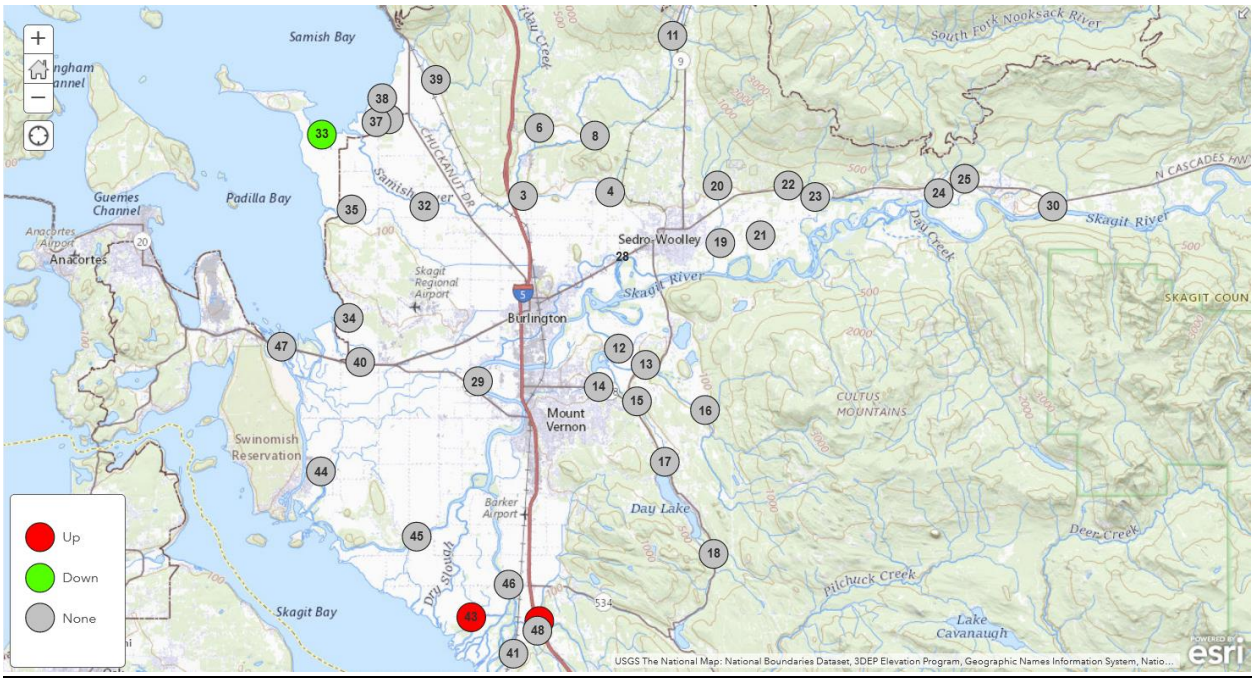


Figure 10 - Five-year trends in fecal coliform (FC)



Nutrients

Nutrient levels in watercourses help determine the potential for algal activity. Excessive nutrient levels can lead to large blooms of algae which can increase DO levels during the day when algae are photosynthesizing. These blooms lead to large decreases in DO at night when the algae are respiring and when the algae die and decompose. Nutrients from freshwater sources discharged into Puget Sound bays can contribute to marine algal blooms as well. Algal blooms can become harmful to recreationists when there are cyanobacteria present, which make ingestion of the water toxic to humans and their pets.

Background

From the beginning of the program in water year 2004 up until the close of water year 2008 nutrients were sampled monthly. After the close of the grant from Ecology, maintaining monthly sampling of all nutrients was deemed too cost-prohibitive for the ongoing project budget. Quarterly sampling began at that time to allow for trend determinations in four- rather than twelve-season.

The subsequent section of this report covering Water Quality Index (WQI) is generated with contribution of this quarterly nutrient data. Therefore, since water year 2008, WQI data has been a four-season metric for this report.

Results

Water samples for measurement of nutrients were taken at each station quarterly. Samples were analyzed by Edge Analytical of Burlington, WA. Quarterly sampling brings with it a large caveat: these trends results are determined by a single sample on one day of an entire three-month period. While imperfect, this is still valuable for identifying and analyzing possible trends. If the conditions of the watercourses sampled were truly randomly assorted based on sampling, with too great of an intermittence (3 months) to have value, then running a trends analysis should show no discernible trend in the data. Any direction of the data would be determined as non-existent or non-significant. The trends analyses returning a large number of significant trends across the county, even with incredibly small slopes (e.g. parts per billion per year) shows that this sampling remains valuable at the three month interval.

Some of these trends are statistically significant even though the actual change in nutrient levels observed in the watercourse is incredibly small. When interpreting data, it is important to take into consideration the actual change over time of that nutrient in the watercourse, as is provided in the tables in **Appendix C**. For example, over the eighteen-year course of this program, a nutrient at a site may have increased by half of a milligram per liter (part per million), or at a different site it may have increased by one microgram per liter (part per billion), or less. Despite this, both analyses could show statistically significant increases in this nutrient on a map.

Table 15 gives mean nutrient values for selected parameters for the 2021 water year. All nutrient values are included in **Appendix A**, with summary statistics found in **Appendix B**, and trends analyses in **Appendix C**.

Most of the natural streams in the program showed moderate levels of total nitrogen, ammonia, and total phosphorus. The drainage infrastructure sampling sites generally had higher levels of nutrients compared to the stream stations.

There are no numeric state standards for nutrients as factors in algal blooms. However, the state has both acute and chronic water quality standards for ammonia toxicity that are calculated from the ammonia level combined with the water temperature, pH, and other factors for each individual ammonia measurement.

The following trends analyses were performed only on the 18-year dataset, representing the entire length of this program's monitoring:

Total Kjeldahl Nitrogen shows a decrease at six sites, and an increase at no sites, with no obvious clustering pattern (**Figure 11**).

Total Phosphorous shows an increase at 11 sites, and a decrease at one site (**Figure 12**). The sites showing increasing phosphorous levels are observed across the valley.

Orthophosphate shows an increase at 15 sites, and a decrease in zero sites (**Figure 13**). This is a very negative trend map and was the worst overall trend among the nutrients measured.

Ammonia levels have gone down at 16 sites around the county with no sites showing an increasing trend. The decreases are observed across the valley (**Figure 14**).

Nitrate + Nitrite levels have decreased at 12 sites spread across the county and have increased at only one site, the Swinomish Channel (**Figure 15**).

Overall, phosphorous (total and ortho) is the only nutrient showing an increase across the valley. Combination of all significant nutrient trends shows a total of 35 positive trends, or decreases, and 27 negative trends, or increases, with 26 of those being phosphorous. Phosphorous is a common "limiting nutrient" for algal blooms in the natural environment, which means that when an excess of phosphorous shows up in the watercourse, it is often the only thing required to trigger an algal bloom.

Table 15 - Mean nutrient values (mg/L) for 2021 water year

Site Number	Watercourse	Location	Total Kjeldahl Nitrogen [1]	Total Phosphorus	Ammonia	Nitrate + Nitrite
3	Thomas Creek	Old Hwy 99 N	0.73	0.11	0.09	0.58
4	Thomas Creek	F&S Grade Rd	0.34	0.06	0.02	1.17
6	Friday Creek	Prairie Rd	0.30	0.05	0.02	0.52
8	Swede Creek	Grip Rd	0.34	0.05	0.02	0.46
11	Samish River	State Route 9	0.25	0.05	0.02	0.31
12	Nookachamps Creek	Swan Rd	0.35	0.05	0.02	0.34
13	E.F. Nookachamps Creek	State Route 9	0.32	0.05	0.02	0.38
14	College Way Creek	College Way	0.36	0.06	0.03	0.43
15	Nookachamps Creek	Knapp Rd	0.55	0.12	0.07	0.32
16	E.F. Nookachamps Creek	Beaver Lake Rd	0.25	0.05	0.01	0.38
17	Nookachamps Creek	Big Lake Outlet	0.28	0.05	0.01	0.27
18	Lake Creek	State Route 9	0.31	0.05	0.01	0.44
19	Hansen Creek	Hoehn Rd	0.30	0.05	0.02	0.47
20	Hansen Creek	Northern State	0.29	0.05	0.01	0.57
21	Coal Creek	Hoehn Rd	0.32	0.06	0.01	0.79
22	Coal Creek	Hwy 20	0.27	0.05	0.01	0.69
23	Wiseman Creek	Minkler Rd	0.38	0.05	0.01	1.05
24	Mannser Creek	Lyman Hamilton Hwy	0.25	0.05	0.01	0.20
25	Red Cabin Creek	Hamilton Cem. Rd	0.25	0.05	0.01	0.56
28	Brickyard Creek	Hwy 20	0.49	0.05	0.03	0.87
29	Skagit River	River Bend Rd	0.25	0.05	0.01	0.10
30	Skagit River	Cape Horn Rd	0.25	0.08	0.01	0.09
32	Samish River	Thomas Rd	0.30	0.06	0.02	0.66
33	Alice Bay Pump Station	Samish Island Rd	2.13	0.66	0.65	3.09
34	No Name Slough	Bayview-Edison Rd	0.97	0.63	0.06	0.20
35	Joe Leary Slough	D'Arcy Rd	1.42	0.43	0.45	1.13
36	Edison Slough at school	W. Bow Hill Rd	0.78	0.26	0.03	2.84
37	Edison Pump Station	Farm to Market Rd	1.96	0.77	0.70	2.77
38	N. Edison Pump Station	North Edison Rd	2.98	1.69	1.04	2.62
39	Colony Creek	Colony Rd	0.43	0.11	0.03	1.20
40	Big Indian Slough	Bayview-Edison Rd	0.77	0.13	0.29	0.52
41	Maddox/Big Ditch	Milltown Rd	1.10	0.23	0.37	0.91
42	Hill Ditch	Cedardale Rd	0.42	0.06	0.04	0.58
43	Wiley Slough	Wylie Rd	1.38	0.15	0.76	0.64
44	Sullivan Slough	La Conner-Whitney	1.16	0.21	0.68	0.64
45	Skagit River – North Fork	Moore Rd	0.25	0.06	0.01	0.10
46	Skagit River – South Fork	Fir Island Rd	0.25	0.05	0.02	0.10
47	Swinomish Channel	County Boat Launch	0.25	0.07	0.05	0.16
48	Fisher Creek	Franklin Rd	0.64	0.19	0.03	0.56

Figure 11 - Eighteen-year trends in Total Kjeldahl Nitrogen (TKN)

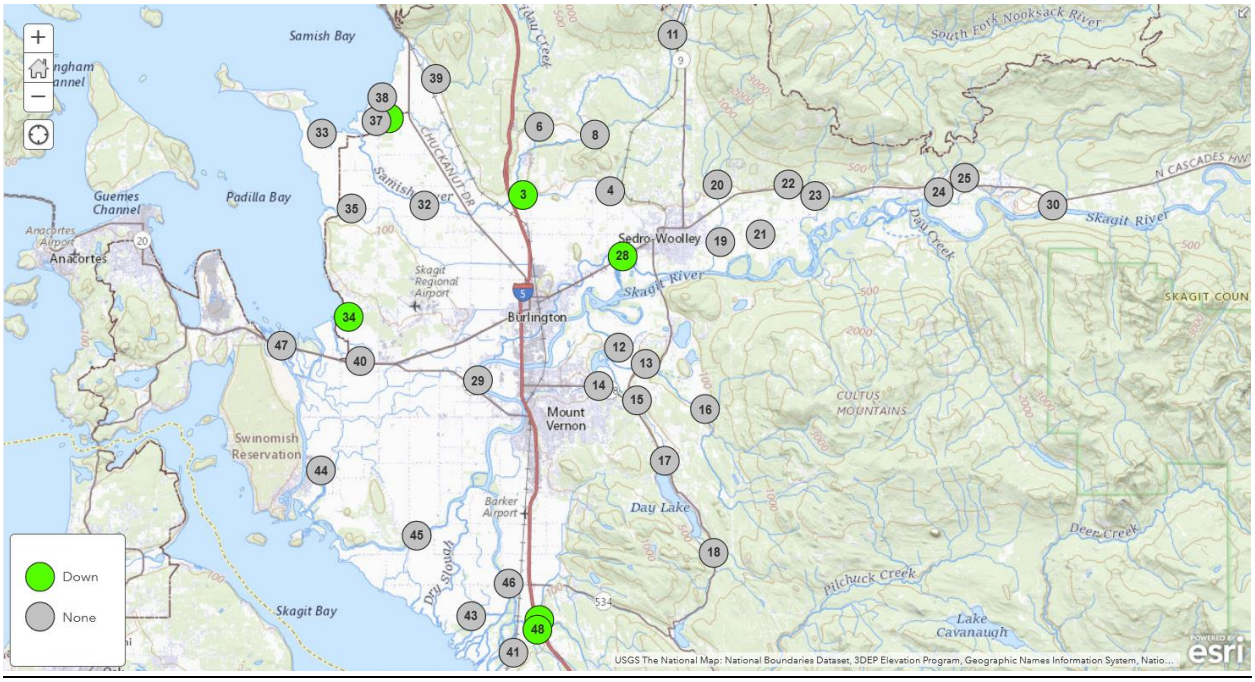


Figure 12 - Eighteen-year trends in Total Phosphorous (TP)

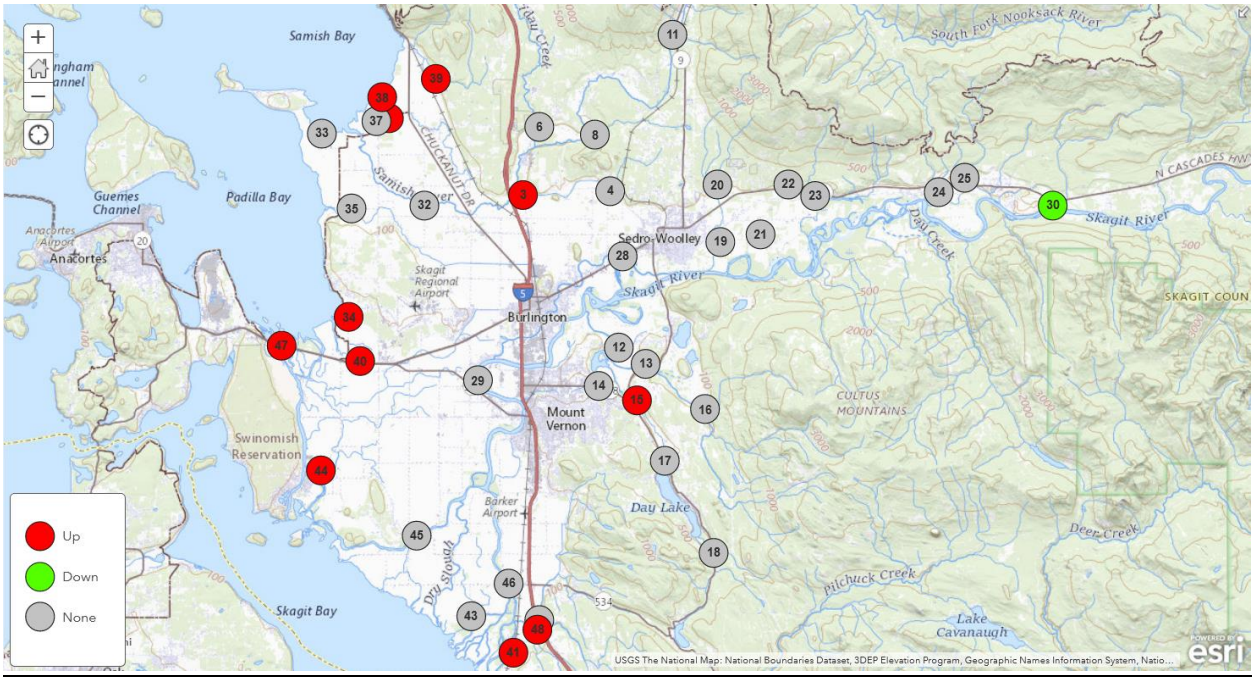


Figure 13 - Eighteen-year trends in Ortho-phosphorous (OP)

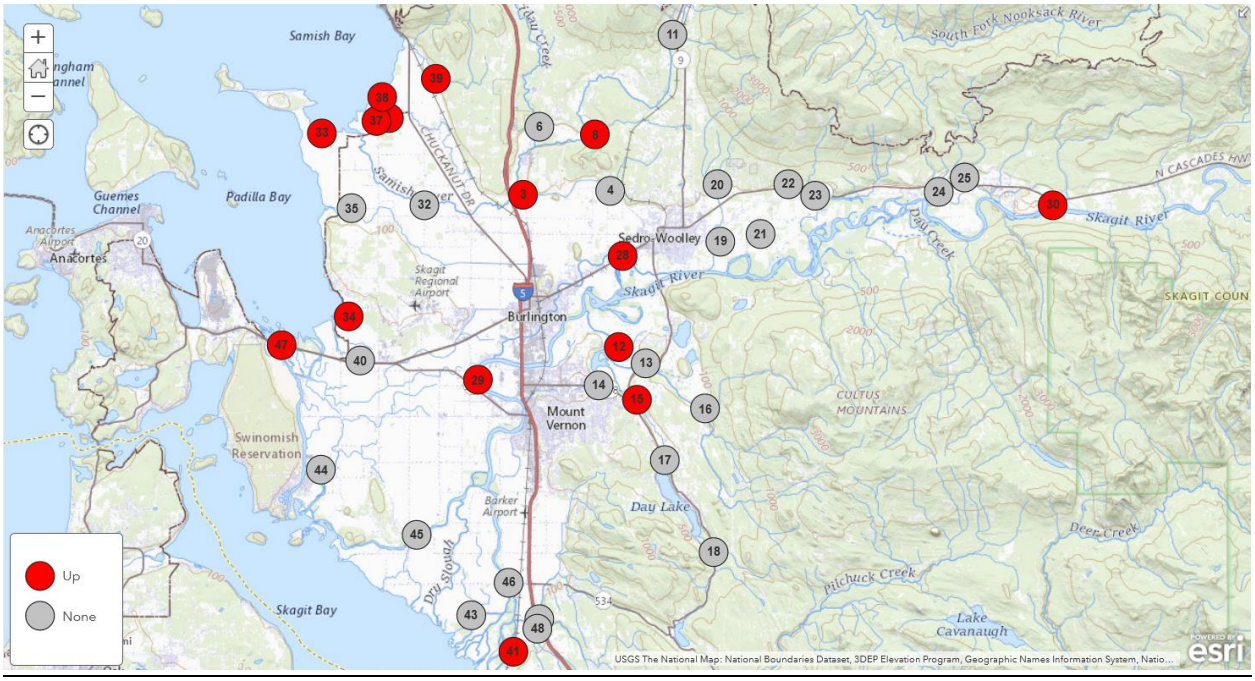


Figure 14 - Eighteen-year trends in Ammonia (NH_3)

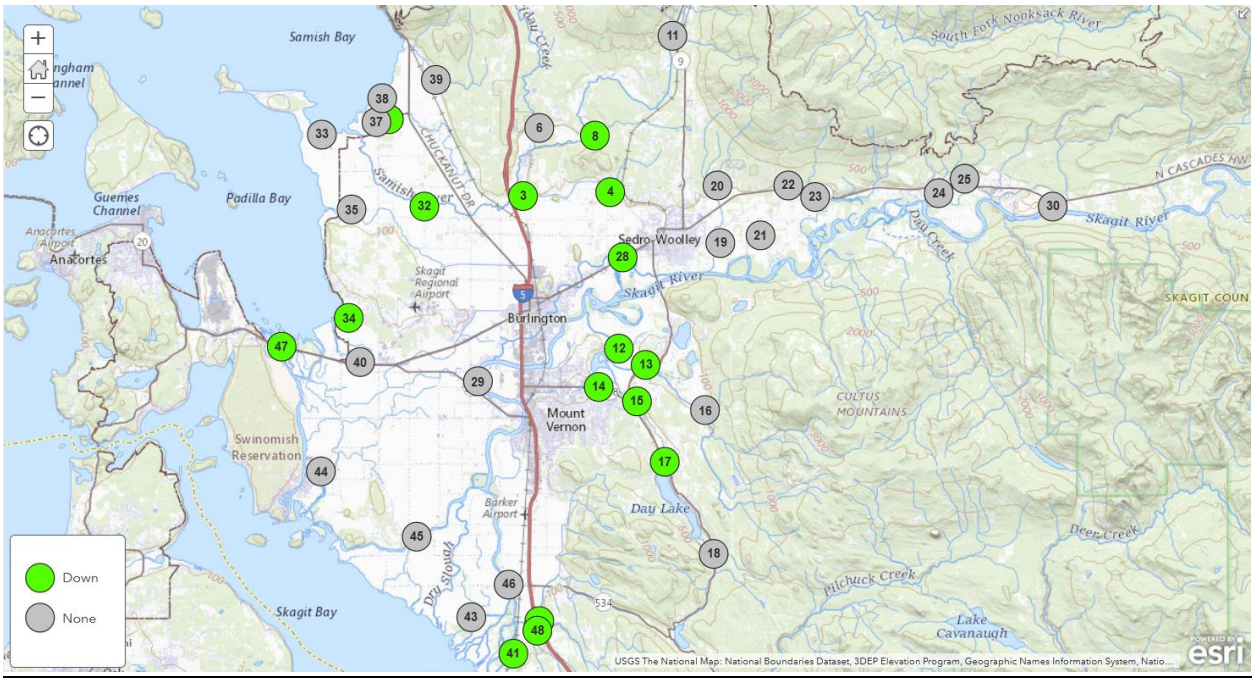
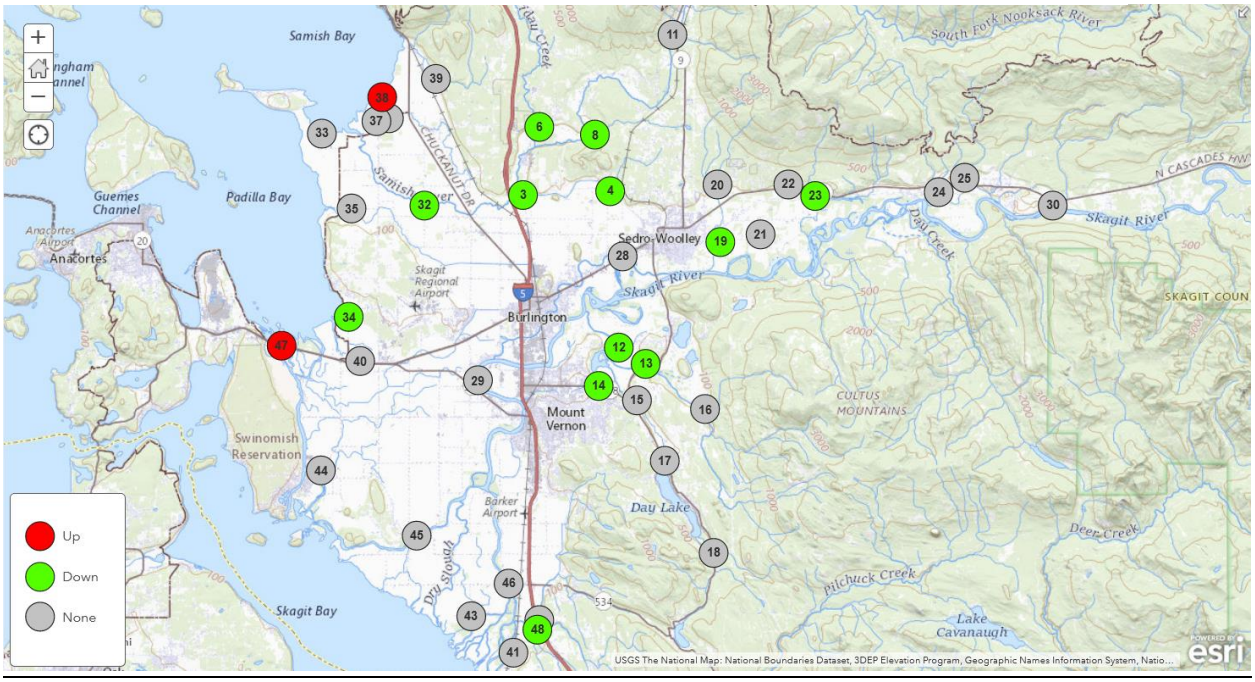


Figure 15 - Eighteen-year trends in Nitrate and Nitrite ($NO_3 + NO_2$)



Other Parameters

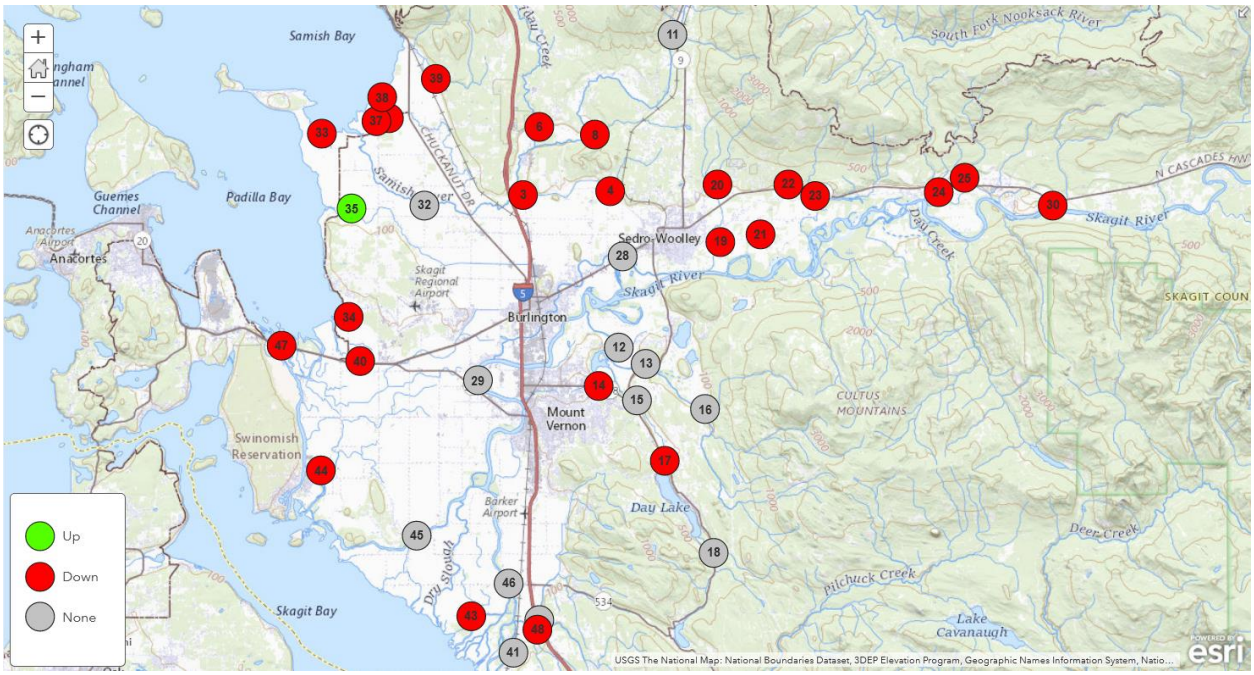
The SCMP also measures pH during each visit to each site. Measurement of pH shows whether a watercourse is within the range that supports aquatic life. In general, pH in the SCMP has been within state standards.

Discharge measurements were made up until 2008 in selected locations and were intended to provide a general indication of the flow regime for that watercourse and as an aid in interpreting other water quality parameters. As Ecology has added several stream gauges in the area, Skagit County has de-emphasized performing manual discharge measurement.

Eighteen-year trends analysis on pH across Skagit County revealed 25 sites with significantly decreasing pH and one site with an increase (**Figure 16**).

All measurements for these parameters are available in **Appendix A** and are summarized in **Appendix B**.

Figure 16 - Eighteen-year trends in pH



Summary Statistics of Significant Trends across Skagit County

To construct a bird's-eye view of what trends are occurring across Skagit County, two summary tables were created. These summary tables were populated from the site-specific tables provided in **Appendix C**. These tables take into account all trends analyses from the 18-year data (18 trends), the ten-year data (six trends), and the five-year data (six trends), combined, for a total of 30 possible significant trends. The results on these tables are biased toward the temperature and FC parameters, as they account for six of the 30 total trends in the group, and biased even further toward DO, as it accounts for eight total categories. Other parameters populate one or two categories each. For this report, positive trends were listed as: Increase in pH, increase in DO, increase in DO% saturation, decrease in temperature, decrease in turbidity, decrease in FC, decrease in nutrients, and decrease in TSS. Negative, or deleterious trends, were considered as the opposite of these statements.

The first table (**Table 16**) arranges all ambient monitoring sites by their percentage of positive significant trends as a ratio of total significant trends. Some sites recorded fewer than ten significant trends, while others recorded over twenty. The first table does not arrange by the number of trends total, but simply by how positively or negatively a particular site is trending overall. The sites in the county that have the highest ratio of positive trends are listed at the top, and the sites exhibiting the highest ratio of negative trends are at the bottom. This table is a quick reference for overall improving or deteriorating water quality for a site.

The second table (**Table 17**) arranges all ambient sampling monitoring sites by their total number of significant trends recorded. Some sites recorded fewer than ten significant trends, while others recorded over twenty. The second table does not arrange by the ratio of positive or negative trends recorded, but simply by the amount of significant change that is occurring at that site. This table is a quick reference for identifying which sites around the county are experiencing the most significant statistical change in water quality, and which sites are not. Sites located at the top of the table are those that have had their water quality parameters change the most.

Table 13 - Summary Statistics of Significant Trends, by Positive/Negative

Site		Significant Trends				Category
		Total	Positive	Negative	% Positive	
Samish River	32	13	13	0	100	Ag - Down
Samish River	11	10	10	0	100	Ag - Up
Skagit River	45	9	8	1	89	Skagit - Low
Joe Leary Slough	35	14	12	2	86	Ag - Down
Thomas Creek	4	13	11	2	85	Ag - Up
Nookachamps Creek	12	6	5	1	83	Ag - Down
Coal Creek	21	11	9	2	82	Ag - Down
Skagit River	46	10	8	2	80	Skagit - Low
Hansen Creek	20	9	7	2	78	Ag - Up
College Way Creek	14	11	8	3	73	Ref - Urban
Skagit River	29	7	5	2	71	Skagit - Mid
Friday Creek	6	10	7	3	70	Ref - RR
Wiseman Creek	23	6	4	2	67	Ag - Up
Coal Creek	22	6	4	2	67	Ag - Up
Brickyard Creek	28	3	2	1	67	Ref - Urban
Fisher Creek	48	14	9	5	64	Ag - Down
No Name Slough	34	19	12	7	63	Ag - Down
EF Nookachamps	16	8	5	3	63	Ag - Mid
Nookachamps Creek	15	10	6	4	60	Ag - Mid
Lake Creek	18	5	3	2	60	Ag - Up
Swede Creek	8	12	7	5	58	Ag - Down
Mannser Creek	24	14	8	6	57	Ag - Mid
Skagit River	30	14	8	6	57	Skagit - Up
Colony Creek	39	8	4	4	50	Ag - Down
Alice Bay Pump	33	9	4	5	44	Ag - Down
Maddox/Big Ditch	41	13	5	8	38	Ag - Down
Hill Ditch/Carpenter	42	16	6	10	38	Ag - Down
Hansen Creek	19	16	6	10	38	Ag - Down
Red Cabin Creek	25	8	3	5	38	Ref - RR
Thomas Creek	3	11	4	7	36	Ag- Down
Edison Slough	36	7	2	5	29	Ag - Down
EF Nookachamps	13	11	3	8	27	Ag - Down
Nookachamps Creek	17	8	2	6	25	Ag - Up
S. Edison Pump	37	8	2	6	25	Ag - Down
N. Edison Pump	38	12	2	10	17	Ag - Down
Swinomish Channel	47	12	2	10	17	Ref - Marine
Big Indian Slough	40	7	1	6	14	Ag - Mid
Sullivan Slough	44	9	0	9	0	Ag - Down
Wiley Slough	43	10	0	10	0	Ag - Down

4

Table 147 - Summary Statistics of Significant Trends, by Total Count

Site		Significant Trends				Category
		Total	Positive	Negative	% Positive	
No Name Slough	34	19	12	7	63	Ag - Down
Hansen Creek	19	16	6	10	38	Ag - Down
Hill Ditch/Carpenter	42	16	6	10	38	Ag - Down
Joe Leary Slough	35	14	12	2	86	Ag - Down
Fisher Creek	48	14	9	5	64	Ag - Down
Mannser Creek	24	14	8	6	57	Ag - Mid
Skagit River	30	14	8	6	57	Skagit - Up
Samish River	32	13	13	0	100	Ag - Down
Thomas Creek	4	13	11	2	85	Ag - Up
Maddox/Big Ditch	41	13	5	8	38	Ag - Down
Swede Creek	8	12	7	5	58	Ag - Down
Swinomish Channel	47	12	2	10	17	Ref - Marine
N. Edison Pump	38	12	2	10	17	Ag - Down
Coal Creek	21	11	9	2	82	Ag - Down
College Way Creek	14	11	8	3	73	Ref - Urban
Thomas Creek	3	11	4	7	36	Ag- Down
EF Nookachamps	13	11	3	8	27	Ag - Down
Samish River	11	10	10	0	100	Ag - Up
Skagit River	46	10	8	2	80	Skagit - Low
Friday Creek	6	10	7	3	70	Ref - RR
Nookachamps Creek	15	10	6	4	60	Ag - Mid
Wiley Slough	43	10	0	10	0	Ag - Down
Skagit River	45	9	8	1	89	Skagit - Low
Hansen Creek	20	9	7	2	78	Ag - Up
Alice Bay Pump	33	9	4	5	44	Ag - Down
Sullivan Slough	44	9	0	9	0	Ag - Down
EF Nookachamps	16	8	5	3	63	Ag - Mid
Colony Creek	39	8	4	4	50	Ag - Down
Red Cabin Creek	25	8	3	5	38	Ref - RR
S. Edison Pump	37	8	2	6	25	Ag - Down
Nookachamps Creek	17	8	2	6	25	Ag - Up
Skagit River	29	7	5	2	71	Skagit - Mid
Edison Slough	36	7	2	5	29	Ag - Down
Big Indian Slough	40	7	1	6	14	Ag - Mid
Nookachamps Creek	12	6	5	1	83	Ag - Down
Coal Creek	22	6	4	2	67	Ag - Up
Wiseman Creek	23	6	4	2	67	Ag - Up
Lake Creek	18	5	3	2	60	Ag - Up
Brickyard Creek	28	3	2	1	67	Ref - Urban

Water Quality Index (WQI)

The Water Quality Index is a tool developed by Ecology as an overall indicator of water quality at a given site. The index compares typical water quality parameters with established standards and yields a single, unitless number between 1 and 100 to describe the overall water quality of a site at the time of sampling. The index can be summarized to give a site an overall score for a water year. The parameters included in the WQI are DO, temperature, pH, turbidity, suspended solids, FC, and nutrients.

The WQI is best used to answer general questions about the condition of watercourses, such as "What is the general condition of this stream?" or "How does this stream compare to others in the area?" (Hallock 2002). Because the index is a distillation of many parameters, it is unsuitable for answering detailed questions concerning the water quality of an individual stream. As is demonstrated by the Samish River, a stream can have an adequate WQI score based on ambient sampling, but significant pollution problems revealed by storm sampling.

Ecology rates streams with WQI Overall Score of 80 or greater "of lowest concern." Streams with ratings of 40-79 are considered "of moderate concern," while scores less than 40 are considered "of highest concern."

Water Quality Index calculations for the sample sites in the SCMP during the 2021 water year are summarized in **Table 18 and** are mapped geographically in **Figure 17**. WQI scores over the length of this program are categorized for the years 2009-2021 in **Table 19**. Note that although the WQI was designed for freshwater bodies, we have applied the index to the Swinomish Channel monitoring site (Site 47), which is primarily marine. This allows trend detection over time at this station, but the WQI for Site 47 should not be compared to the freshwater sites.

The WQI results show that several watercourses in the study area fall into the "highest concern" category. Most, but not all, are agricultural drainages with little summer flow that are not considered salmonid habitat.

Over the course of the SCMP, the number of sites in the Lavender (Lowest Concern) category has increased somewhat since 2012, while the number of sites in the Red (Highest Concern) category has held steady. Streams and ditches in the Red category can have either one water quality parameter that is well below standards or several categories that are below standards.

Water quality during storm events remains problematic as the results from storm event monitoring in the Samish Basin associated with the CSI continue to show excessive fecal coliform concentrations.

Table 15 - Water Quality Index (WQI) results for the 2021 Water Year

Site Number	Watercourse	Location	Overall Score*
3	Thomas Creek	Old Hwy 99 N	44
4	Thomas Creek	F&S Grade Rd	75
6	Friday Creek	Prairie Rd	89
8	Swede Creek	Grip Rd	82
11	Samish River	State Route 9	86
12	Nookachamps Creek	Swan Rd	70
13	E.F. Nookachamps Creek	State Route 9	73
14	College Way Creek	College Way	62
15	Nookachamps Creek	Knapp Rd	49
16	E.F. Nookachamps Creek	Beaver Lake Rd	89
17	Nookachamps Creek	Big Lake Outlet	74
18	Lake Creek	State Route 9	87
19	Hansen Creek	Hoehn Rd	86
20	Hansen Creek	Northern State	90
21	Coal Creek	Hoehn Rd	84
22	Coal Creek	Hwy 20	96
23	Wiseman Creek	Minkler Rd	93
24	Mannser Creek	Lyman Hamilton Hwy	69
25	Red Cabin Creek	Hamilton Cem. Rd.	97
28	Brickyard Creek	Hwy 20	75
29	Skagit River	River Bend Rd	83
30	Skagit River	Cape Horn Rd	86
32	Samish River	Thomas Rd	86
33	Alice Bay Pump Station	Samish Island Rd	34
34	No Name Slough	Bayview-Edison Rd	37
35	Joe Leary Slough	D'Arcy Rd	18
36	Edison Slough	W. Bow Hill Rd	50
37	Edison Pump Station	Farm to Market Rd	23
38	N. Edison Pump Station	North Edison Rd	1
39	Colony Creek	Colony Rd	79
40	Big Indian Slough	Bayview-Edison Rd	44
41	Maddox Slough/Big Ditch	Milltown Rd	27
42	Hill Ditch	Cedardale Rd	57
43	Wiley Slough	Wylie Rd	10
44	Sullivan Slough	La Conner-Whitney	18
45	Skagit River – North Fork	Moore Rd	86
46	Skagit River – South Fork	Fir Island Rd	87
47	Swinomish Channel	County Boat Launch	63
48	Fisher Creek	Franklin Rd	87

Color code: Lowest Concern (>80 Overall Score), Moderate Concern (40-80), Highest Concern (<40)

*Note: Overall score is the mean of the three lowest monthly scores (Hallock 2002)

Figure 17 - Color coded map of 2021 WQI results

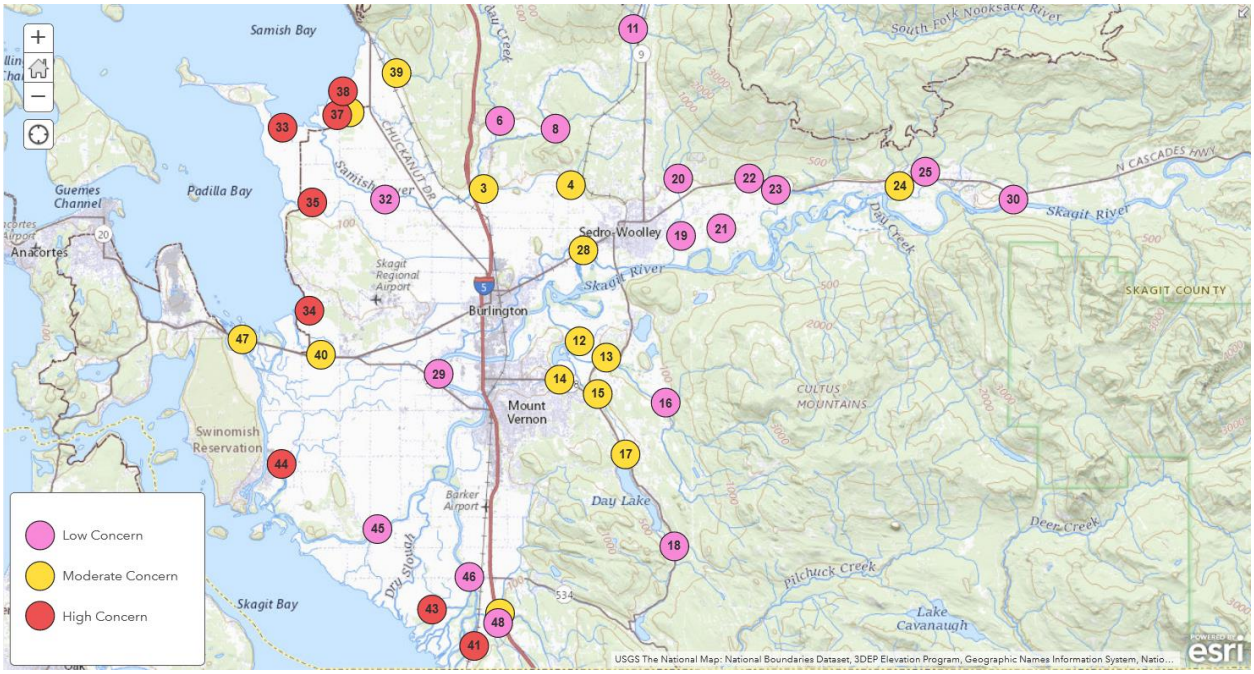


Table 16 - Number of sites in each WQI category

Year	Lavender (80-100)	Light yellow (40-79)	Red (1-40)
2009	17	11	12
2010	13	19	8
2011	20	9	11
2012	13	16	11
2013	15	14	11
2014	16	13	11
2015	16	13	11
2016	15	15	10
2017	20	8	12
2018*	23	6	10
2019*	15	12	12
2020*	15	14	10
2021*	17	14	8

*39 sites sampled from 2018 forward

Site Report Cards (SRCs)

The figures on the following pages report results from the Skagit County Monitoring Program for dissolved oxygen (DO), temperature, and fecal coliform (FC). Full data listings for each sampling event at each sample site for the entire history of the program are included in Appendix A. A summary of water quality results for each sample site for water year 2021 is included in Appendix B.

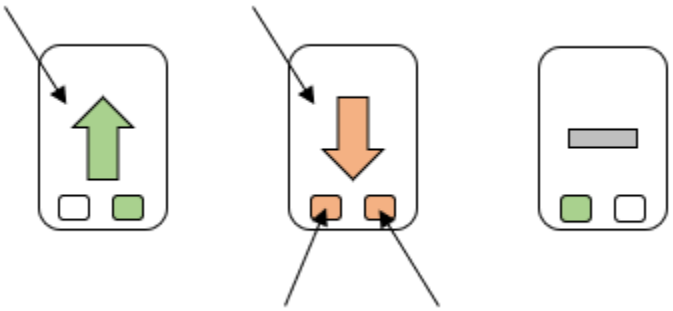
The graphs give an overall picture of the water quality at a given site over time. They are not intended to fully describe the conditions at that site, only to give an "at a glance" indication of the conditions over the course of the project. Trends analysis statistics tables are included in Appendix C.

Note that the y-axes on the graphs in this section are not all equivalent. The y-axes color schemes for temperature and DO align with the state standard that applies at that sampling site. The y-axes for FC counts are different to accommodate the large variance in sampling data for each site. Normalizing these y-axes to each other would render data un-viewable and un-interpretable at several sites. Some data are outliers to a data set and would stretch the size of the y-axis to a point that this same effect would be seen and have been cropped at the top of the plot. The quantification of the data point has been added next to the crop to inform the reader of its value.

All photographs in the following section were taken by the previous project manager and are public property.

How to interpret the SRCs

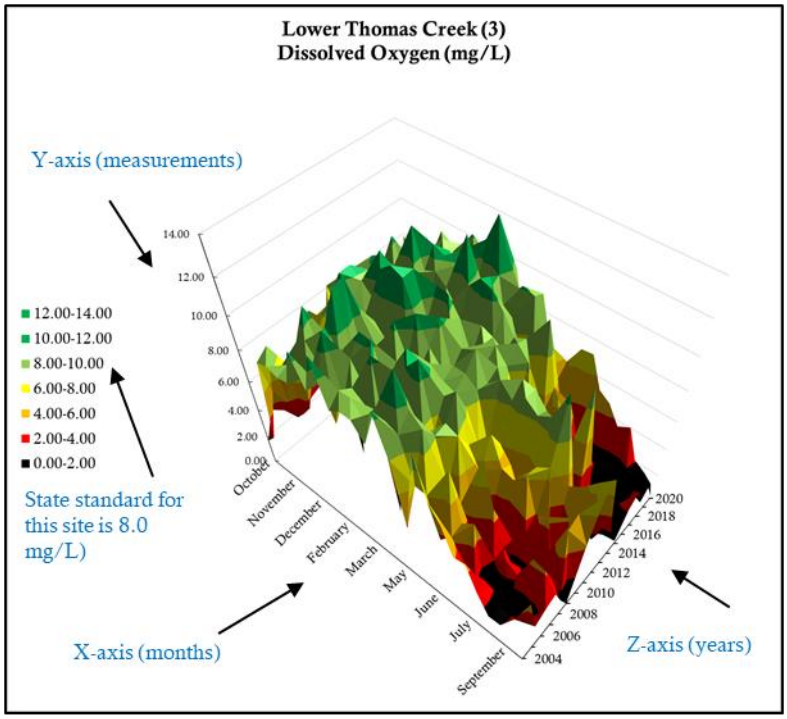
- If there is an arrow, the statistic showed significant change on a monthly examination, at 95% confidence. This is our main statistic for determining changes.
- If the arrow is green, the direction of the change one that is positive for water quality.
- If the arrow is red, the direction of change is one that is negative for water quality.
- If the lower left box is shaded in, the statistic showed significant change on a bi-weekly examination. This is more sensitive and less robust.
- If the lower right box is shaded in, then the statistic was nearly significant on a monthly examination, at 90% confidence.
- These extra boxes exist to show a more sensitive view of what may be occurring at a site, rather than simply a binary yes or no statistic using the main monthly metric.
- A site with an arrow and both boxes filled in shows the strongest trend.



The graphic on the left shows a positive significant monthly trend upward, at 95% and 90% confidence levels.
The graphic in the middle shows a negative significant monthly trend downward, at 95% and 90% confidence levels, and was also significant on a bi-weekly basis, at 95% confidence.
The graphic on the right shows no significant monthly trend at the 95% or 90% confidence levels but shows a significant trend on the bi-weekly examination, at 95% confidence.

3D Maps

- Each 3D map has a threshold color for that particular metric and sampling site.
- For dissolved oxygen, everything passing state standard is green.
- For temperature, everything failing state standard is red.
- For fecal coliform, everything passing state standard is green.

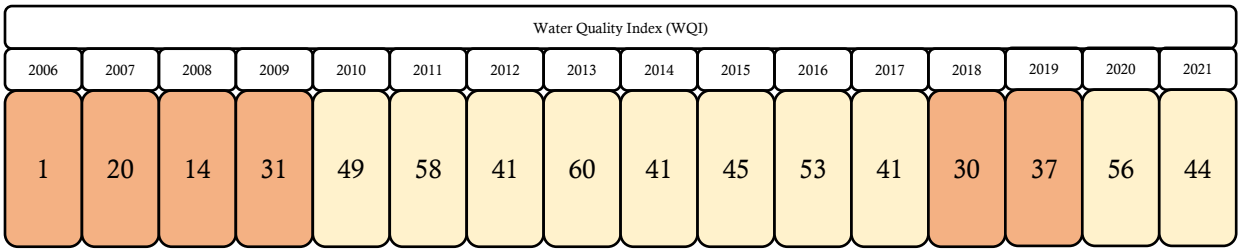


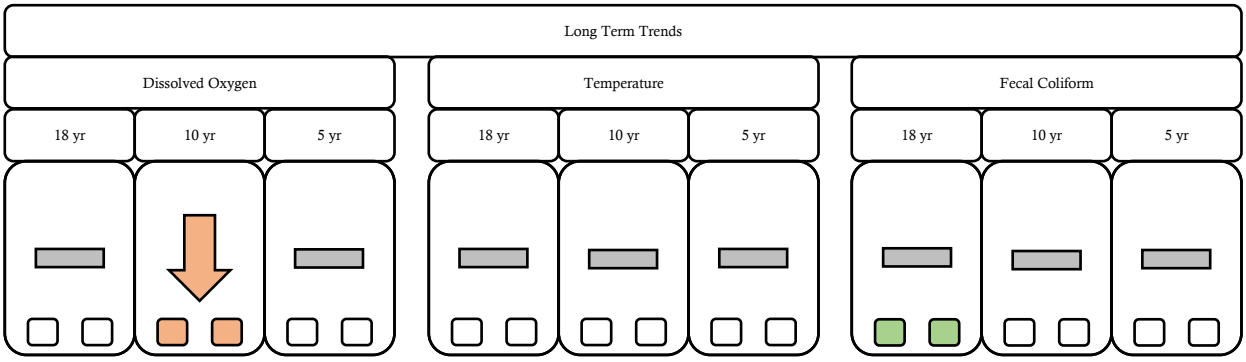
- The x-axis contains the months of the water year, from October through September.
- The y-axis contains the values of the metric, in this case, mg/L of dissolved oxygen.
- The z-axis contains the years of the program, from 2004 until present.

3

Thomas Creek
@ Highway 99

Downstream Ag



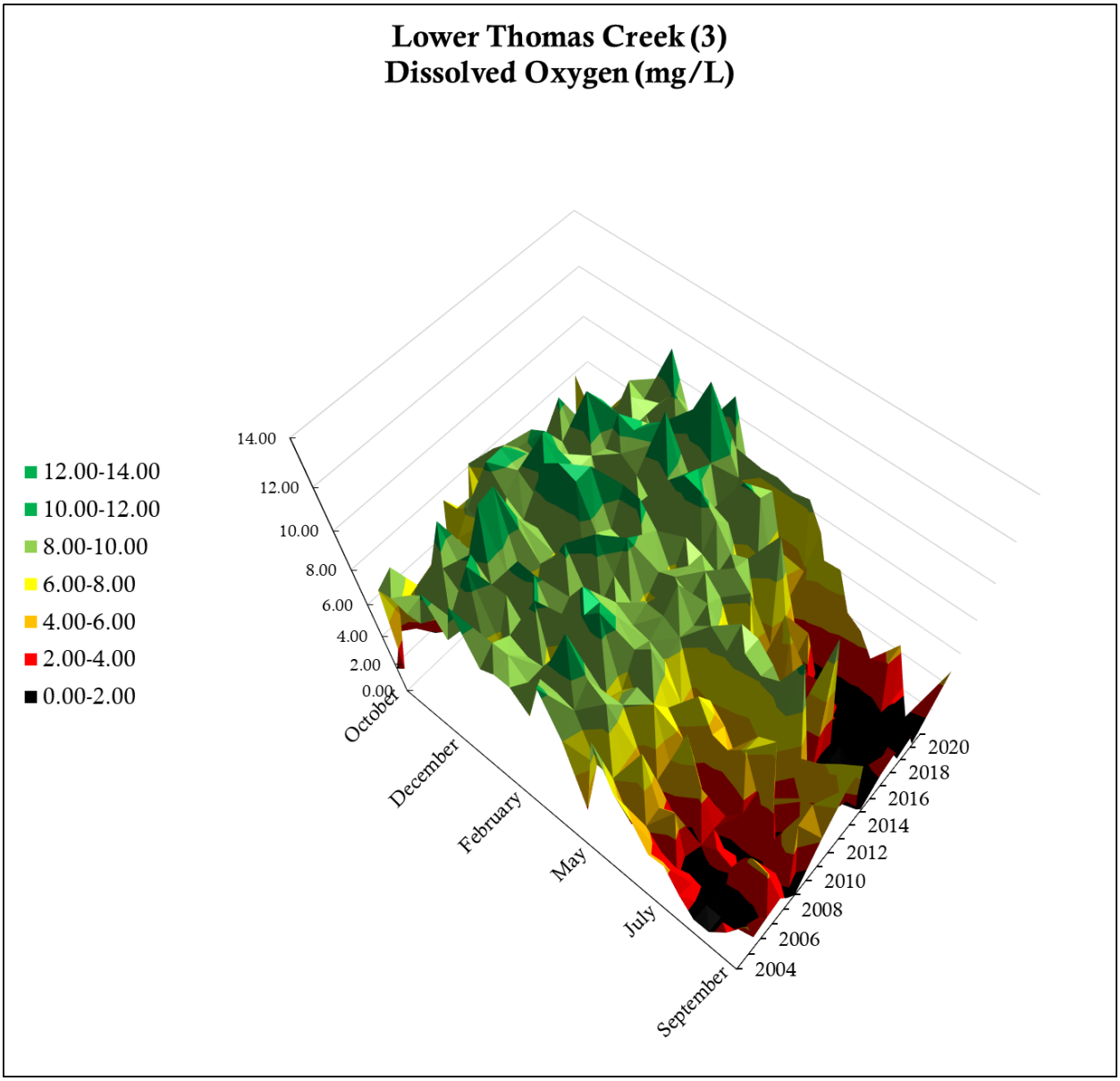


Site 3 is Thomas Creek, downstream from site 4, and sits just prior to the creek joining the Samish River. This section of the creek is more of a slough, with slow-moving, channelized water. This site has substantially lower flow volumes in the summer months. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

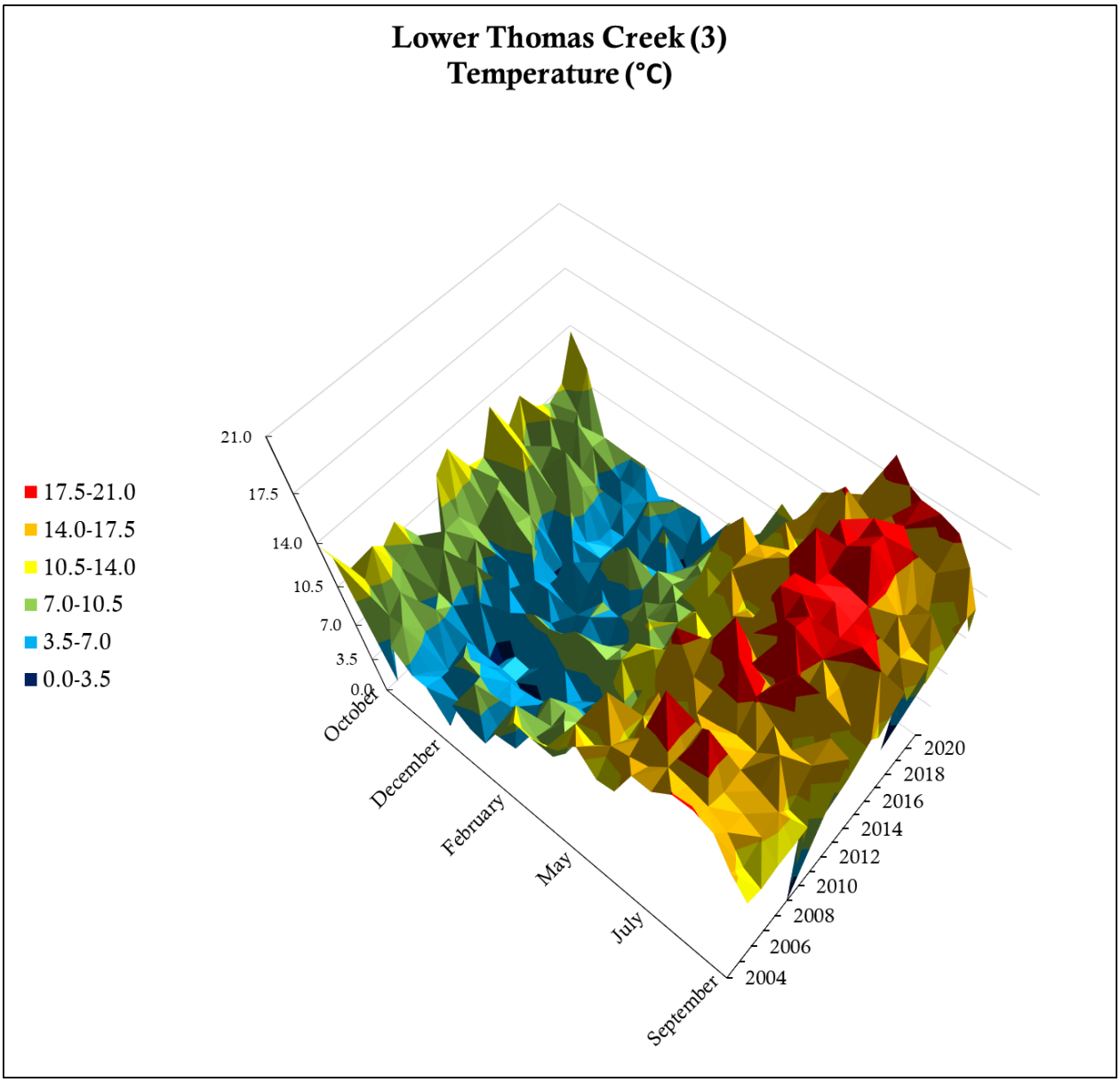
Dissolved oxygen has declined over the last ten years. Fecal coliform counts are lower than they were eighteen years ago. WQI scores have improved since monitoring began but have never reached the category of lowest concern.

Site 3 regularly fails to meet state standards for DO and temperature in the warmer months. Annual FC levels meet state standards.

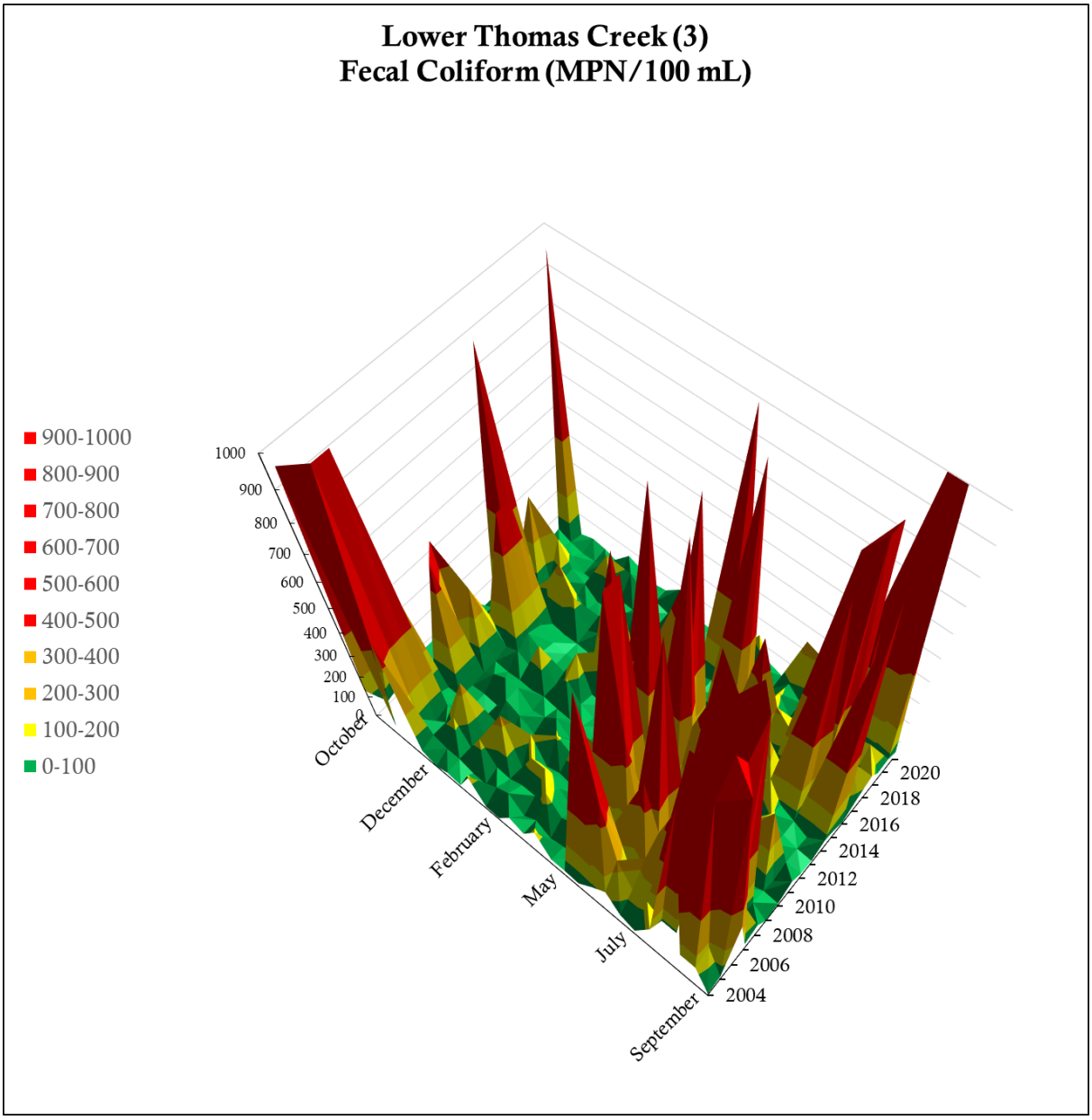
Site 3 is tied for 14th out of 39 sites for number of significant trends, with 11, and 30th out of 39 sites for positive trends, at 36%.



The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.



The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

4

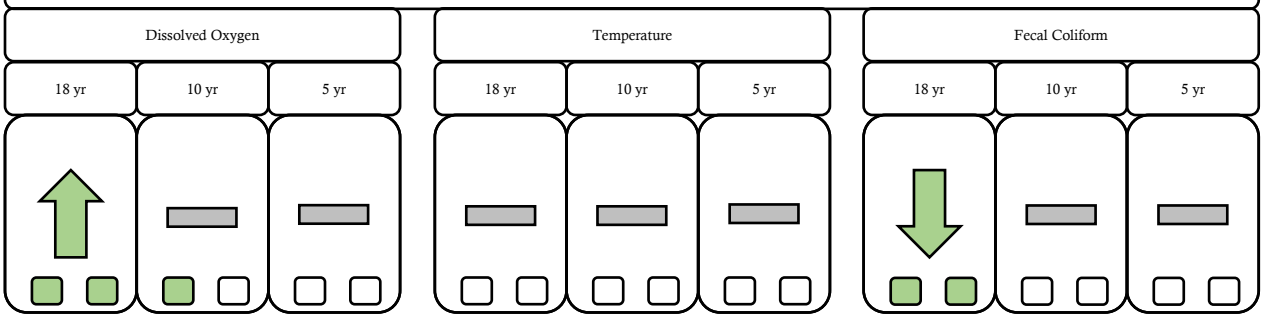
Thomas Creek
@ F&S Grade Road

Upstream Ag

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
15	54	39	66	76	77	62	81	89	71	52	89	81	65	72	75

Long Term Trends

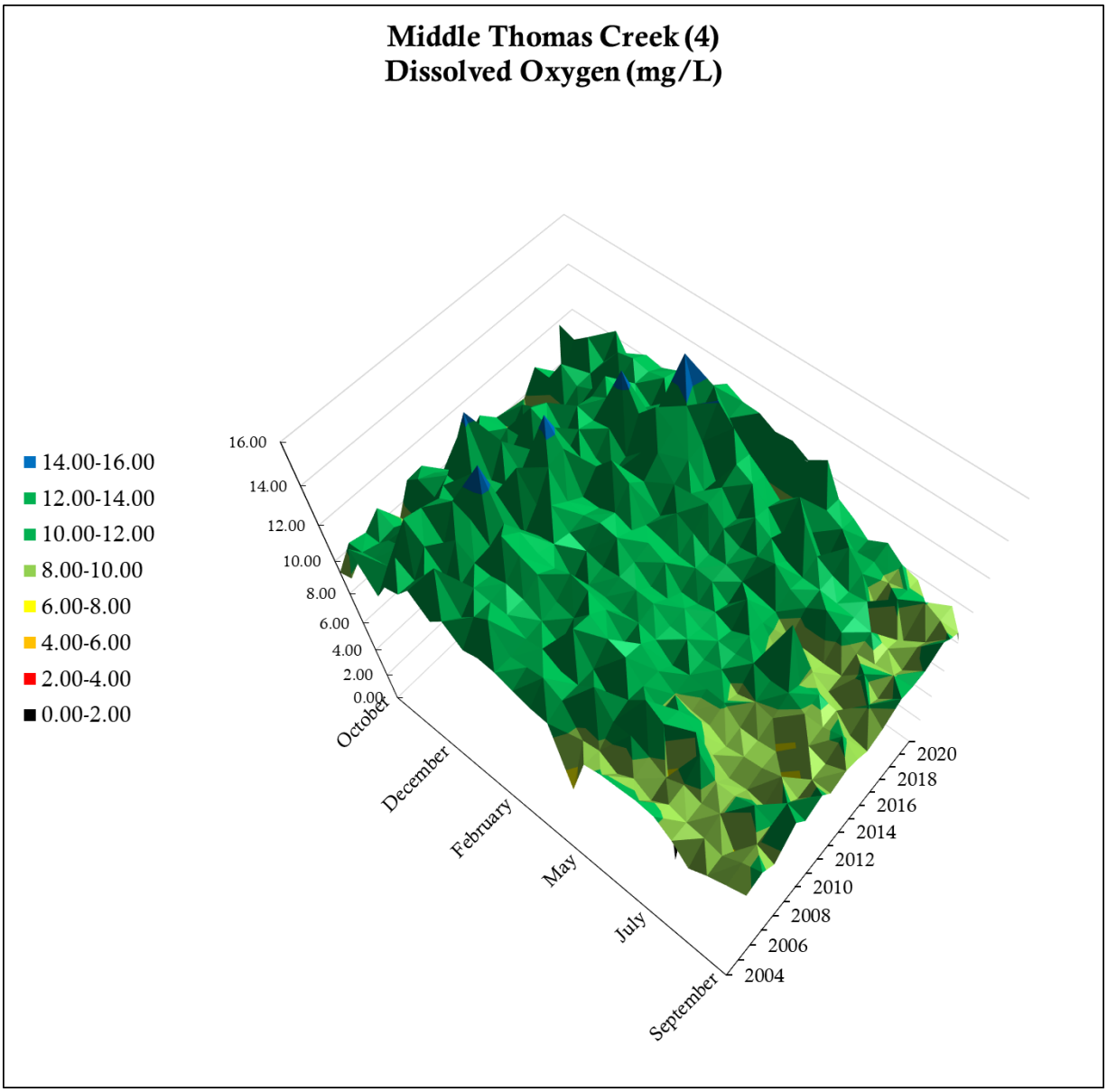


Site 4 is Thomas Creek, upstream of site 3. Upstream of this sampling site, the creek is fairly oxygenated and fast-moving. This site has substantially lower flow volumes in the summer months. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

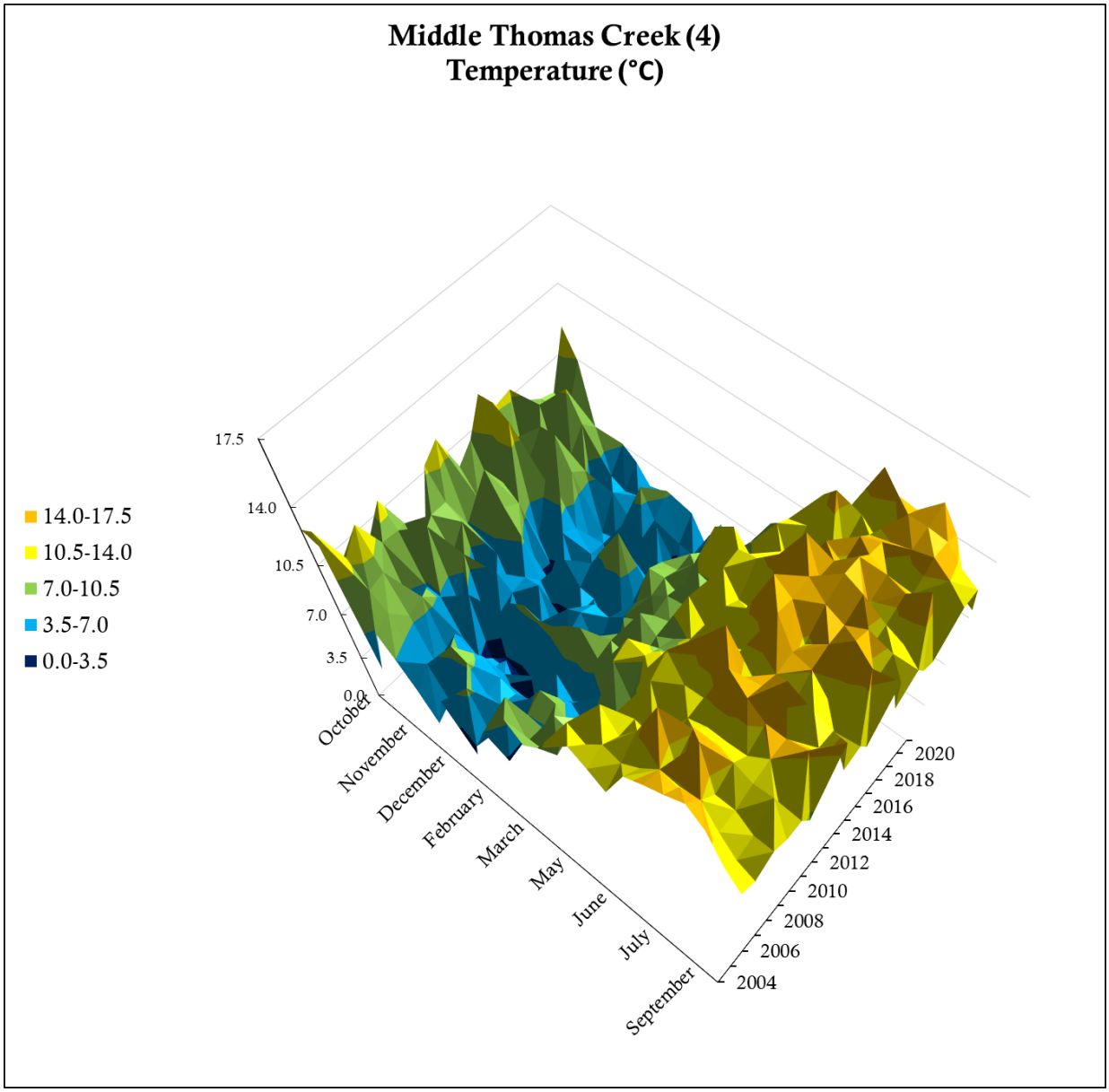
Dissolved oxygen has increased significantly across the last 18 years and ten years. Fecal coliform counts are lower than they were 18 years ago. WQI scores have substantially improved since monitoring began.

Site 4 regularly meets state standards for temperature and DO year-round. Annual fecal coliform and *E. coli* levels for WY2021 did not pass state standards.

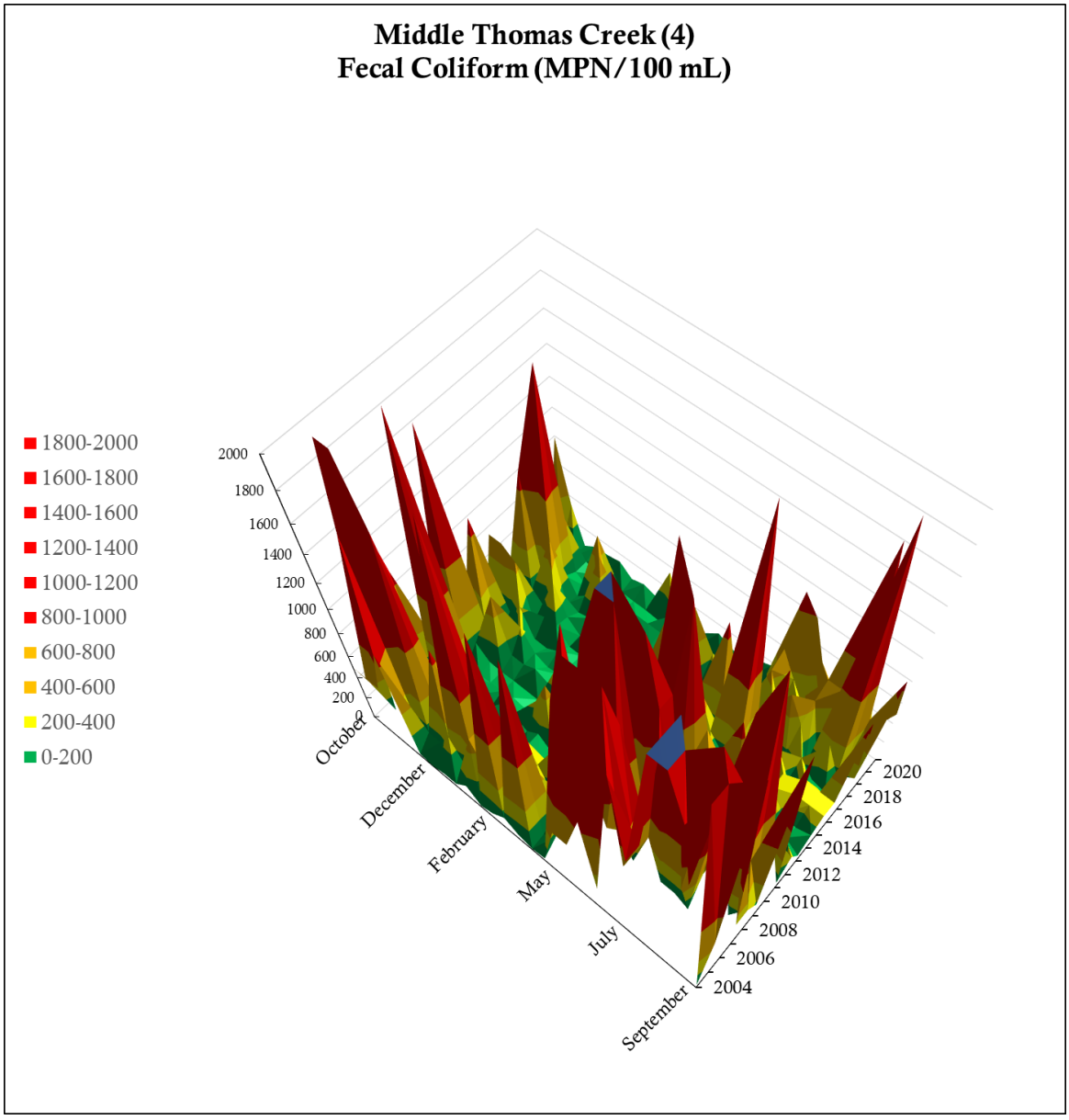
Site 4 is tied for 8th out of 39 sites for number of significant trends, with 12, and 5th out of 39 sites for positive trends, at 85%.



The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

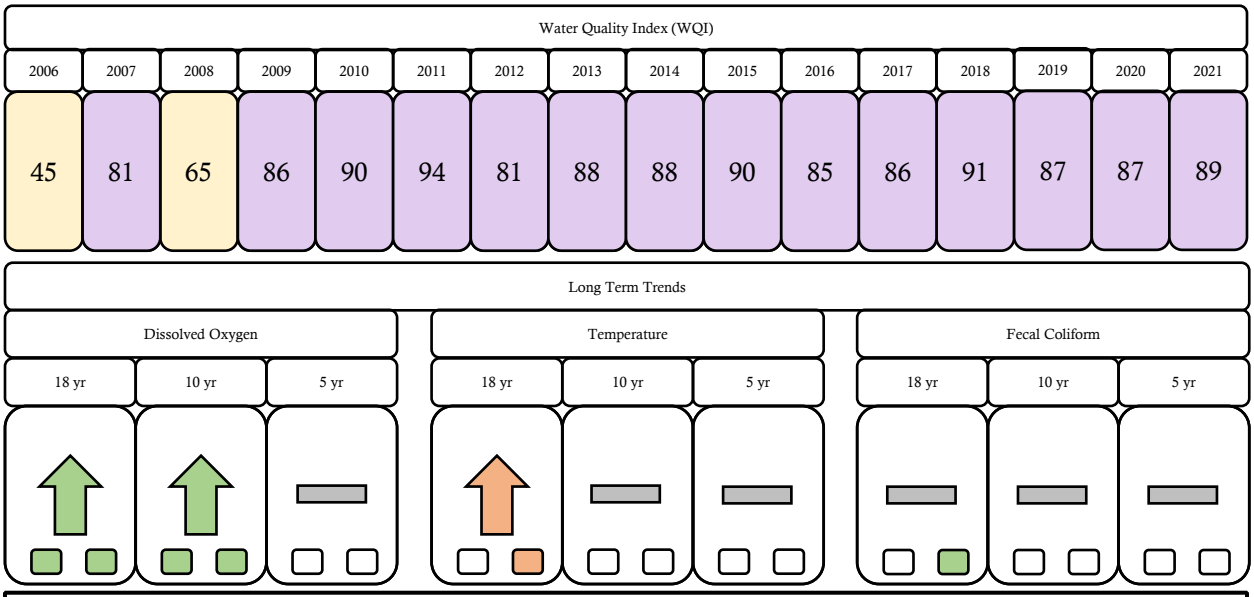


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green almost meets that standard. The water year on the x-axis begins in October and ends in September.

6

Friday Creek
@ Prairie Road

Reference – Rural Reserve

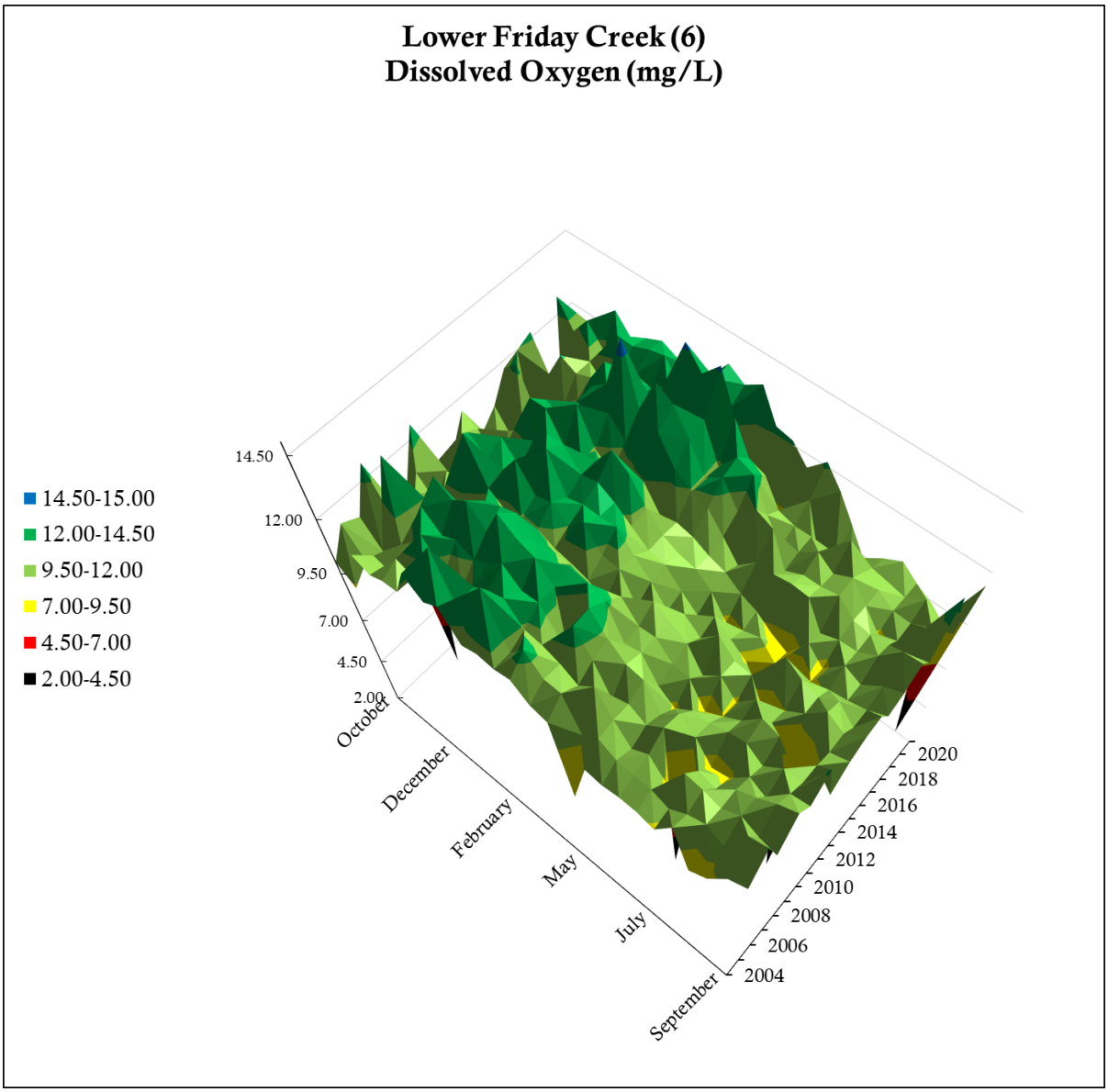


Site 6 is Friday Creek, and sits just prior to the creek joining the Samish River. This creek has a high flow volume and rate, and can seasonally contribute around 40% or more of the total volume of the Samish River. This site is designated as core salmonid habitat.

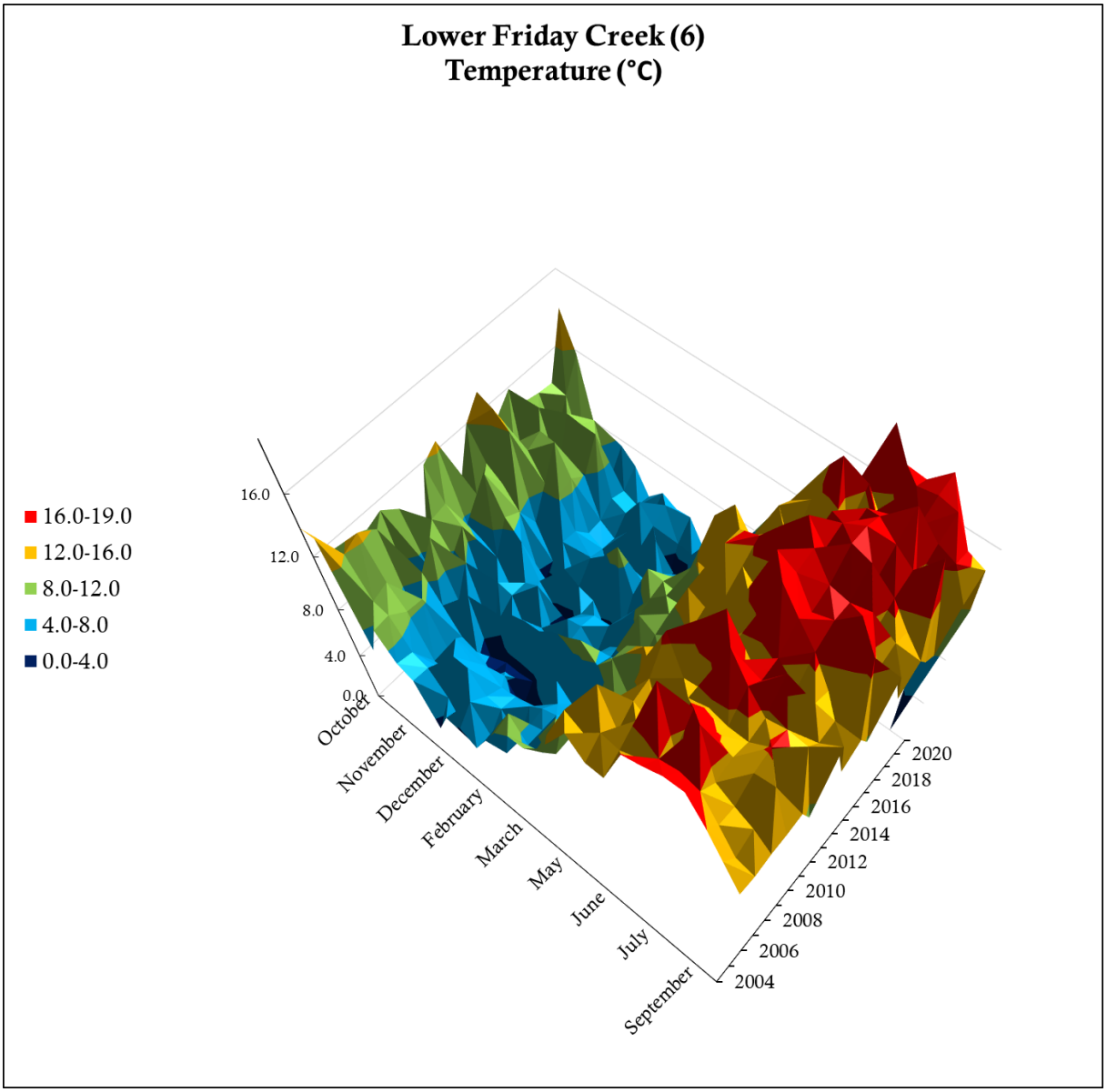
Dissolved oxygen has significantly increased over the last 18 and ten years. Temperature is significantly higher now than it was 18 years ago. Fecal coliform is lower than it was 18 years ago. WQI is consistently in the category of least concern.

Site 6 regularly meets state standards for DO year-round. Temperature exceeds state standards during the hottest time of the year. The bacterial levels for the 2021 water year easily met state standards.

Site 6 is tied for 18th out of 39 sites for number of significant trends, with 10, and is 12th out of 39 sites for positive trends, at 70%.

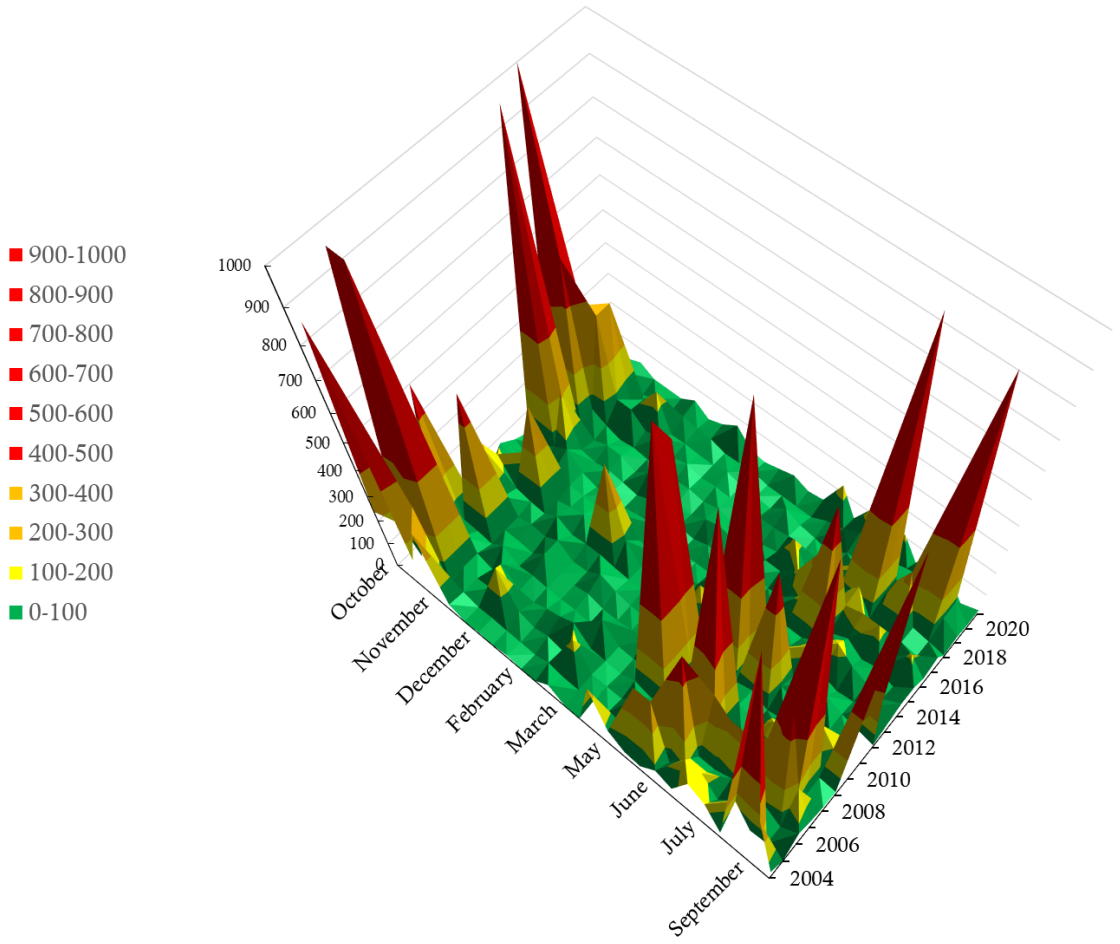


The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

Lower Friday Creek (6)
Fecal Coliform (MPN/100 mL)



The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

8

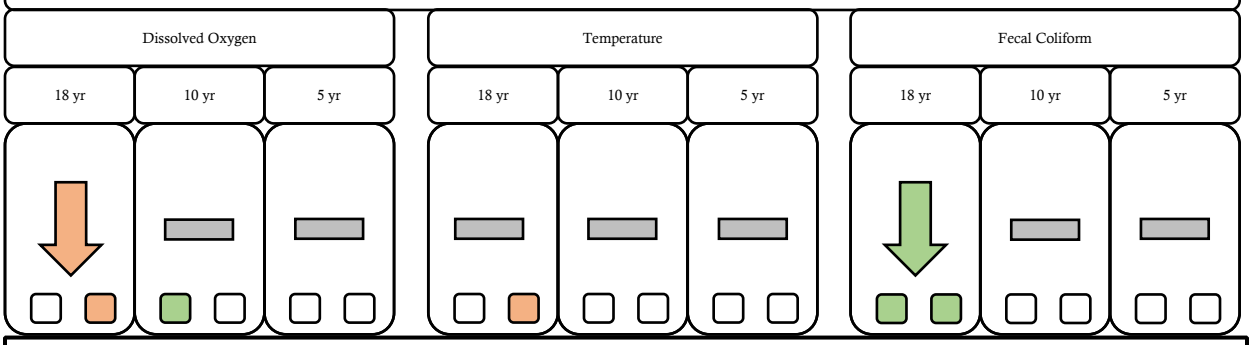
Swede Creek
@ Grip Road

Downstream Ag

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
34	58	48	72	76	90	71	83	77	75	61	75	81	59	75	82

Long Term Trends

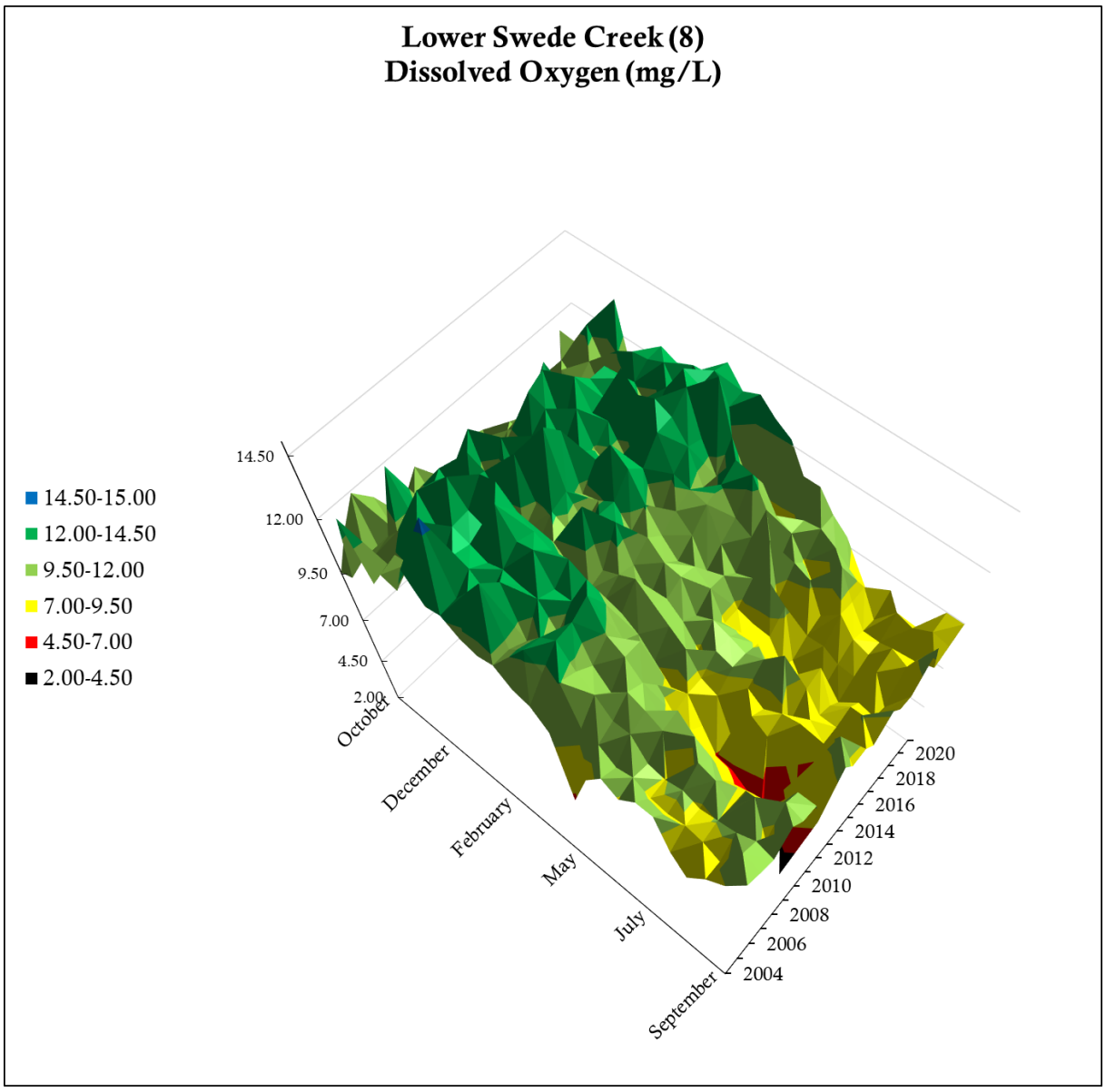


Site 8 is Swede Creek and sits just prior to the creek joining the Samish River. Swede Creek has been a focus of pollution monitoring efforts in the Samish basin, with rural residential and agricultural sources in the watershed. The site is designated as core salmonid habitat.

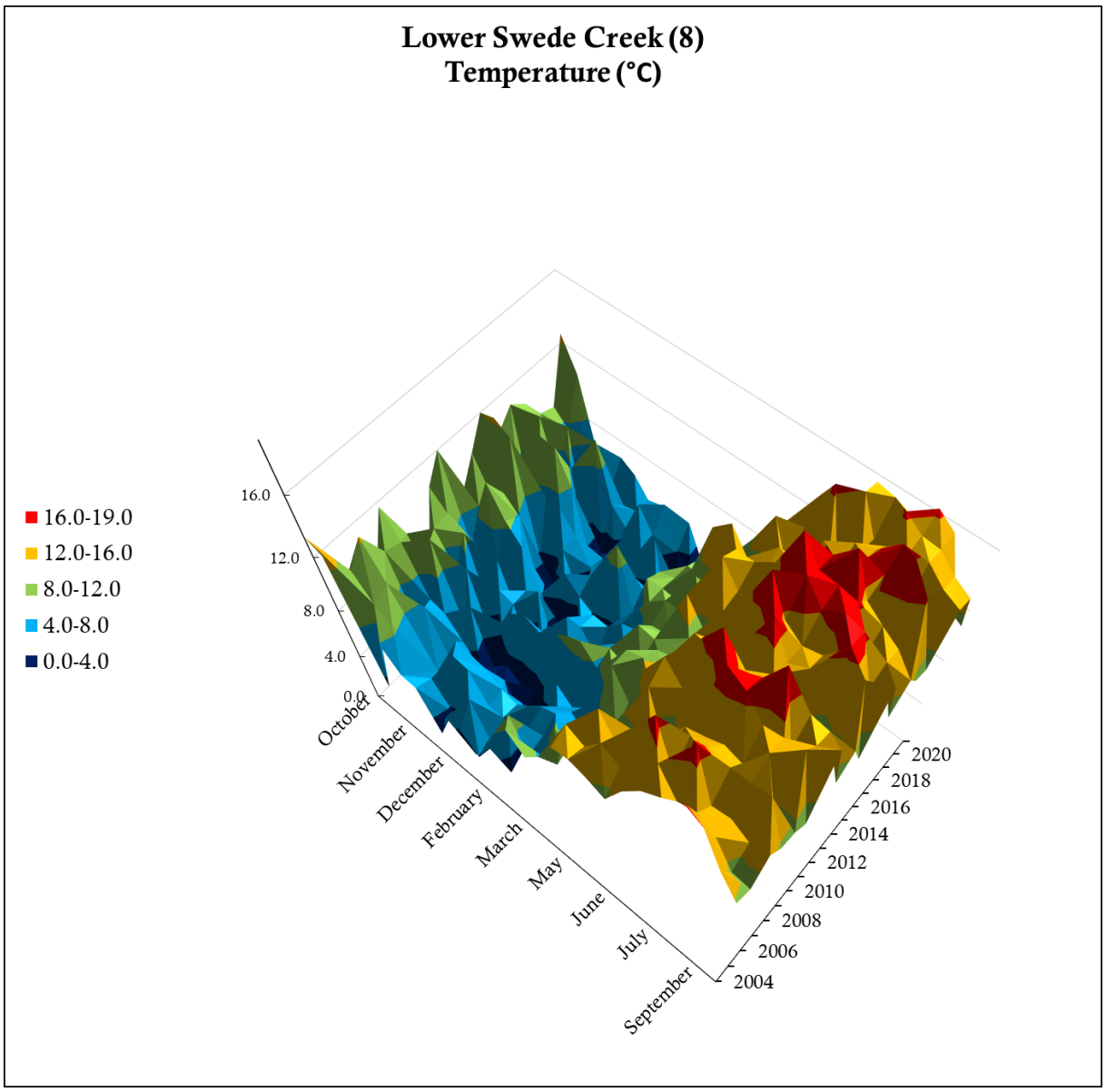
Dissolved oxygen has declined as compared to 18 years ago, but has improved over the last ten. Temperatures are higher than they were 18 years ago. Fecal coliform counts are lower than they were 18 years ago. WQI scores are generally in the higher-scoring end of the moderate concern category, and sometimes score as least concern.

Site 8 fails to meet state DO standards in the warmer months and fails to meet state temperature standards only at the warmest time of year. FC levels for WY2021 easily passed the 100 FC standard but did not pass the 90th percentile requirement. Standards for EC were met.

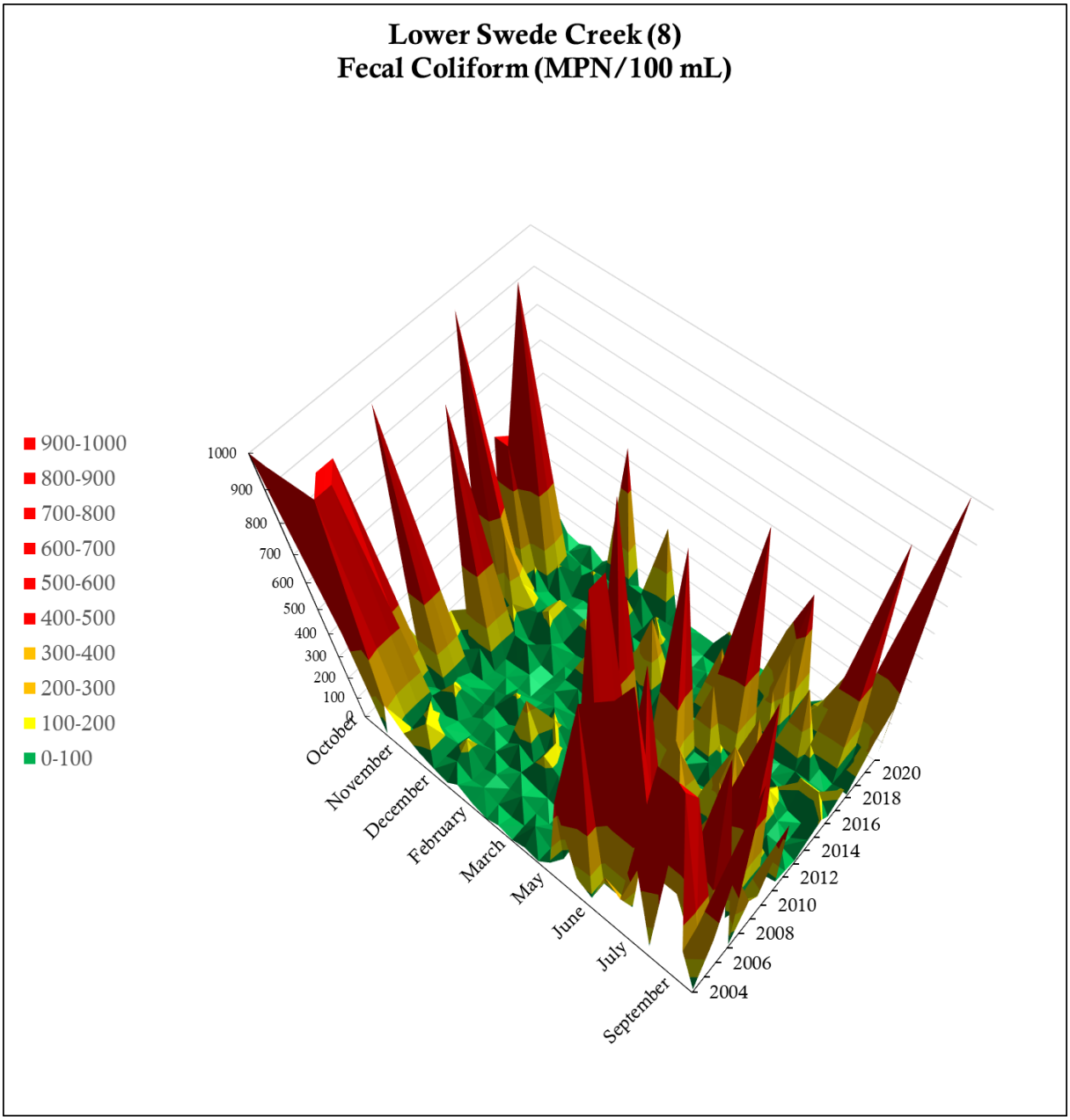
Site 8 is tied for 11th out of 39 sites for number of significant trends, with 12, and tied for 21st out of 39 sites for positive trends, at 58%.



The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

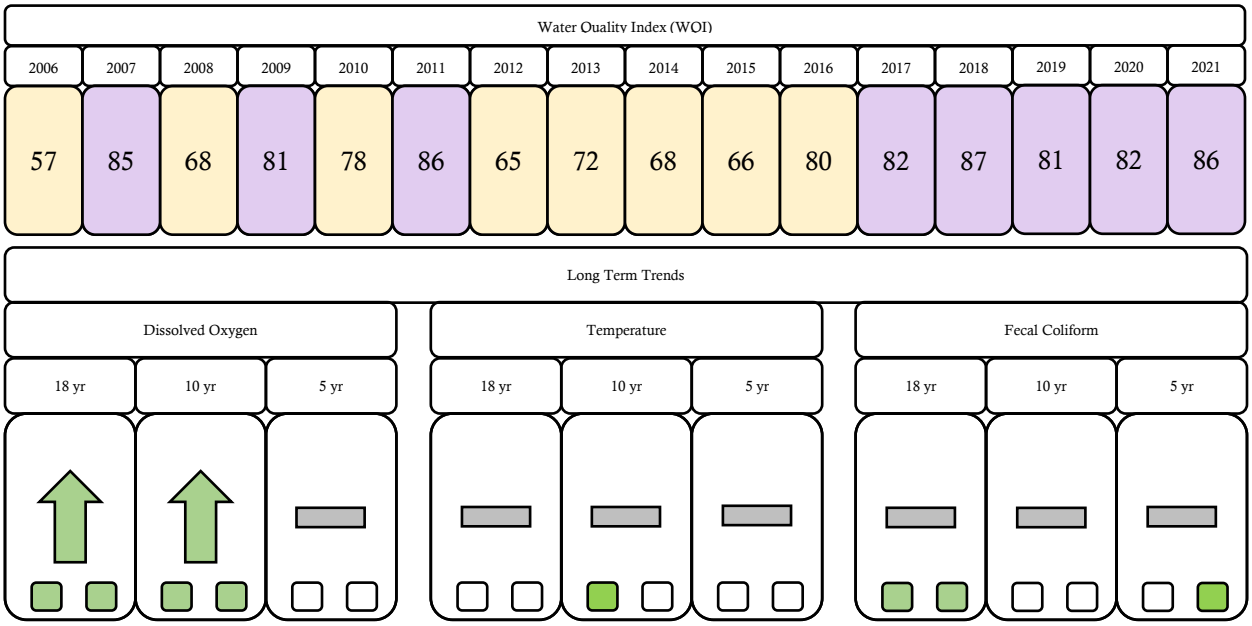


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

11

Samish River
@ Highway 9

Upstream Ag

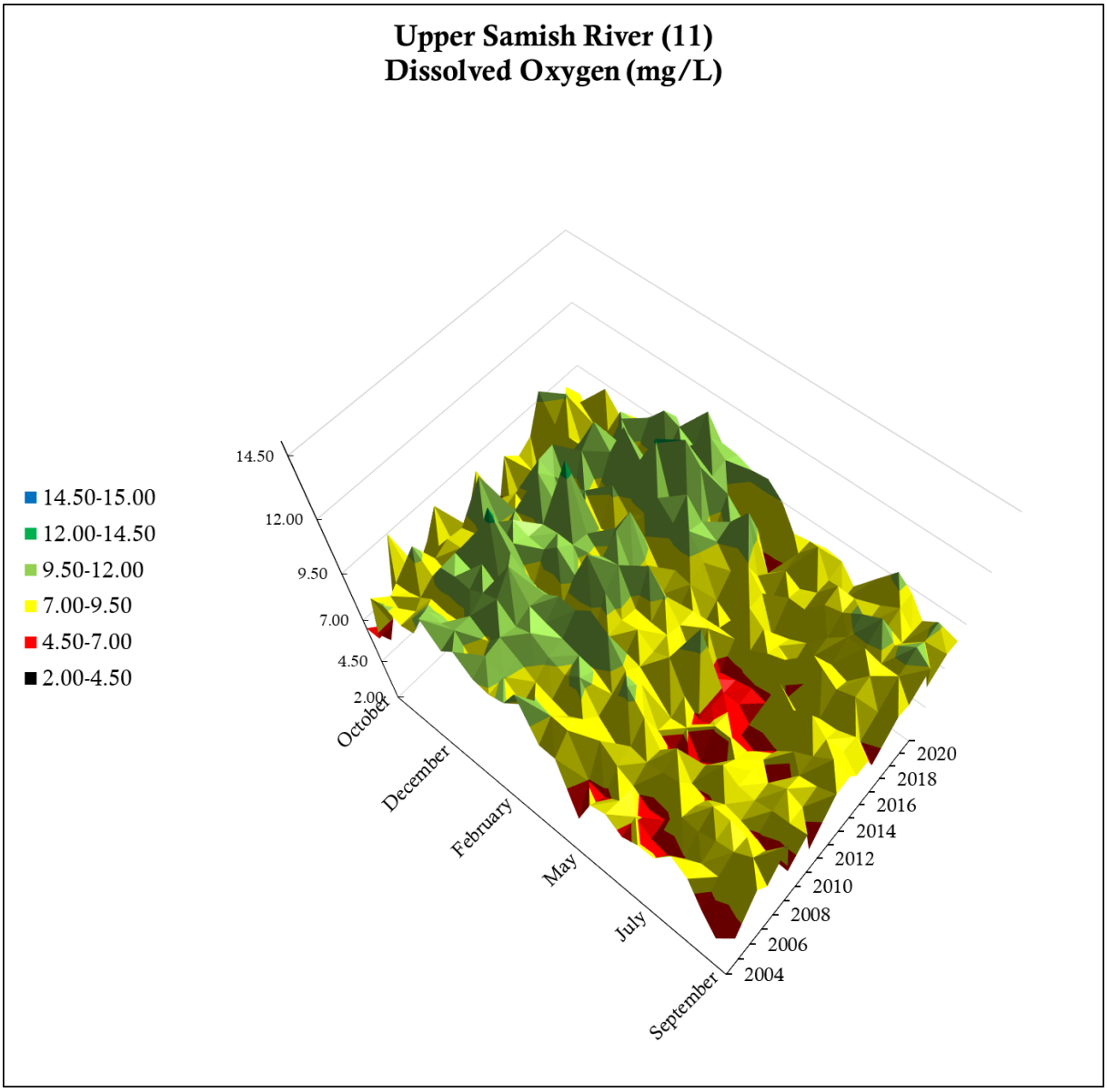


Site 11 is the Samish River, upstream of all other Samish River sampling sites. This site shows the condition of the Samish River prior to all monitored tributaries. This site is designated as core salmonid habitat.

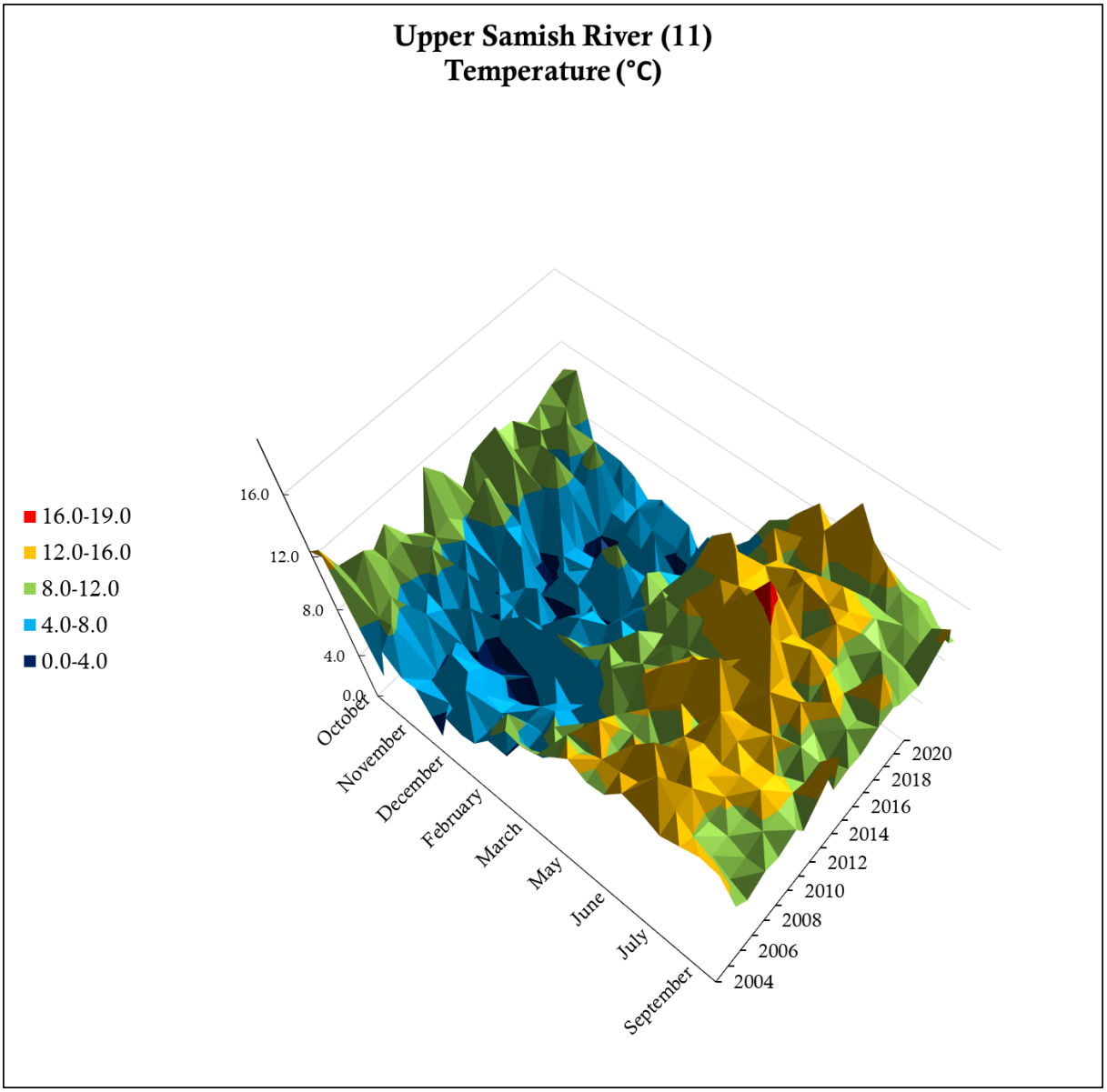
Dissolved oxygen has significantly increased over the 18 and ten year time periods. Fecal coliform counts are lower than they were 18 and five years ago. WQI scores are generally in the higher-scoring end of the moderate concern category, and often score as least concern.

Site 11 regularly fails to meet state standards for DO, but easily passes state standards for temperature, year-round. Annual bacterial levels easily meet state standards.

Site 11 is tied for 18th out of 39 sites for number of significant trends, with 10, and tied for 1st out of 39 sites for positive trends, with 100%.

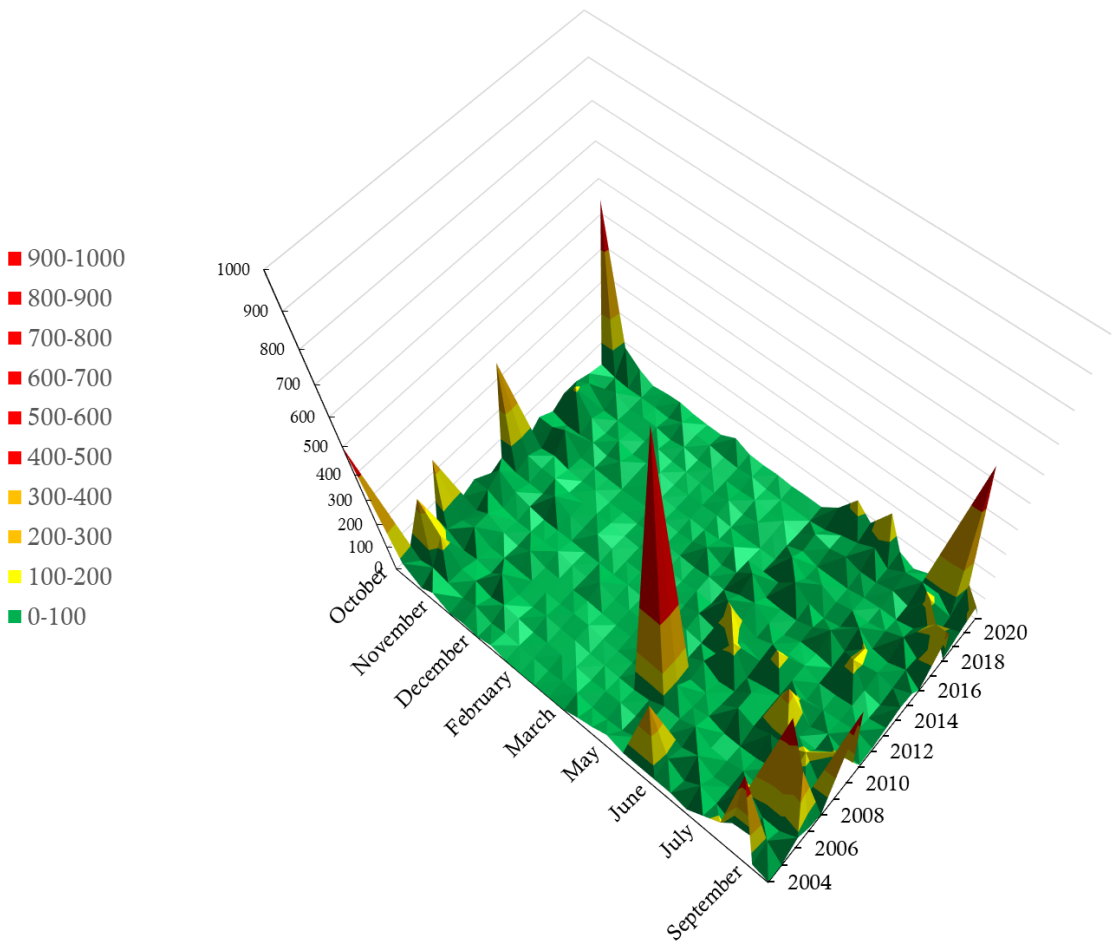


The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in



The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

Upper Samish River (11)
Fecal Coliform (MPN/100 mL)

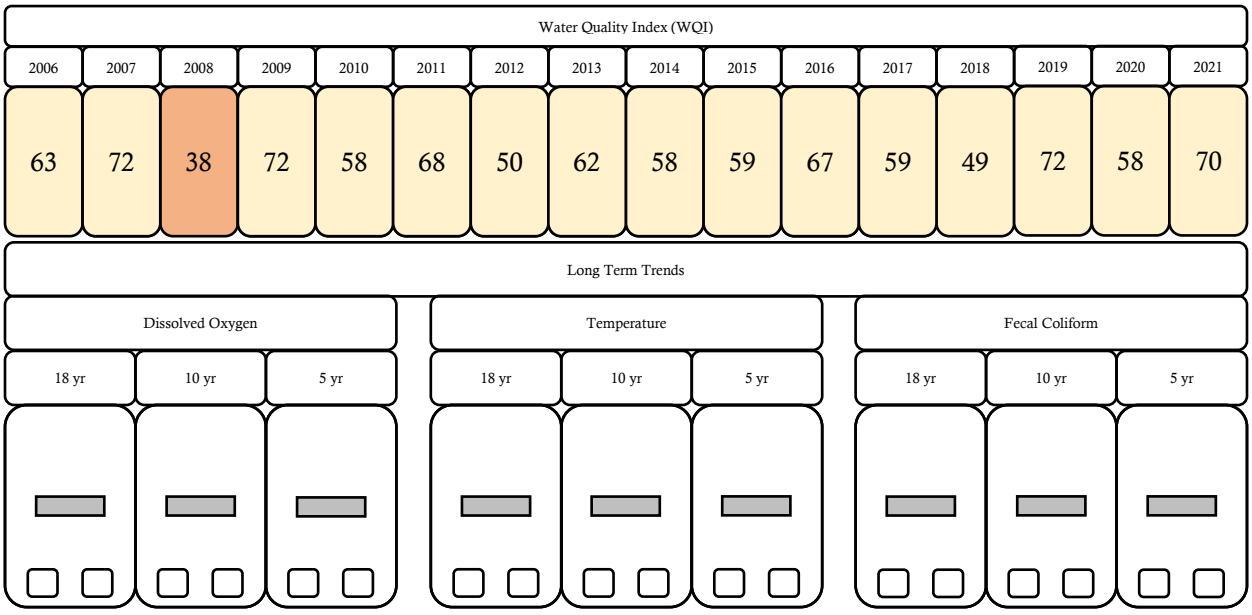


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

12

Nookachamps Creek
@ Swan Road

Downstream Ag, TMDL

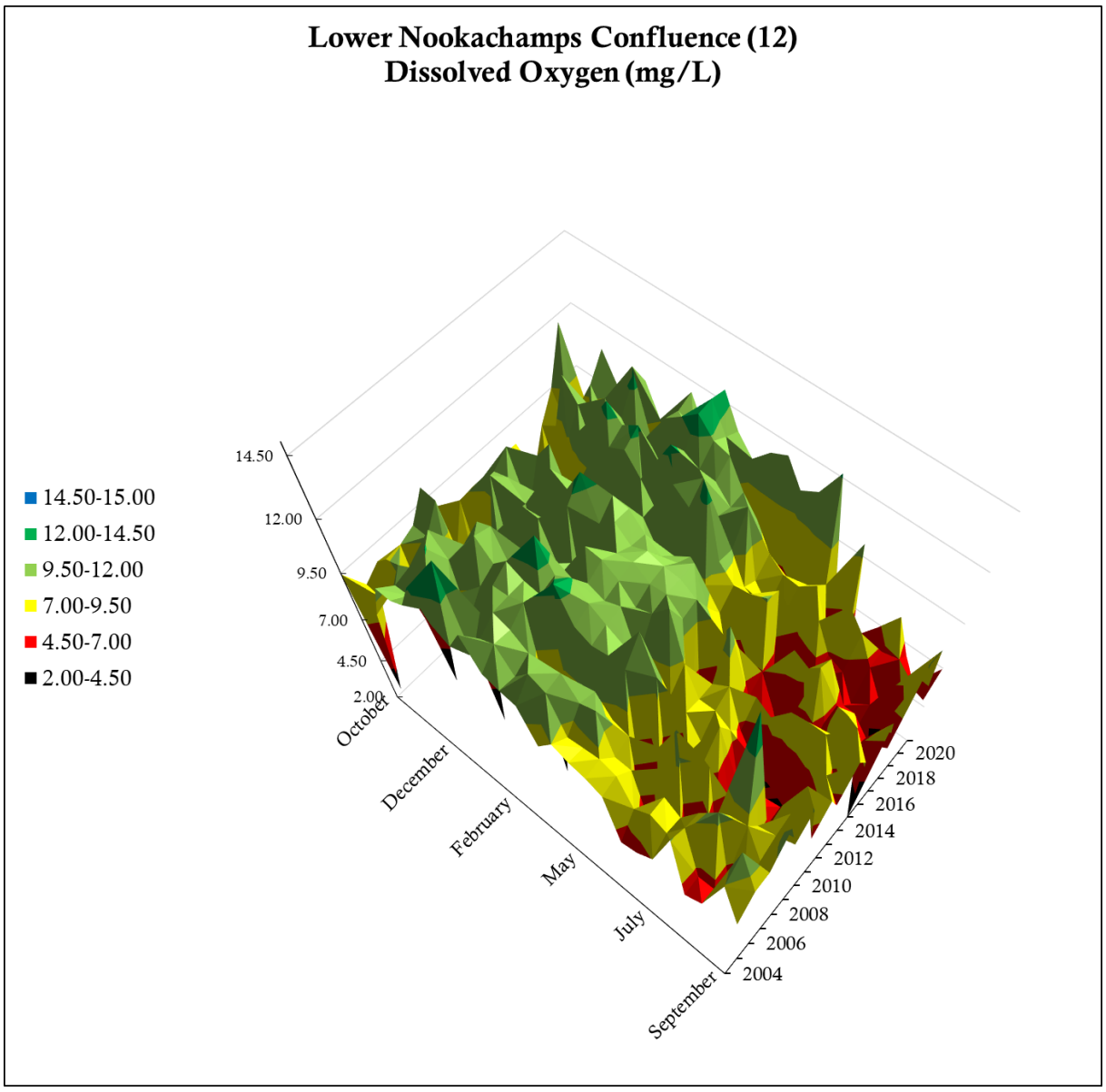


Site 12 is Nookachamps Creek and is the furthest downstream site of the creek in this program, located just prior to joining the Skagit River. This creek drains a large valley of rural residential and agriculturally zoned areas. This site is designated as core salmonid habitat.

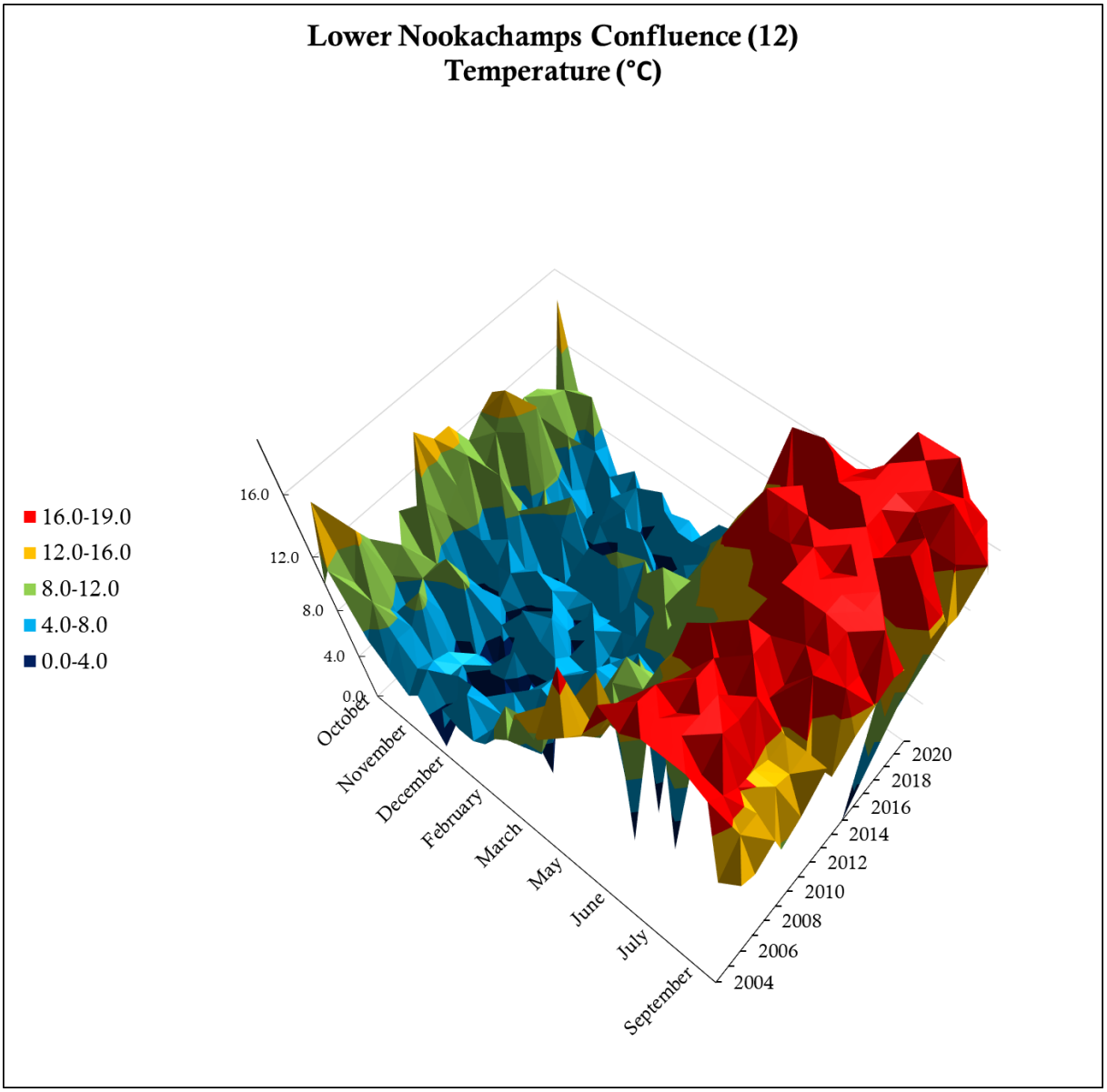
There have been no significant changes in dissolved oxygen, temperature, or FC during any of the observed time periods. WQI scores are regularly in the category of moderate concern.

Site 12 regularly fails to meet state standards for DO and temperature during the warmer months. Annual FC levels for WY2021 easily passed the 100 FC standard but did not pass the 90th percentile requirement. EC levels passed state standards.

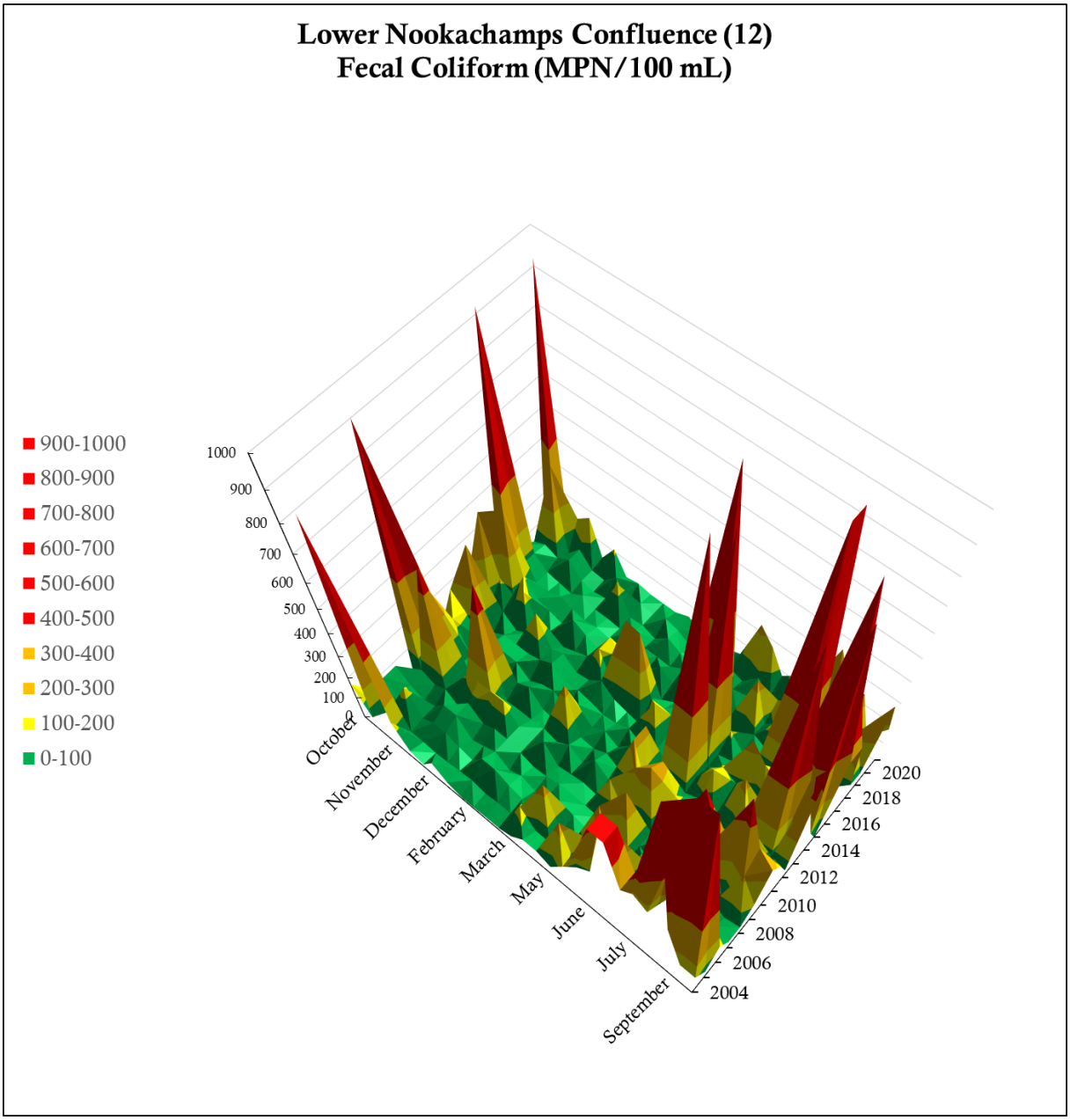
Site 12 is tied for 35th out of 39 sites for number of significant trends, with 6, and is 6th out of 39 sites for positive trends, with 83%.



The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in



The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

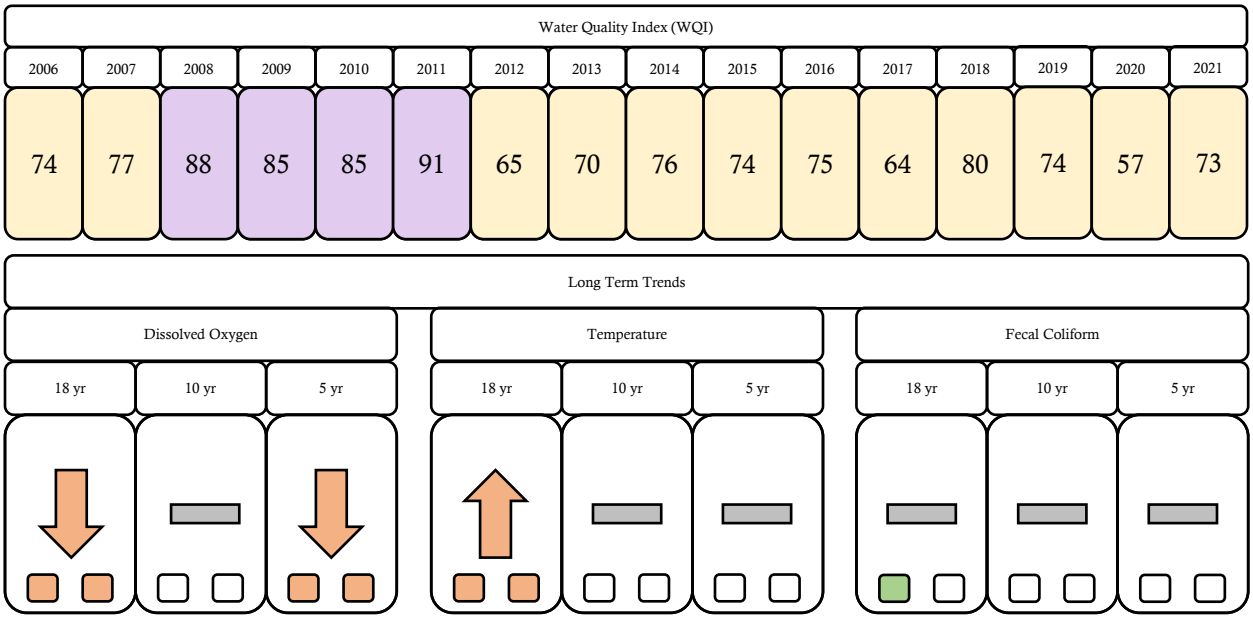


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

13

EF Nookachamps Creek
@ Highway 9

Downstream Ag, TMDL

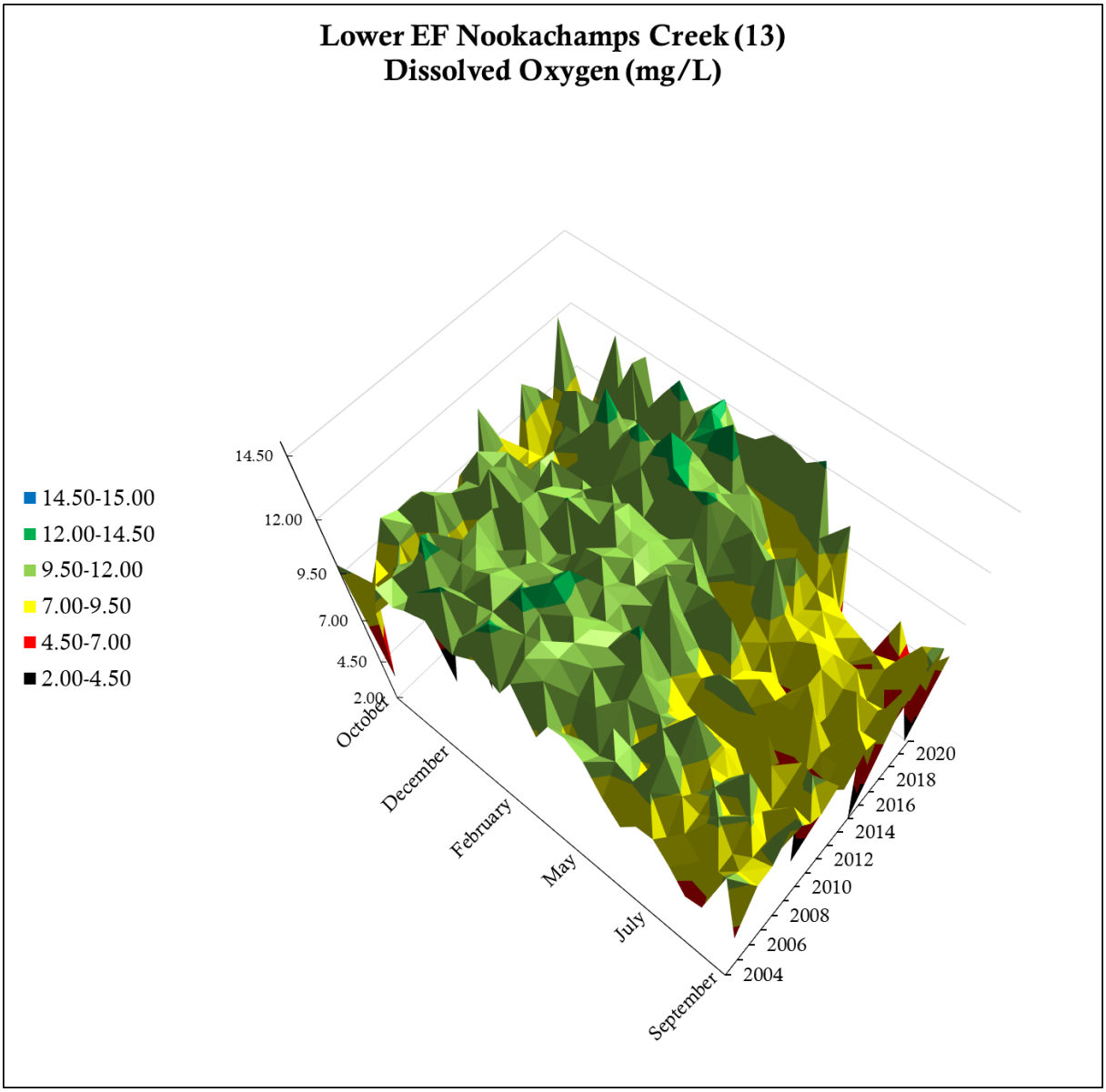


Site 13 is East Fork Nookachamps Creek, downstream of site 16, and sitting just prior to joining Nookachamps Creek and ultimately the Skagit River. It sits downstream of a stretch of agricultural activity. This site is designated as char spawning and rearing status.

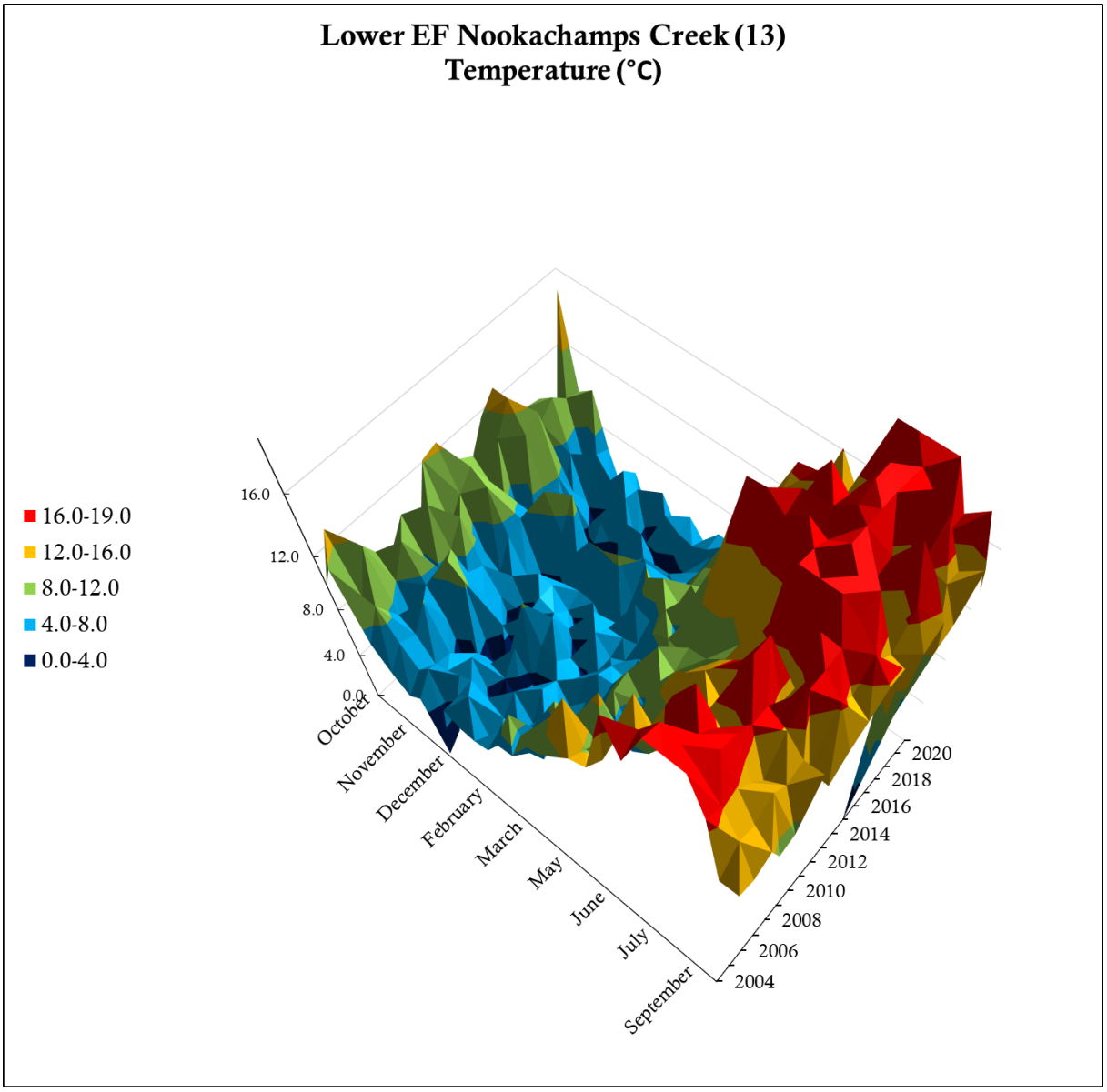
Dissolved oxygen has declined since 18 and 5 years ago. Temperature is higher than it was 18 years ago. WQI scores are generally in the higher-scoring end of the moderate concern category, and sometimes score as least concern.

Site 13 regularly fails to meet state standards for DO and temperature during the warmer months. Annual fecal coliform levels for WY2021 easily passed the 100 FC and EC standards, but did not pass the 90th percentile requirement for either metric.

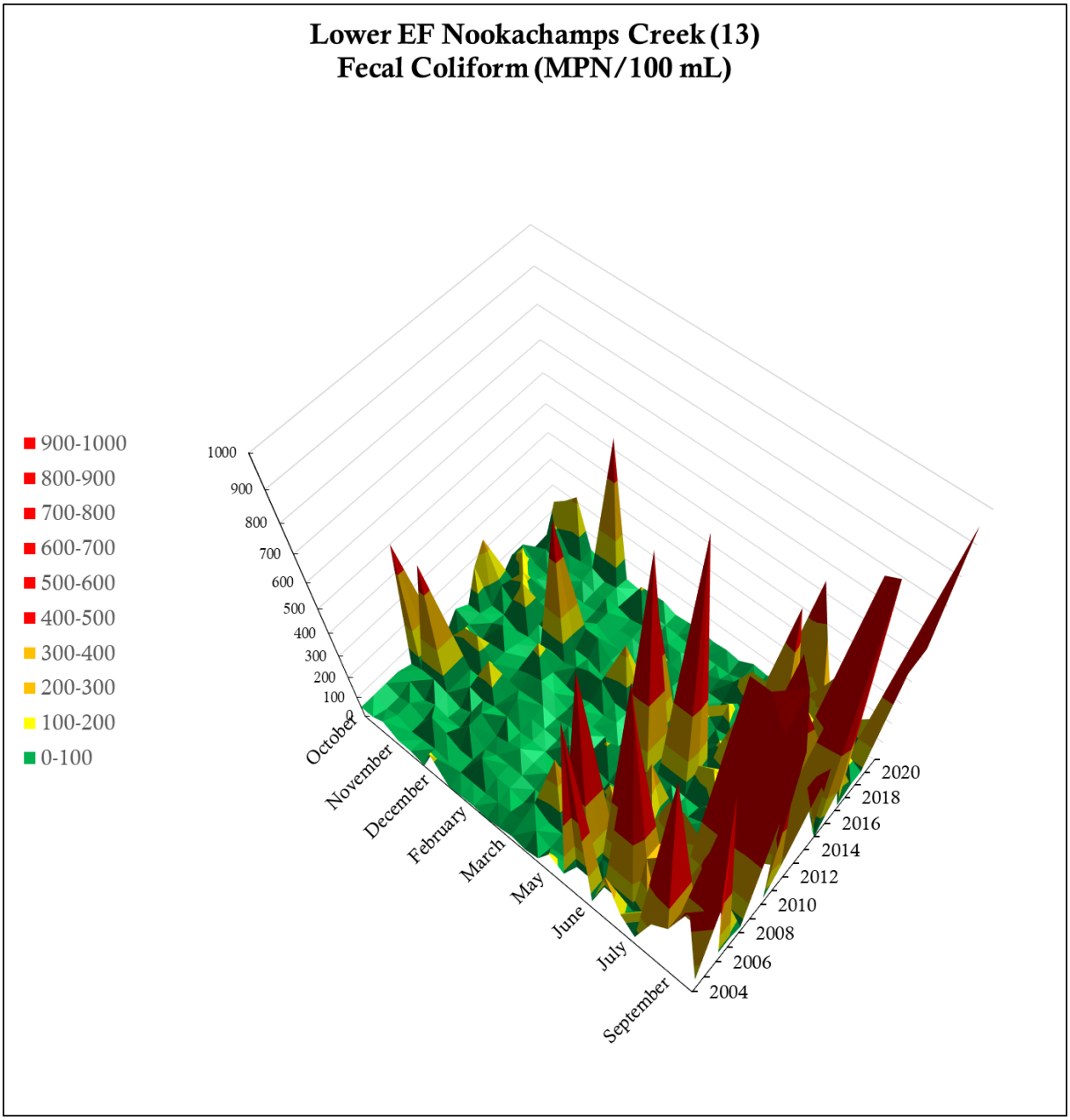
Site 13 is tied for 14th out of 39 sites for number of significant trends, with 11, and 32nd out of 39 sites for positive trends, with 27%.



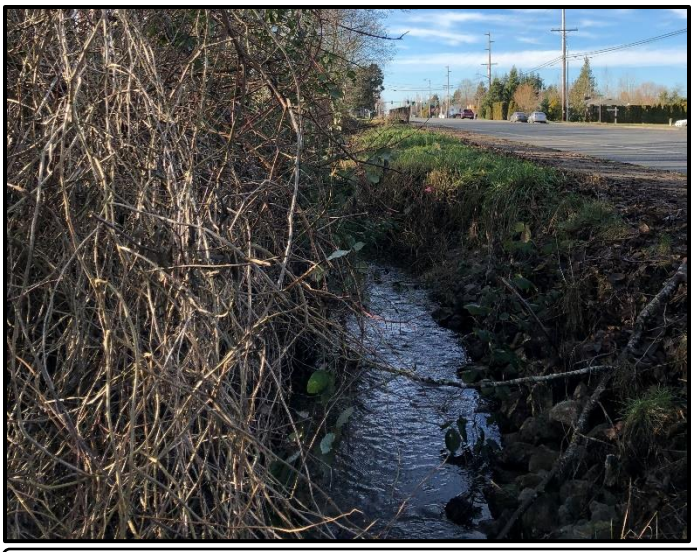
The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.



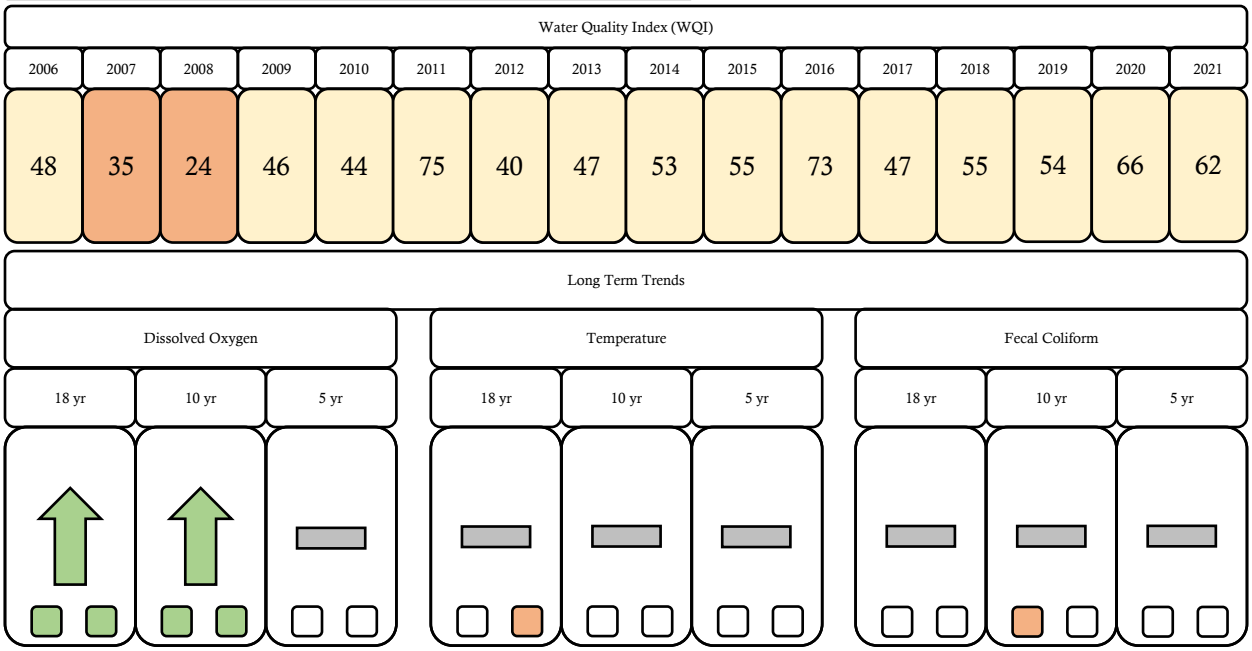
The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



14

College Way Creek
@ College Way

Reference – Urban/suburban

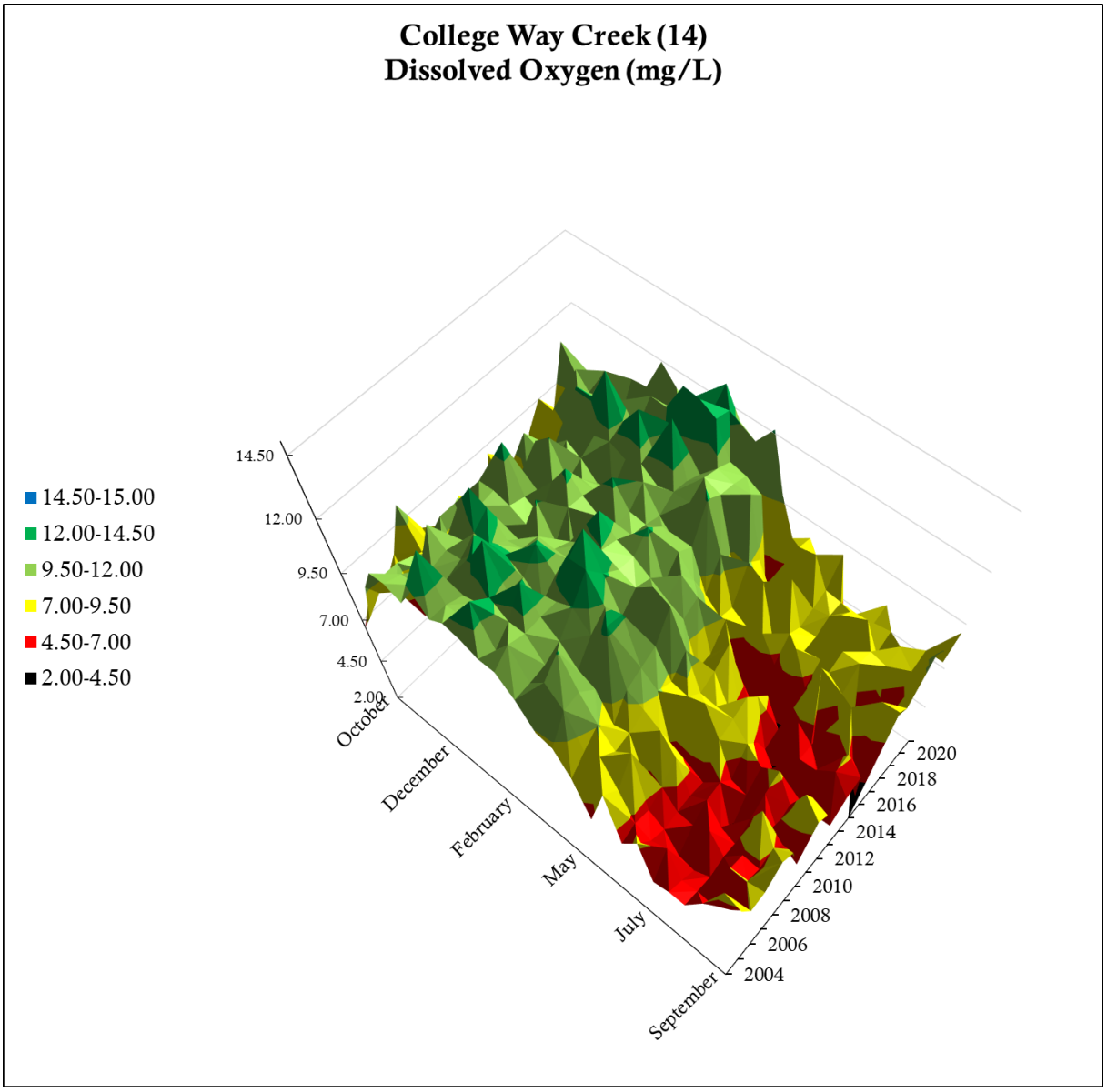


Site 14 is College Way Creek. This creek drains an urban/suburban area of northeast Mount Vernon, and terminates into Nookachamps Creek just prior to Barney Lake, and eventually into the Skagit River. This site is designated as core salmonid habitat.

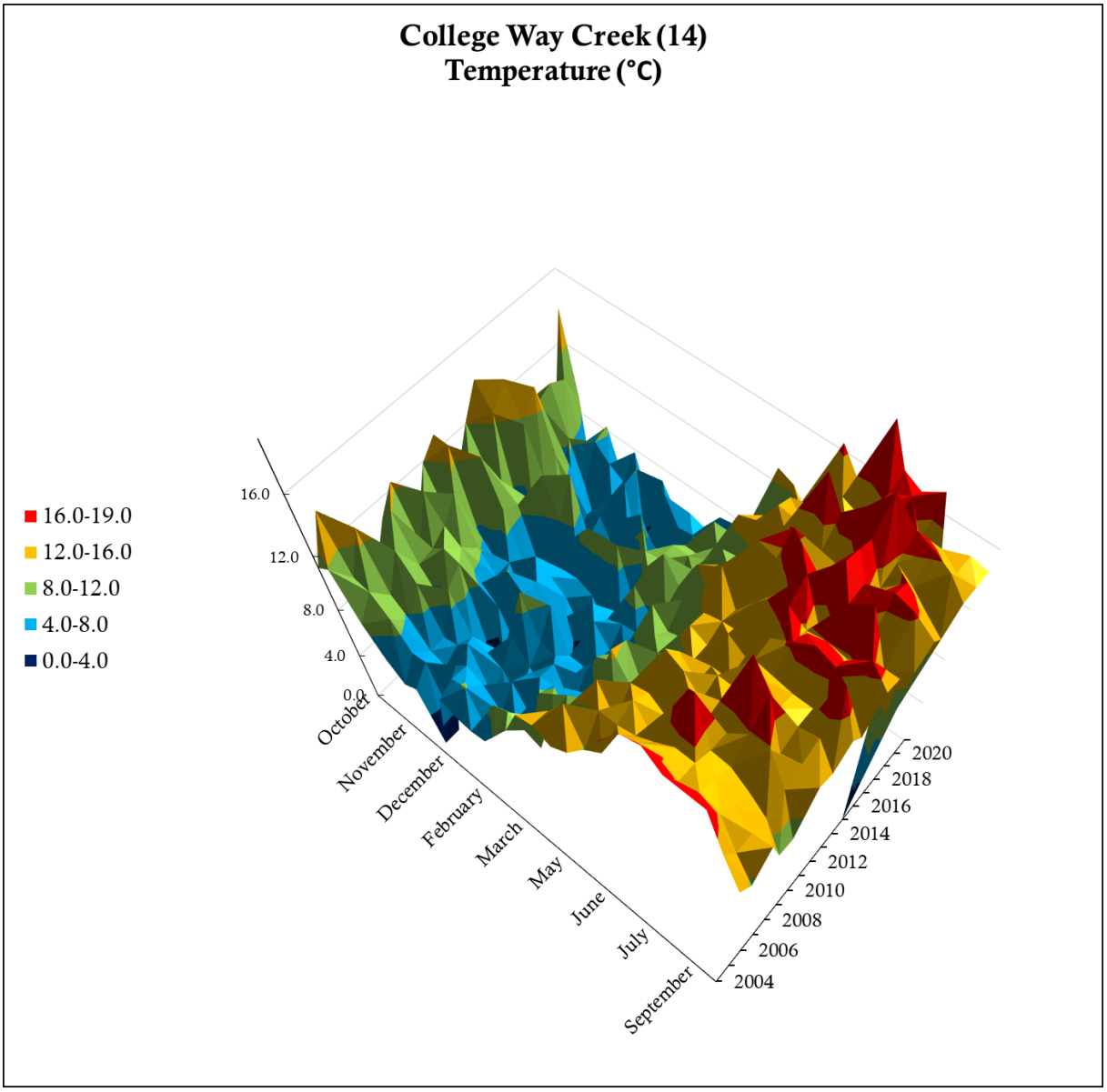
Dissolved oxygen has significantly increased over the 18- and 10-year time periods. WQI scores are regularly in the category of moderate concern.

Site 14 regularly fails to meet state standards for DO during the warmer months, and often fails to meet state standards for temperature during the hottest time of the year. Annual bacterial levels consistently and exceedingly fail to meet state standards.

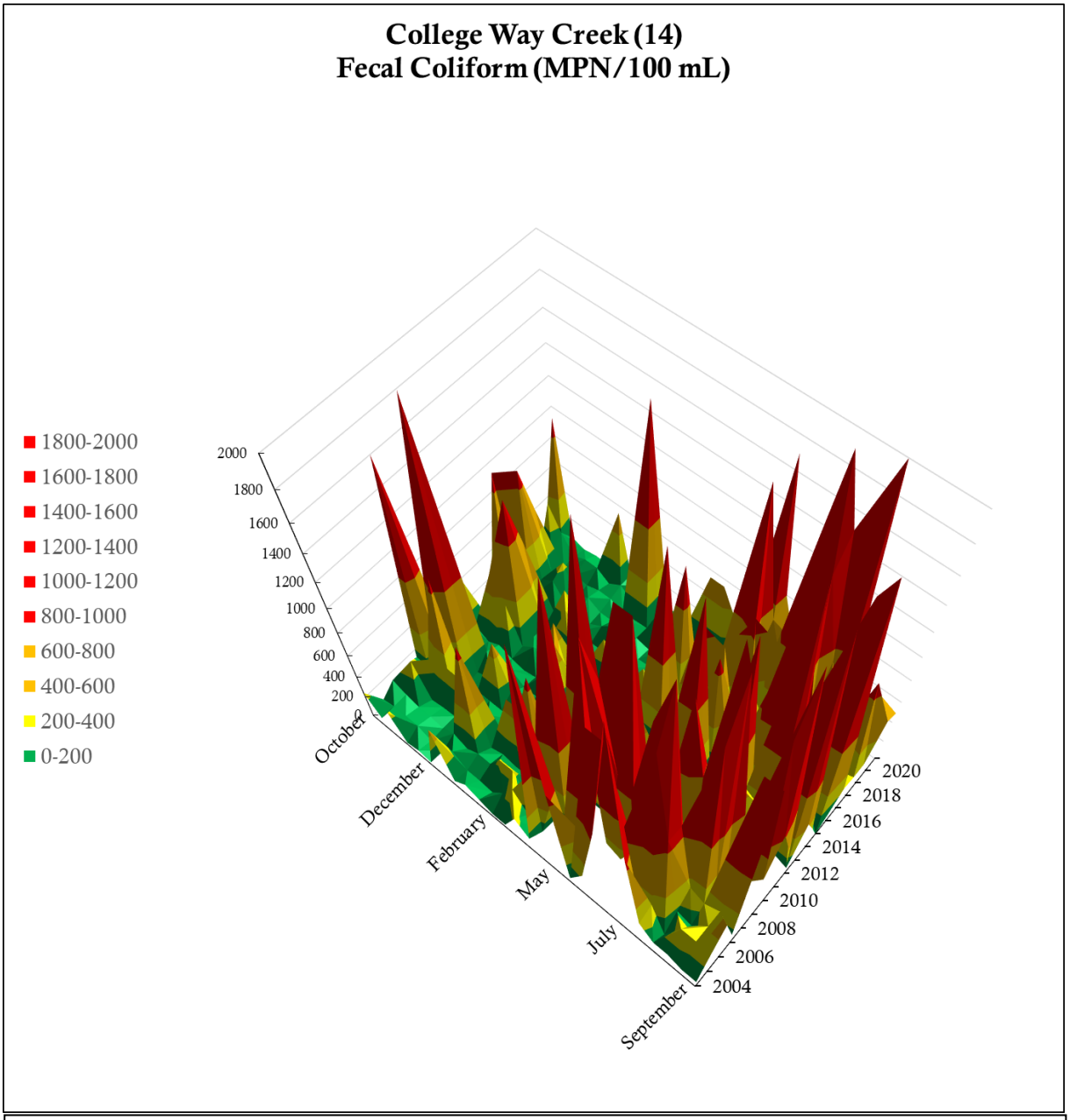
Site 14 is tied for 14th out of 39 sites for number of significant trends, with 11, and is 10th out of 39 sites for positive trends, with 73%.



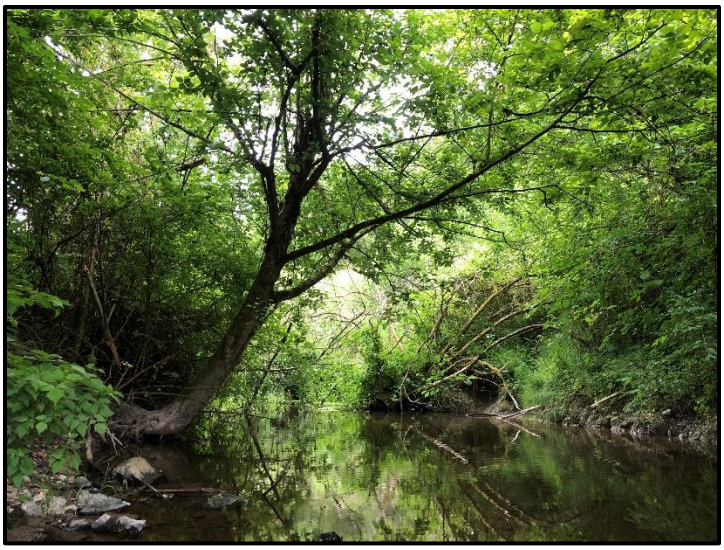
The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.



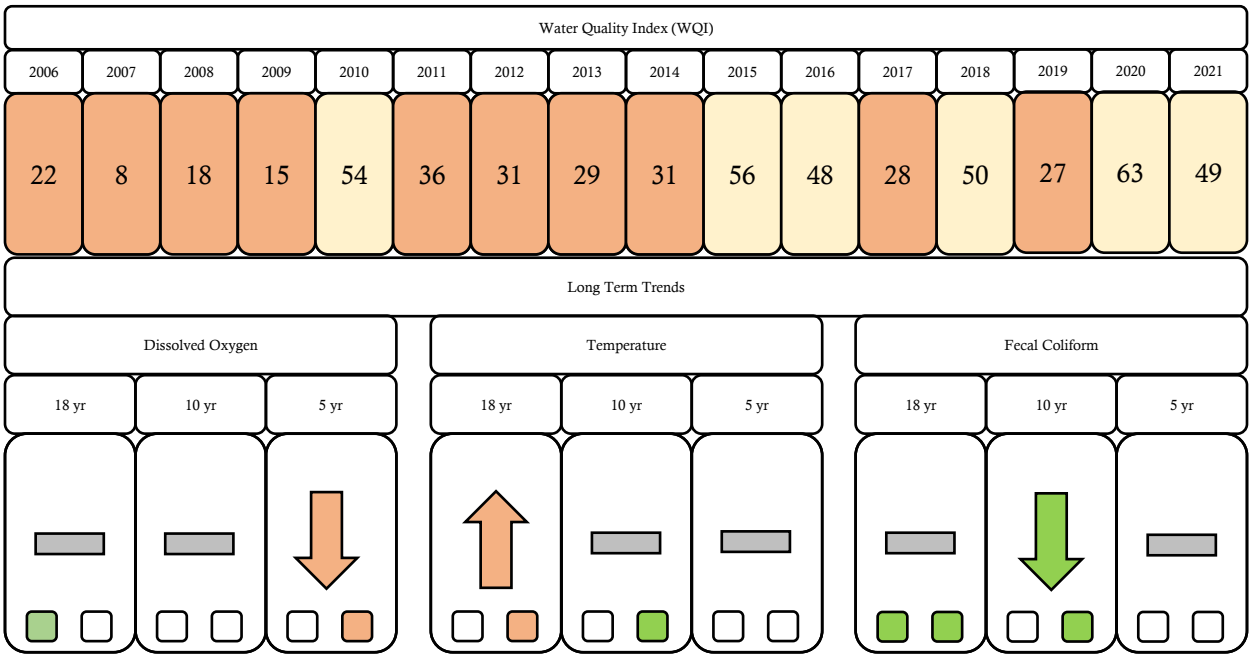
The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green almost meets that standard. The water year on the x-axis begins in October and ends in September.



15

Nookachamps Creek
@ Knapp Road

Midstream Ag, TMDL



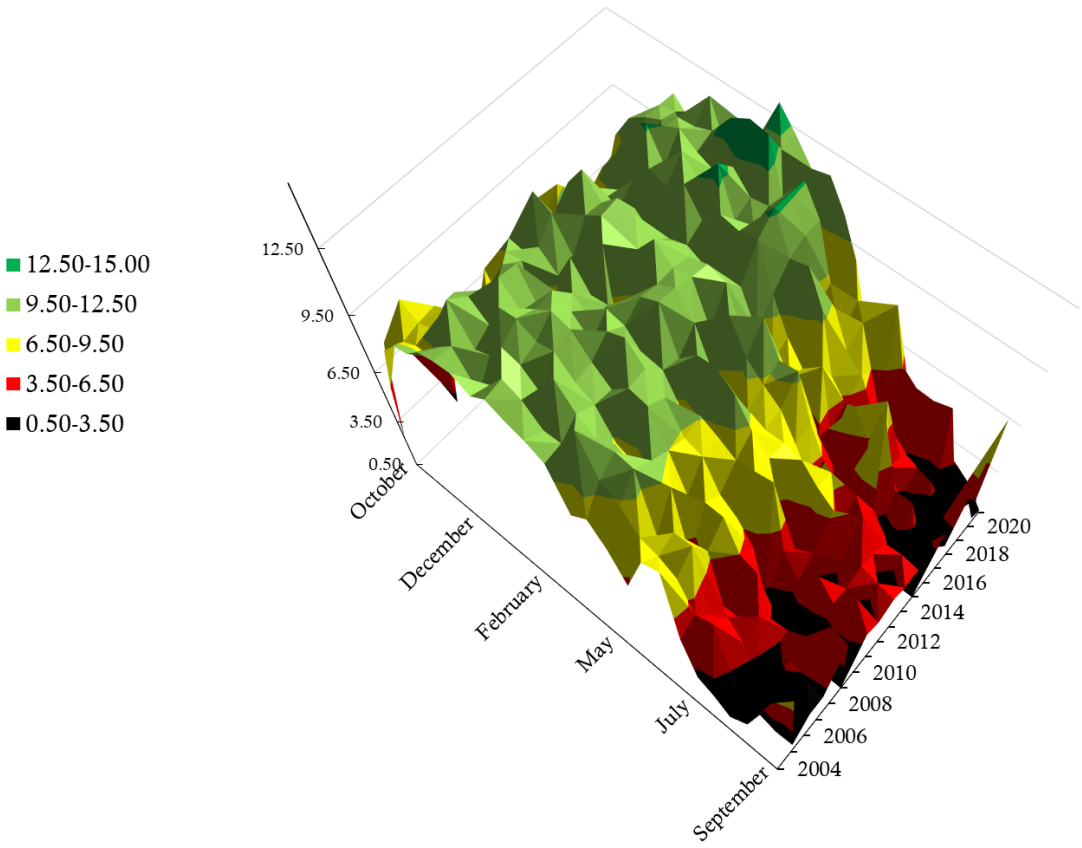
Site 15 is Nookachamps Creek mid-stream, upstream from site 12, and downstream from Big Lake and site 17. This site is designated as core salmonid habitat.

Dissolved oxygen is higher than it was 17 years ago, but it has a negative trend in the last 5 years. Water temperature is higher than it was at the beginning of this study, but lower than it was 10 years ago. Fecal coliform counts are lower now than they were ten years ago. WQI scores are consistently in the category of highest concern, but they are improving since the beginning of this study.

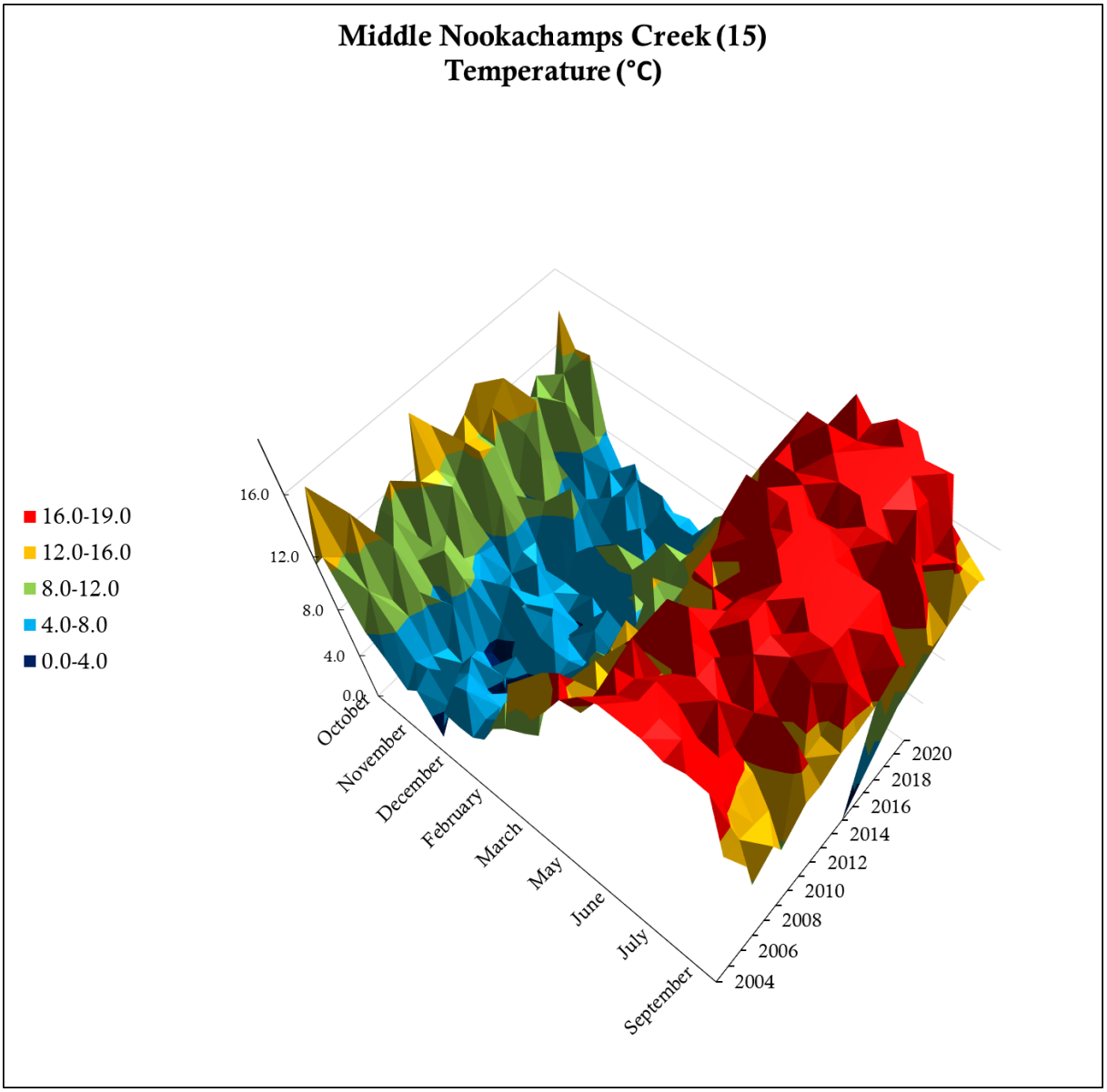
Site 15 regularly fails to meet state standards for DO and temperature during the warmer months. Annual FC levels for WY2021 easily passed the 100 MPN state standard, but failed the 90th percentile. Both standards for EC were met.

Site 15 is tied for 18th out of 39 sites for number of significant trends, with 10, and is tied for 19th of 39 sites for positive trends, with 60%.

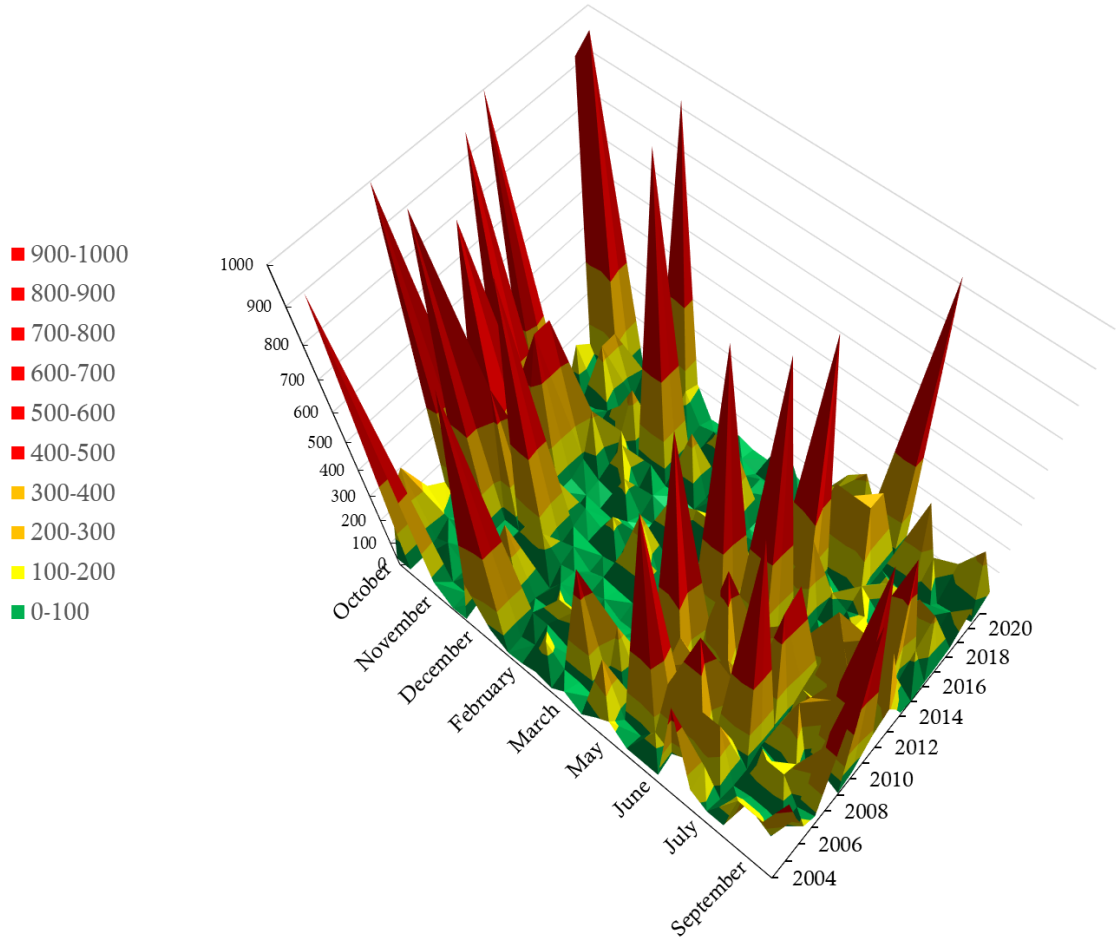
Middle Nookachamps Creek (15)
Dissolved Oxygen (mg/L)



The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

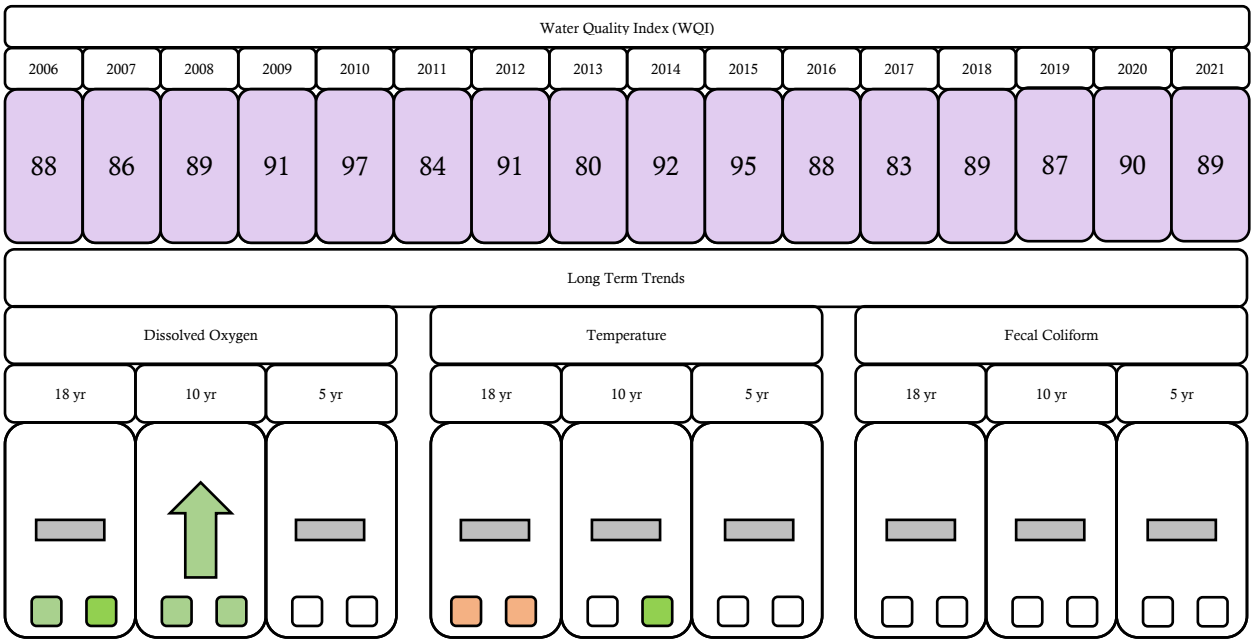


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

16

EF Nookachamps Creek
@ Beaver Lake Road

Midstream Ag, TMDL

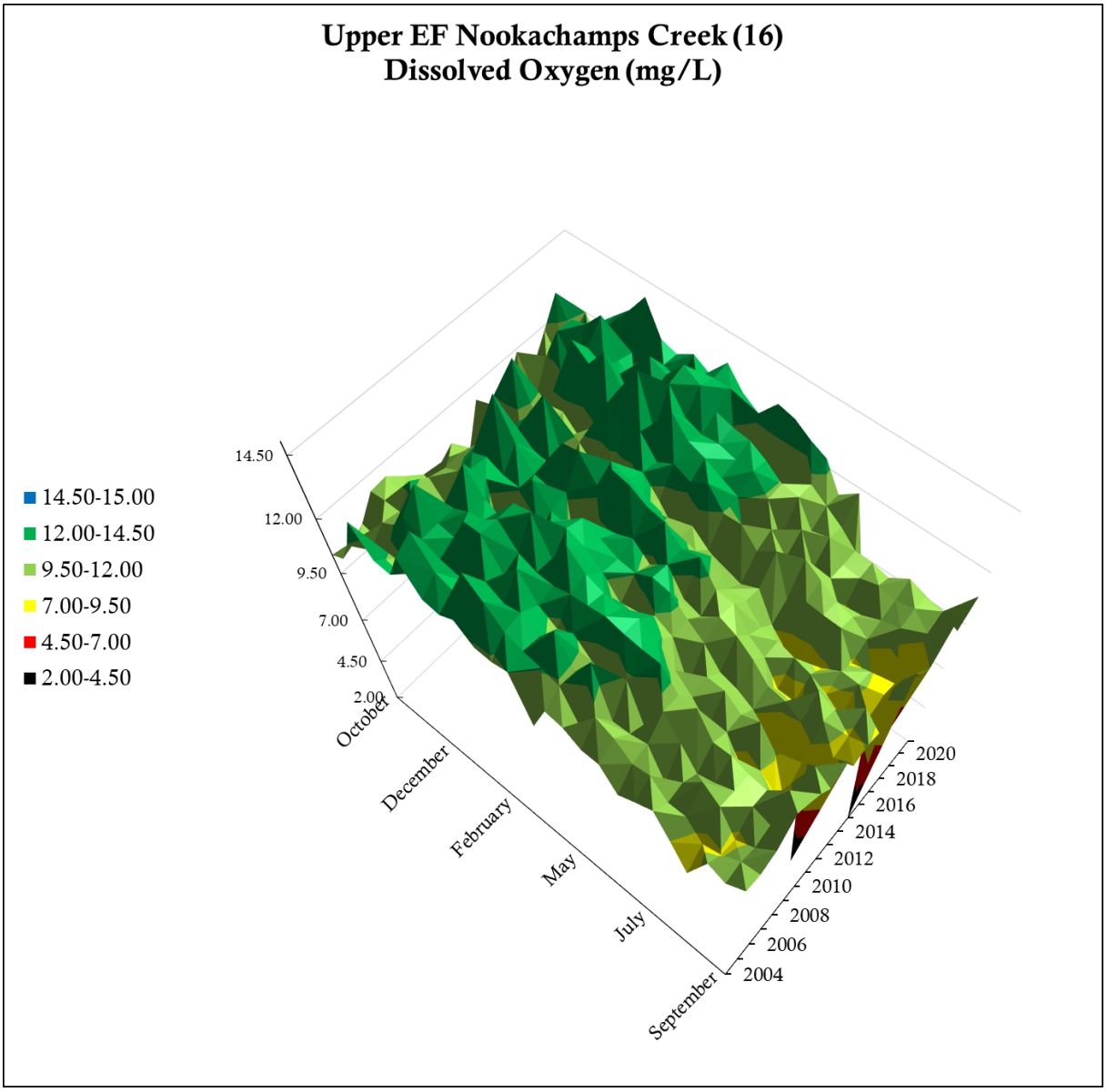


Site 16 is East Fork Nookachamps Creek, upstream of site 13, and immediately after adjoining with Cold Spring Creek. This site is influenced by light agricultural uses and undeveloped land. This site is designated as char spawning and rearing status.

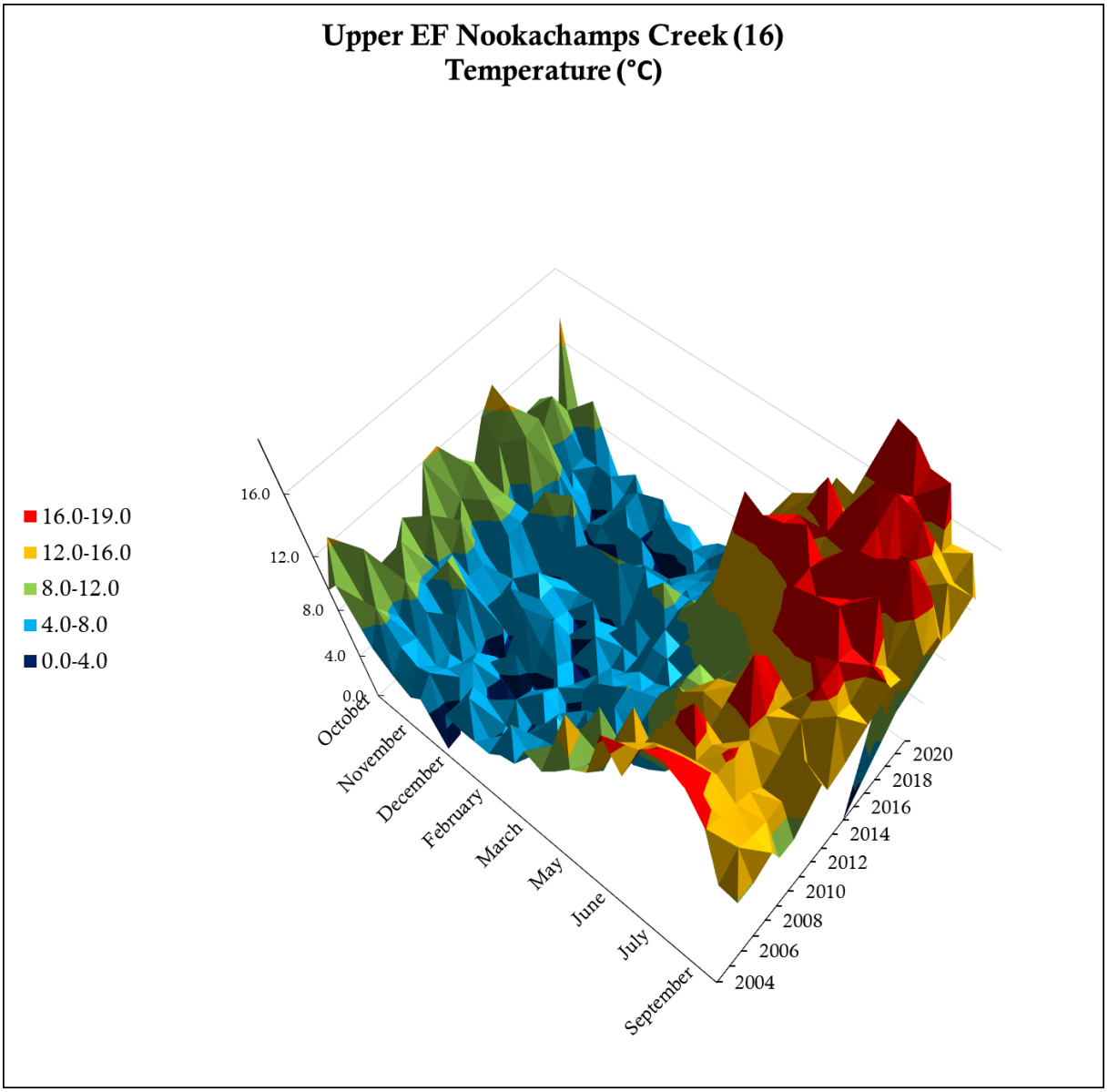
Dissolved oxygen has significantly increased over the last ten years. There were no significant trends in fecal coliform. WQI scores have never been outside of the category of least concern.

Site 16 easily passes state standards for DO, but water temperatures can often exceed state standards during the warmest time of year. Annual bacterial levels meet the 100 MPN state standards, but exceeded 90th percentile standards for both EC and FC in 2021.

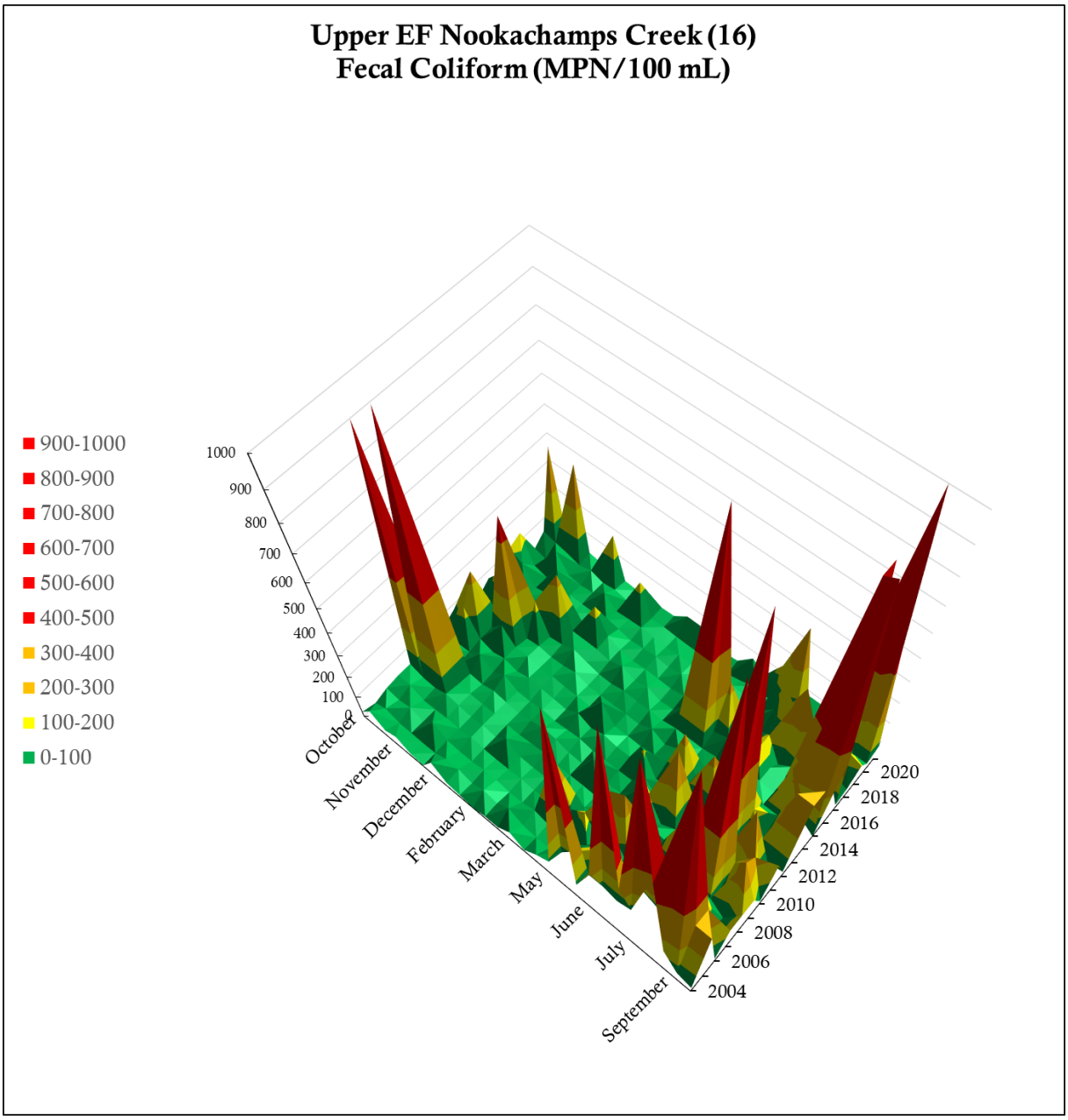
Site 16 is tied for 27th out of 39 sites for number of significant trends, with 8, and is tied for 17th out of 39 sites for positive trends, with 63%.



The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

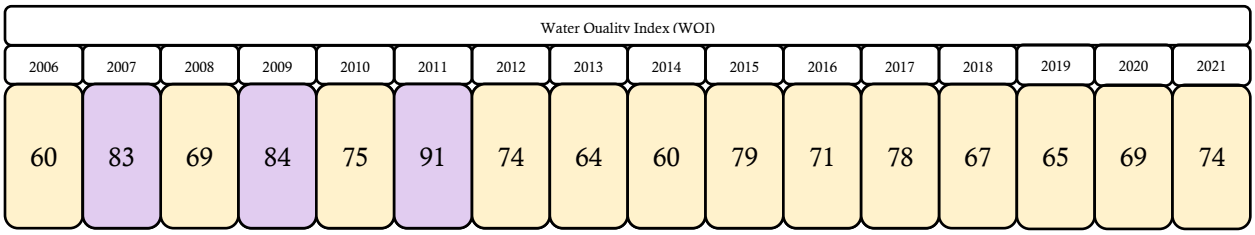


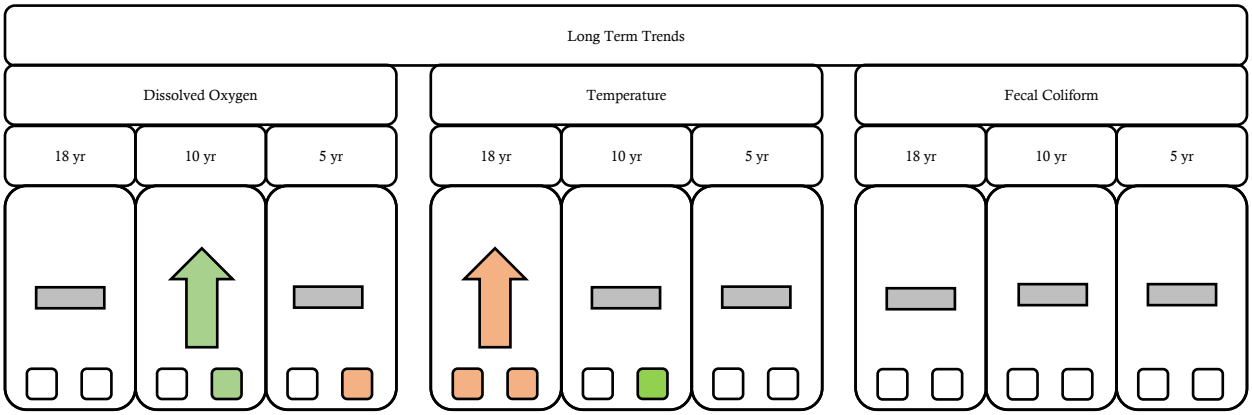
The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

17

Nookachamps Creek
@ Big Lake Outlet

Upstream Ag, TMDL



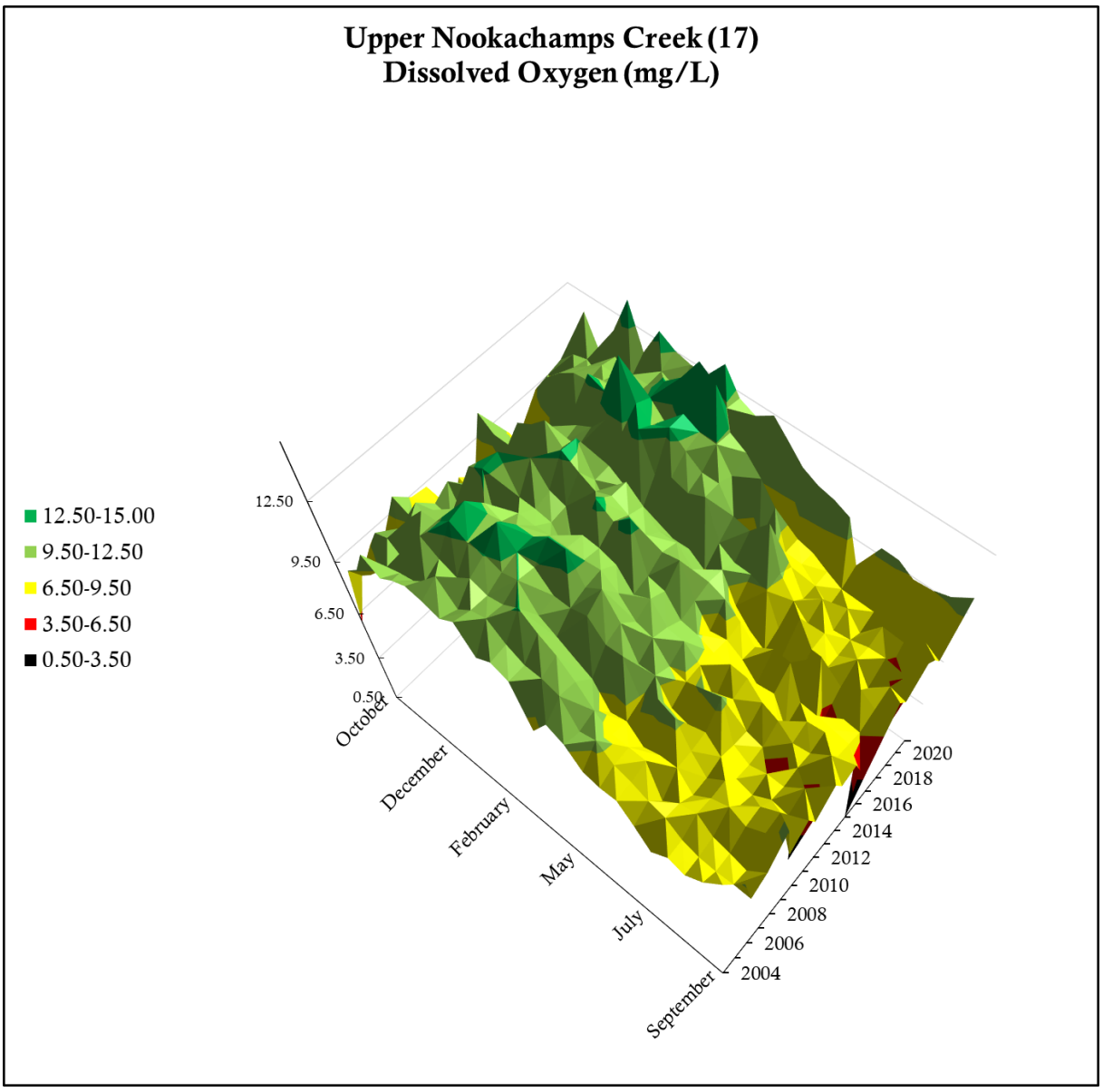


Site 17 is Nookachamps Creek, at its source, immediately after leaving Big Lake. This site is upstream from sties 15 and 12. This site is designated as core salmonid habitat.

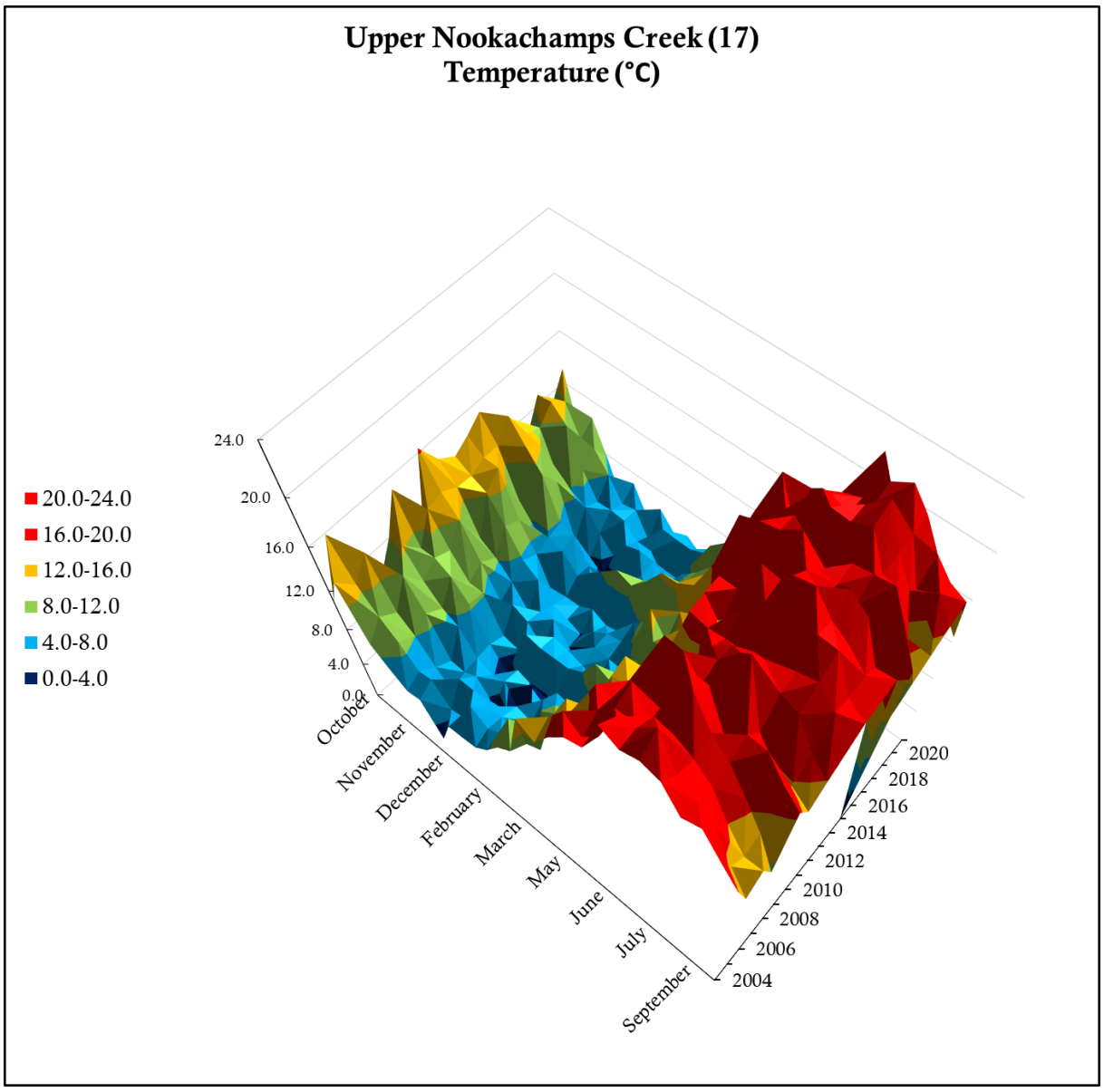
Over the most recent ten years, dissolved oxygen has increased. Water temperature has increased since 18 years ago. WQI scores are generally in the upper end of the moderate concern category, and has scored in the least concern category in the past.

Site 17 regularly fails to meet state standards for DO and temperature during the warmer months. Annual bacterial levels easily meet state standards.

Site 17 is tied for 27th out of 39 sites for number of significant trends, with 8, and is tied for 33rd out of 39 sites for positive trends, with 25%.

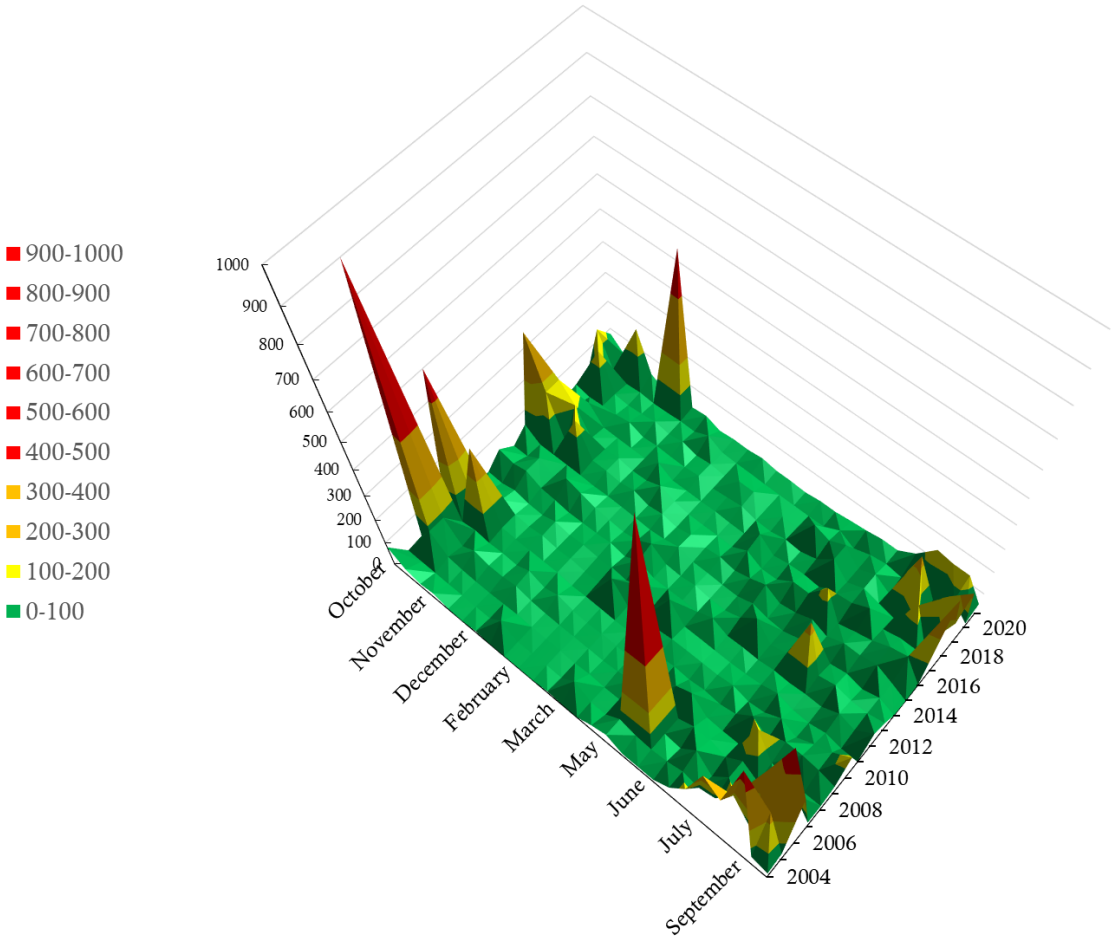


The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

Upper Nookachamps Creek (17)
Fecal Coliform (MPN/100 mL)

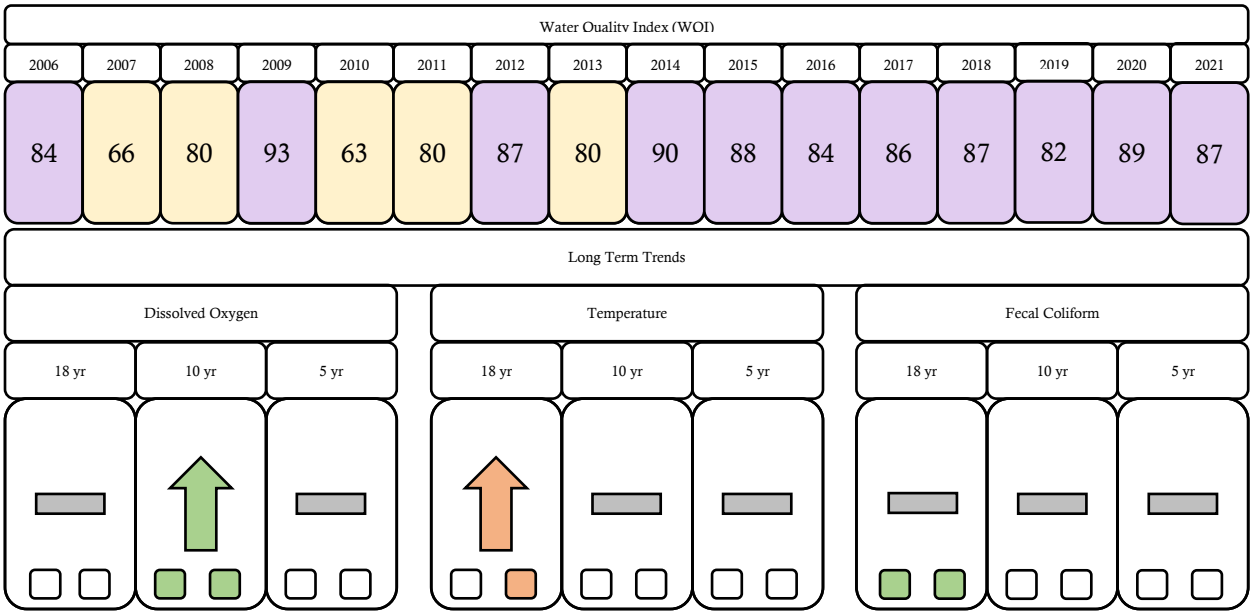


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

18

Lake Creek
@ Big Lake Boulevard

Upstream Ag, TMDL

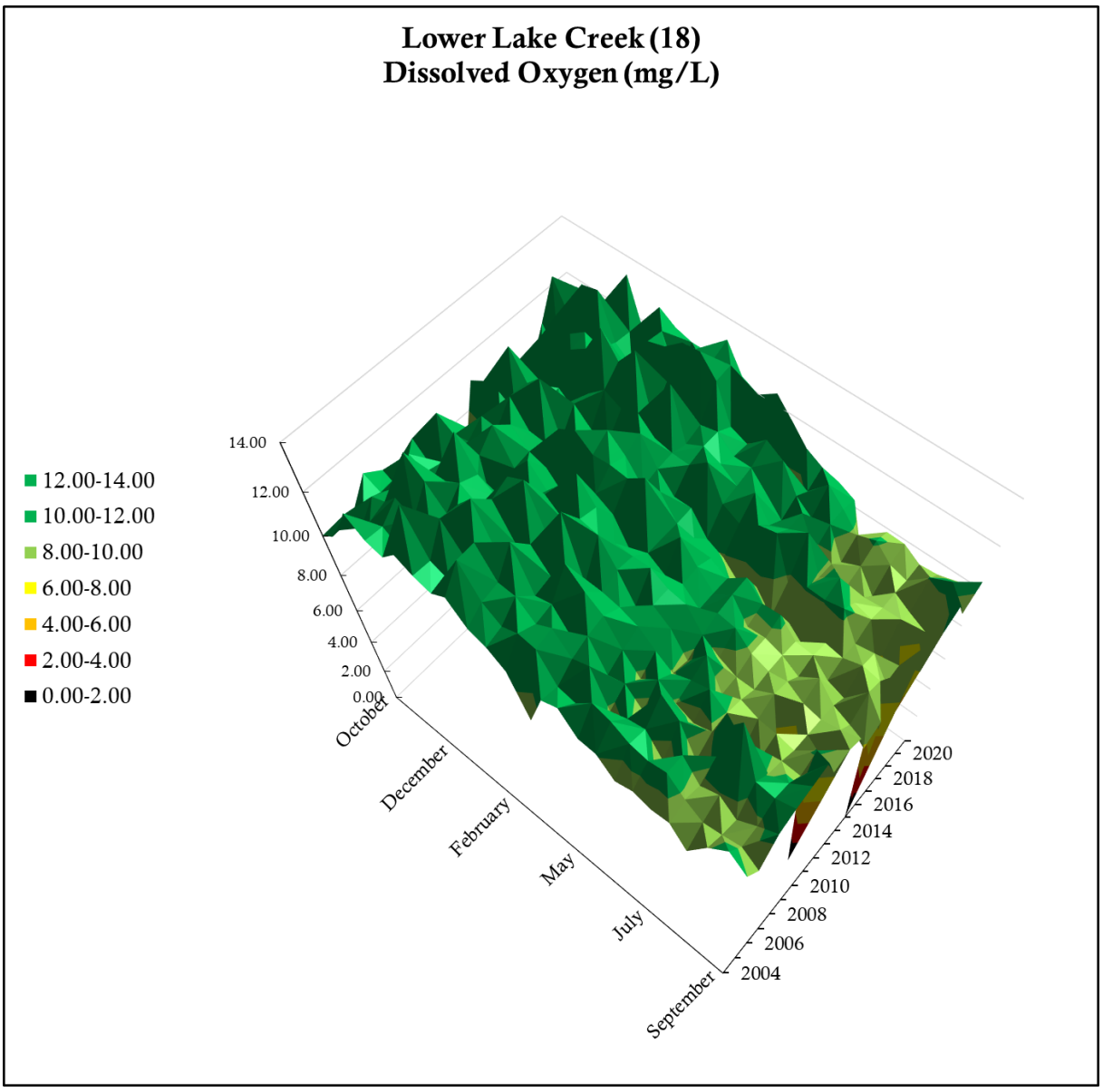


Site 18 is Lake Creek, coming out of Lake McMurray, and just prior to entering Big Lake. This site contributes to water quality data bracketing of Big Lake along with site 17. This site is designated as core salmonid habitat.

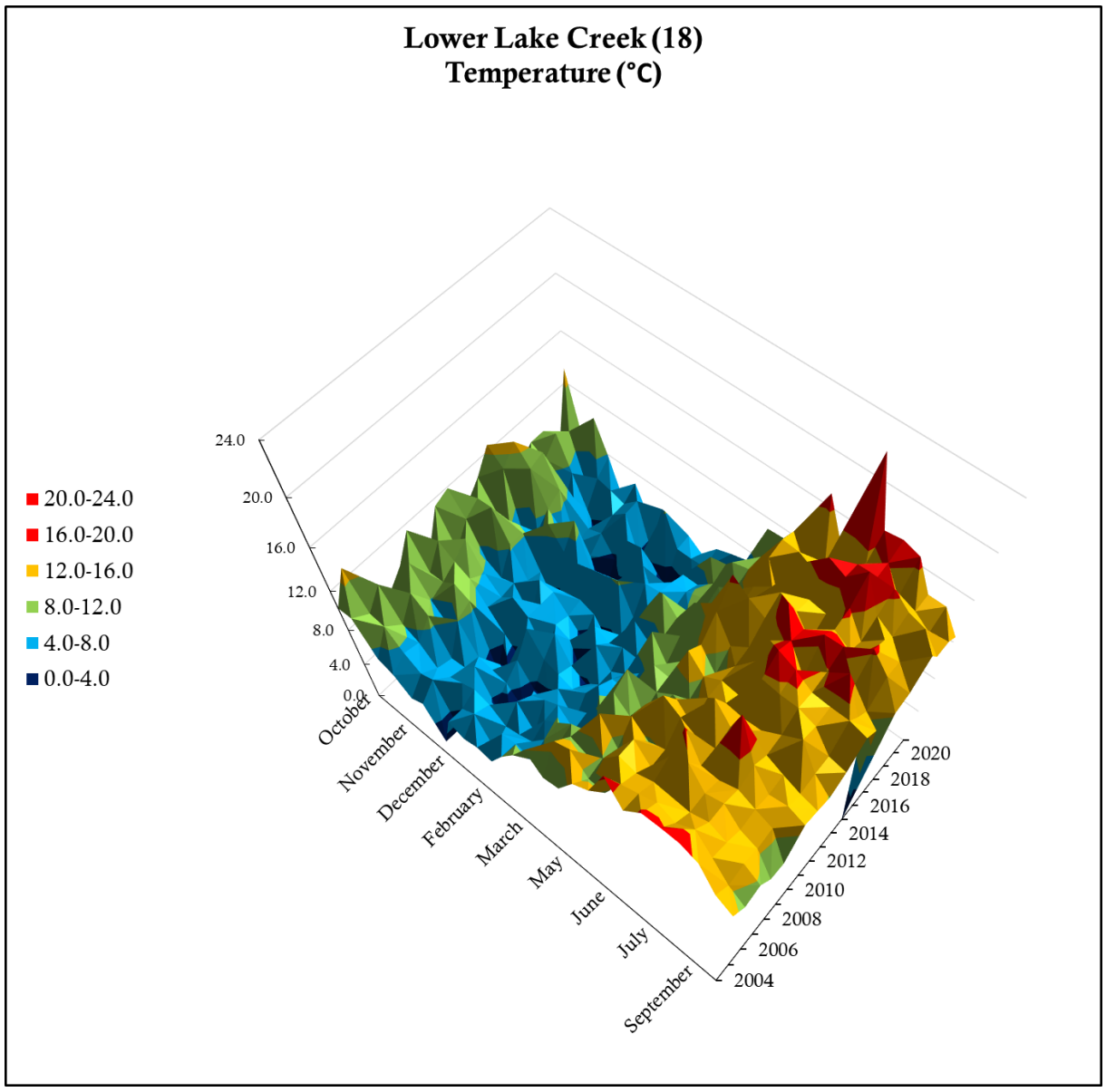
Dissolved oxygen has increased in the most recent ten years. Water temperature has increased in the last 18 years. Fecal coliform is lower than it was 18 years ago.

Site 18 easily passes state standards for DO and fails state standards for temperature in the warmest months. Annual bacterial levels for the 2021WY pass the state standards for geomean of 100, but fail the state standards for a 90th percentile.

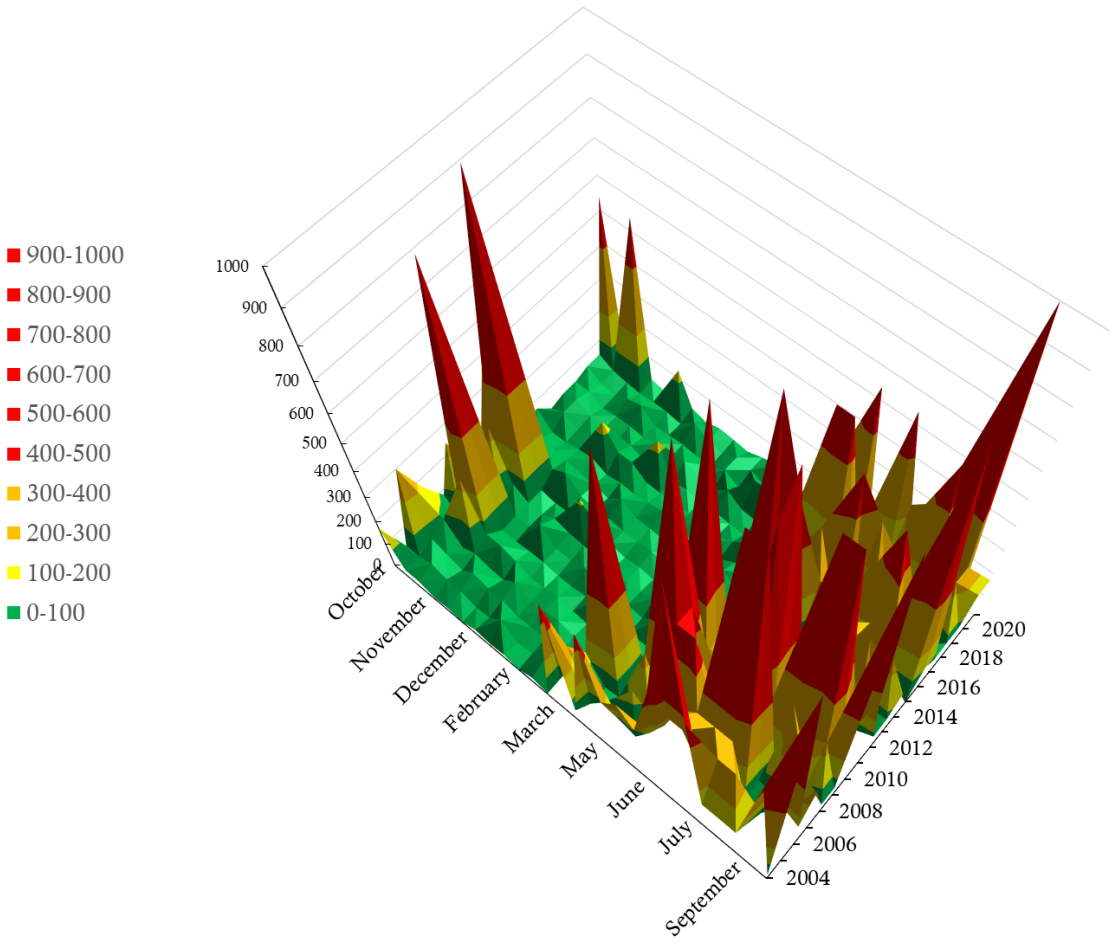
Site 18 is 38th out of 39 sites for number of significant trends, with 5, and is tied for 19th out of 39 sites for positive trends, with 60%.



The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

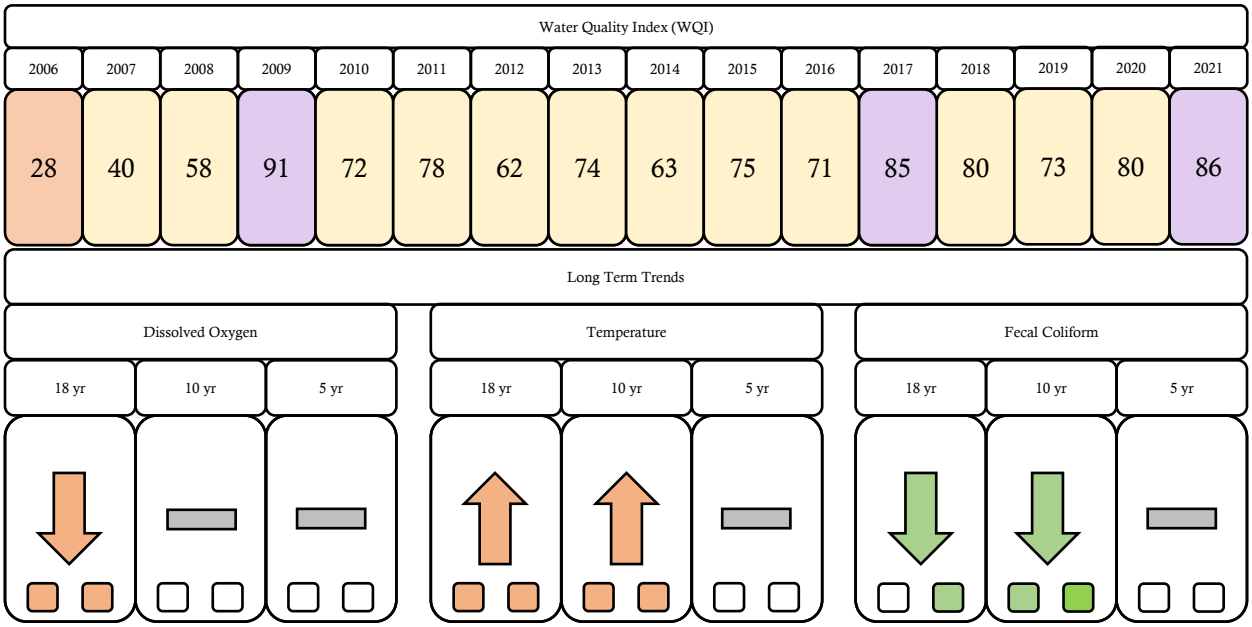


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

19

Hansen Creek
@ Hoehn Road

Downstream Ag, TMDL

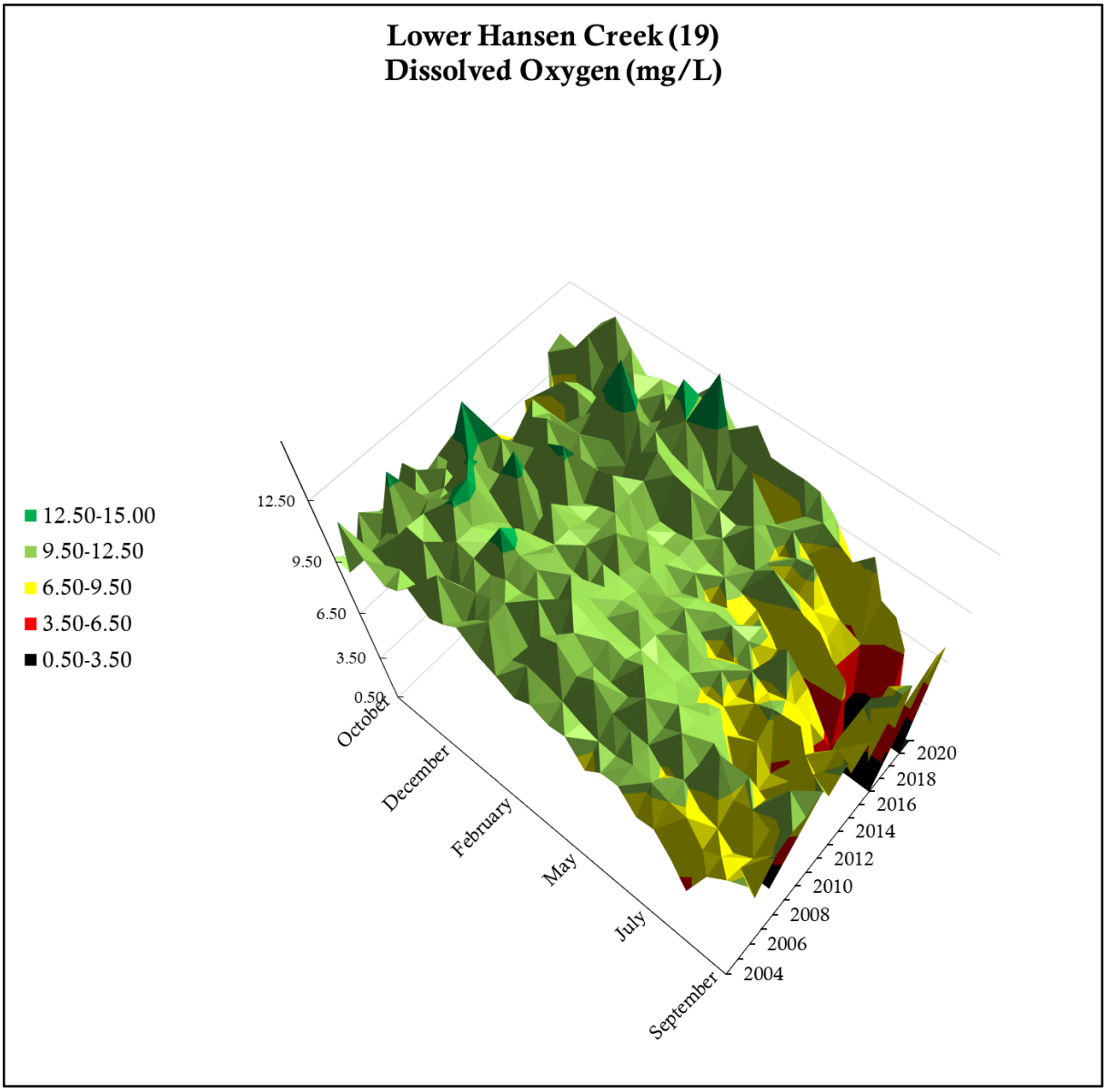


Site 19 is Hansen Creek, downstream from site 20 at the Northern State Recreation Area. This site is pseudo-ephemeral and often can stop flowing by the end of the summer. This site is designated as core salmonid habitat.

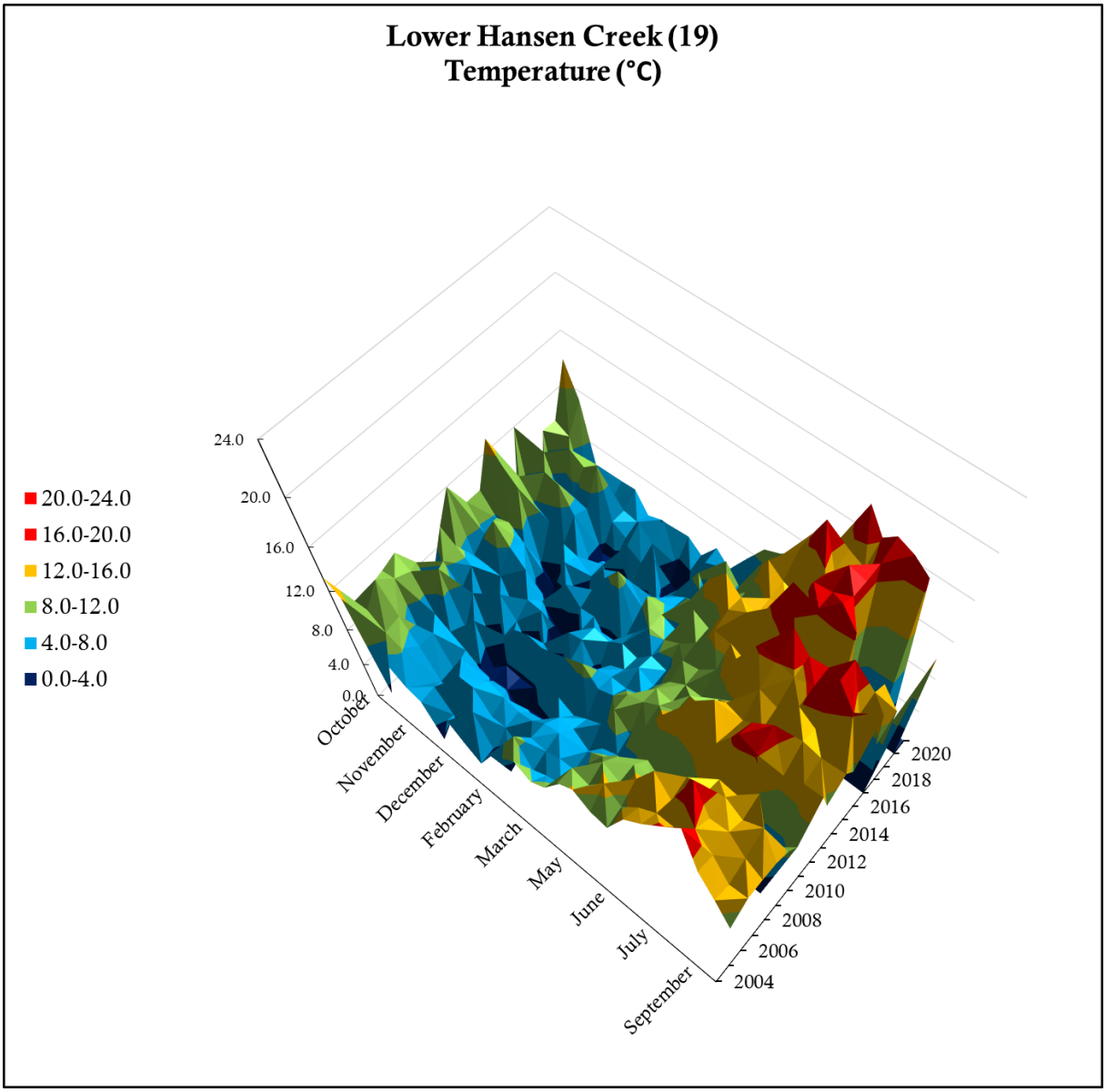
Over the 18-year life of this program, DO has declined, and water temperatures have increased, while FC has gone down. WQI scores are generally in the upper-score end of the moderate concern category.

Site 19 typically fails to meet state standards for DO during the warmer months when its flow volume becomes extremely low, and often fails to meet state standards for temperature during the hottest time of the year. Annual bacterial levels for WY2021 passed state standards.

Site 19 is tied for 2nd out of 39 sites for number of significant trends, with 16, and is tied for 26th out of 39 sites for positive trends, with 38%.

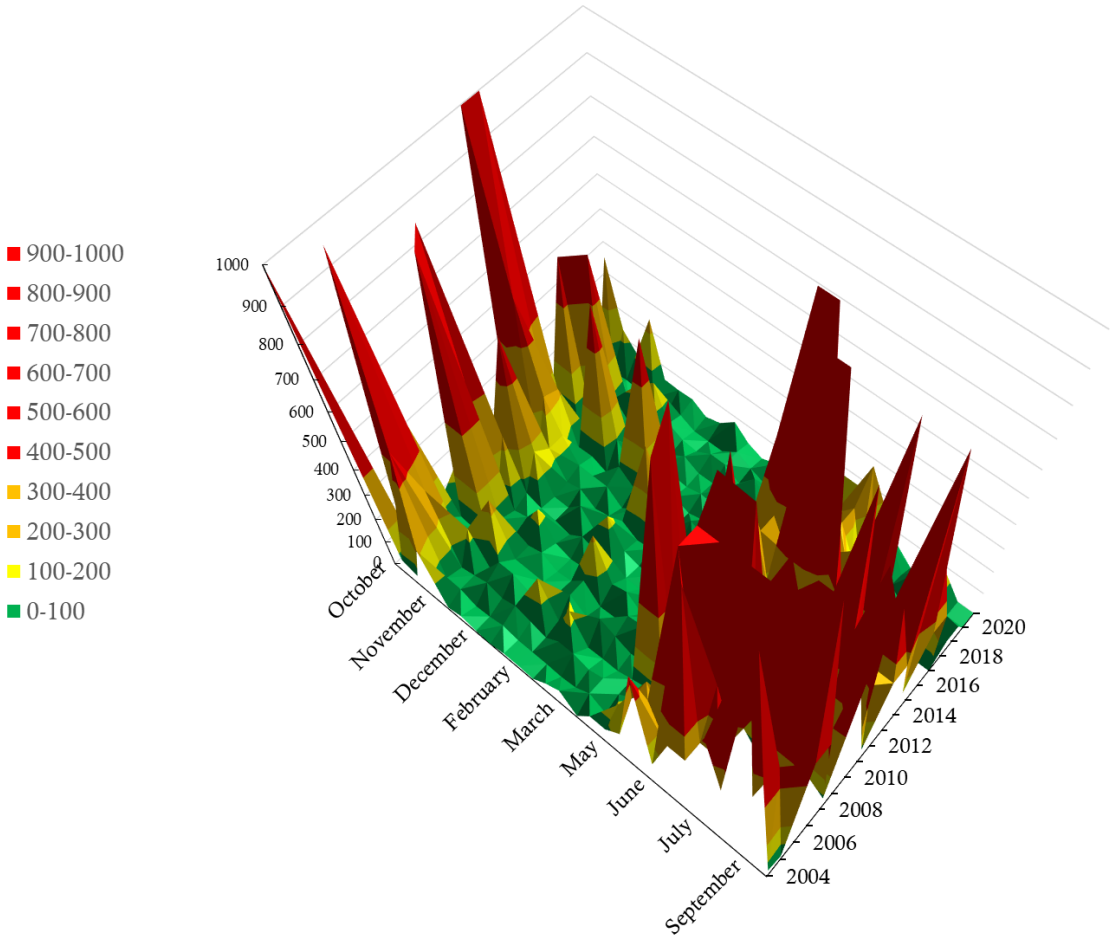


The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

Lower Hansen Creek (19)
Fecal Coliform (MPN/100 mL)

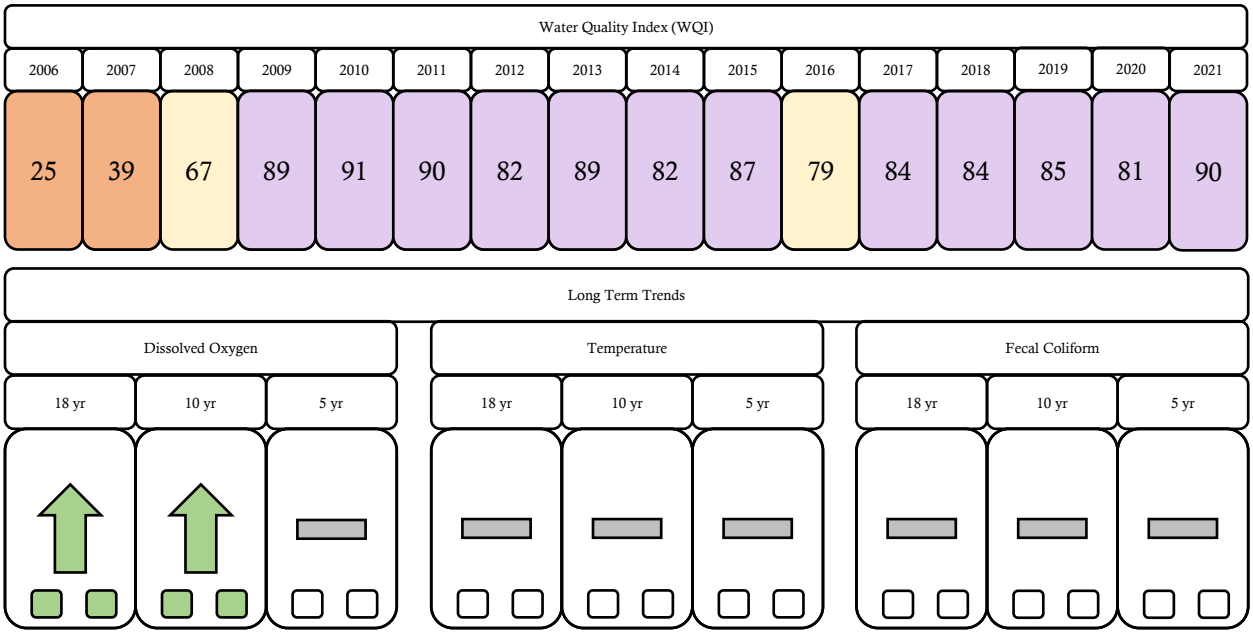


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

20

Hansen Creek
@ Northern State

Upstream Ag, TMDL

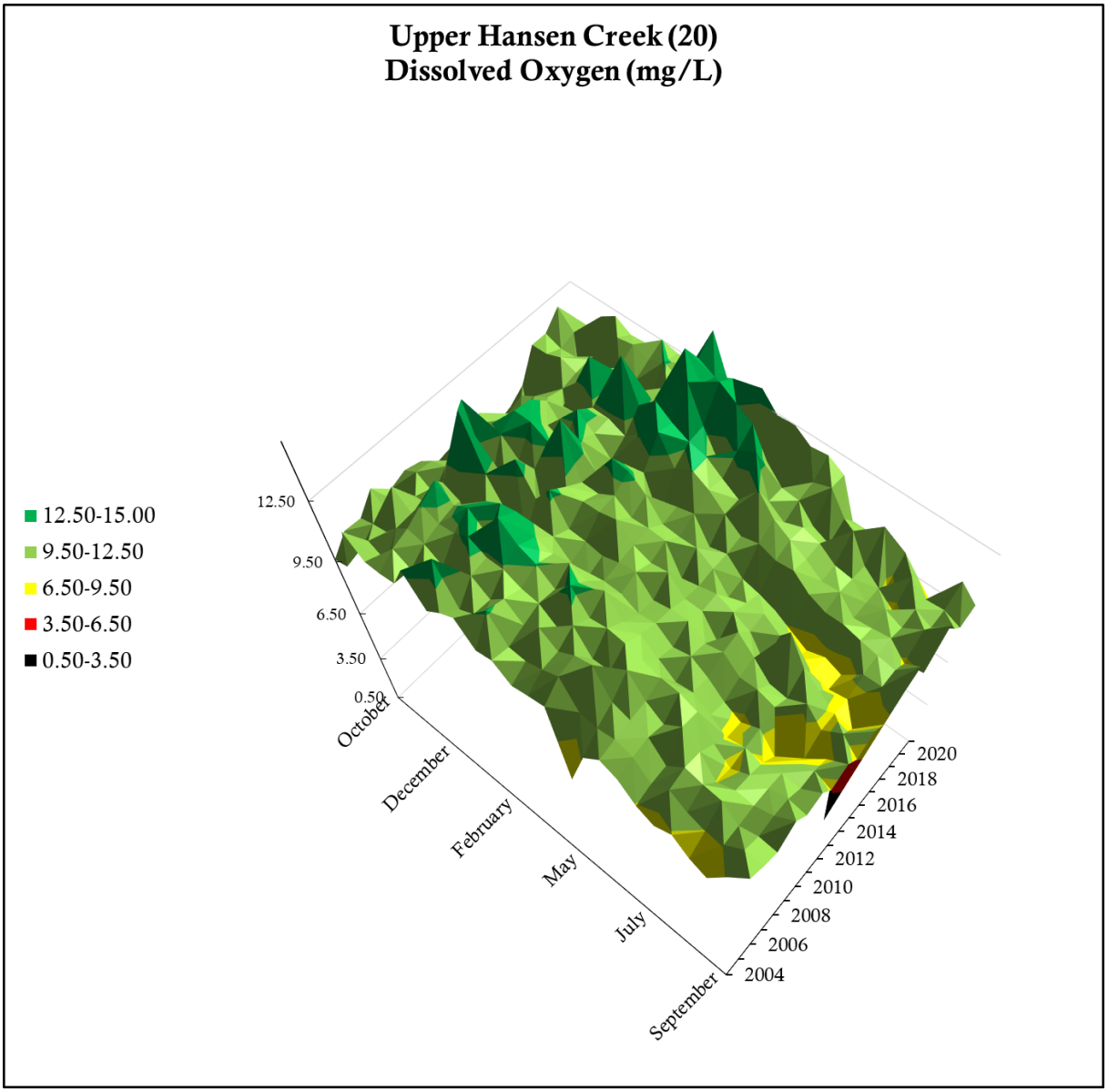


Site 20 is Hansen Creek at the Northern State Recreation Area, upstream from site 19. Water input to this site comes down from Lyman Hill and has very little developed land. This site is designated as core salmonid habitat.

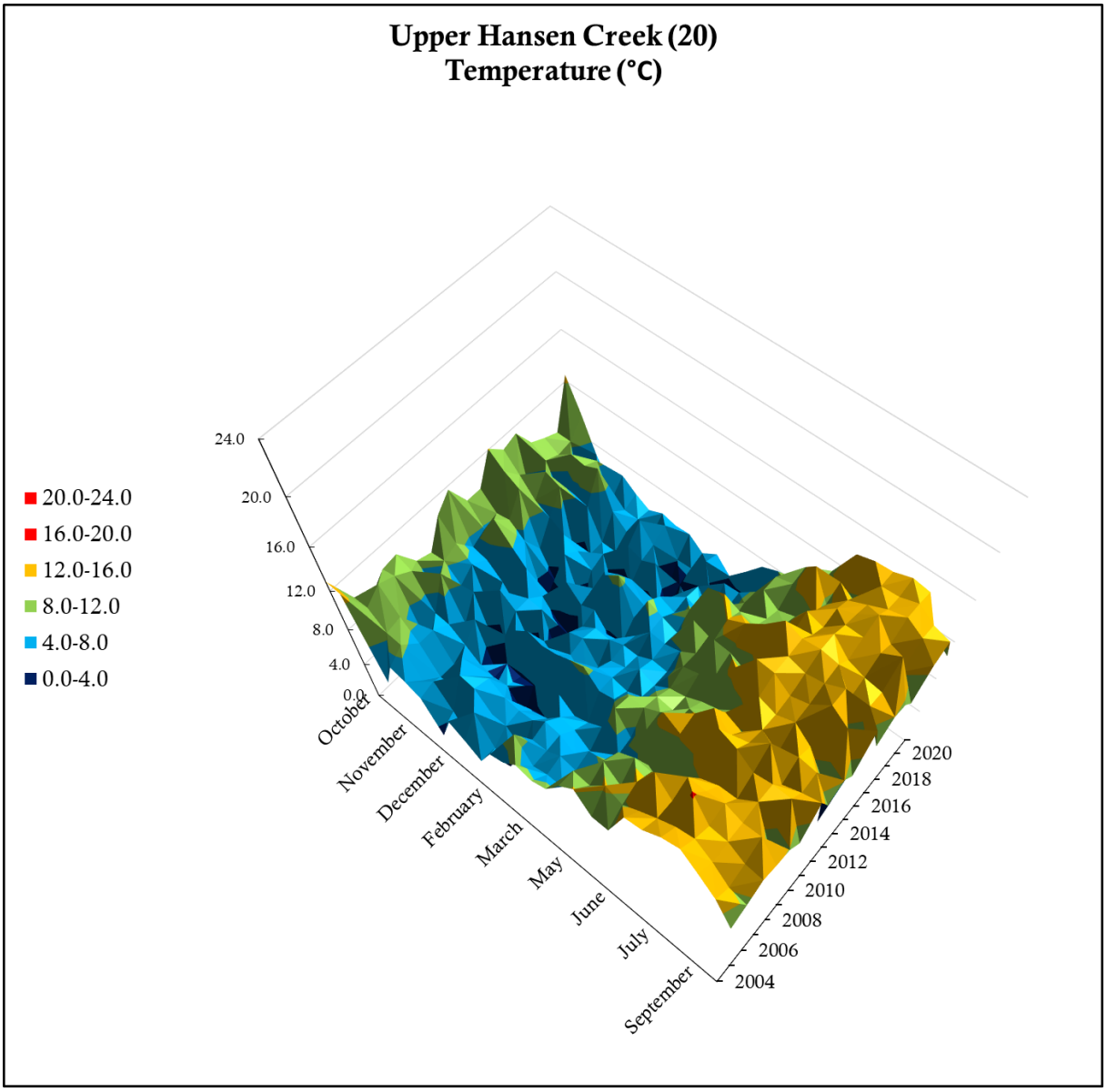
Dissolved oxygen has been increasing over the last 17 years and ten years. Trends at this site are distinctly different than those downstream at site 19. WQI scores have typically been in the category of least concern over the past ten years.

Site 20 rarely ever fails to pass state standards for both DO and temperature, year-round. Annual FC levels for WY2021 passed the state geomean standard but failed for 90th percentile. EC levels passed both standards.

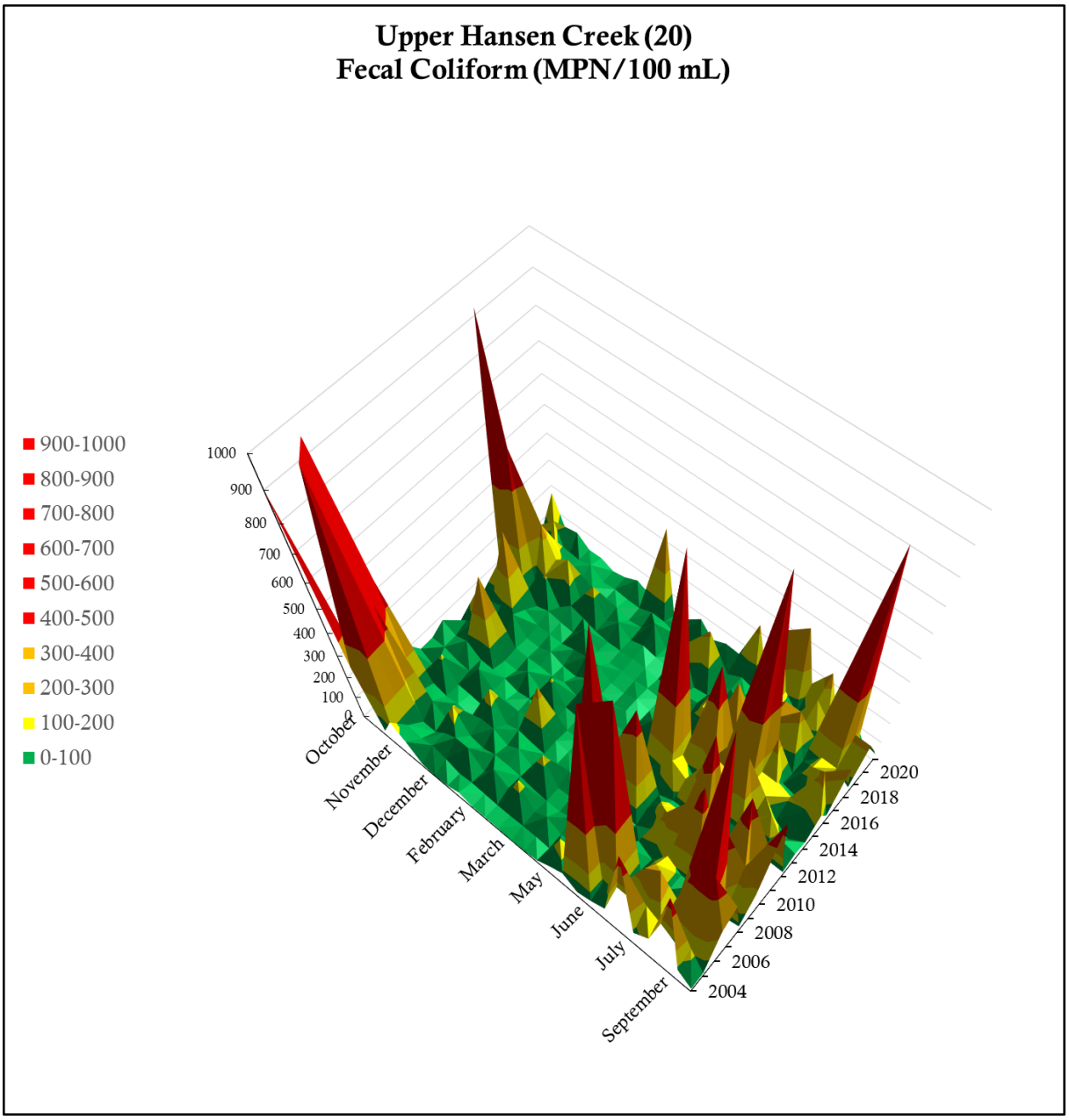
Site 20 is tied for 2nd out of 39 sites for number of significant trends, with 16, and is 9th out of 39 sites for positive trends, with 78%.



The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

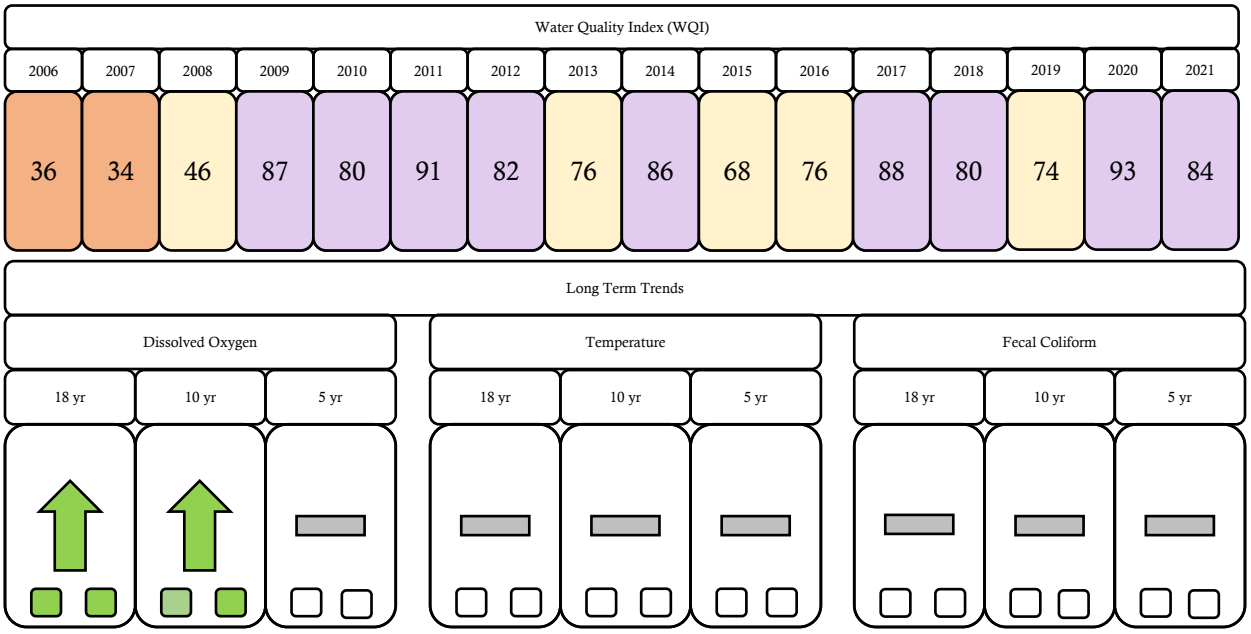


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

21

Coal Creek
@ Hoehn Road

Downstream Ag

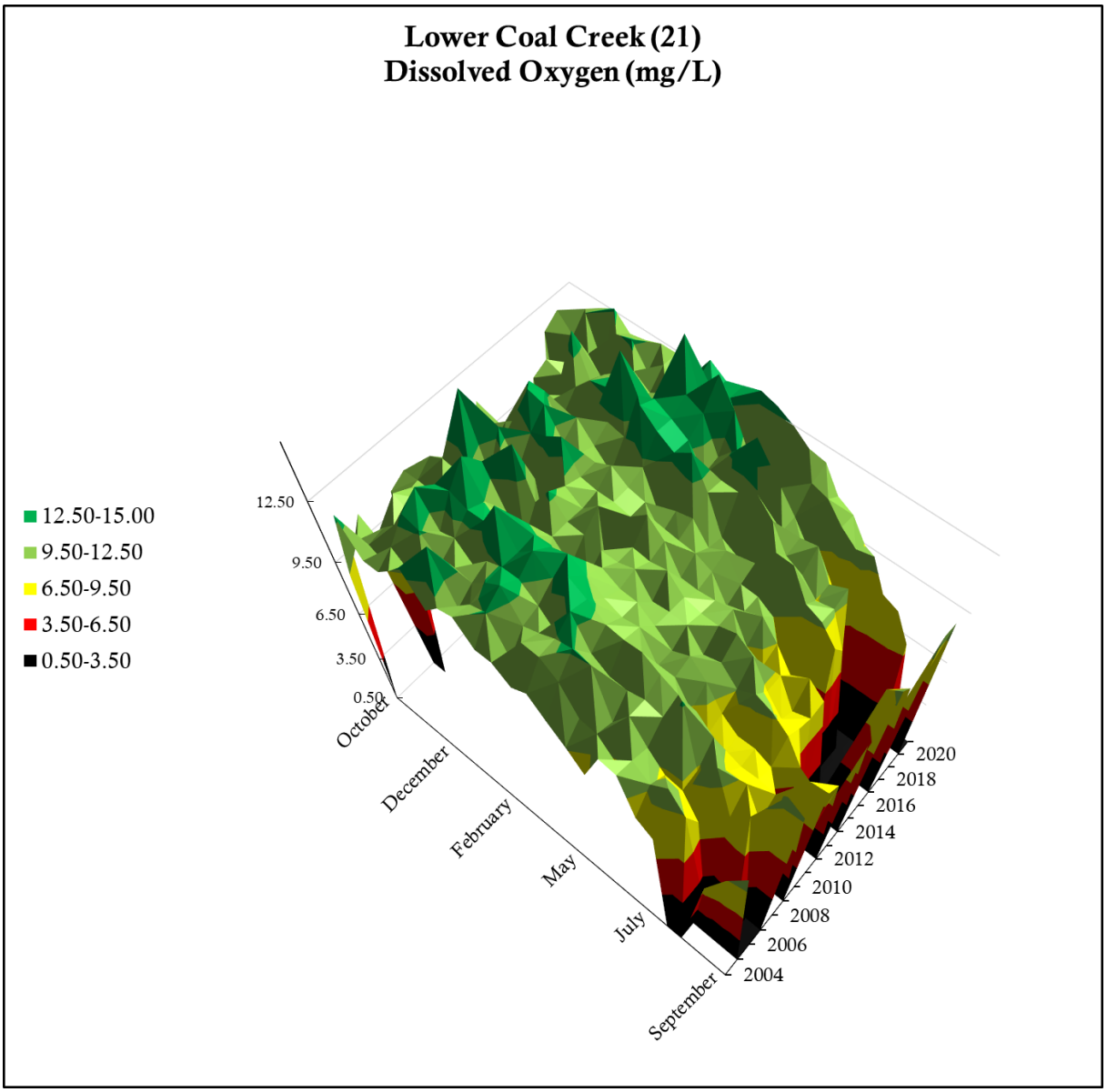


Site 21 is Coal Creek, downstream from site 22, and just prior to arriving in Skiyou Slough and ultimately the Skagit River. This site is pseudo-ephemeral and can often stop flowing by the end of the summer. This site is designated as core salmonid habitat.

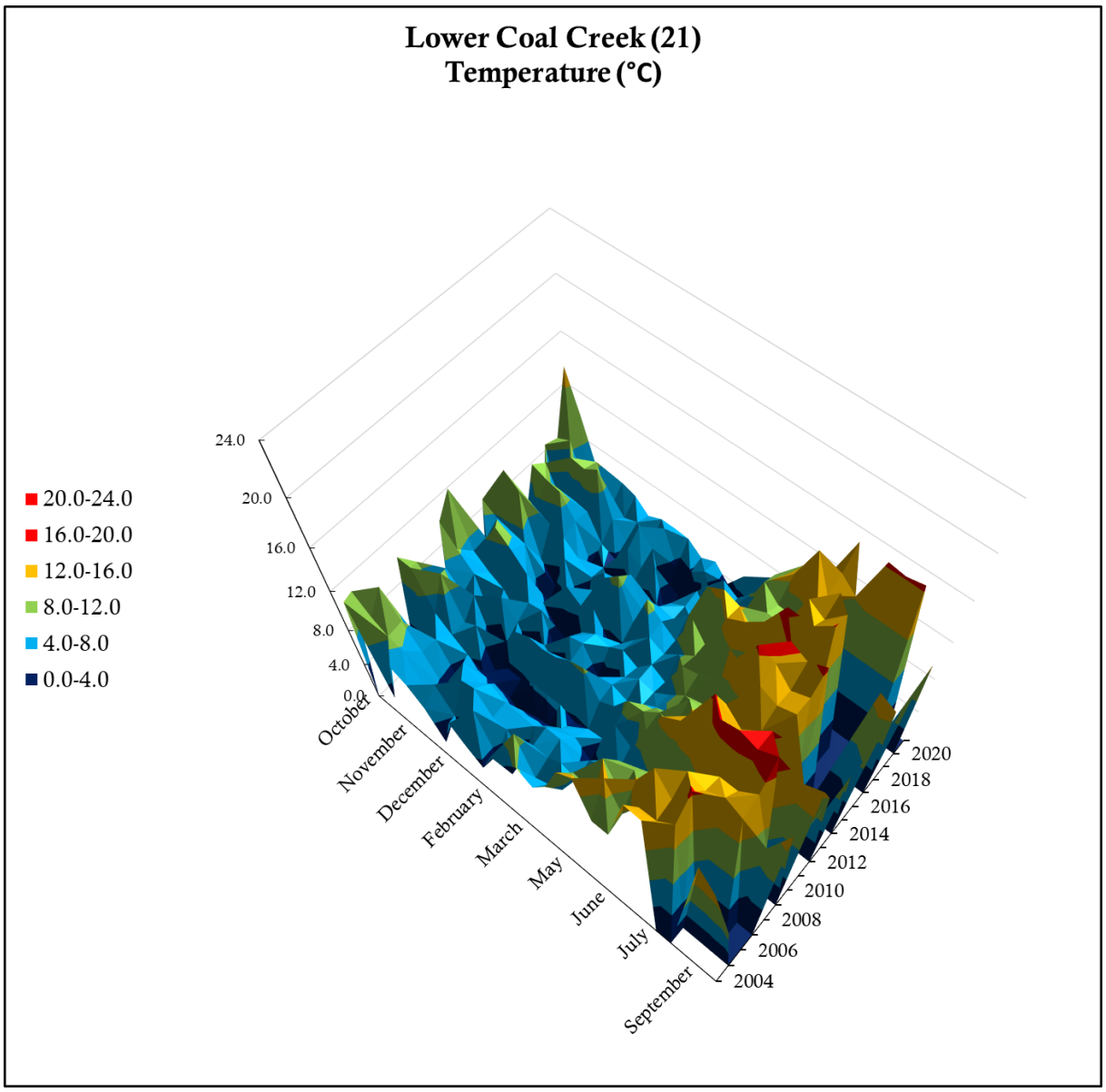
DO has increased in the 17- and 10- year time frames. WQI scores are generally in the upper-score end of the moderate concern category, and often score as least concern.

Site 21 regularly fails to meet state standards for DO during the warmest months, but rarely fails to meet state standards for water temperature. Annual bacterial levels for WY2021 passed the geomean standards for both FC and EC but did not pass the 90th percentile requirement for either analyte.

Site 21 is tied for 14th out of 39 sites for number of significant trends, with 11, and is 7th out of 39 sites for positive trends, with 82%.

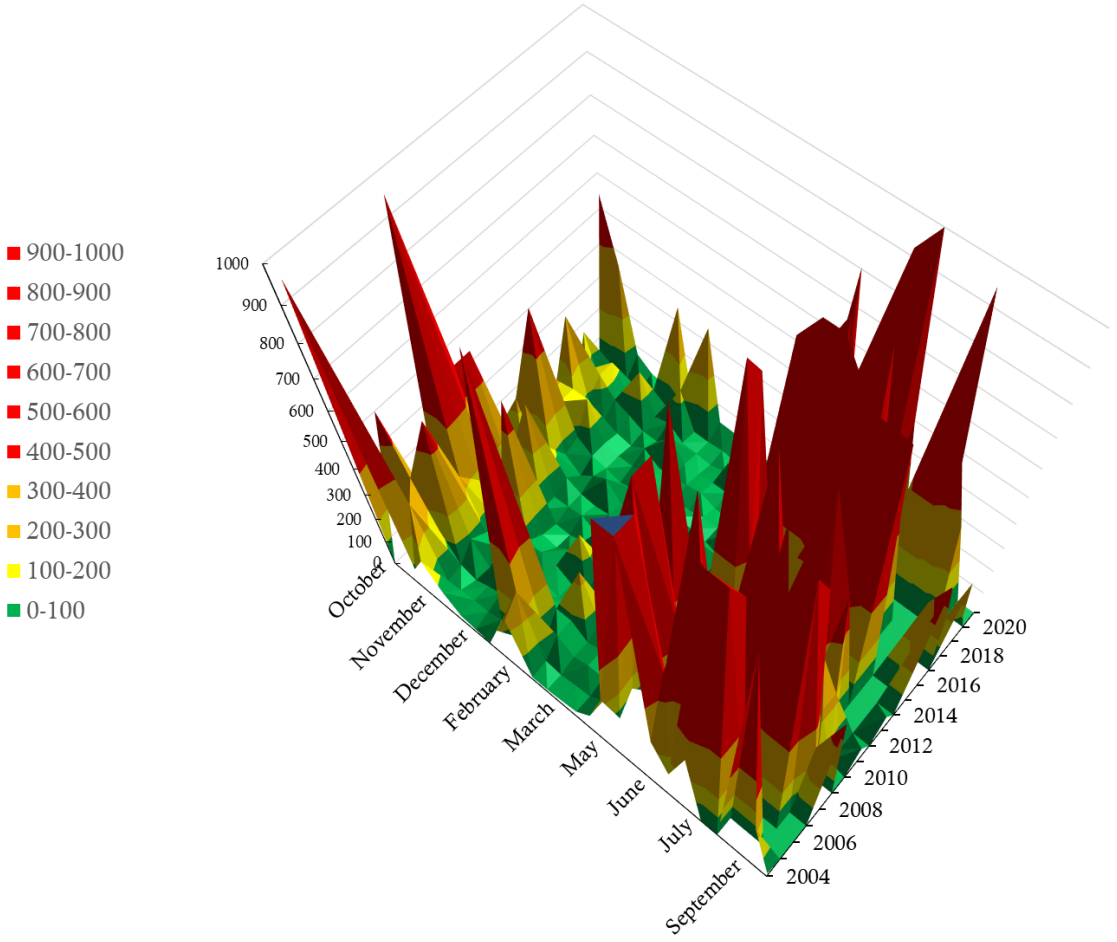


The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

Lower Coal Creek (21)
Fecal Coliform (MPN/100 mL)

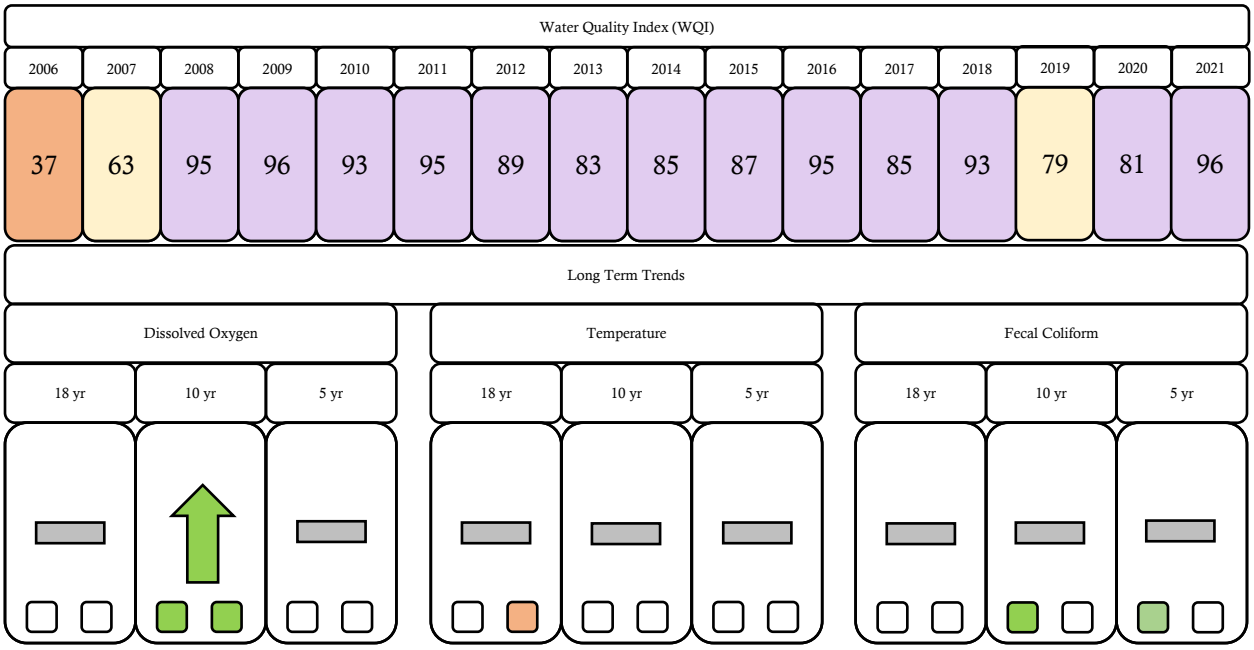


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

22

Coal Creek
@ Highway 20

Upstream Ag

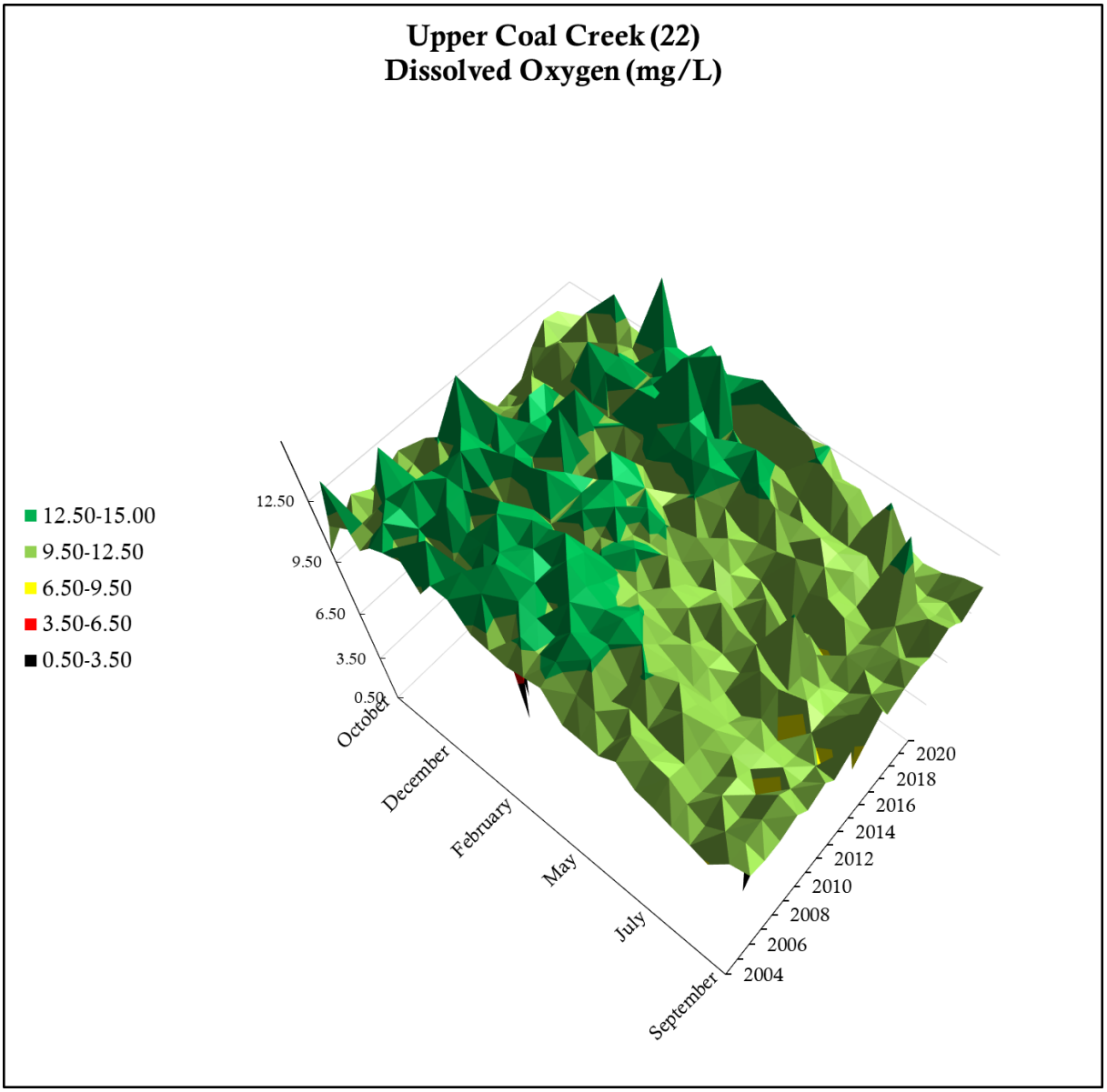


Site 22 is Coal Creek as it comes down off Lyman Hill and is upstream of site 21. This site is designated as core salmonid habitat.

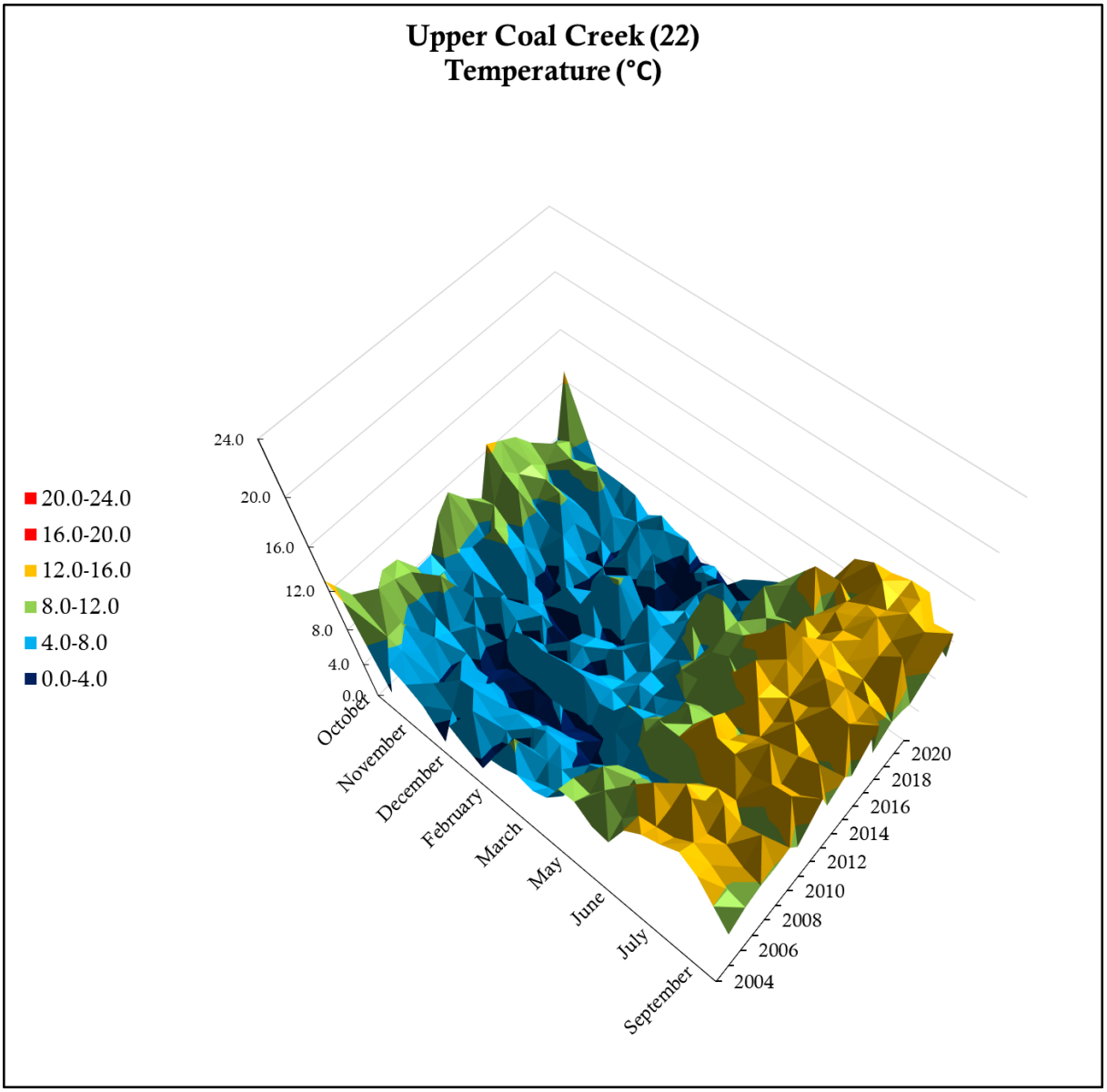
Temperature increased in the last ten years. WQI scores are regularly in the category of least concern.

Site 22 rarely fails to meet state standards for DO or temperature, year-round. Annual bacterial levels for the 2021WY easily passed state standards.

Site 22 is tied for 35th out of 39 sites for number of significant trends, with 6, and is tied for 13th out of 39 sites for positive trends, with 67%.

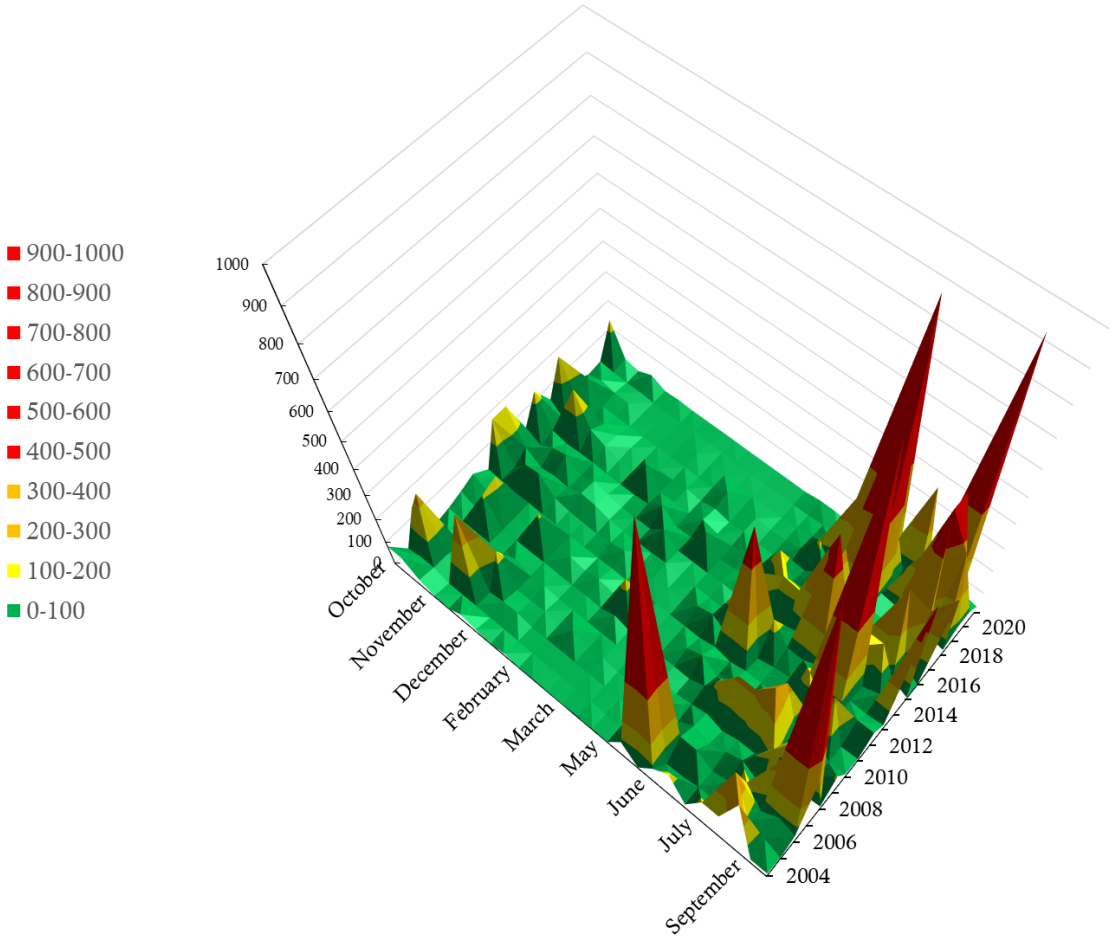


The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

Upper Coal Creek (22)
Fecal Coliform (MPN/100 mL)

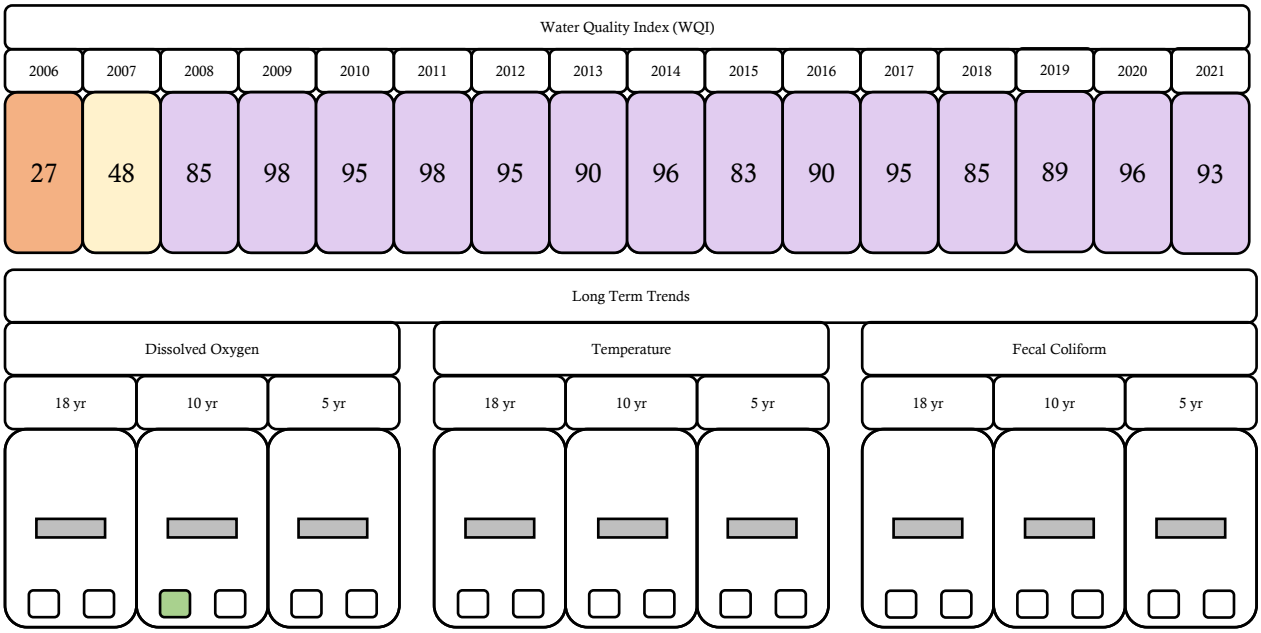


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

23

Wiseman Creek
@ Minkler Road

Upstream Ag

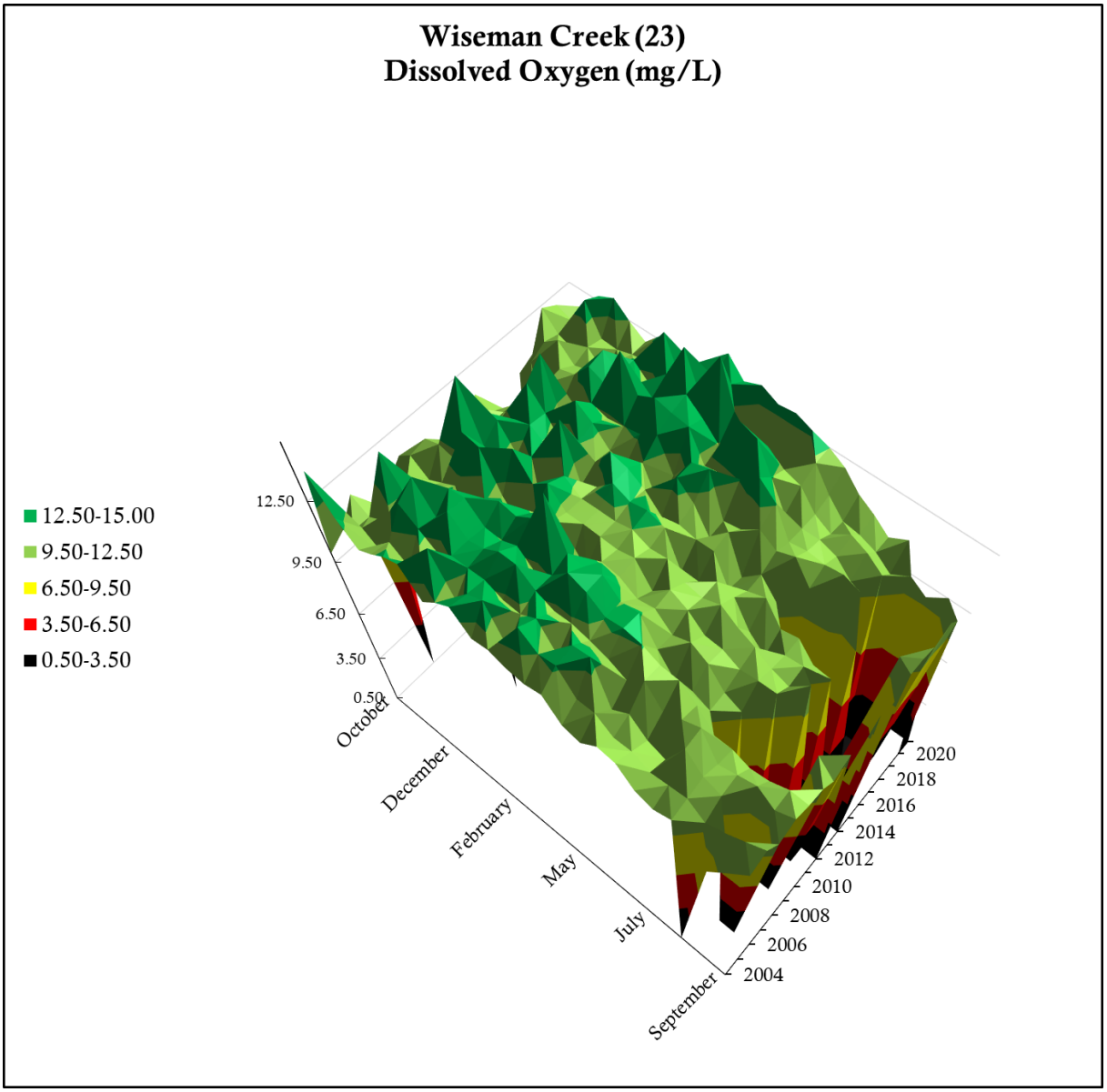


Site 23 is Wiseman Creek as it comes down off Lyman Hill, and prior to entering Skiyou Slough and ultimately the Skagit River. This site is designated as core salmonid habitat.

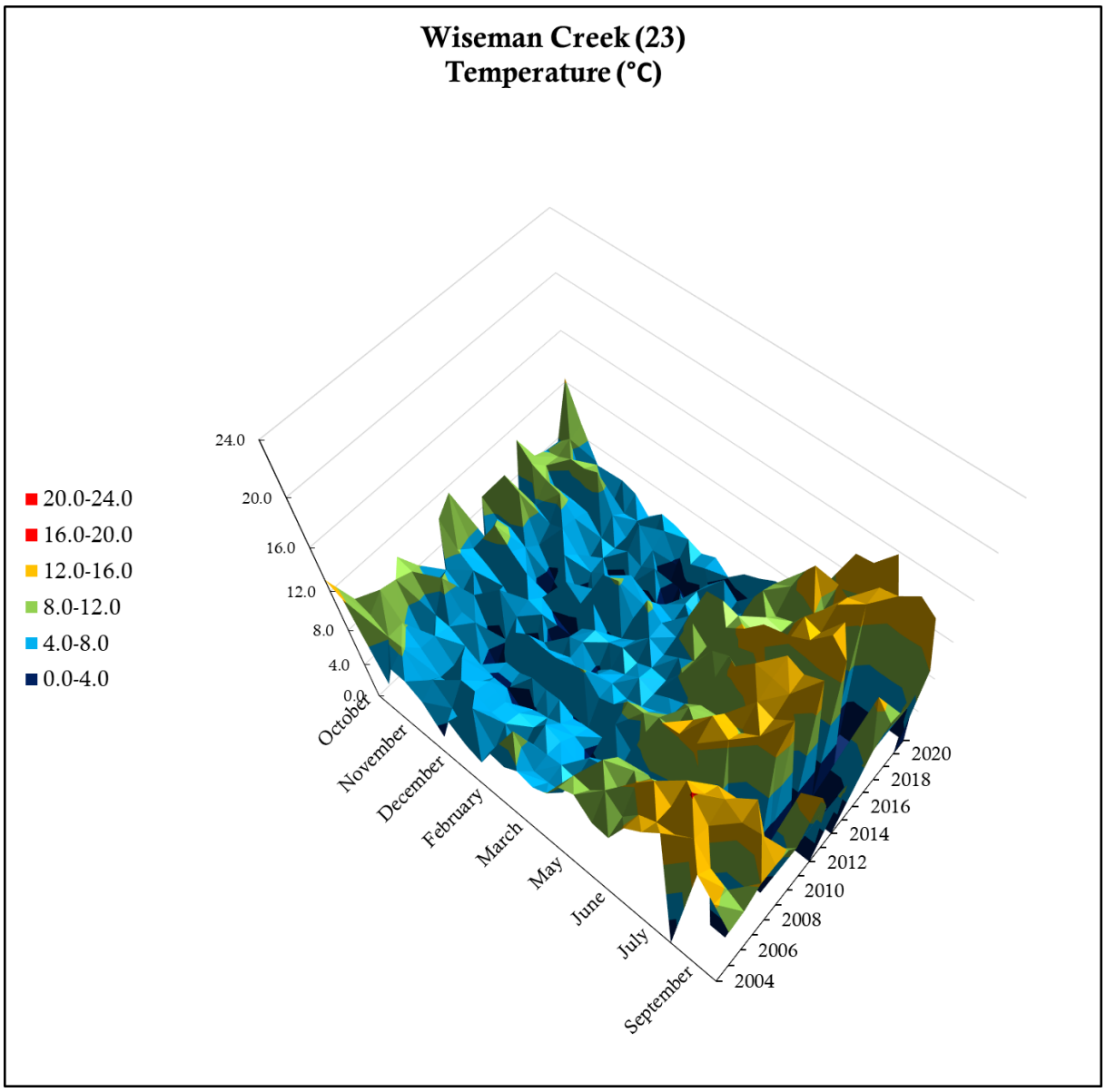
DO has seen a significant positive trend in the last 10 years. No other significant monthly trends were observed in dissolved oxygen, temperature, or fecal coliform at this site, over any of the time periods analyzed. WQI is consistently in the category of least concern.

Site 23 rarely, if ever, fails to meet state standards for DO and water temperature, year-round. Annual bacterial levels easily meet state standards.

Site 23 is tied for 35th out of 39 sites for number of significant trends, with 6, and is tied for 13th out of 39 sites for positive trends, with 67%.

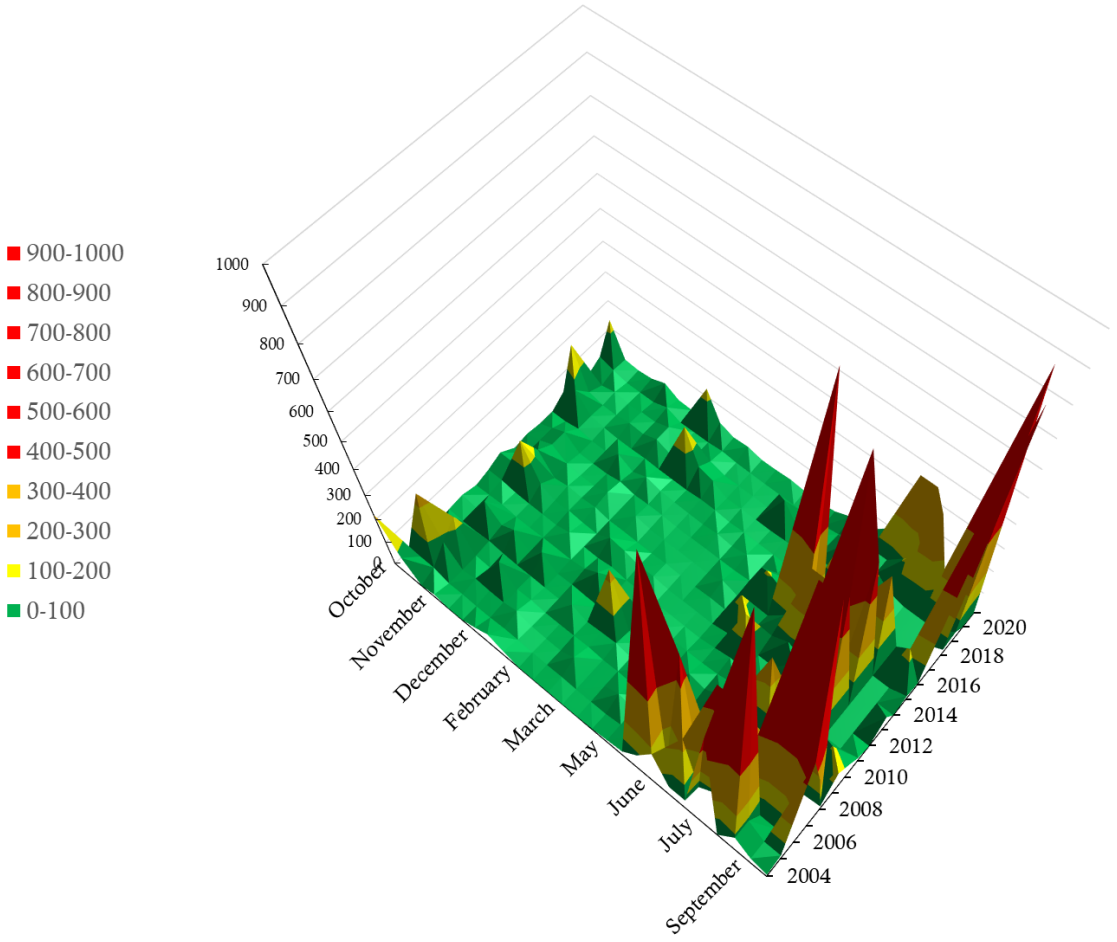


The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

Wiseman Creek (23)
Fecal Coliform (MPN/100 mL)

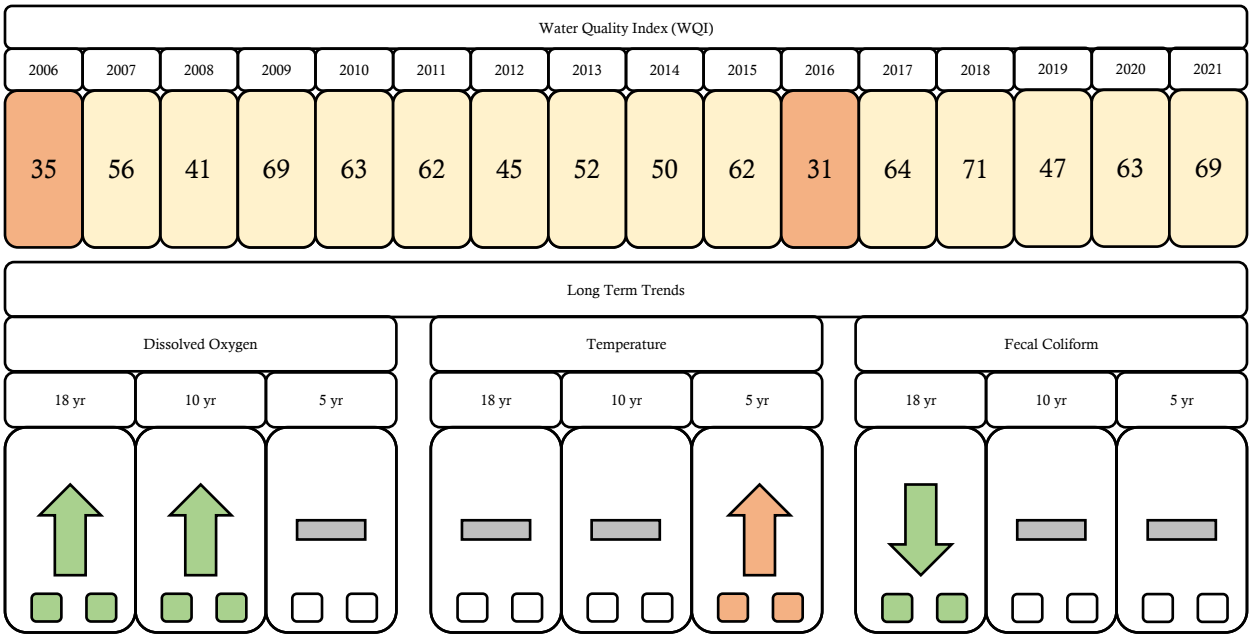


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

24

Mannser Creek
@ Lyman-Hamilton Highway

Midstream Ag

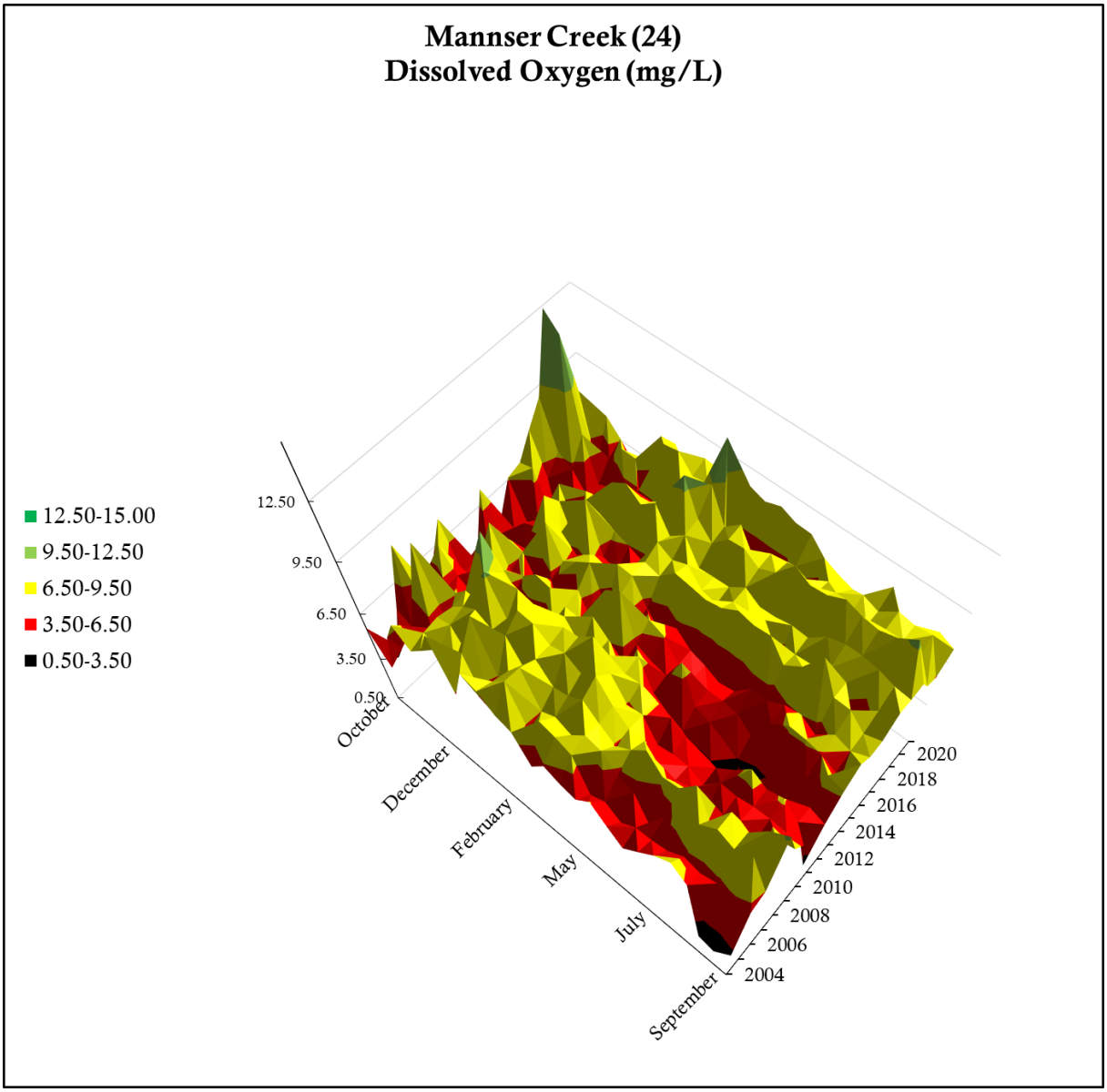


Site 24 is Mannser Creek, after descending off Mount Josephine and prior to joining the Skagit River, just east of Lyman. This site is designated as core salmonid habitat.

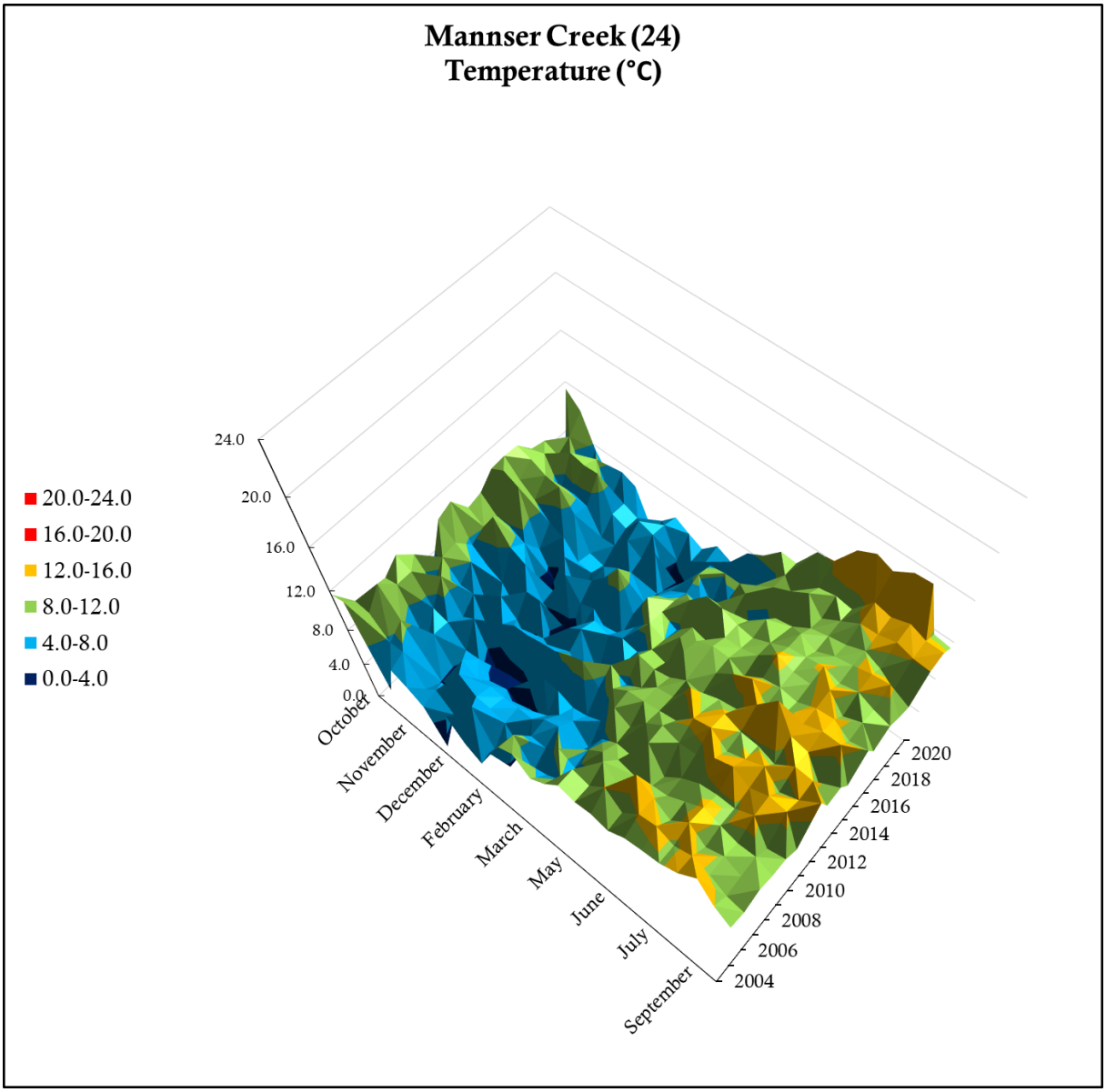
Dissolved oxygen has significantly increased across the 17- and 10-year time periods. Temperature has increased in the last 5 years. Fecal coliform has decreased compared to 17 years ago. WQI scores are regularly in the category of moderate concern.

Site 24 is slow-moving and inundated with invasive reed canary grass. This has the effect of lowering DO but also decreasing temperature. As a result, this site is almost always below state standards for DO year-round but has never exceeded state temperature standards even once in the history of this program. Annual FC levels also easily meet state standards.

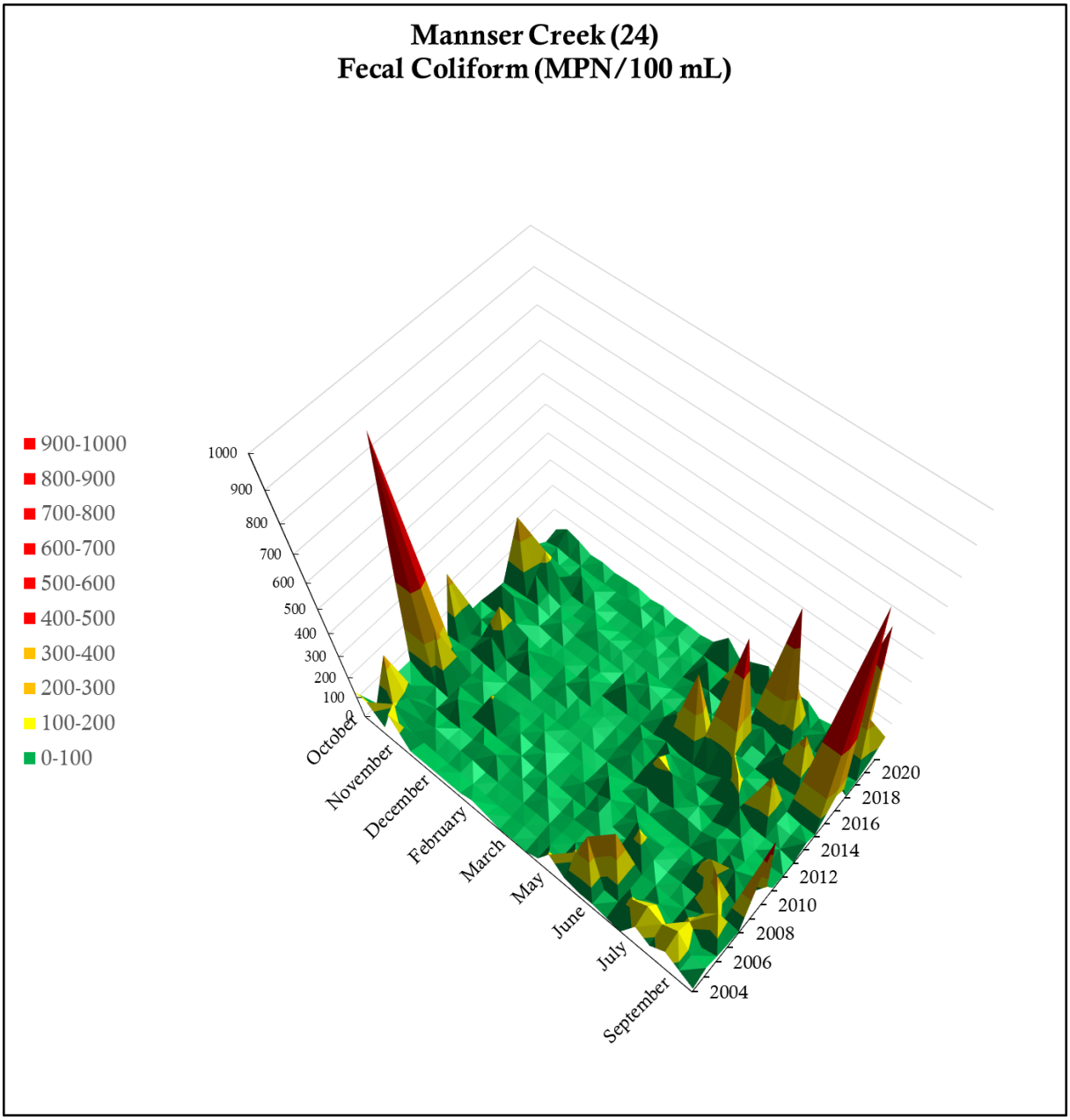
Site 24 is tied for 4th out of 39 sites for number of significant trends, with 14, and is tied for 22nd out of 39 sites for positive trends, with 57%.



The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.



The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

25

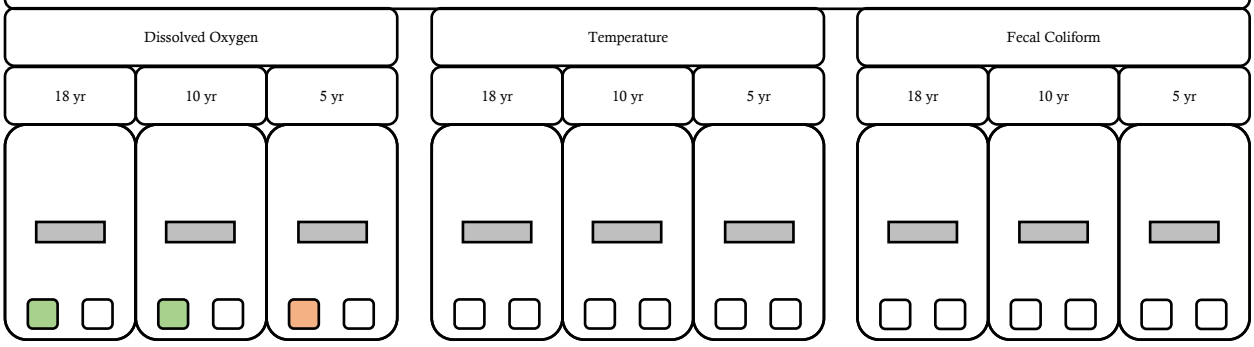
Red Cabin Creek
@ Hamilton Cemetery Road

Reference – Rural Reserve

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
74	90	87	97	97	96	96	97	97	94	93	94	96	91	94	97

Long Term Trends

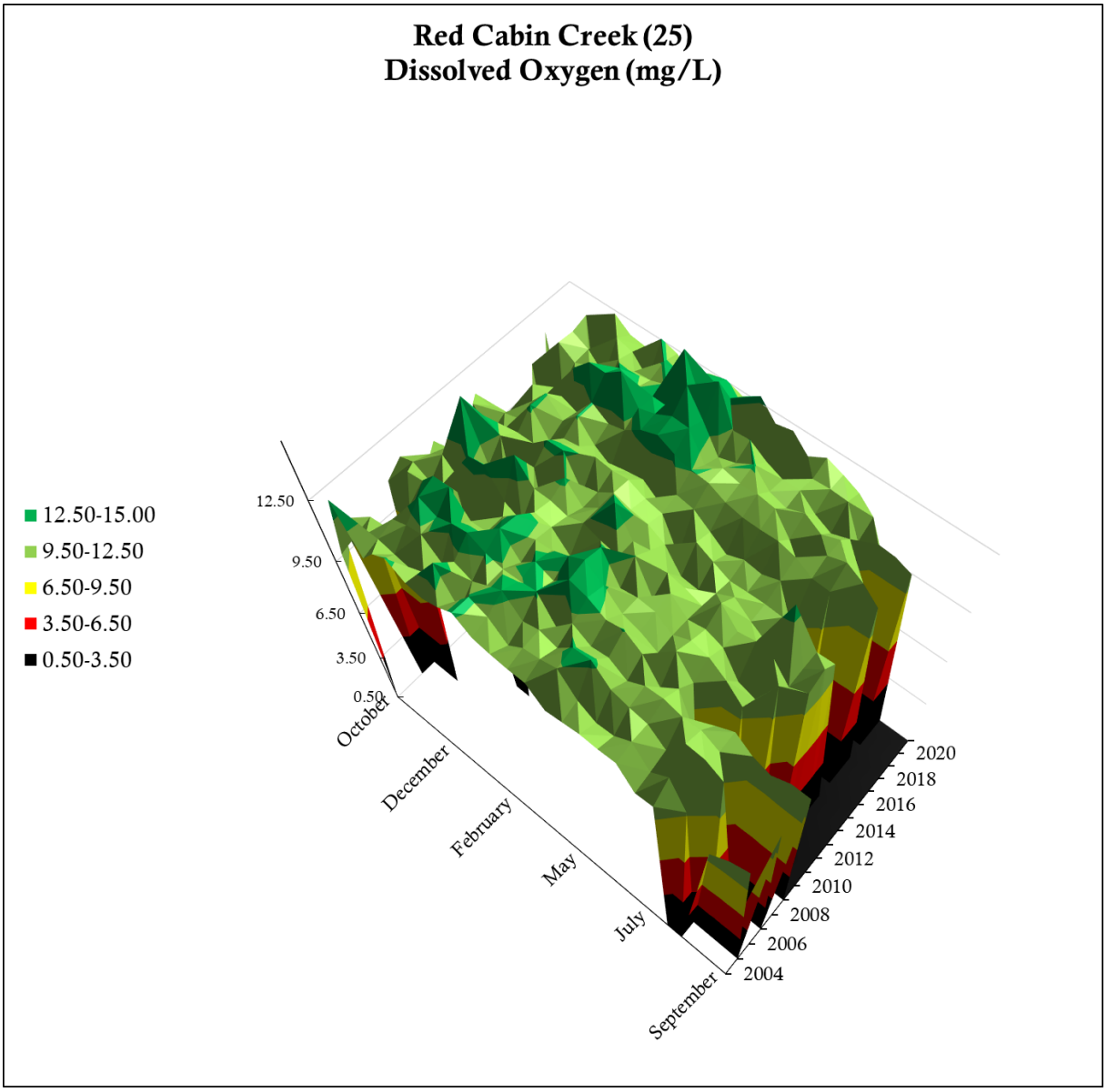


Site 25 is Red Cabin Creek, after it comes off Mount Josephine in between Lyman and Hamilton. This is an ephemeral creek that regularly dries up by the end of summer. This site is designated as core salmonid habitat.

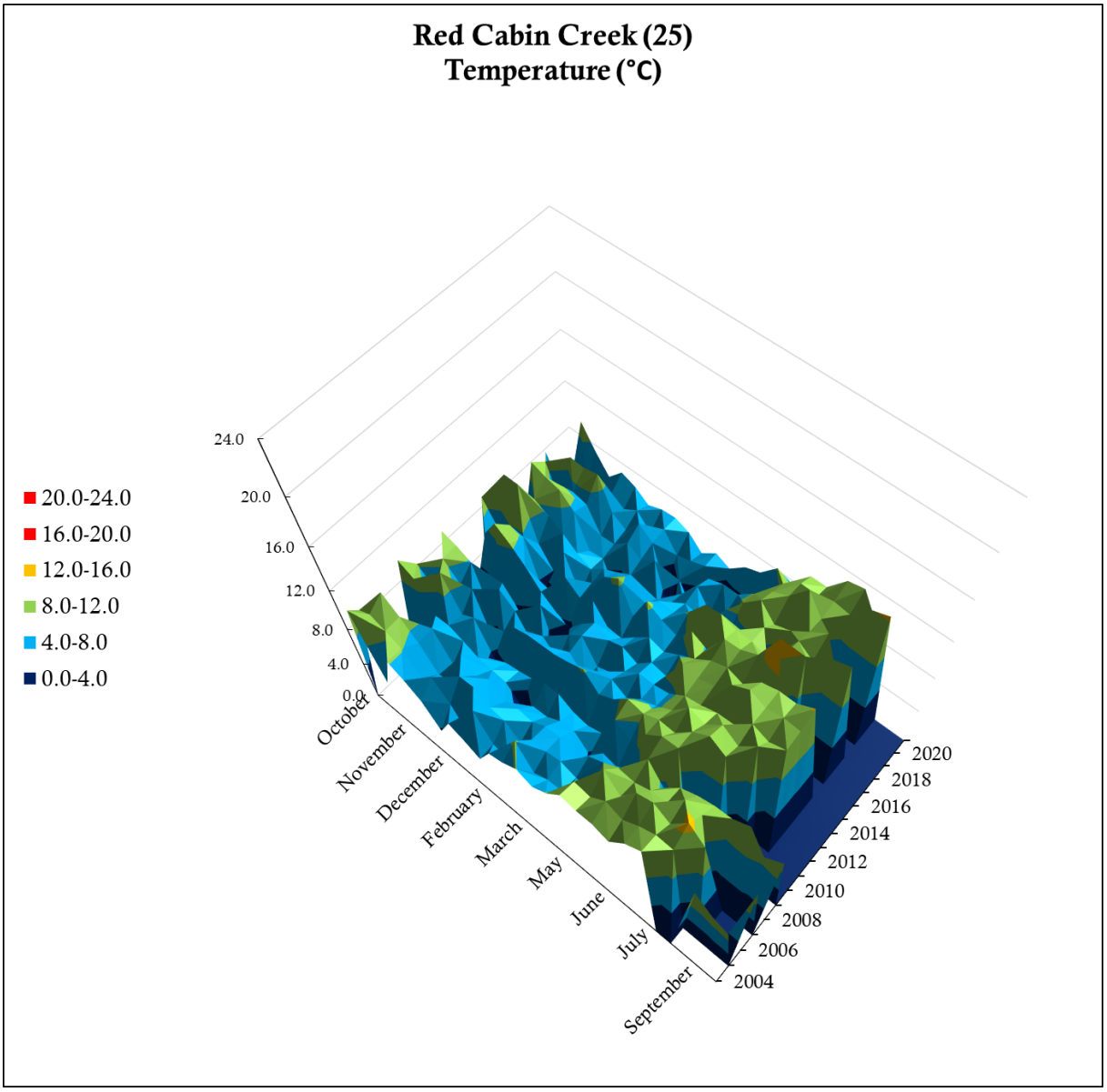
Except for the first year of WQI monitoring, this creek has solely been in the category of least concern.

Site 25 has never failed to meet state standards for DO or water temperature on any collection day over the history of this program. Annual bacterial levels easily meet state standards.

Site 25 is tied for 27th out of 39 sites for number of significant trends, with 8, and is tied for 26th out of 39 sites for positive trends, with 38%.

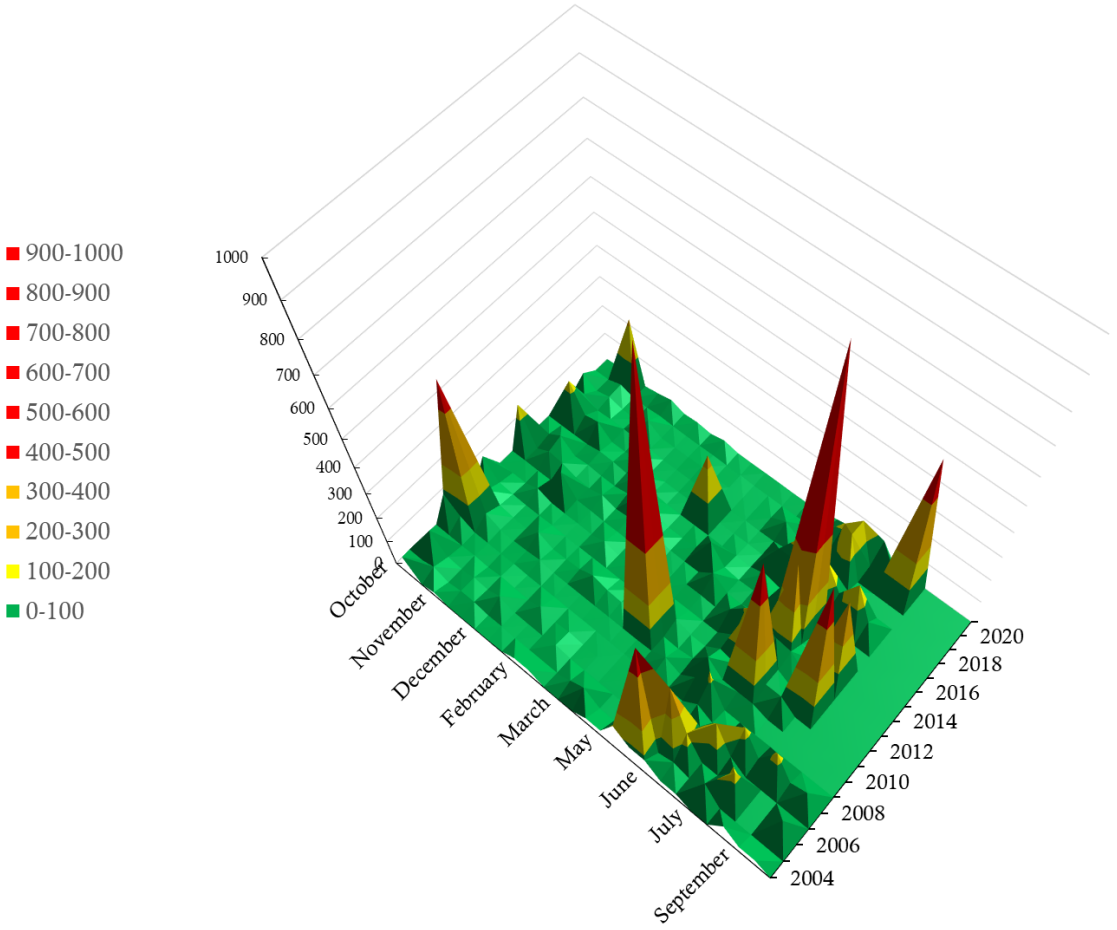


The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

Red Cabin Creek (25)
Fecal Coliform (MPN/100 mL)



The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

28

Brickyard Creek
@ Highway 20

Reference – Urban/suburban

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
62	77	56	71	79	83	65	75	84	88	77	93	84	85	79	75

Long Term Trends

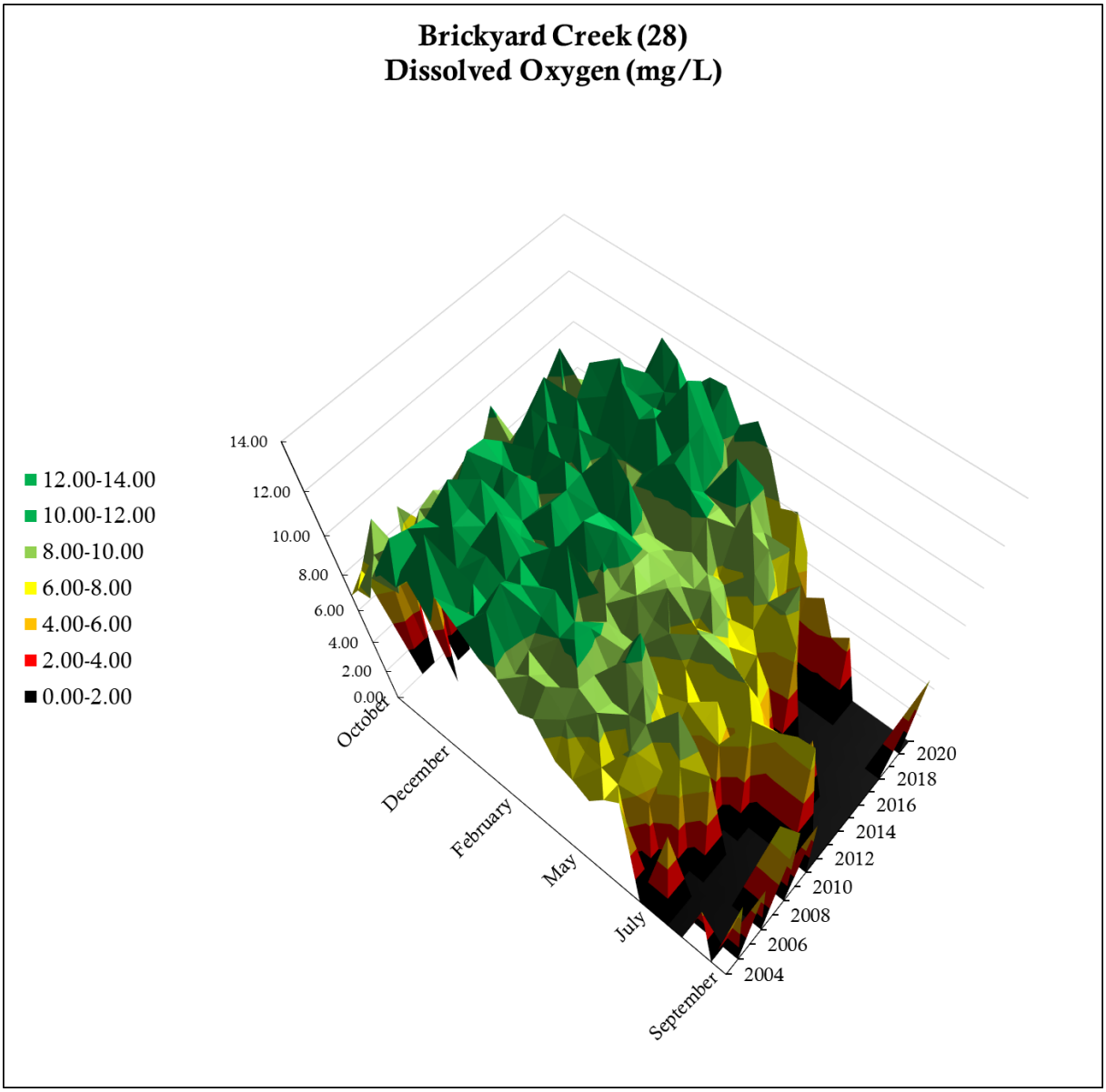
Dissolved Oxygen			Temperature			Fecal Coliform		
18 yr	10 yr	5 yr	18 yr	10 yr	5 yr	18 yr	10 yr	5 yr
		Not Enough Data			Not Enough Data			Not Enough Data

Site 28 is Brickyard Creek, after it has passed through northern Sedro-Woolley, just prior to entering Hart Slough, and eventually the Skagit River. This is an ephemeral creek that regularly dries up by the end of summer. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

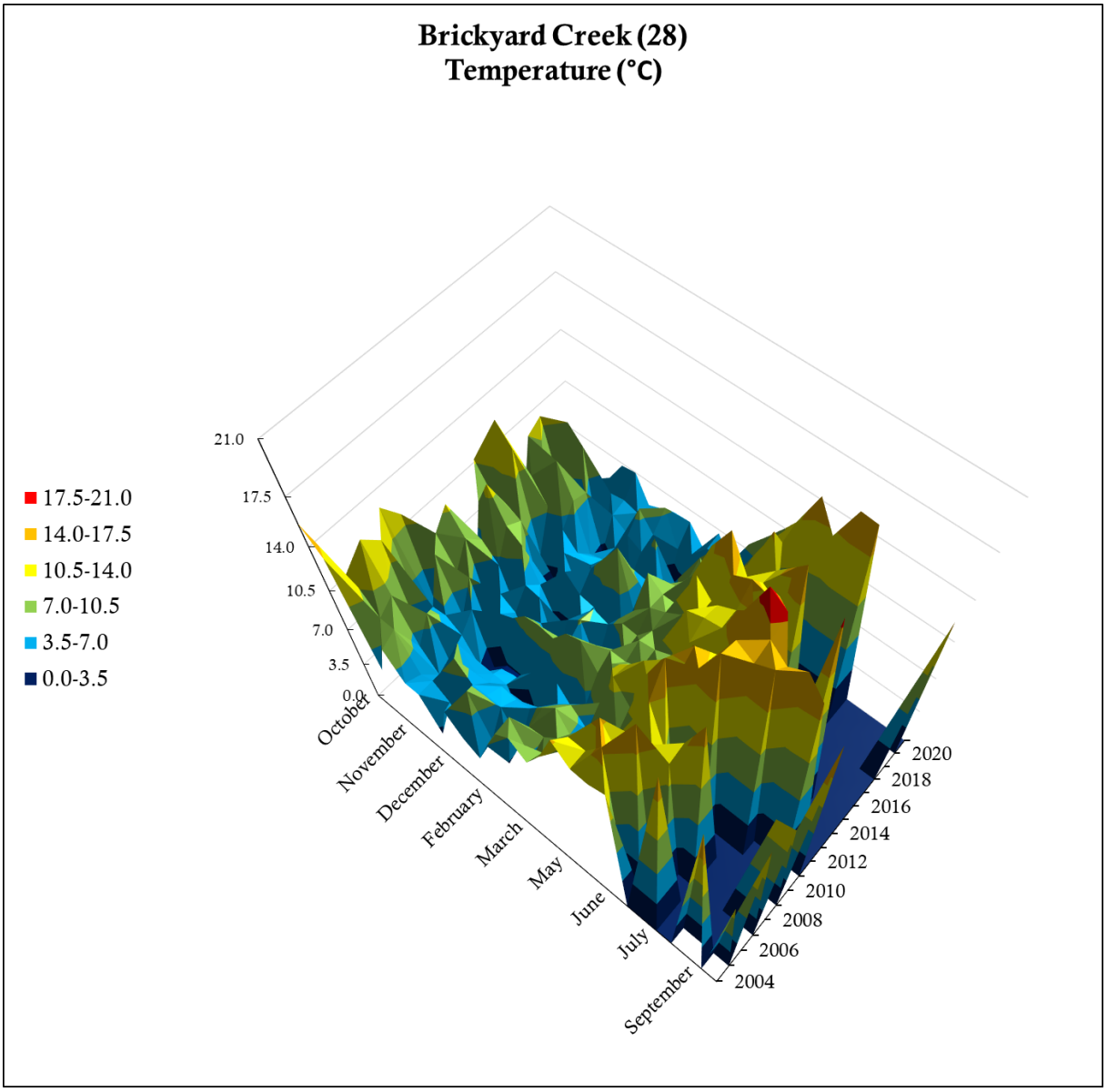
Due to the ephemeral nature of this creek, there were not enough data points collected to be sufficient for generating five-year monthly trends. No monthly trends for DO, temperature, or FC were observed across any of the time periods analyzed in this report.

Site 28 regularly fails to meet state standards for DO during the warmer months, but rarely fails state standards for water temperature. Annual bacterial levels for WY2021 easily passed state standards.

Site 28 is last out of 39 sites for number of significant trends, with 3, and is tied for 13th out of 39 sites for positive trends, with 67%.

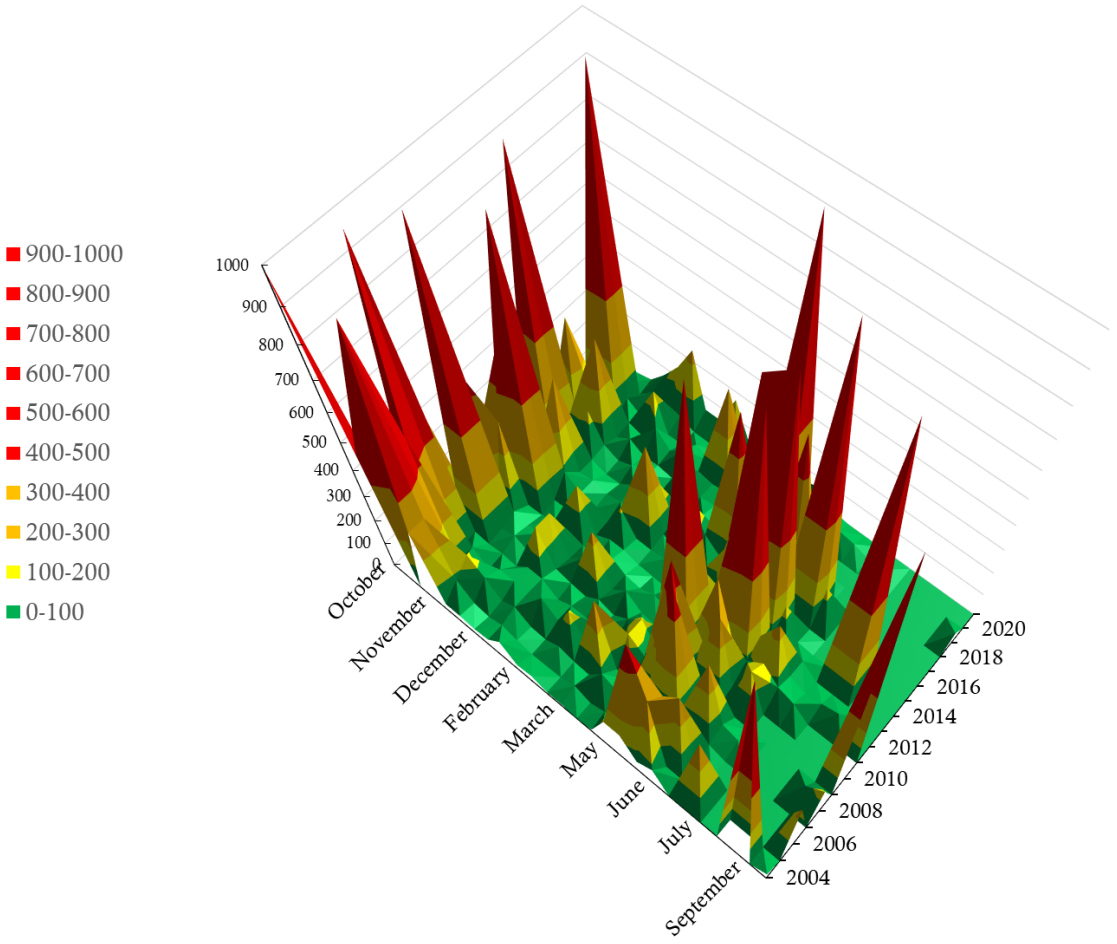


The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

Brickyard Creek (28)
Fecal Coliform (MPN/100 mL)



The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

29

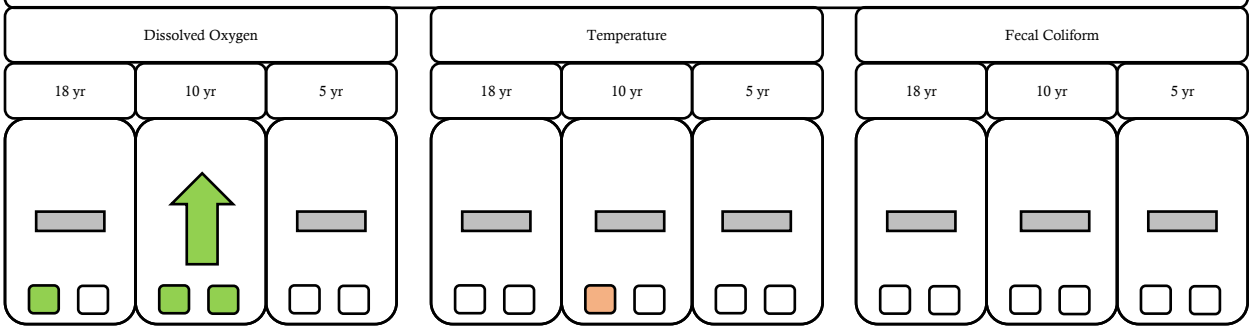
Skagit River
@ River Bend Road

Mainstem Skagit – Mid, TMDL

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
76	63	82	94	92	86	82	87	94	93	93	85	92	81	82	83

Long Term Trends

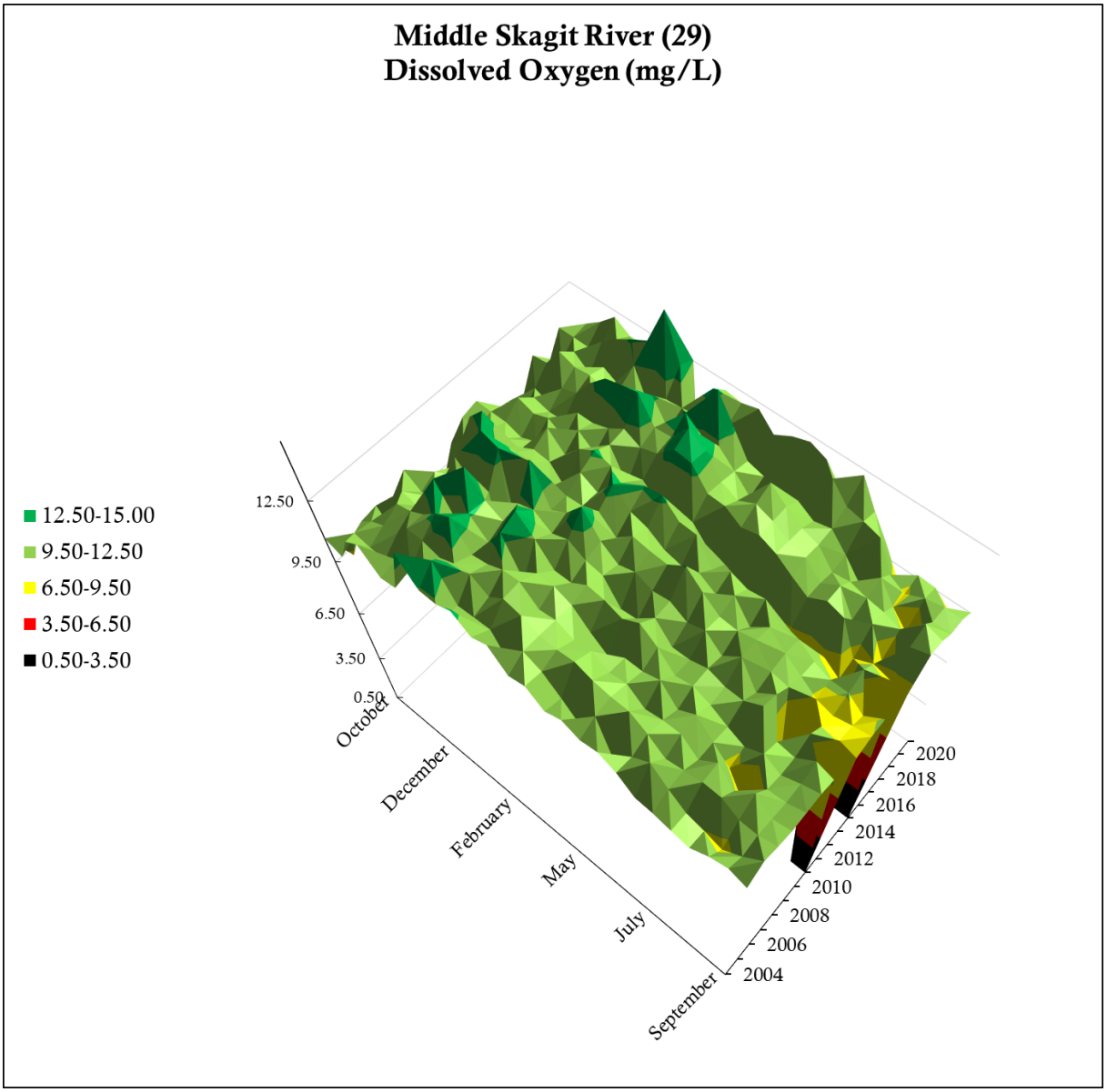


Site 29 is the Skagit River, after it intersects Burlington and Mount Vernon, and prior to the terminal fork. The river is designated as core salmonid habitat and as salmonid spawning, rearing, and migration (SRM) status.

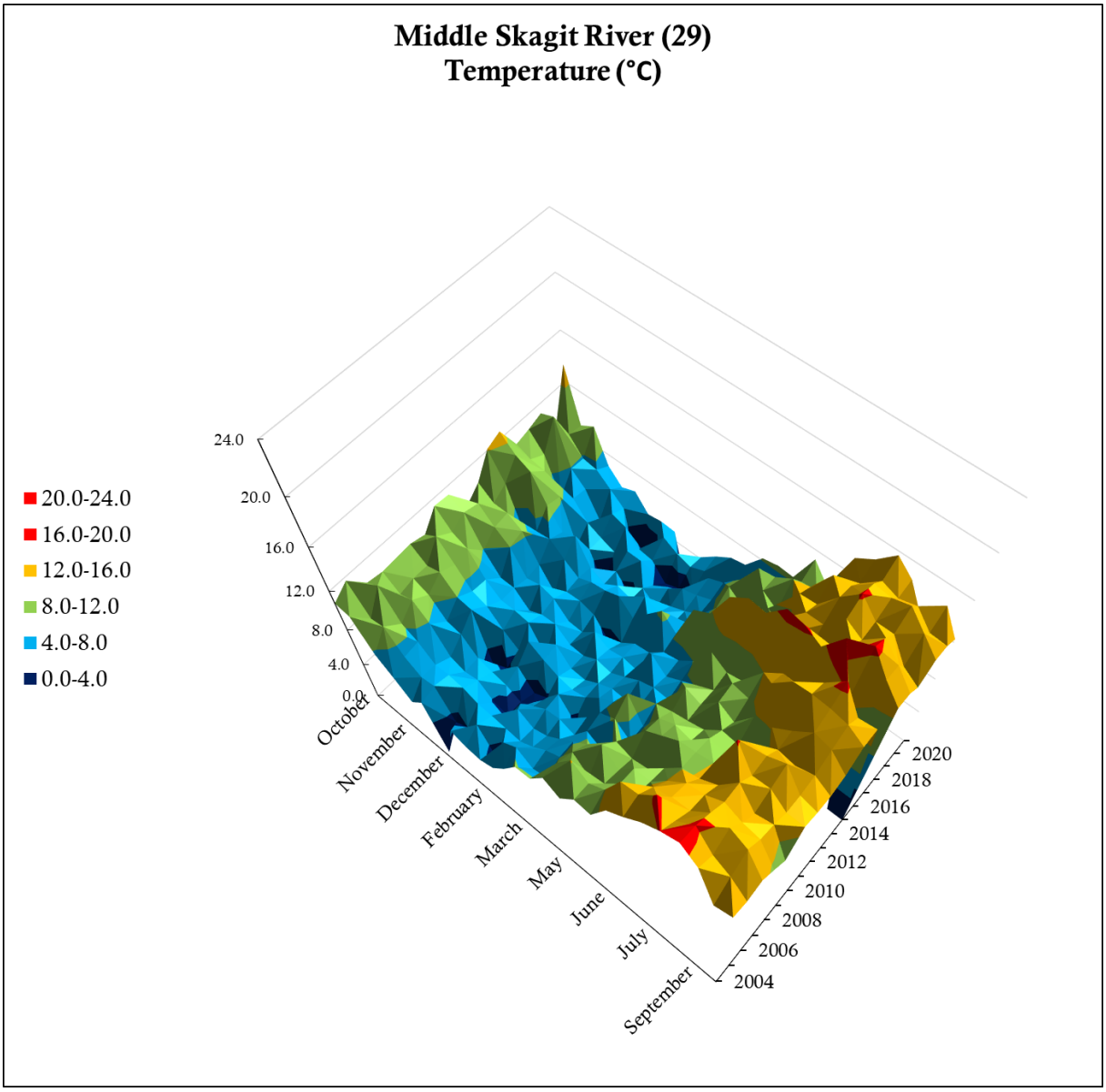
DO is up in the last 17 and 10 years, and temperature has increased in the last 10 years. No other significant long-term trends were observed in temperature or FC across all time periods measured. WQI scores are consistently in the category of least concern.

Site 29 rarely fails to meet state standards for DO and water temperature, and only ever at the warmest days of the year. Annual bacterial levels easily meet state standards.

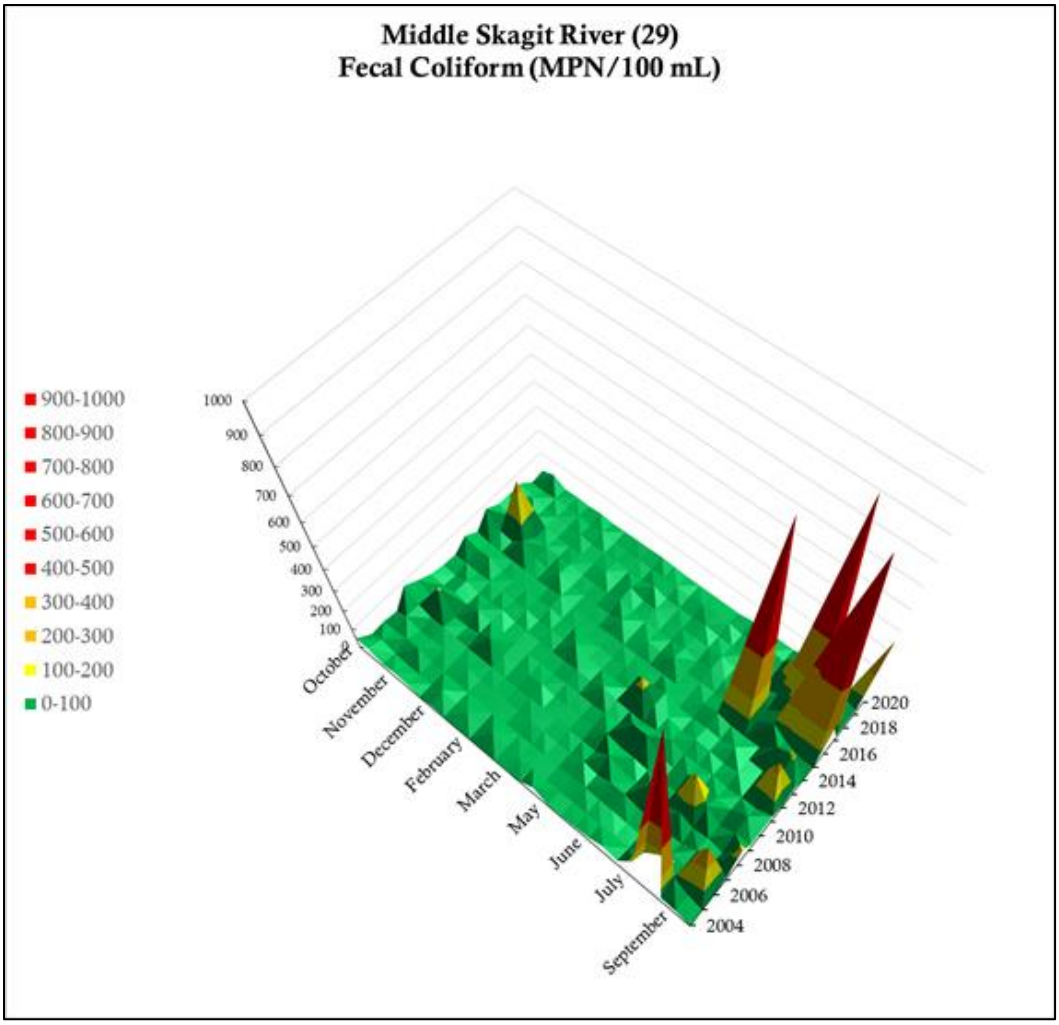
Site 29 is tied for 32nd out of 39 sites for number of significant trends, with 7, and is 11th out of 39 sites for positive trends, with 71%.



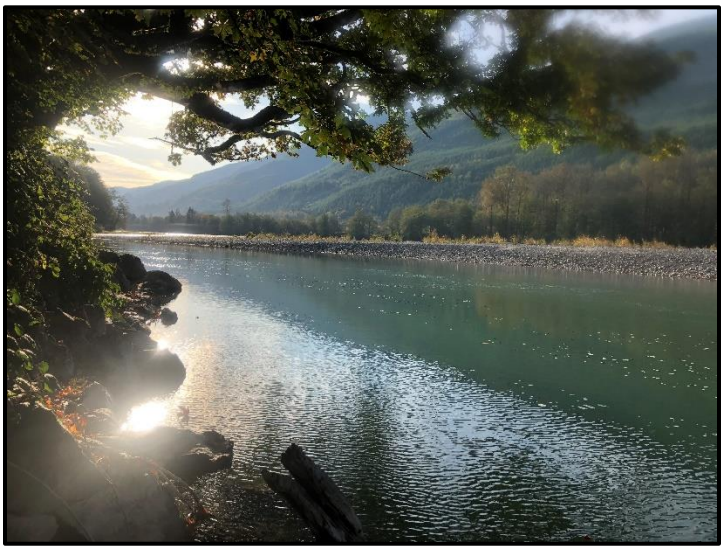
The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.



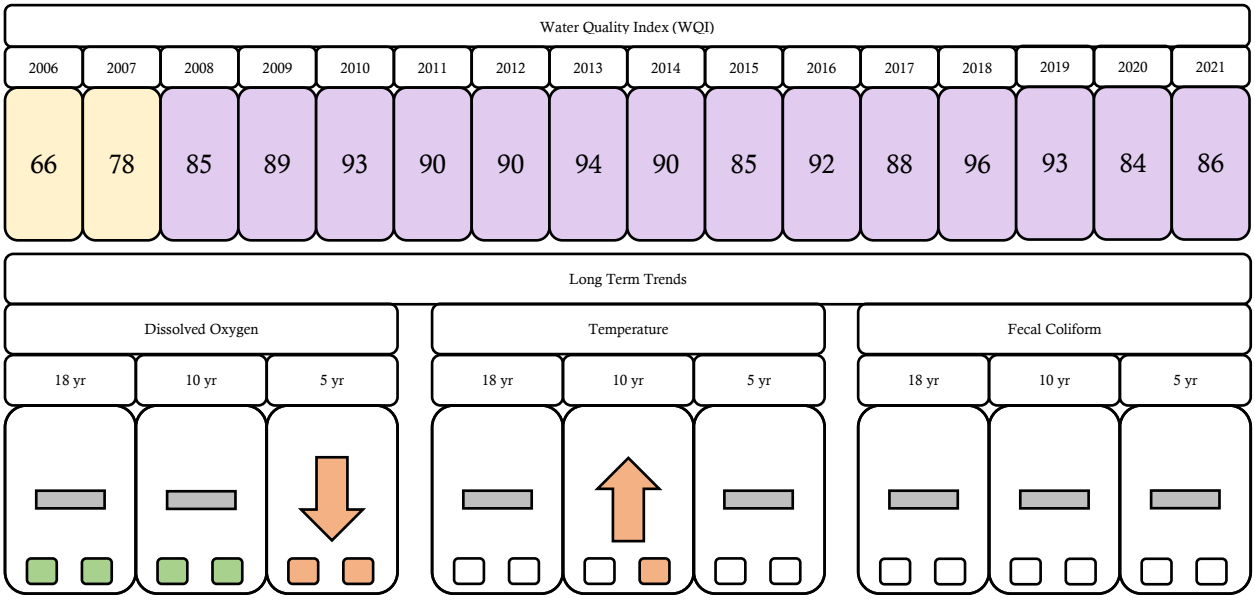
The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



30

Skagit River
@ Cape Horn Road

Mainstem Skagit - Upper

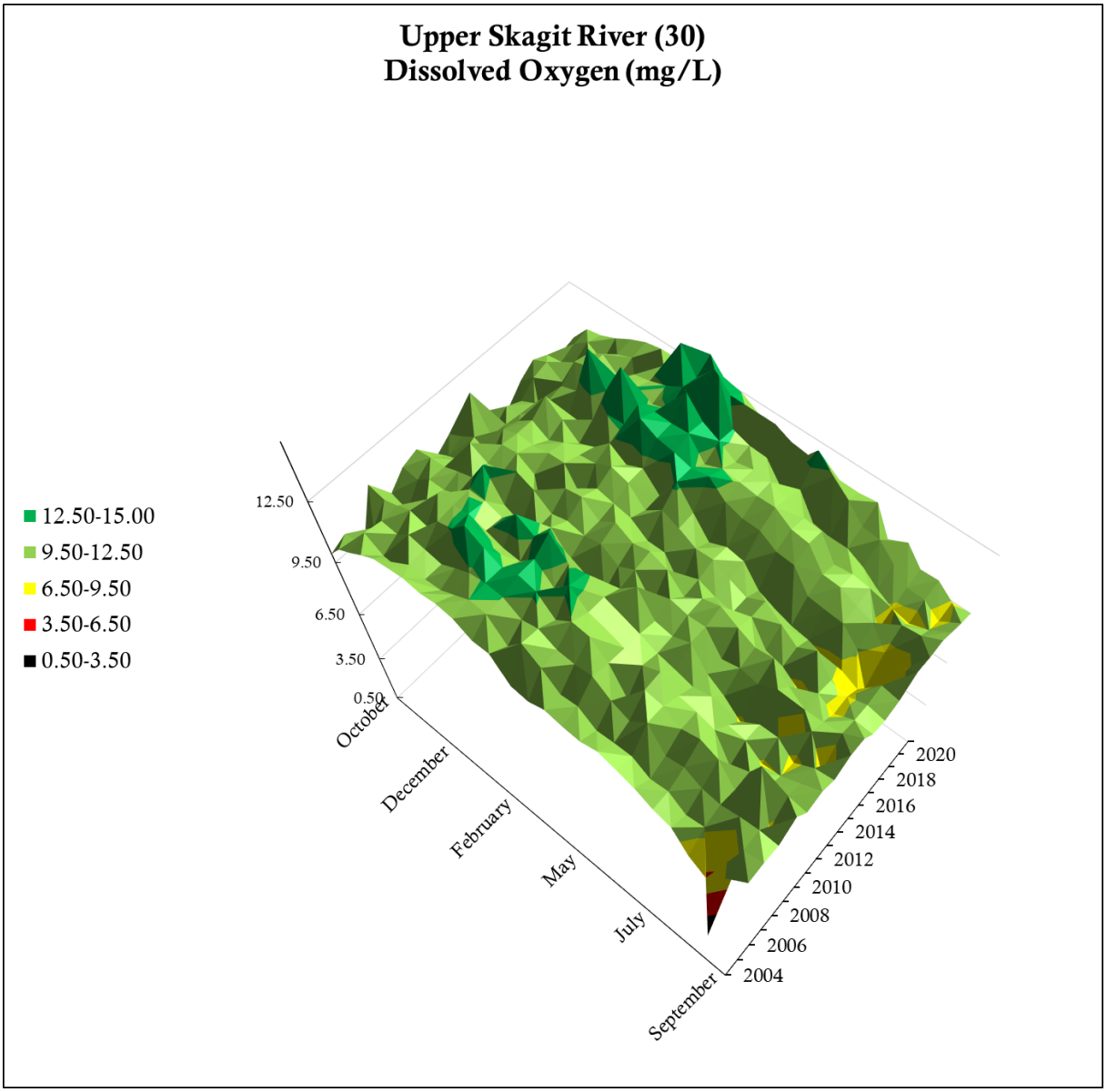


Site 30 is the Skagit River, at its furthest upstream sampling point for this program, east of Hamilton. The river is designated as core salmonid habitat.

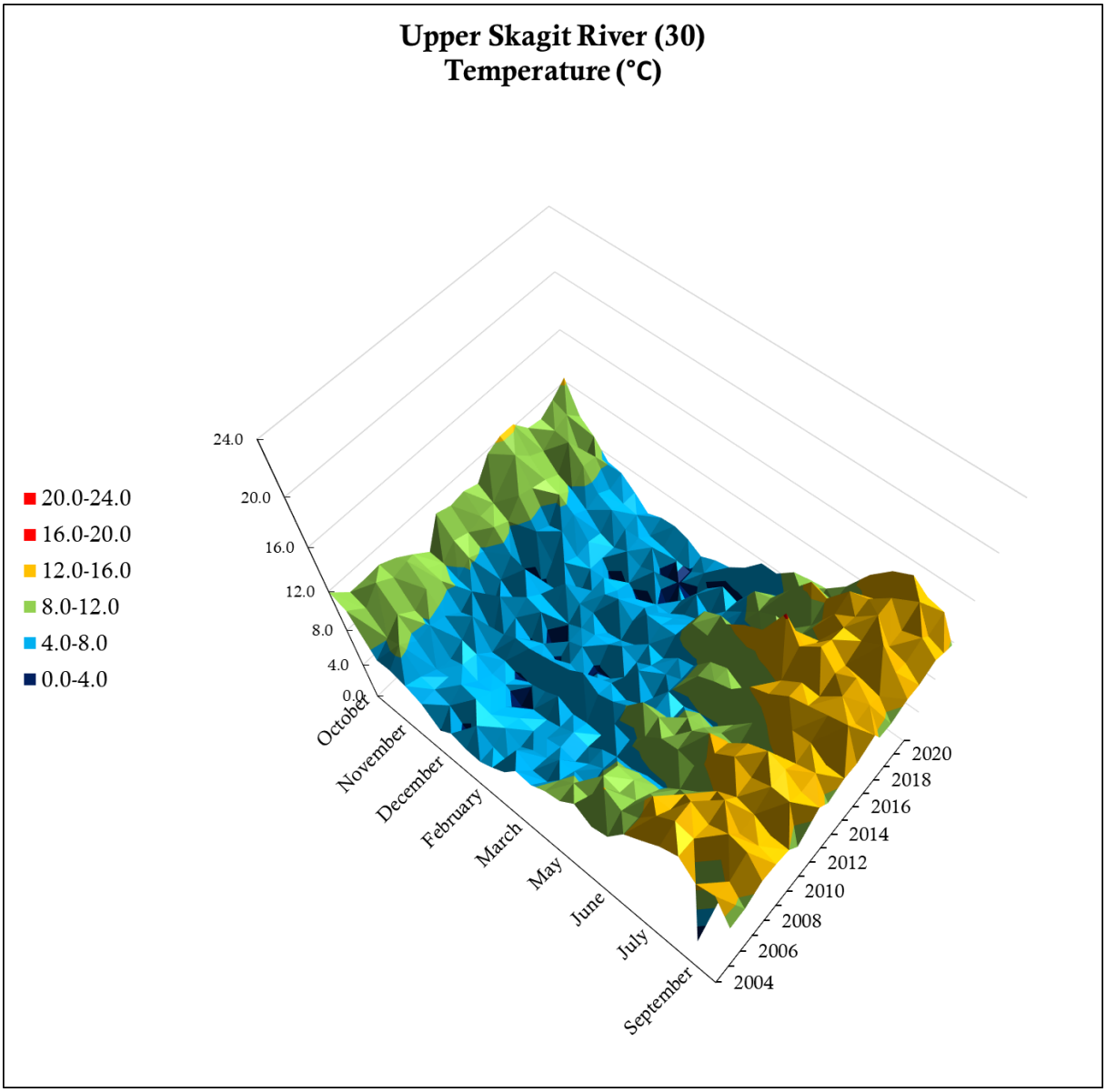
Dissolved oxygen has nearly significantly increased over the last 17 years and ten years, but it has decreased in the 5-year time frame. Water temperature is warmer now than it was ten years ago. WQI scores are consistently in the category of least concern.

Site 30 rarely fails to meet state standards for DO and water temperature, and only ever at the very warmest days of the year. Annual bacterial levels easily meet state standards.

Site 30 is tied for 4th out of 39 sites for number of significant trends, with 14, and is tied for 22nd out of 39 sites for positive trends, with 57%.

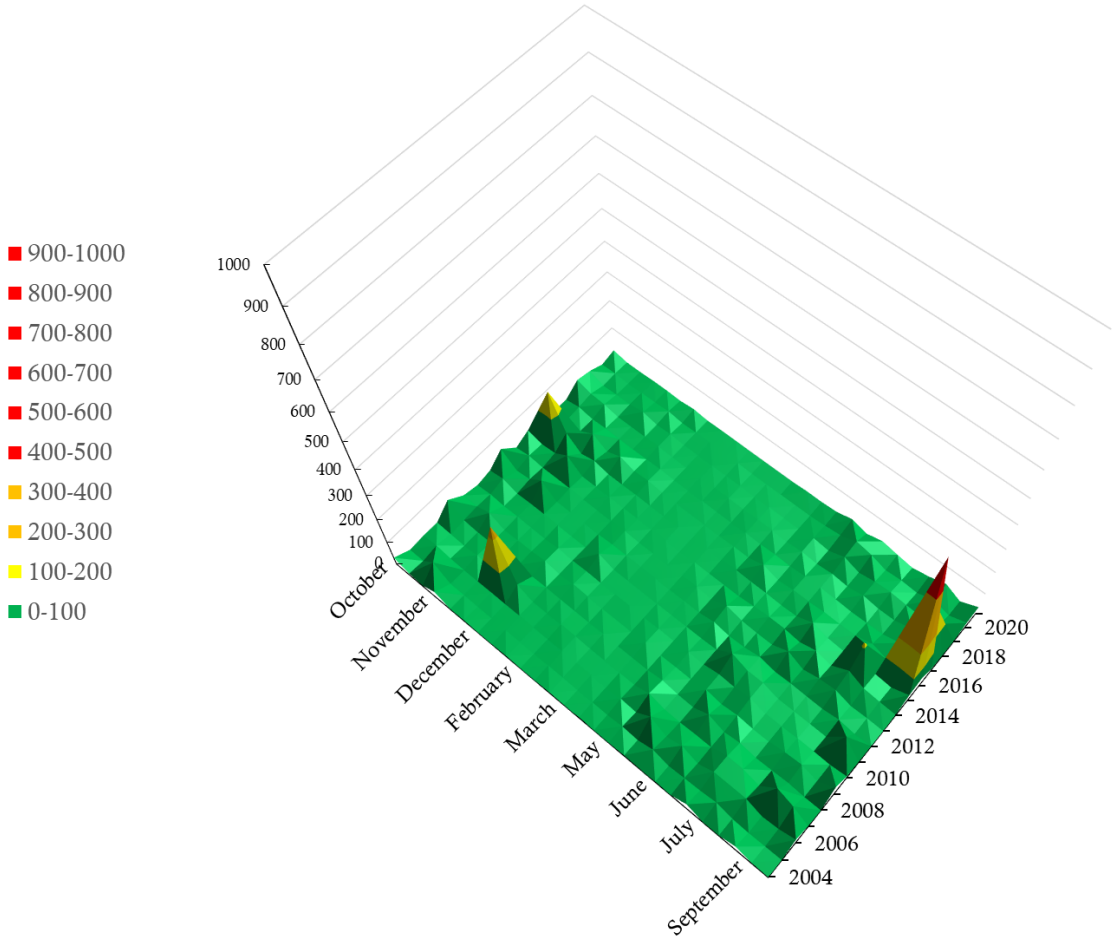


The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

Upper Skagit River (30)
Fecal Coliform (MPN/100 mL)



The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

32

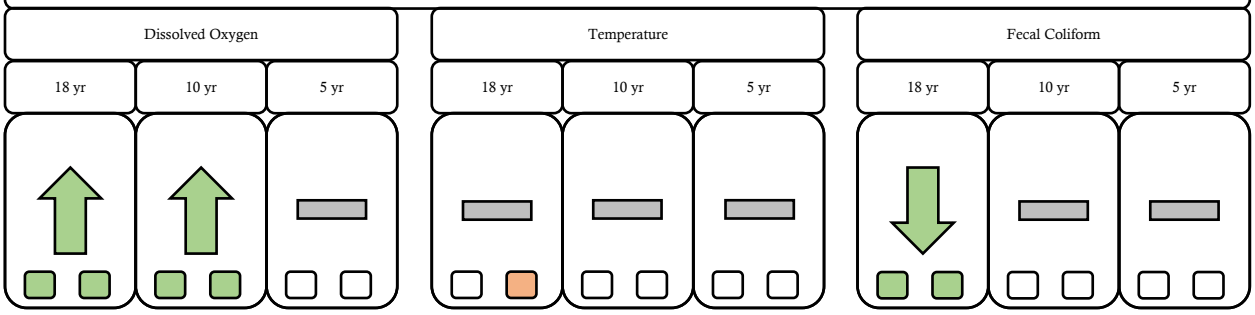
Samish River
@ Thomas Road

Downstream Ag

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
34	47	43	75	83	92	70	89	88	83	80	84	93	91	83	86

Long Term Trends

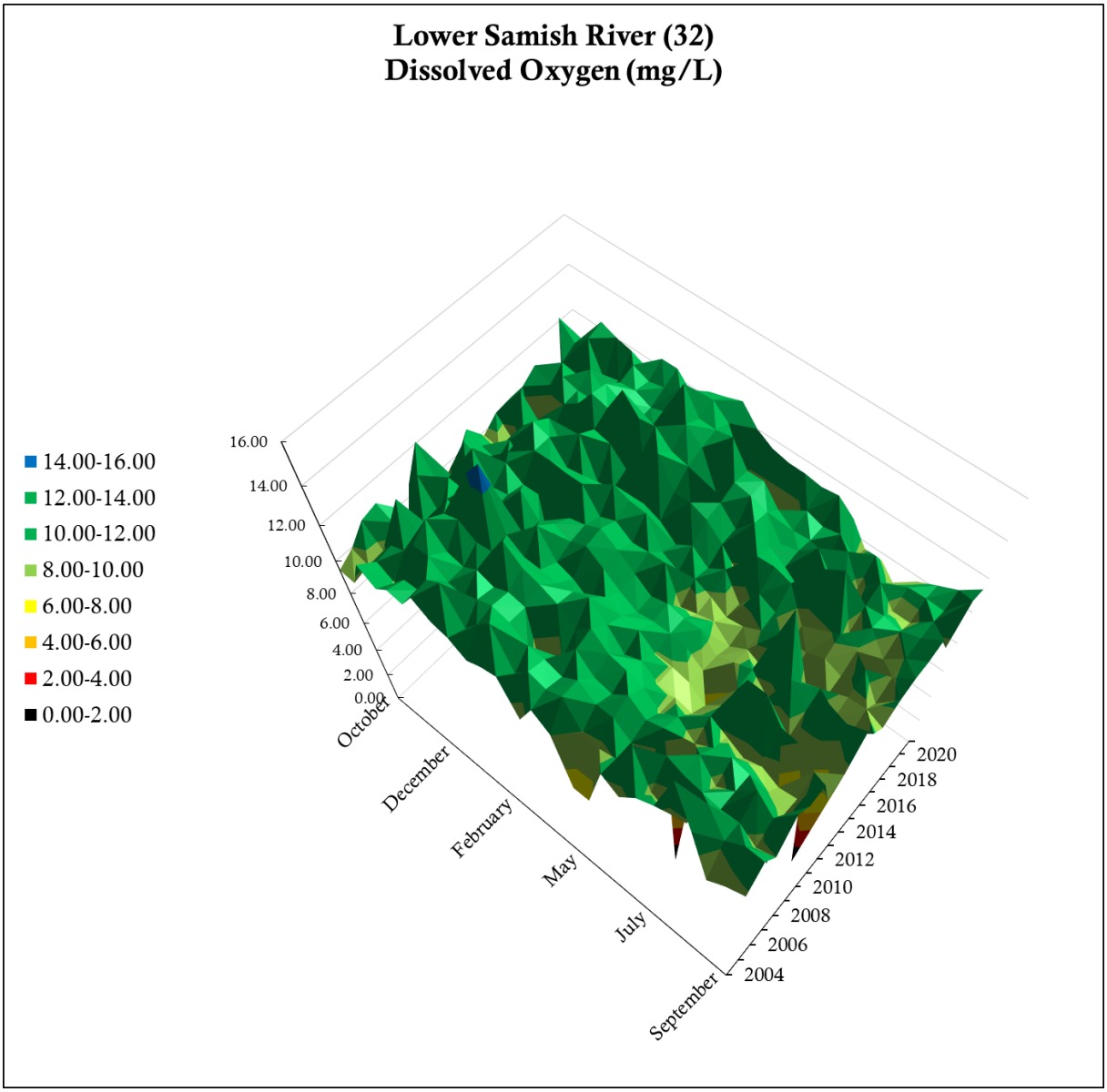


Site 32 is the Samish River and is the last site that is sampled by this program prior to the river terminating in Samish Bay. The Samish River's watershed contains expansive agricultural activity. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

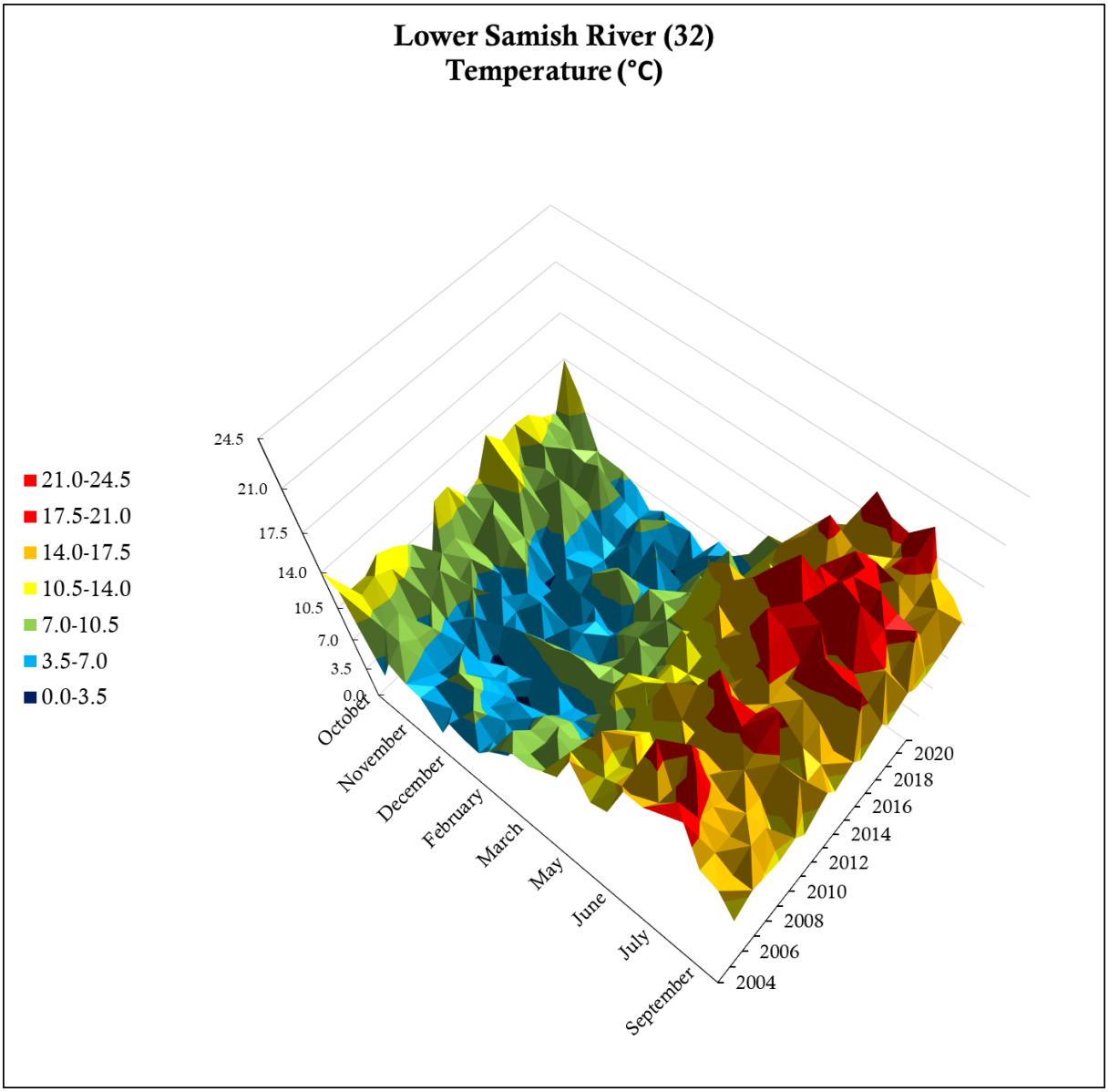
Dissolved oxygen has increased over the last 17 and ten years. Fecal coliform counts are lower now than they were when this program began. WQI Scores have improved over the length of this program and are now consistently in the category of least concern.

Site 32 almost never fails to meet state standards for DO, but typically exceeds state standards for water temperature during the warmer months of the year. Annual bacterial levels passed the state standards in the 2021WY.

Site 32 is tied for 8th out of 39 sites for number of significant trends, with 13, and is tied for 1st out of 39 sites for positive trends, with 100%.

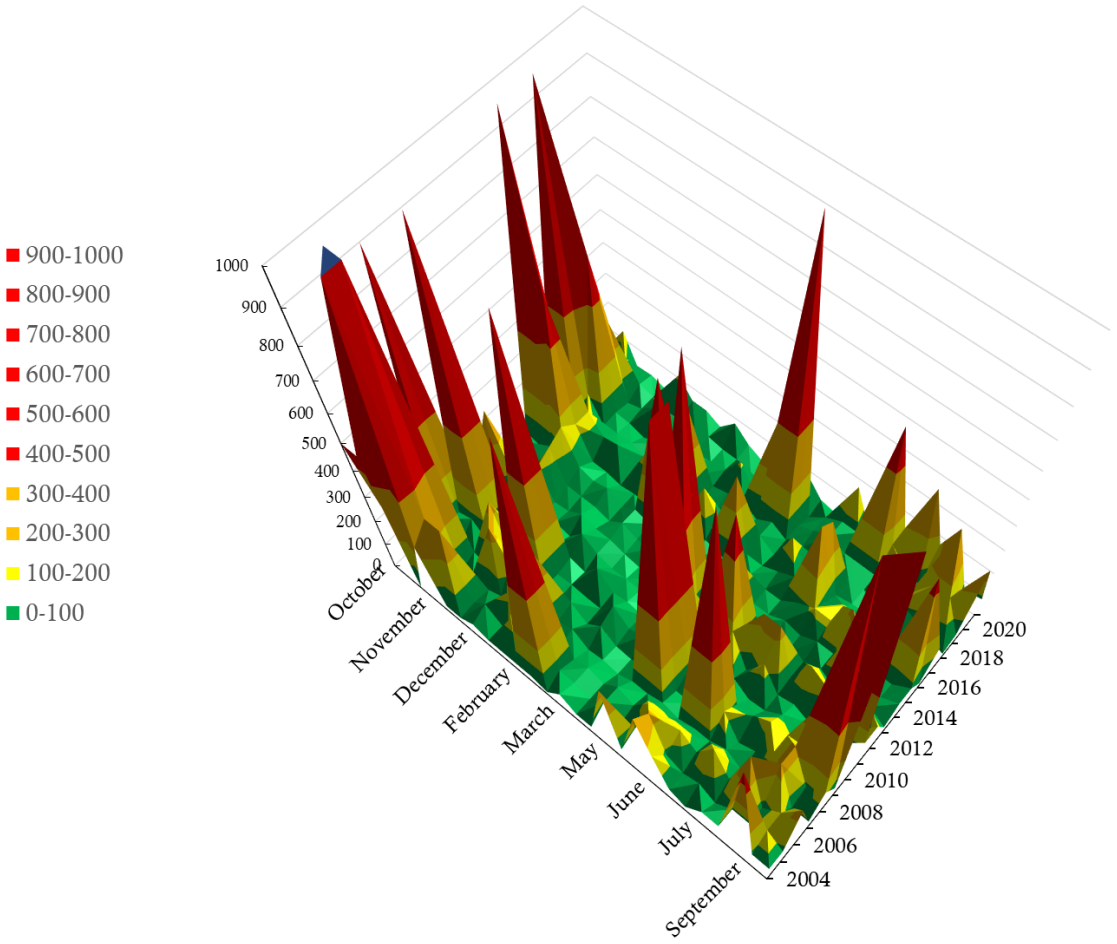


The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

Lower Samish River (32)
Fecal Coliform (MPN/100 mL)



The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

33

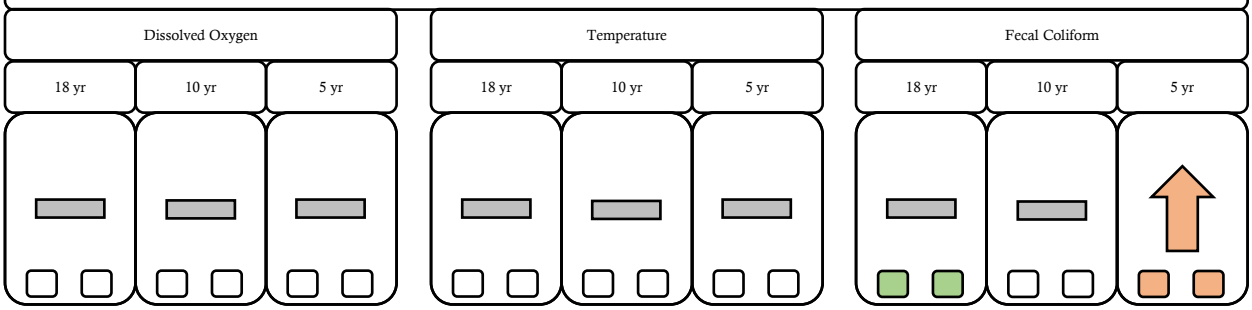
Alice Bay Pump Station
@ Samish Island Road

Downstream Ag

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
2	5	6	15	12	33	37	24	17	24	23	35	42	16	26	34

Long Term Trends

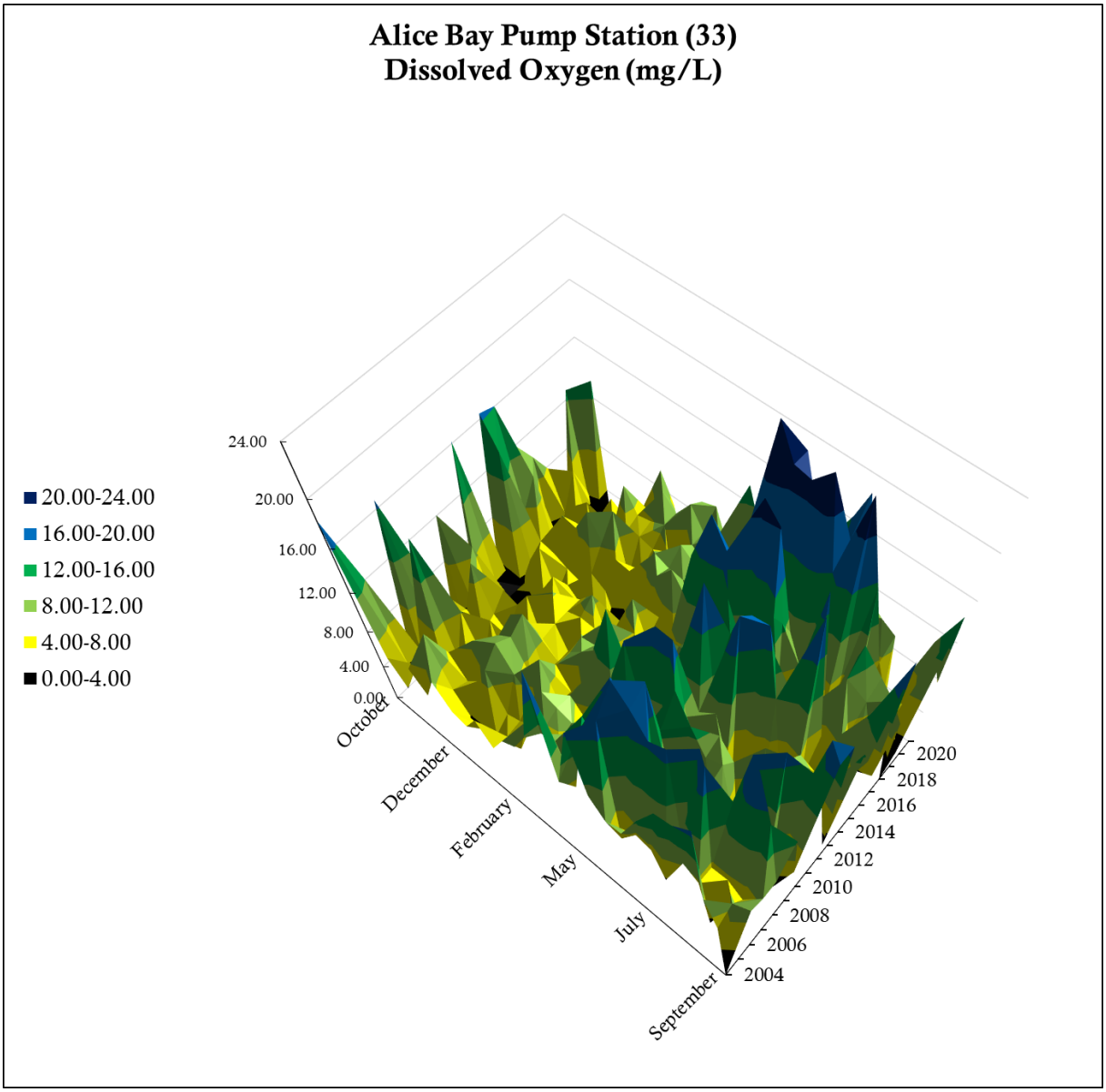


Site 33 is the pump station for the agricultural drainage ditches at Alice Bay, just to the west of the mouth of the Samish River. Sites like this are characterized by being stagnant or slow-moving and are heavily tidally influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

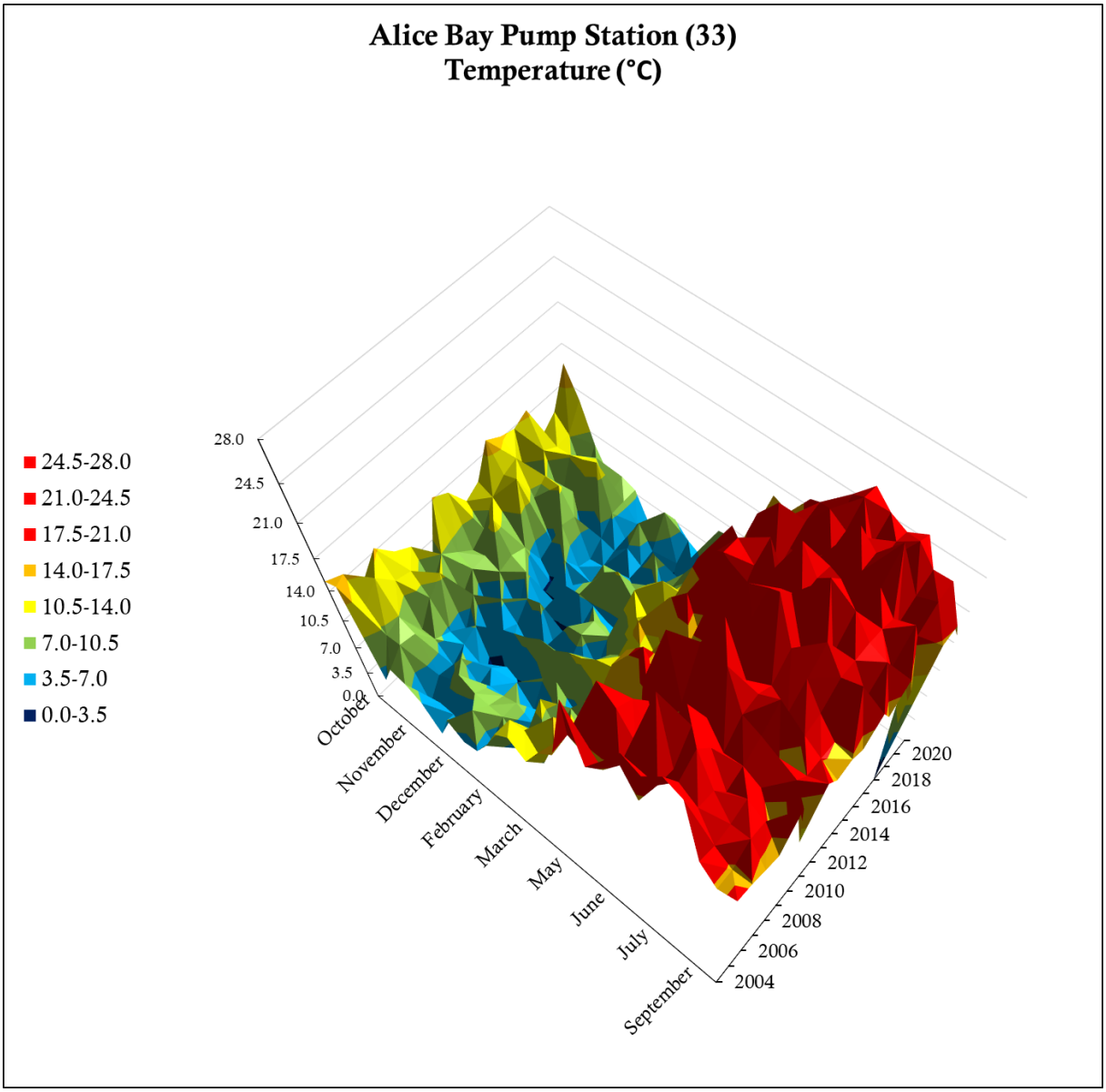
Fecal coliform counts at this site have declined over the last 18 years, but they increased in the last 5. WQI scores are consistently in the category of highest concern.

Site 33 regularly fails to meet state standards for DO and water temperature. Annual FC levels pass the state standard for geomean of 100 but fail the state standard for a 90th percentile of 200. EC standards were met at the site.

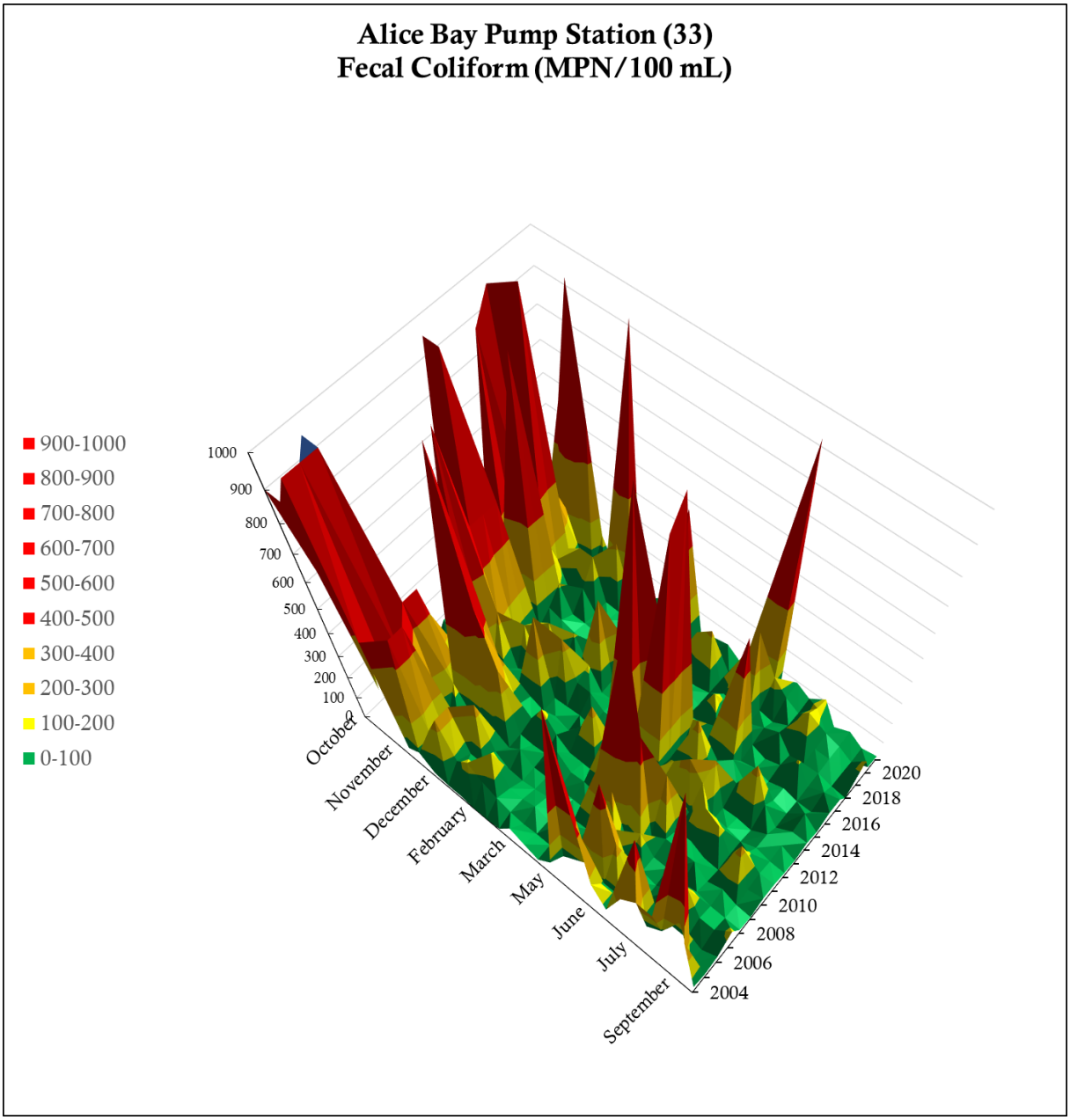
Site 33 is tied for 23rd out of 39 sites for number of significant trends, with 9, and is 25th out of 39 sites for positive trends, with 44%.



The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

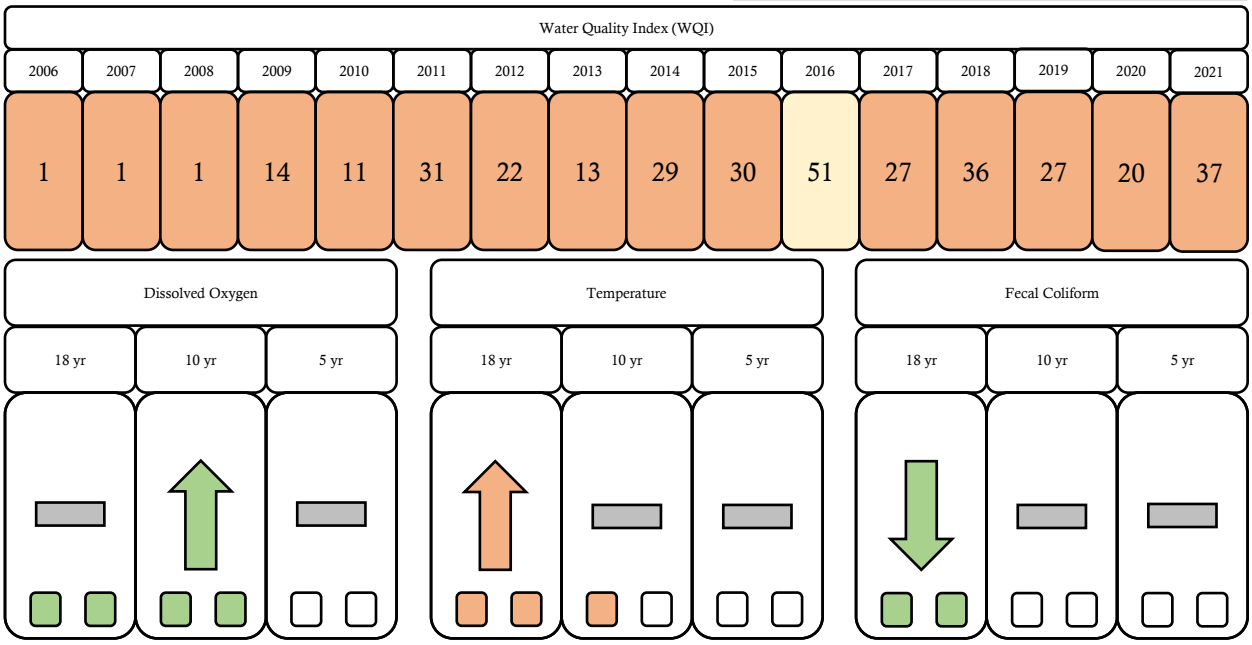


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

34

No Name Slough
@ Bayview-Edison Road

Downstream Ag

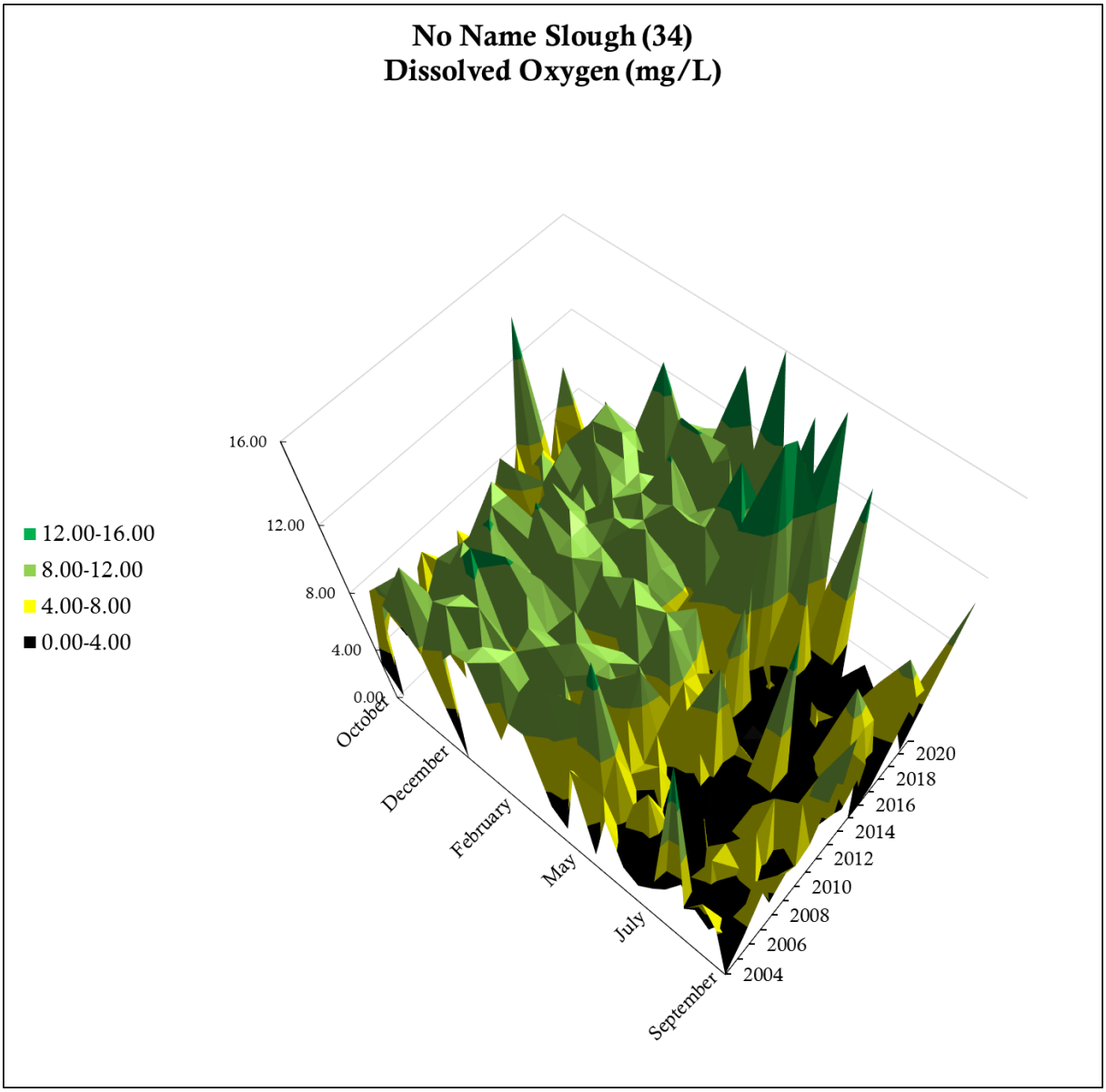


Site 34 is No Name Slough, west of the Skagit Regional Airport, and just prior to terminating in Padilla Bay. Sites like this are characterized by being stagnant or slow-moving and are heavily tidally influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

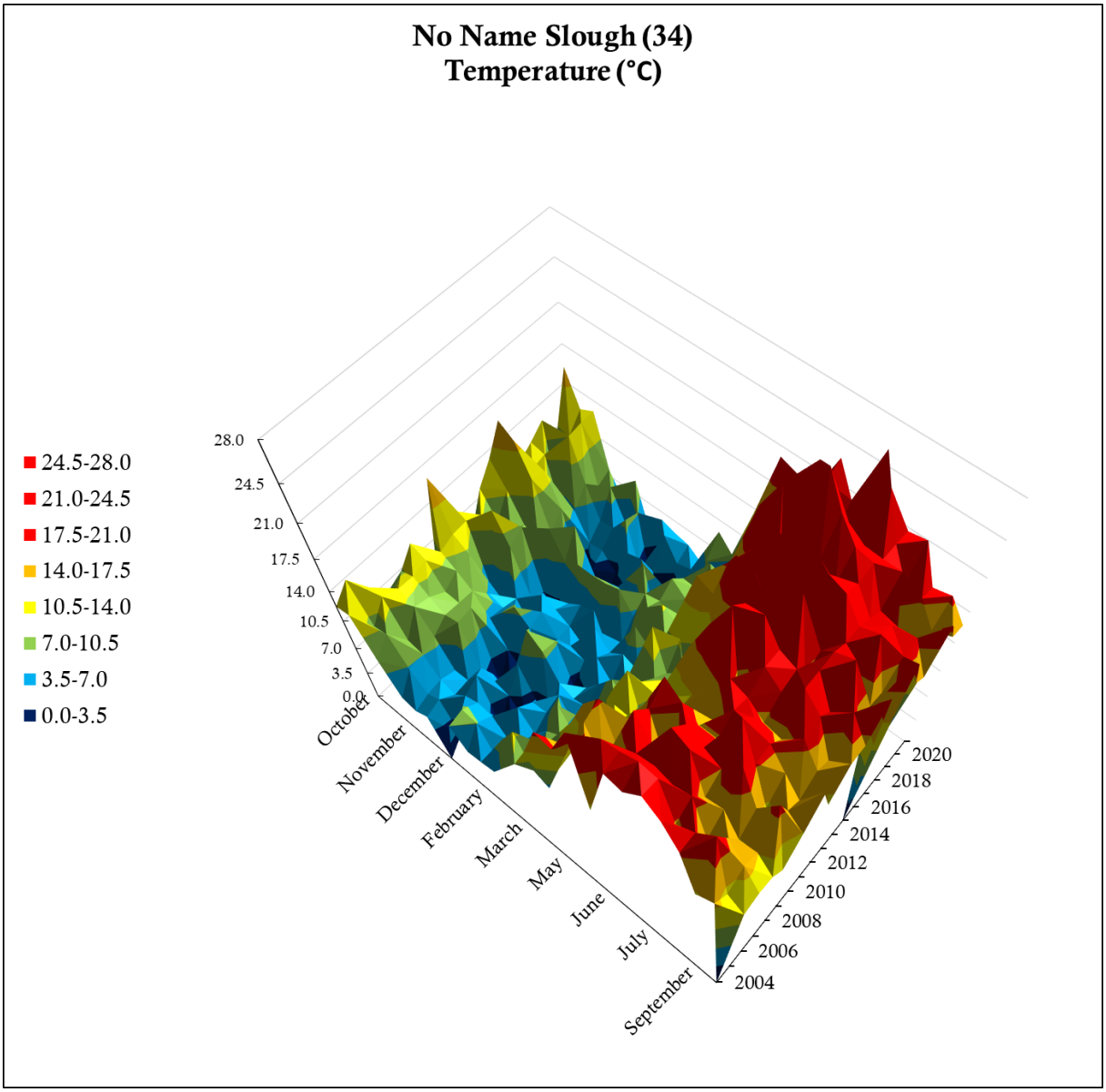
Dissolved oxygen has increased in the 18- and 10-year time frames. Water temperatures are warmer now than they were at the beginning of the program and 10 years ago. Fecal coliform counts are lower than they were at the beginning of this program 18 years ago.

Site 34 regularly fails to meet state standards for DO and water temperature. Annual FC levels failed state standards for geomean and 90th percentile while standards for EC were met.

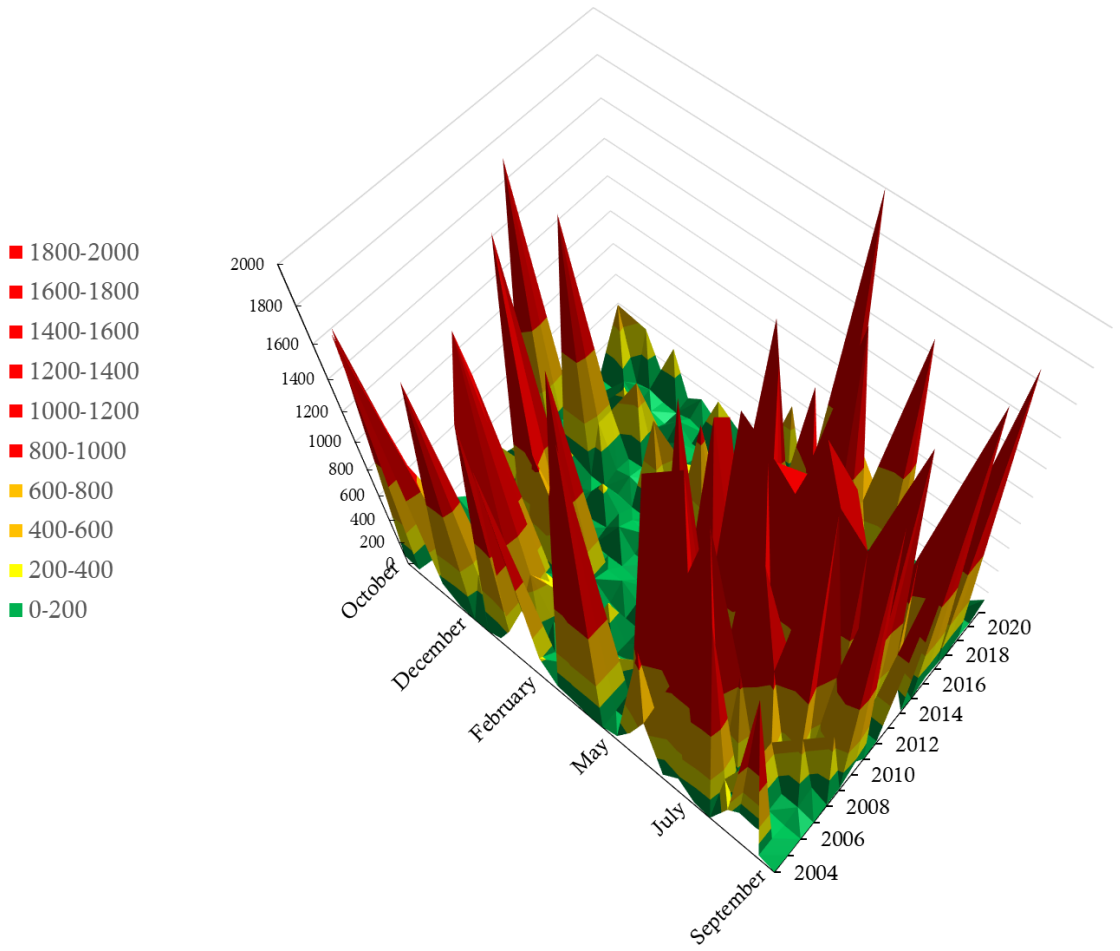
Site 34 is 1st out of 39 sites for number of significant trends, with 19, and is tied for 17th out of 39 sites for positive trends, with 63%.



The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

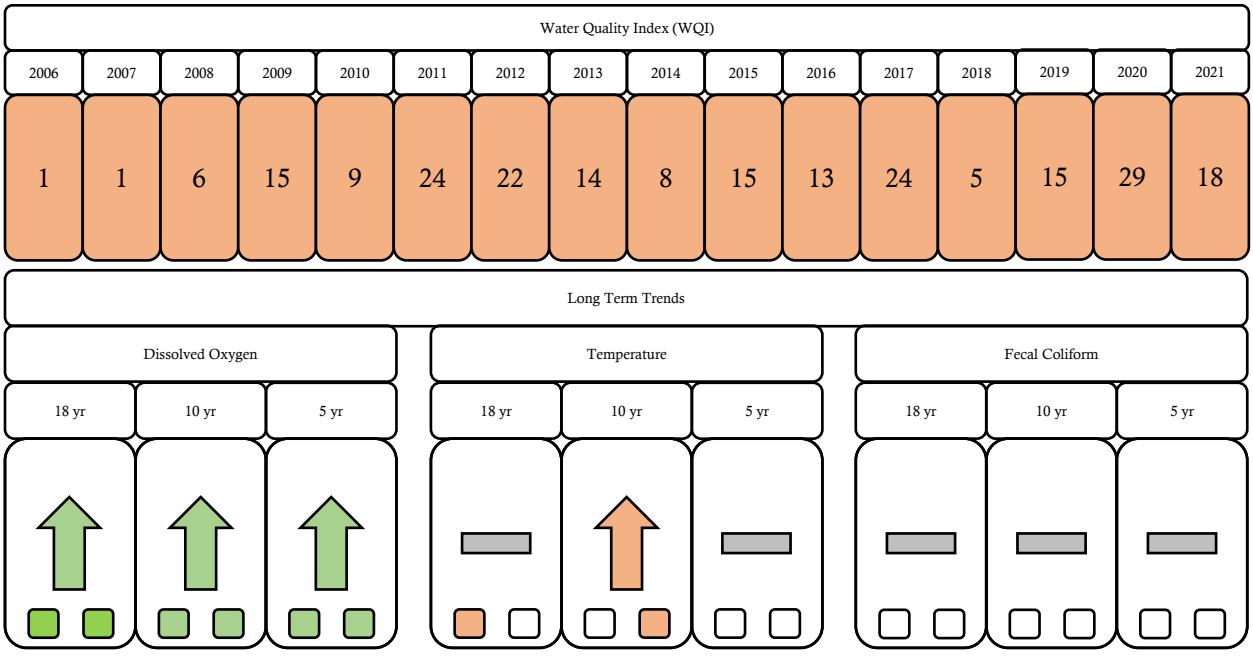


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green almost meets that standard. The water year on the x-axis begins in October and ends in September.

35

Joe Leary Slough
@ D'Arcy Road

Downstream Ag

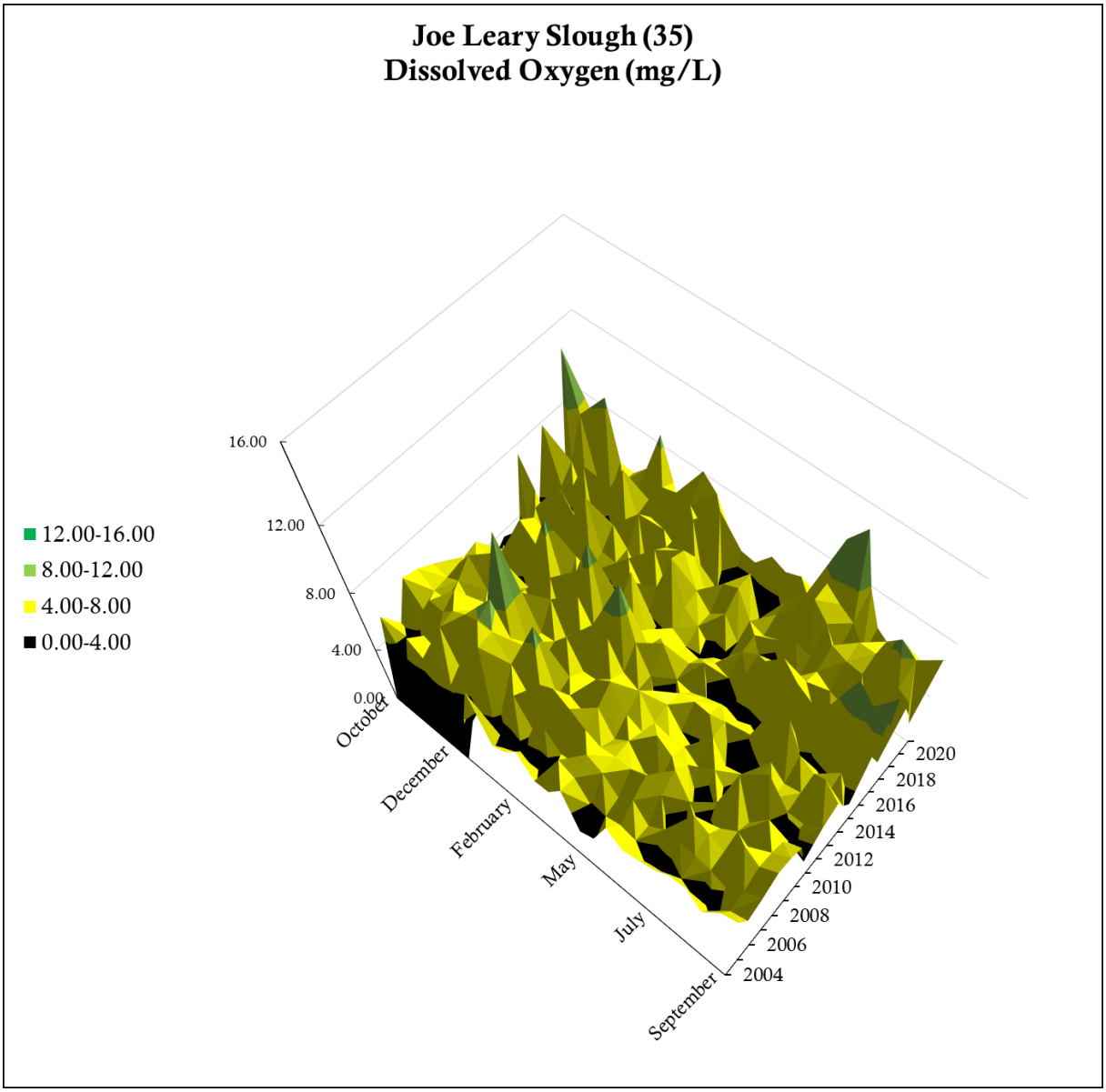


Site 35 is Joe Leary Slough, just prior to where it enters Padilla Bay. This slough was constructed for agricultural drainage and was not naturally formed. Sites like this are characterized by being stagnant or slow-moving and are heavily tidally influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

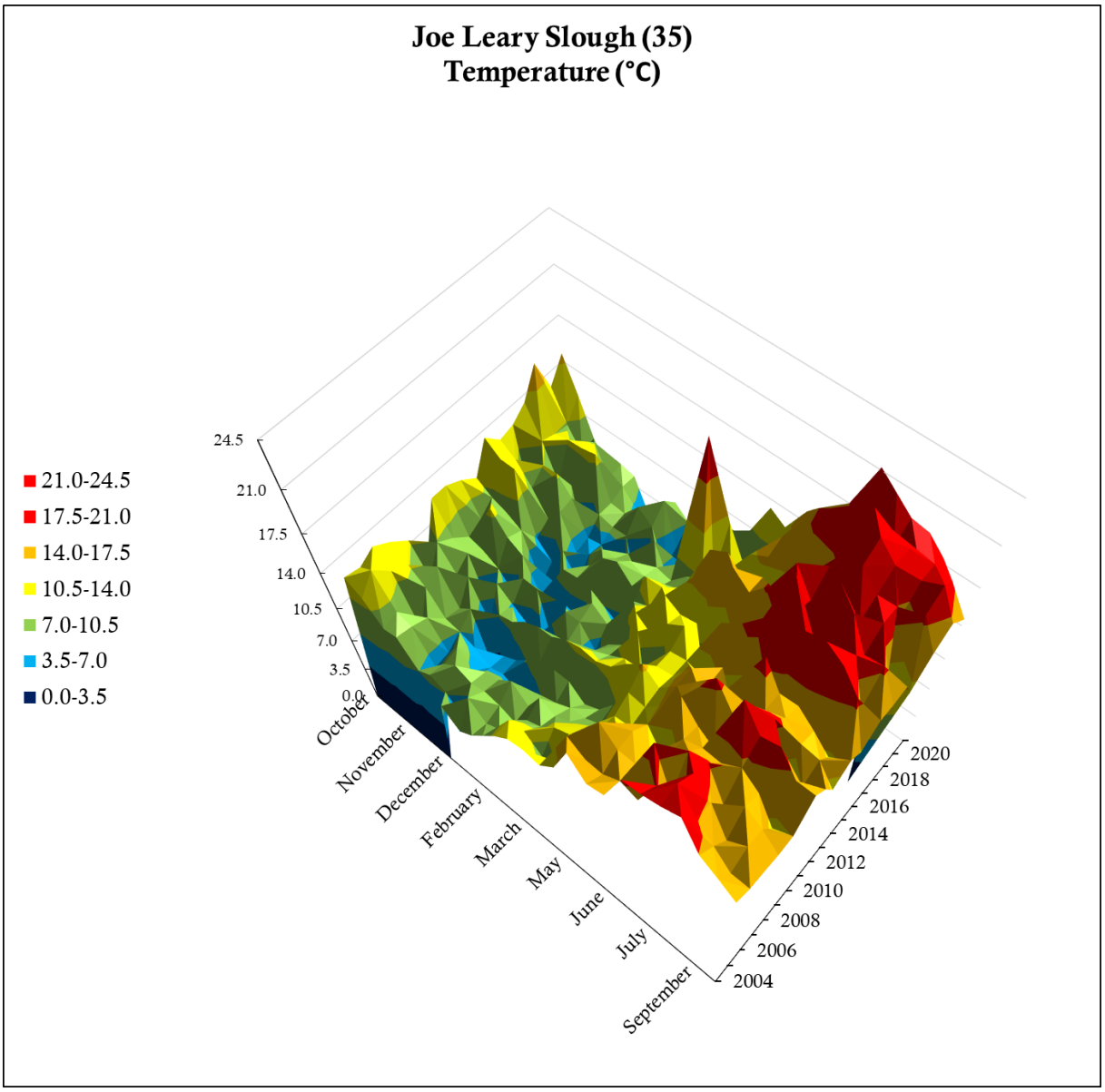
Dissolved oxygen as increased significantly over all measured time frames. Water temperatures are higher now than they were ten years ago. WQI scores are consistently in the category of highest concern.

Site 35 very rarely ever meets state standards for DO and fails to meet state standards for water temperature during the warmer months. Annual FC levels pass the state standard for geomean of 100 but fail the state standard for a 90th percentile of 200. EC levels met states standards for YR2021

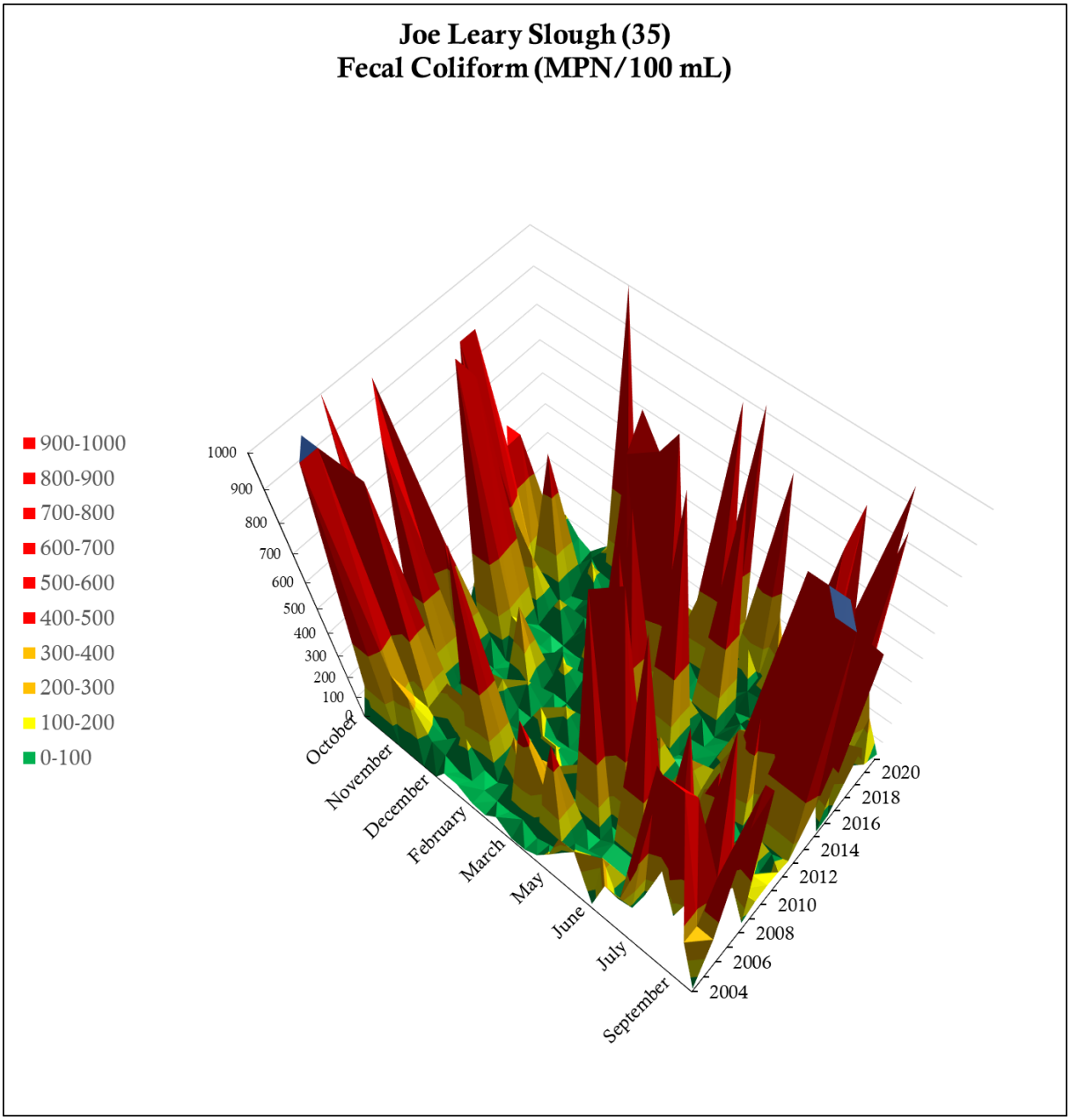
Site 35 is tied for 4th out of 39 sites for number of significant trends, with 14, and is 4th out of 39 sites for positive trends, with 86%.



The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

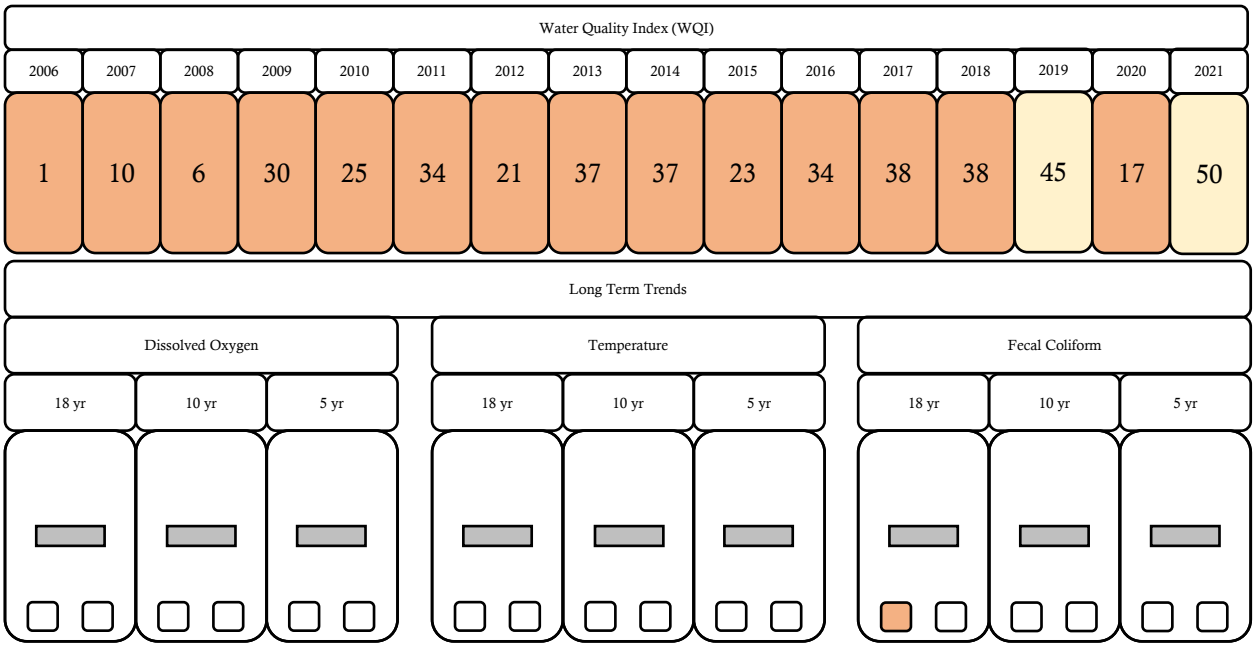


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

36

Edison Slough
@ Edison Elementary

Downstream Ag

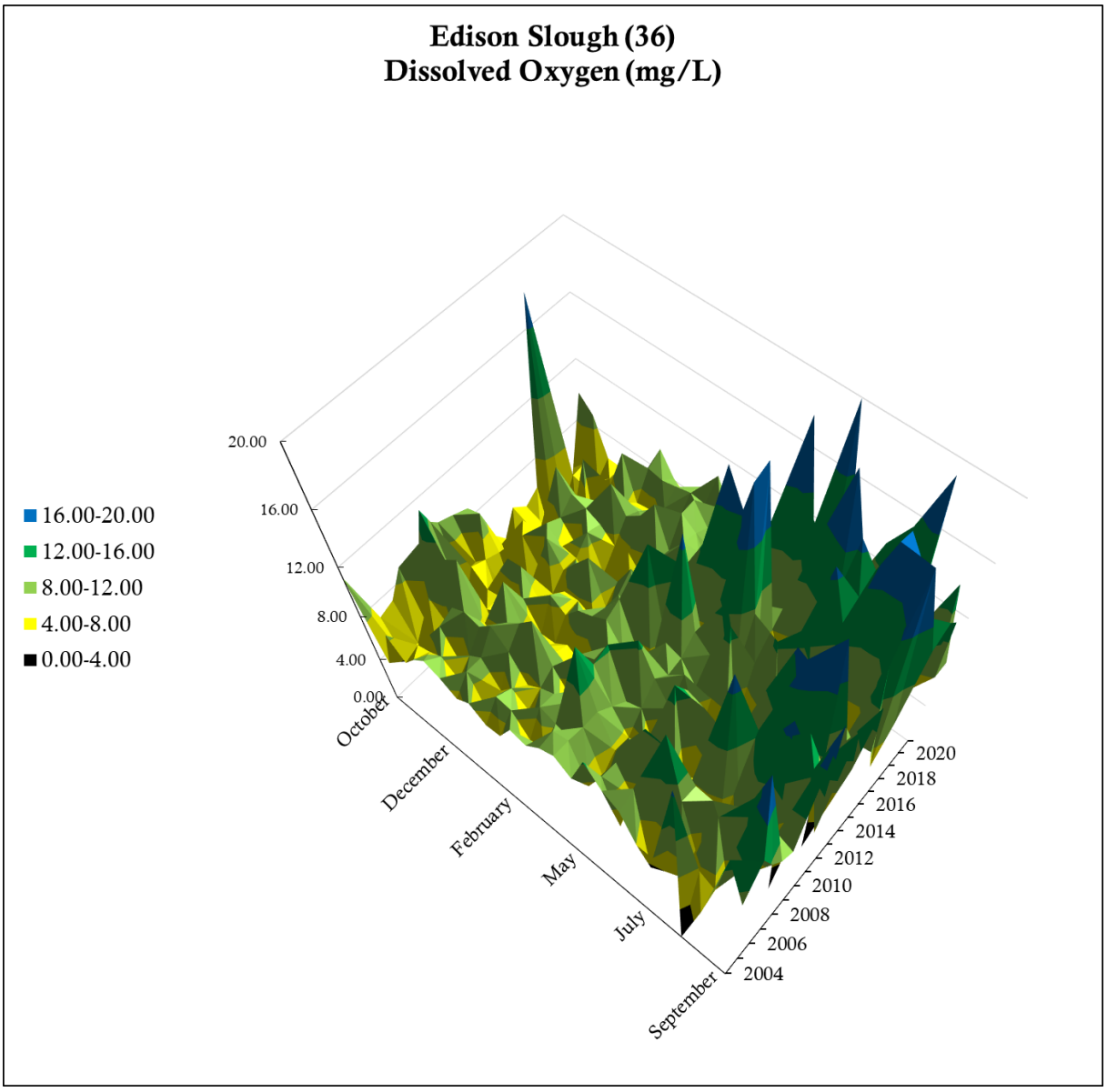


Site 36 is Edison Slough, just prior to the town of Edison and its terminal discharge into Samish Bay. Sites like this are characterized by being stagnant or slow-moving, and are heavily tidally-influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

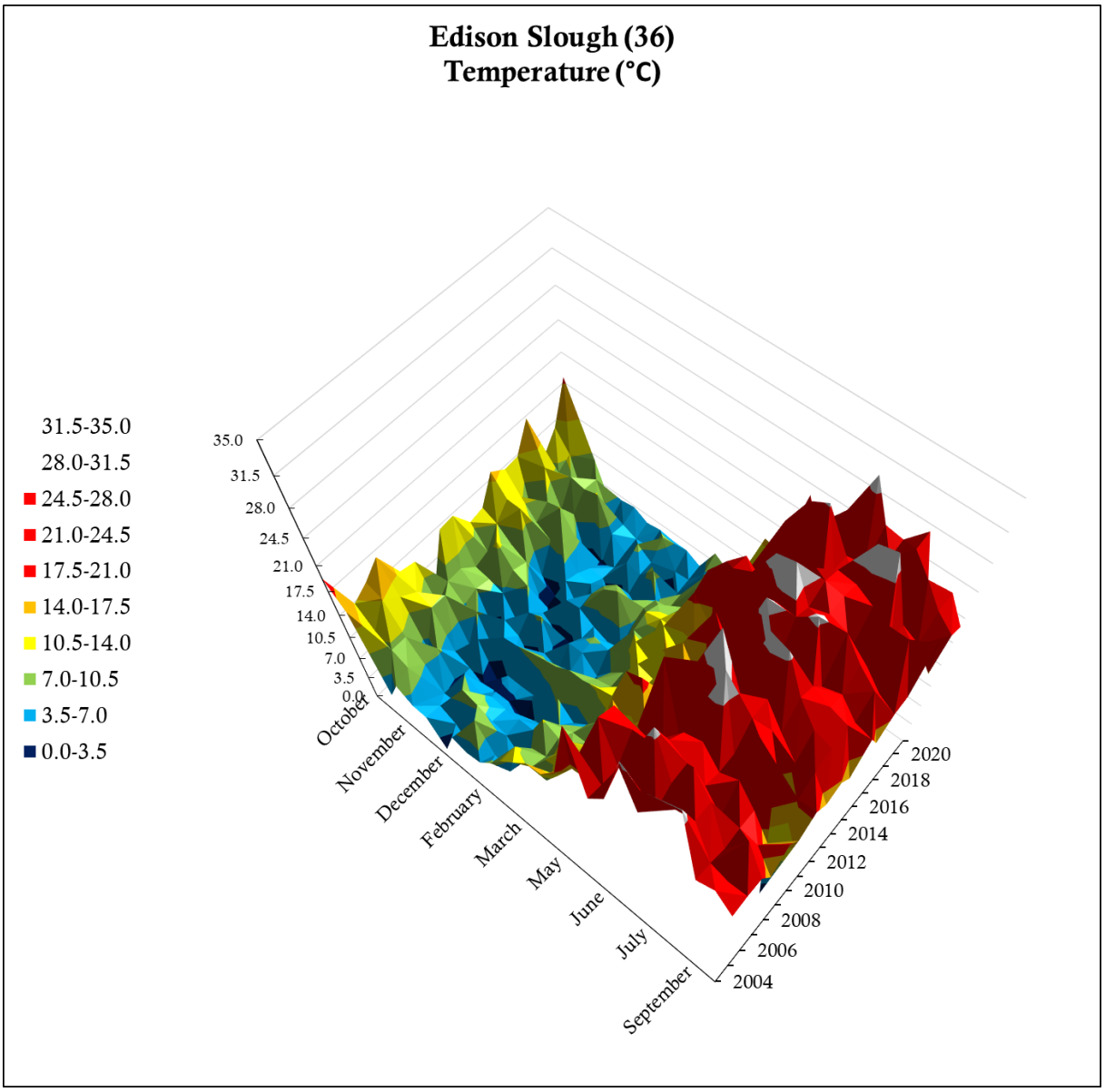
No monthly trends for DO or temperature were observed across any of the time periods analyzed in this report. FC is higher than it was 18 years ago. WQI scores are consistently in the category of highest concern.

Site 36 regularly fails to meet state standards for DO and water temperature. Annual bacterial levels for WY2021 passed state standards for geomean, but not for 90th percentile.

Site 36 is tied for 32nd out of 39 sites for number of significant trends, with 7, and is 31st out of 39 sites for positive trends, with 29%.

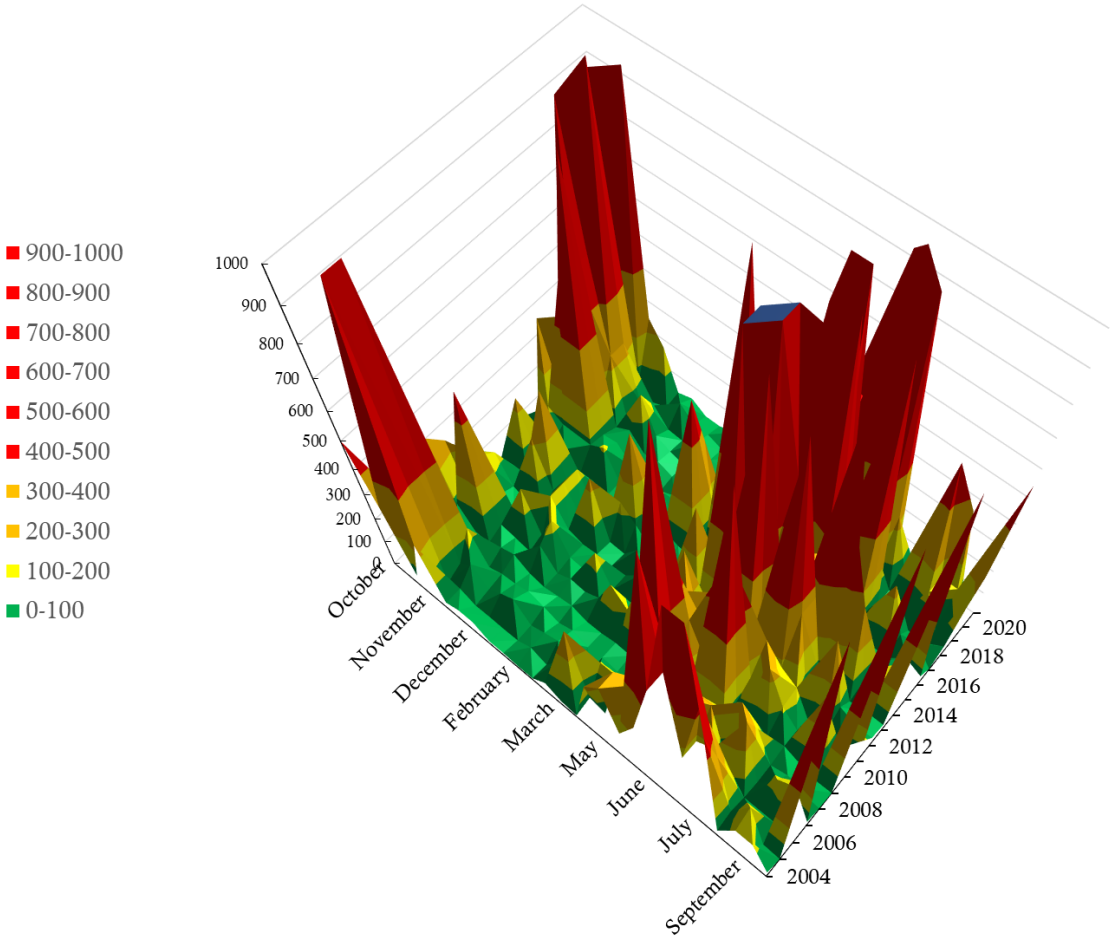


The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

Edison Slough (36)
Fecal Coliform (MPN/100 mL)

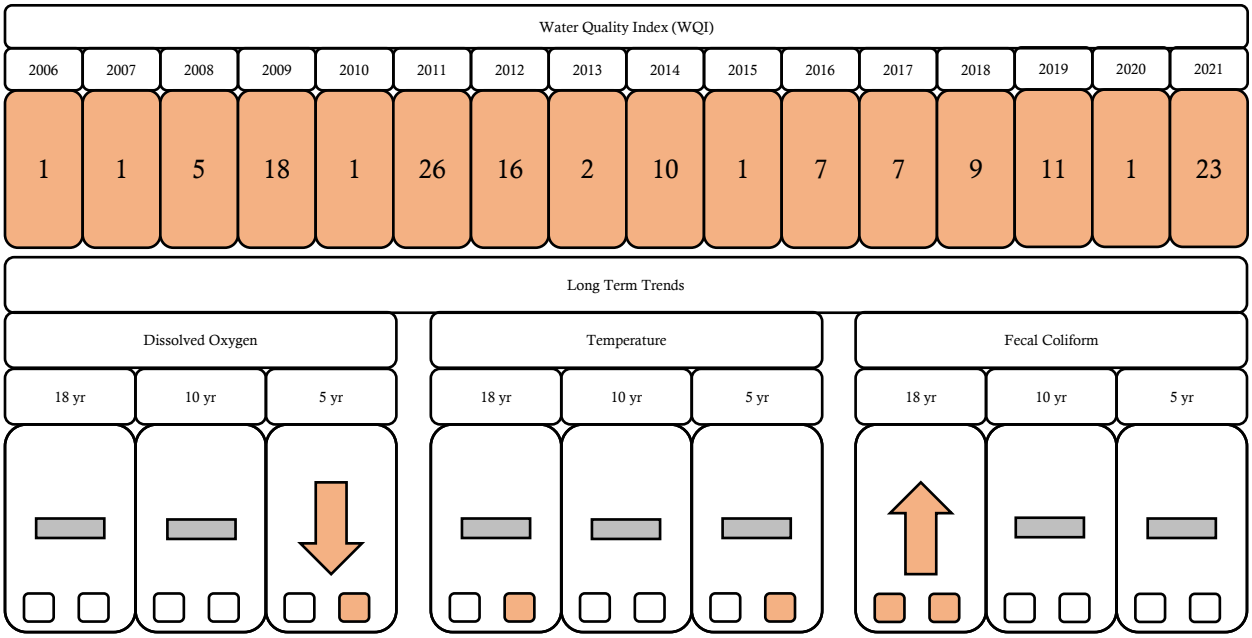


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

37

South Edison Drainage
@ Farm to Market Road

Downstream Ag



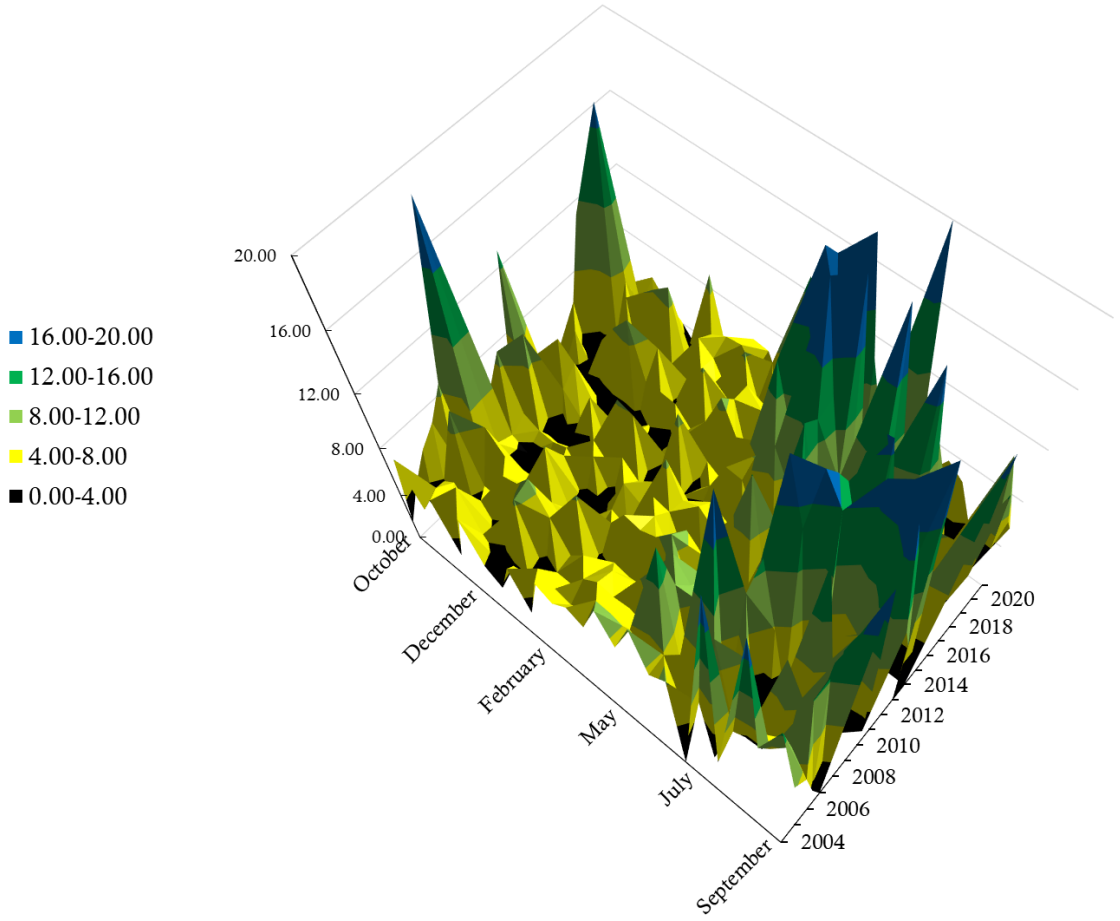
Site 37 is the south pump station of agricultural drainages in the town of Edison, on Samish Bay. Sites like this are characterized by being stagnant or slow-moving and are heavily tidally influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

Water temperatures have increased over the past 5 years. Fecal coliform counts are higher now than they were at the beginning of the program. WQI scores are consistently in the category of highest concern, and often in the single digits.

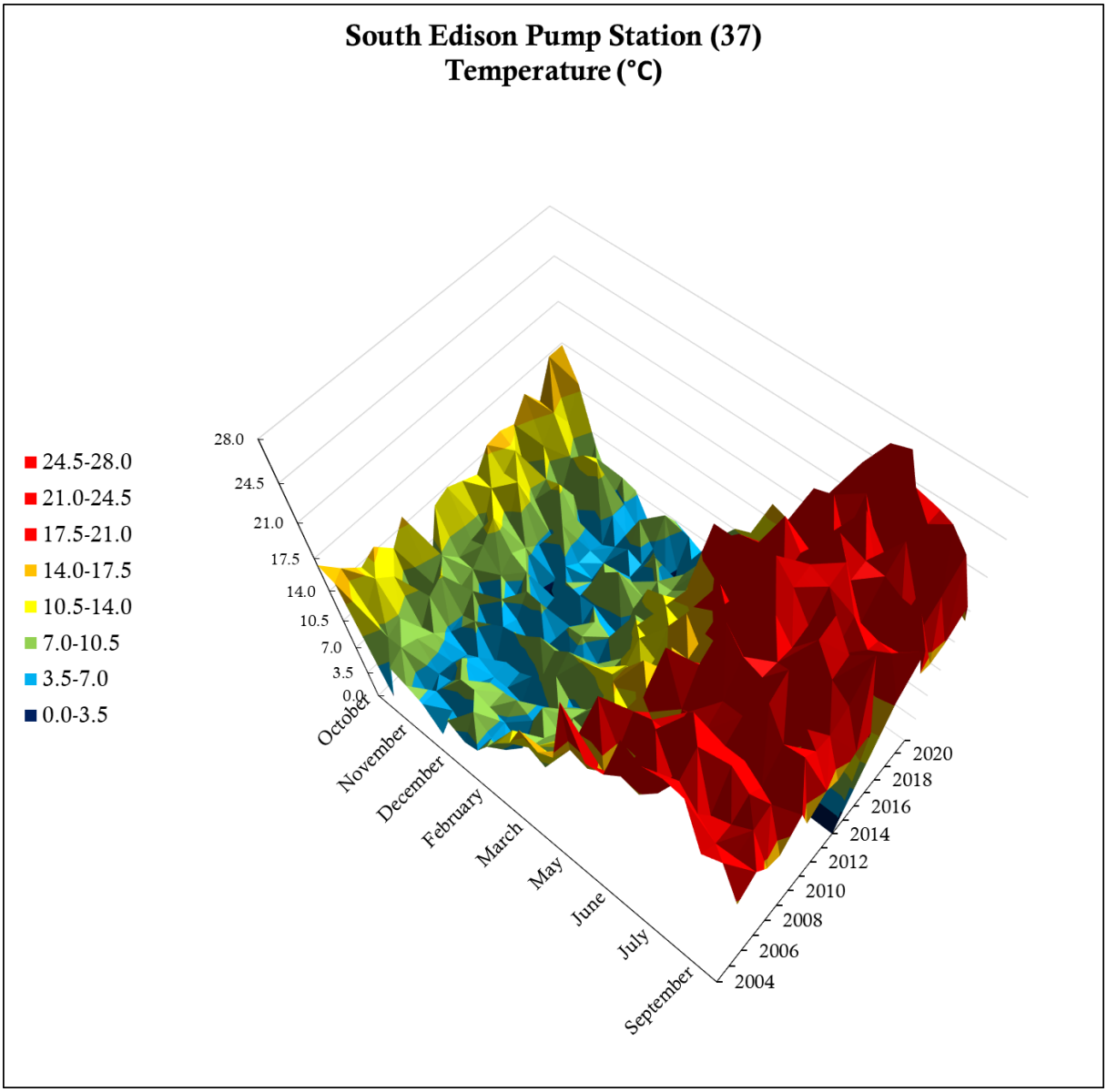
Site 37 regularly fails to meet state standards for DO and water temperature. Annual FC levels fail state standards. EC levels passed the state standard for geomean but failed for 90th percentile.

Site 37 is tied for 27th out of 39 sites for number of significant trends, with 8, and tied for 33rd out of 39 sites for positive trends, with 25%.

South Edison Pump Station (37)
Dissolved Oxygen (mg/L)

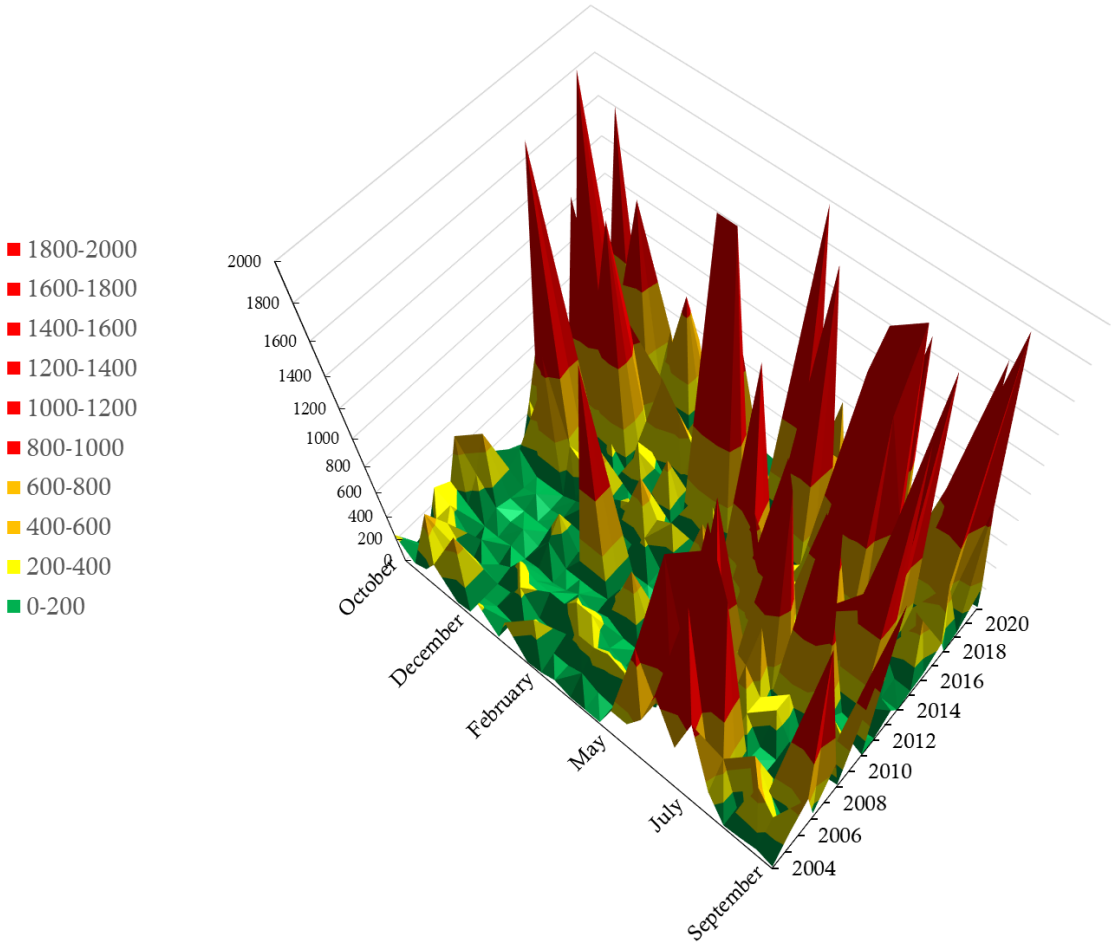


The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

South Edison Pump Station (37)
Fecal Coliform (MPN/100 mL)

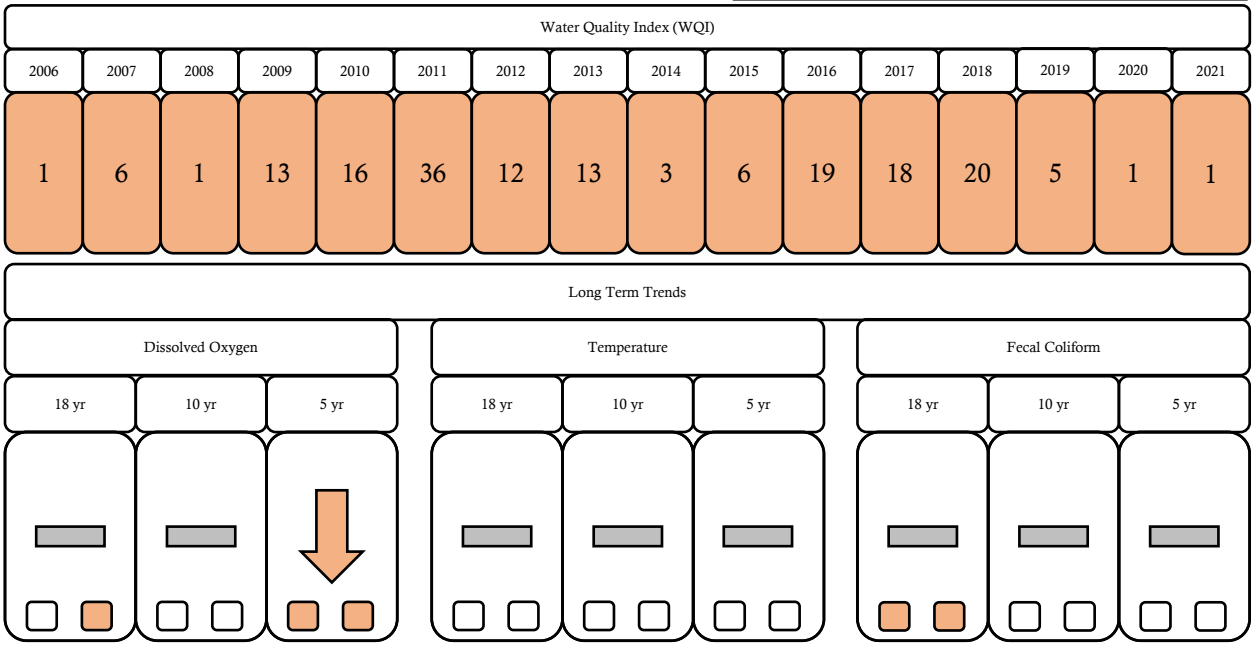


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green almost meets that standard. The water year on the x-axis begins in October and ends in September.

38

North Edison Drainage
@ Smith Road

Downstream Ag

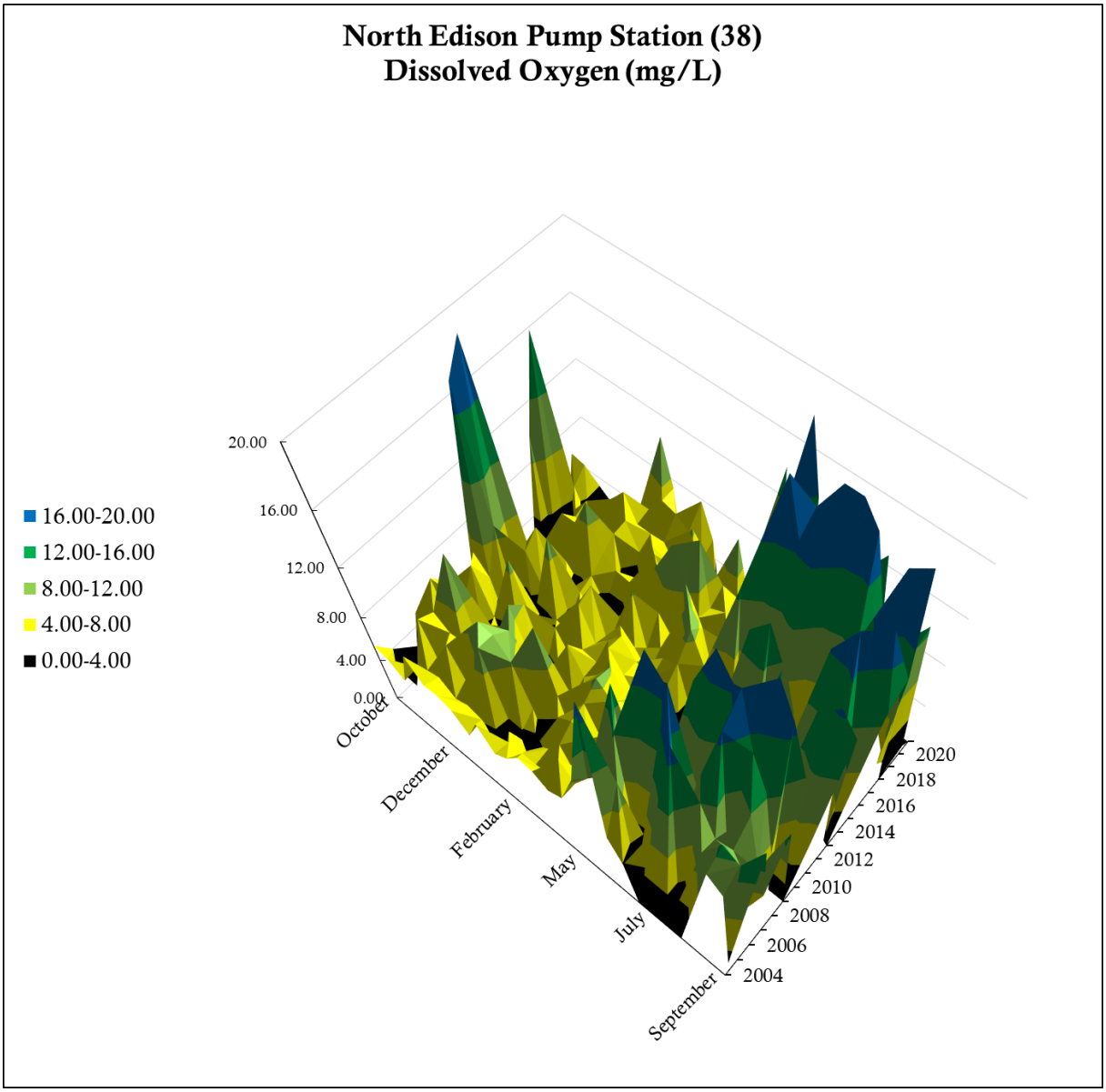


Site 38 is the north pump station of agricultural drainages in the town of Edison, on Samish Bay. Sites like this are characterized by being stagnant or slow-moving and are heavily tidally influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

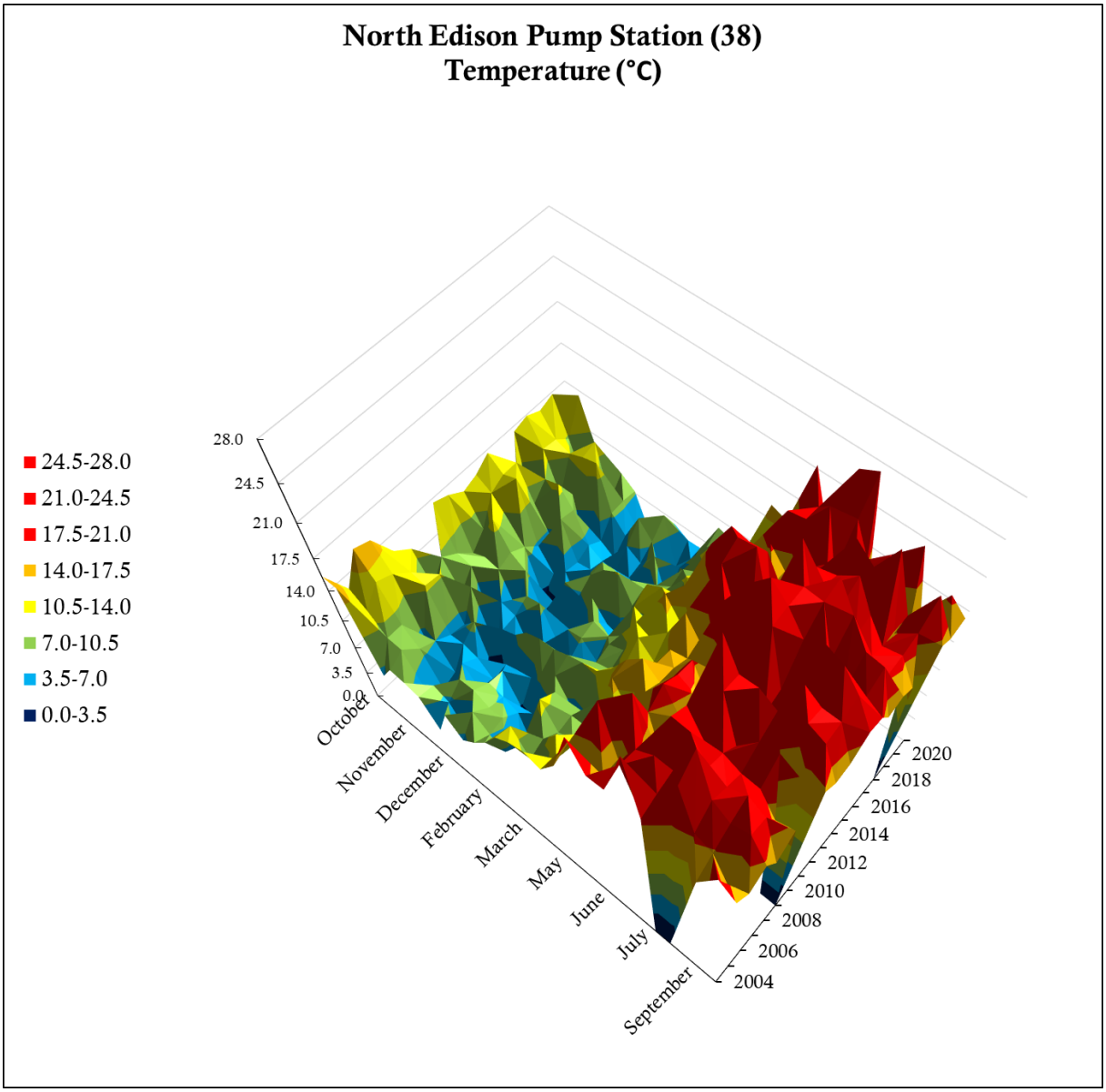
Dissolved oxygen is lower now than it was five years ago. WQI scores are consistently in the category of highest concern, and often in the single digits.

Site 38 regularly fails to meet state standards for DO and water temperature. Annual bacterial levels fail state standards and were the highest of any site monitored in the 2021 water year.

Site 38 is tied for 11th out of 39 sites for number of significant trends, with 12, and is tied for 35th out of 39 sites for positive trends, with 17%.

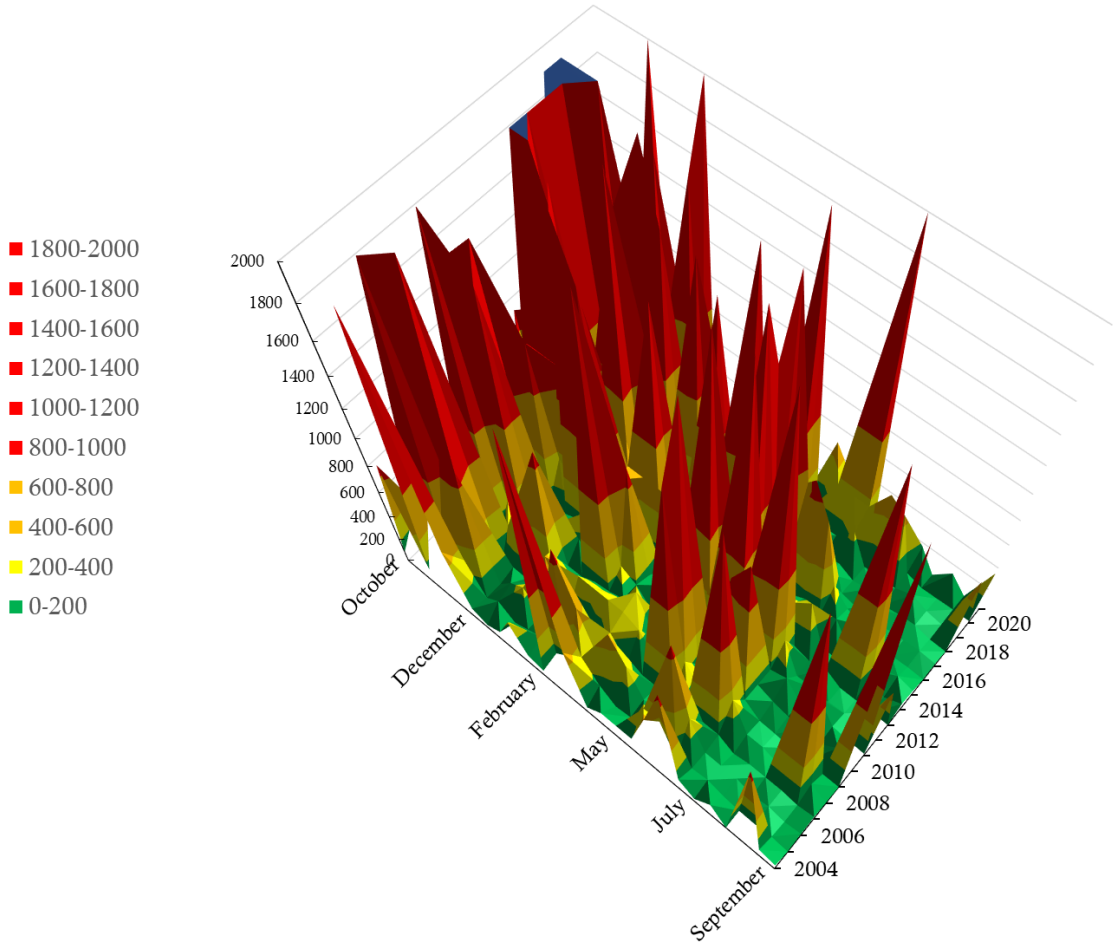


The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

North Edison Pump Station (38)
Fecal Coliform (MPN/100 mL)

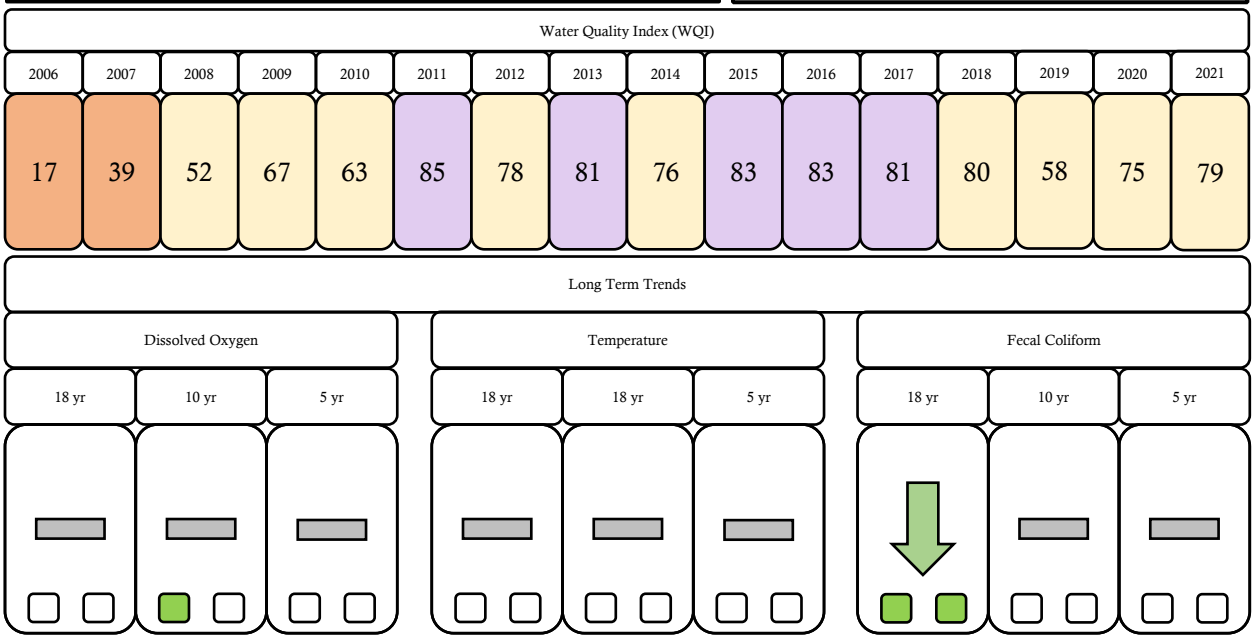


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green almost meets that standard. The water year on the x-axis begins in October and ends in September.

39

Colony Creek
@ Colony Road

Downstream Ag

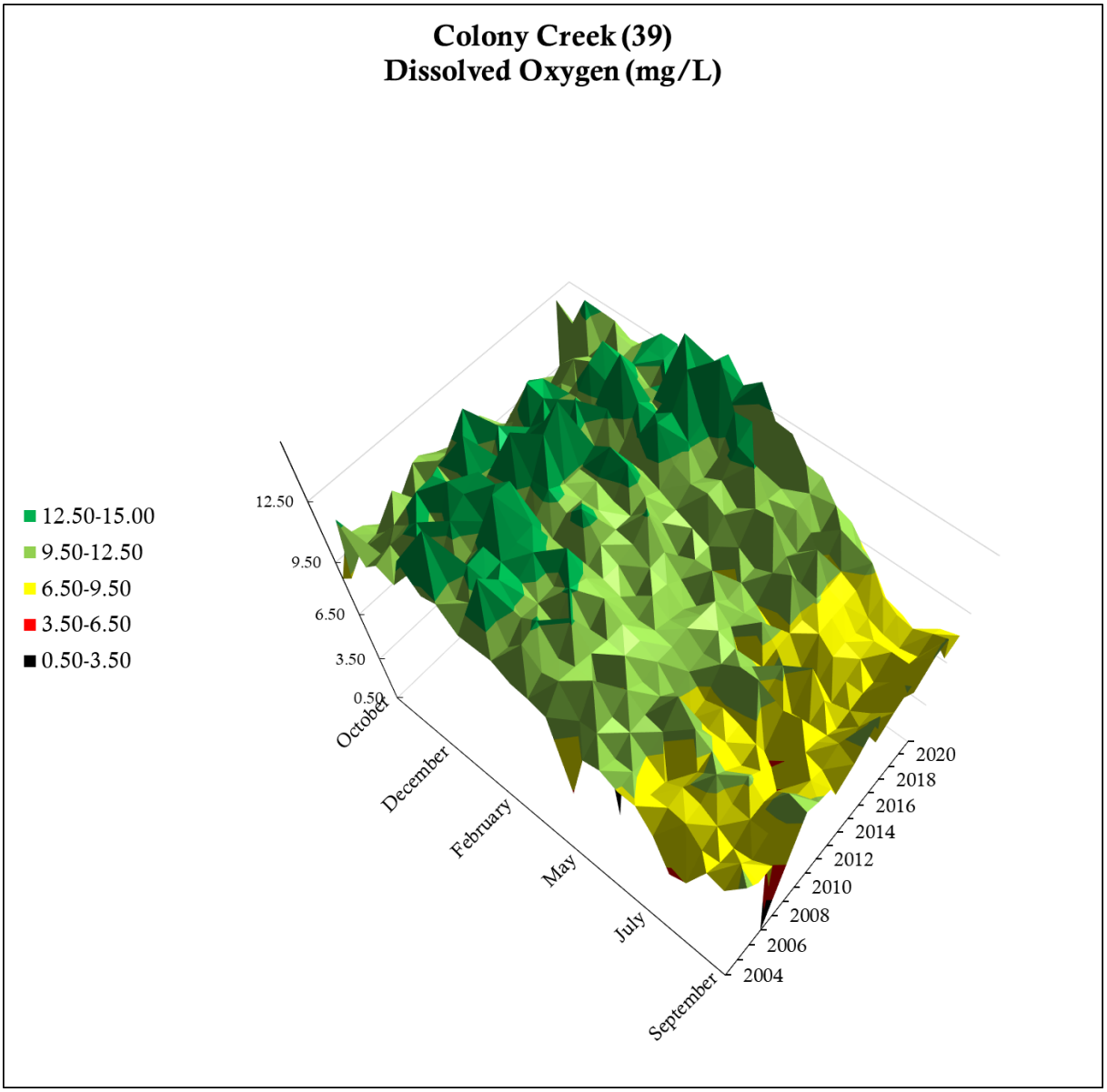


Site 39 is Colony Creek, prior to its convergence with Harrison Creek and termination in the north end of Samish Bay, and has rural residential and agricultural influences. This site is designated as core salmonid habitat.

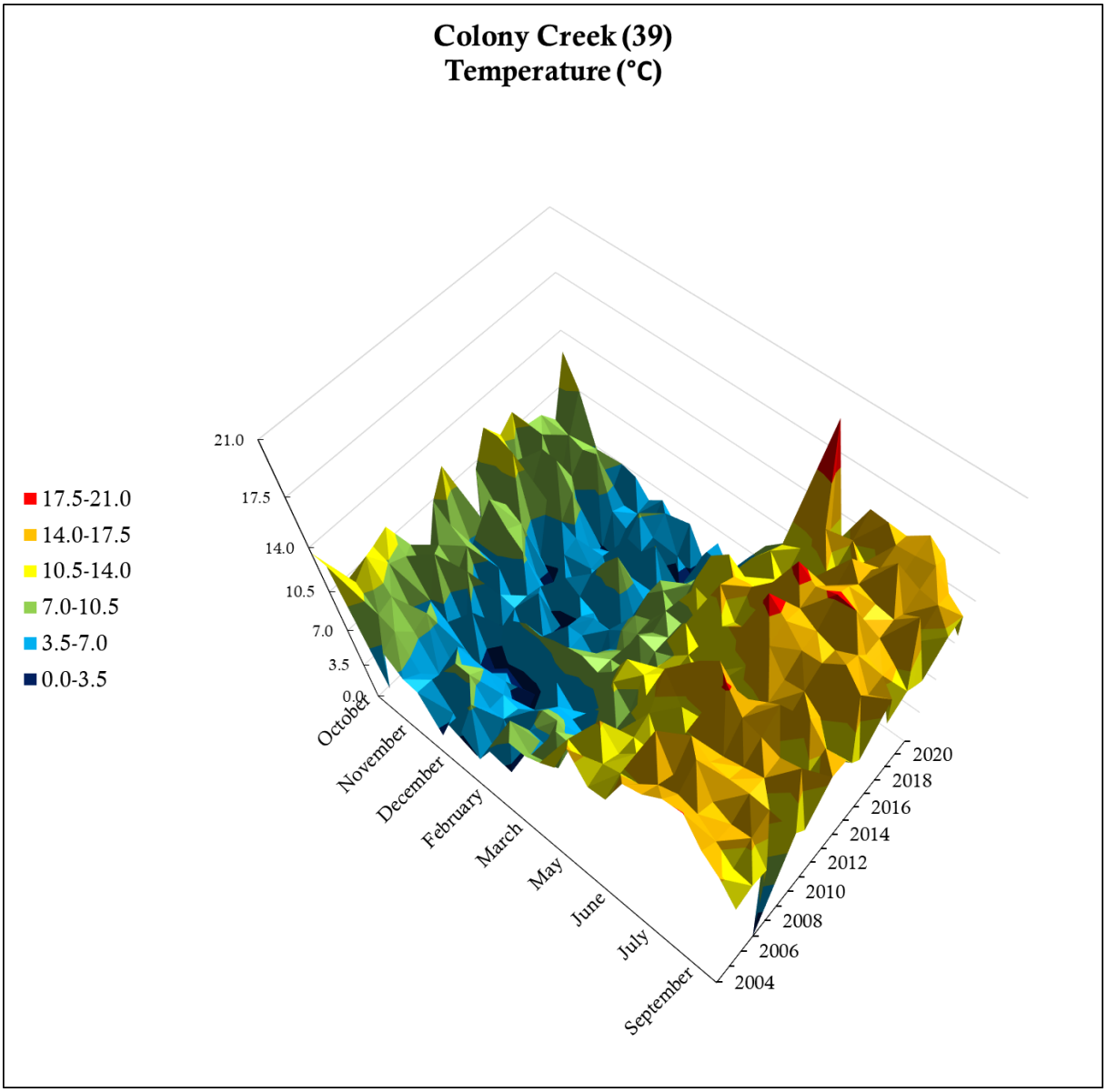
Fecal coliform counts are lower than they were 18 years ago. WQI scores are generally in the upper-score end of the moderate concern category, and sometimes score as least concern.

Site 39 rarely fails to meet state standards for DO and water temperature, and only does so at the warmest time of year. Annual bacterial levels pass the state standards for geomean, but fail the state standard for a 90th percentile for both FC and EC.

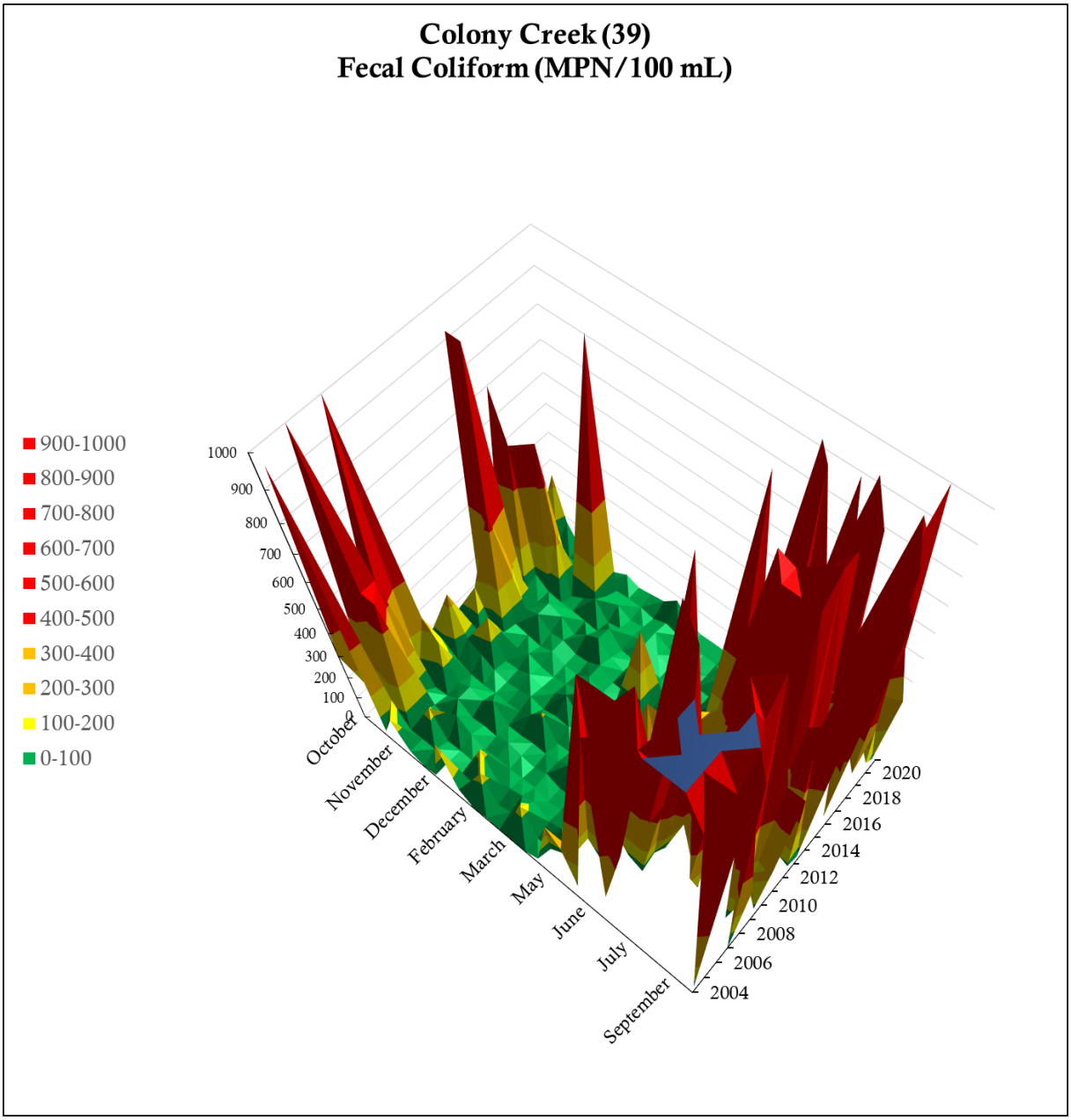
Site 39 is tied for 27th out of 39 sites for number of significant trends, with 8, and is 24th out of 39 sites for positive trends, with 50%.



The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

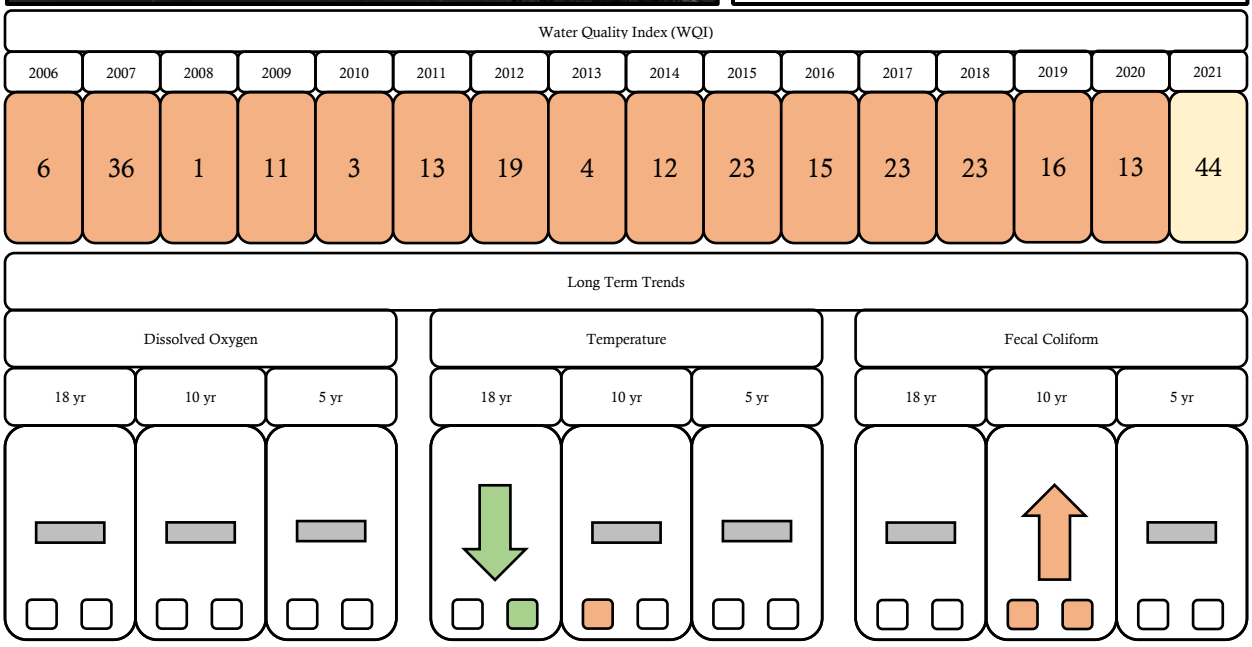


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

40

Big Indian slough
@ Highway 20

Midstream Ag

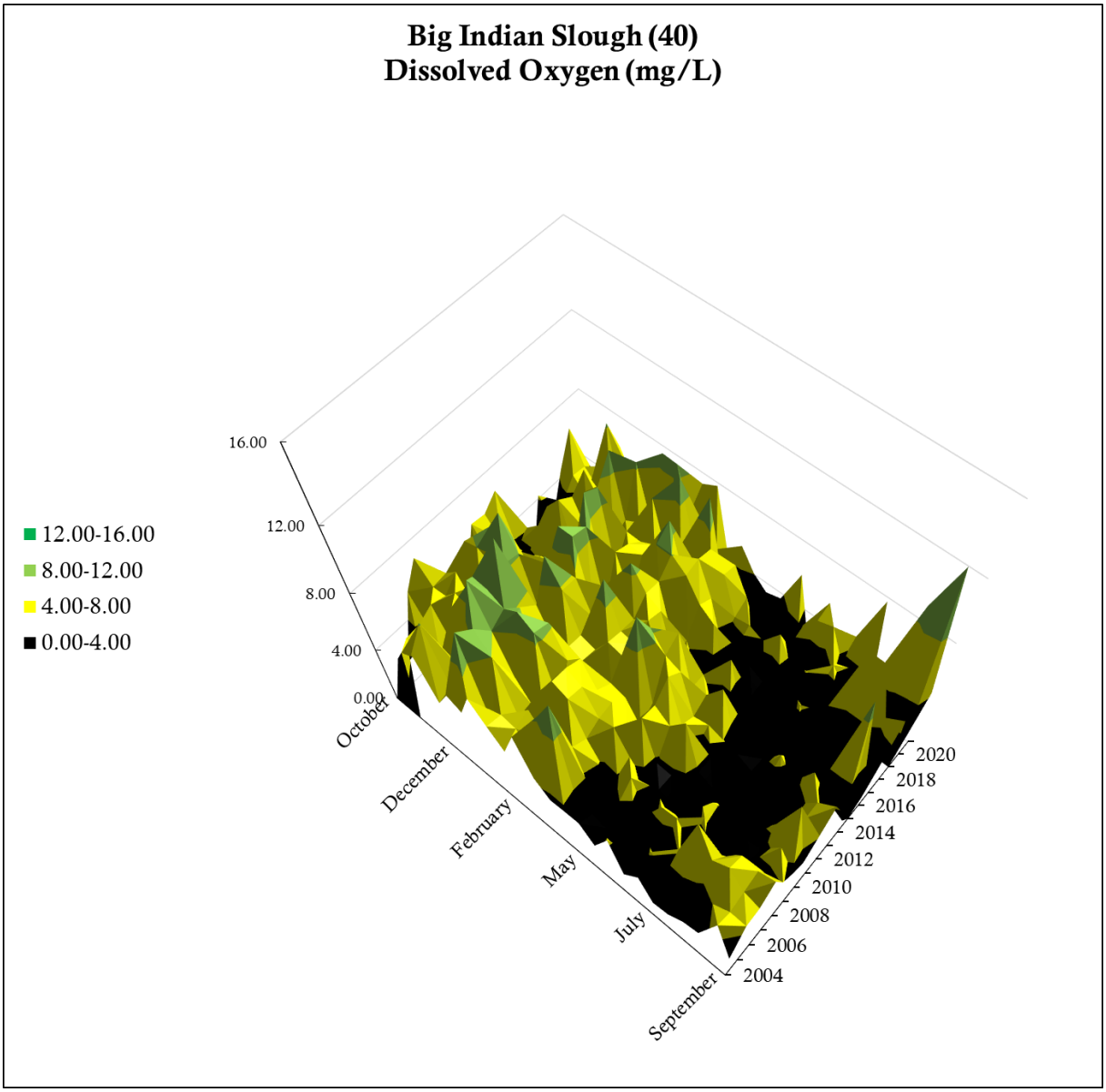


Site 40 is Big Indian Slough, just north of Highway 20 and prior to entering Padilla Bay. This site has industrial, agricultural, and urban influences. Sites like this are characterized by being stagnant or slow-moving and may be tidally influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

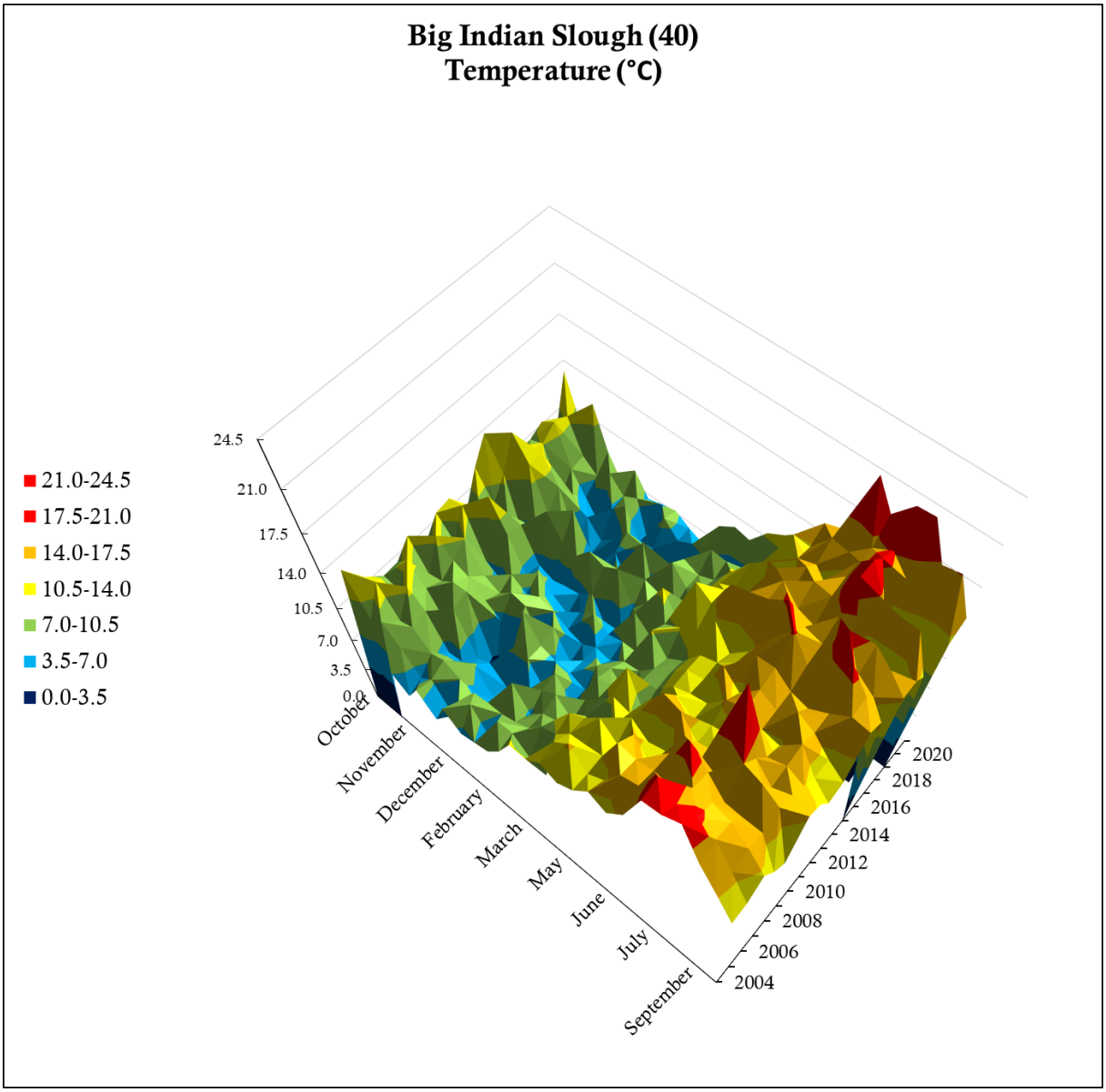
Water temperature is lower than it was at the beginning of this program. FC counts have increased in the last 10 years. WQI scores are consistently in the category of highest concern.

Site 40 regularly fails to meet state standards for DO and fails to meet state standards for water temperature during the warmer months. Annual FC levels fail the state standards for geomean and 90th. EC levels pass the geomean standard but fail for 90th percentile.

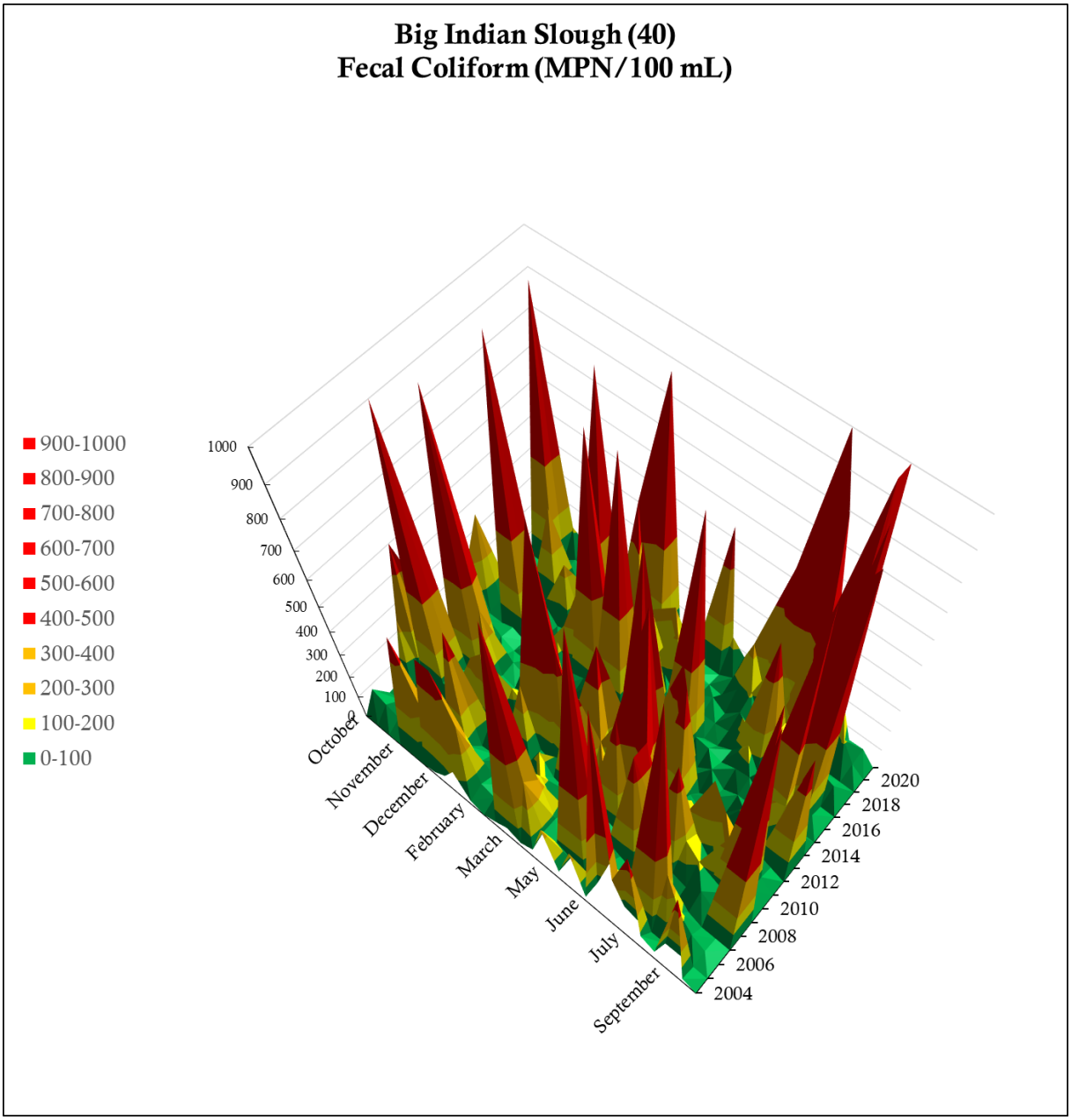
Site 40 is tied for 32nd out of 39 sites for number of significant trends, with 7, and is 37th out of 39 sites for positive trends, with 14%.



The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

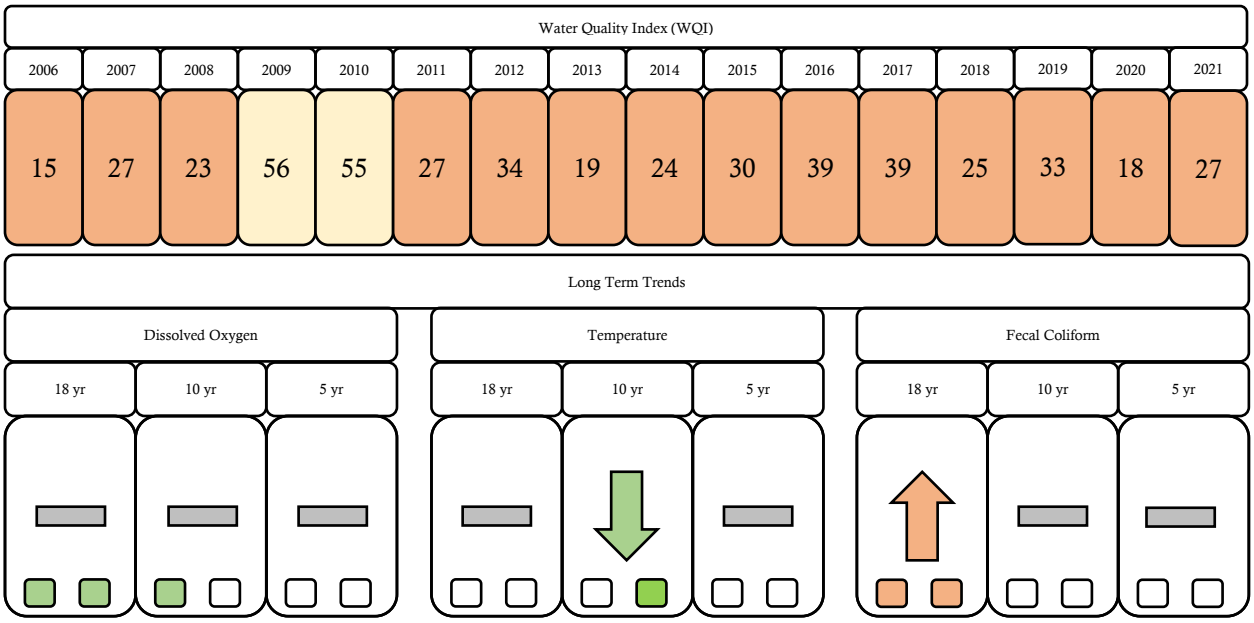


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

41

Maddox Slough
@ Milltown Road

Downstream Ag

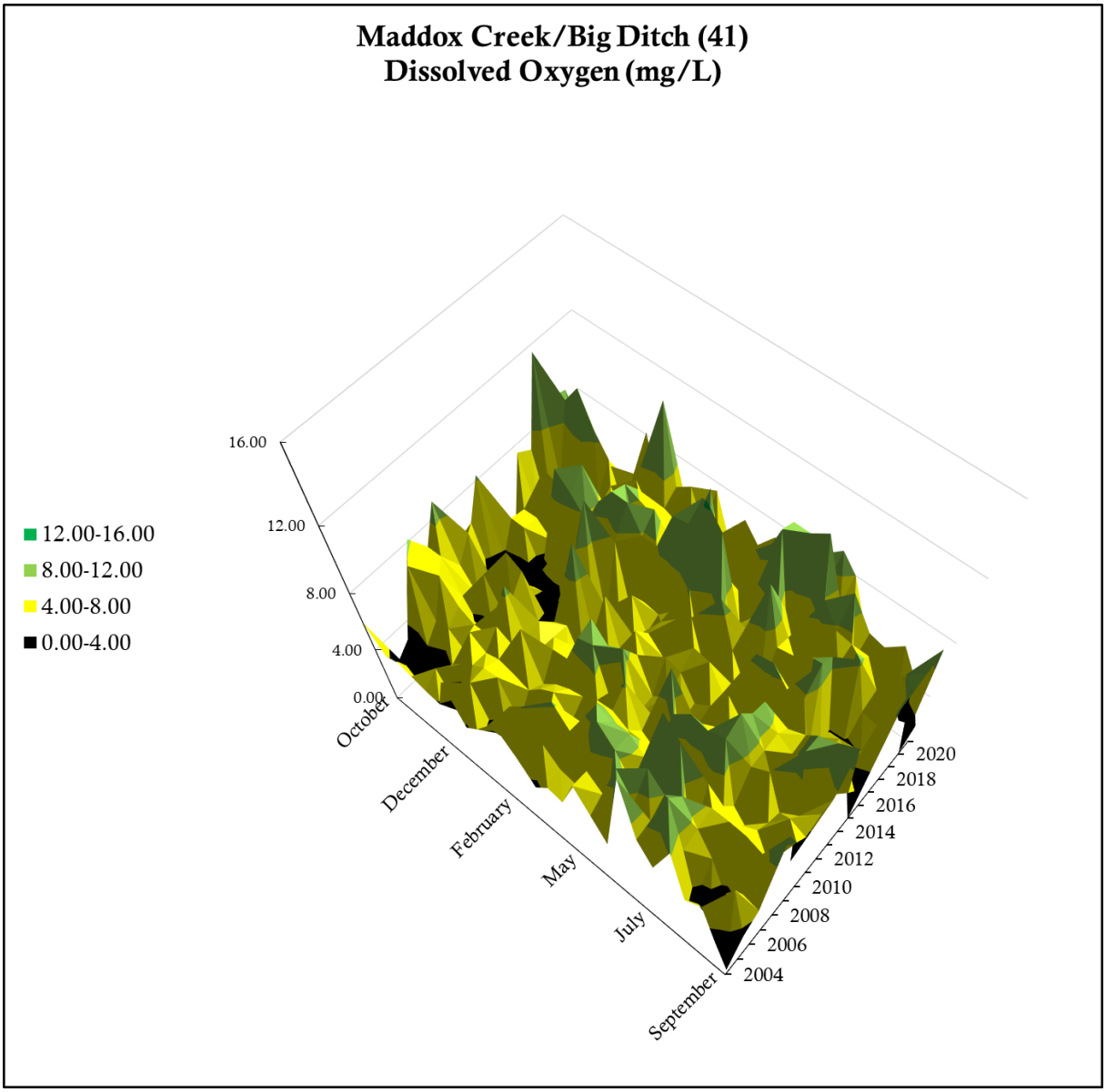


Site 41 is Maddox Slough, or Big Ditch, prior to entering Skagit Bay. Sites like this are characterized by being stagnant or slow-moving and are heavily tidally influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

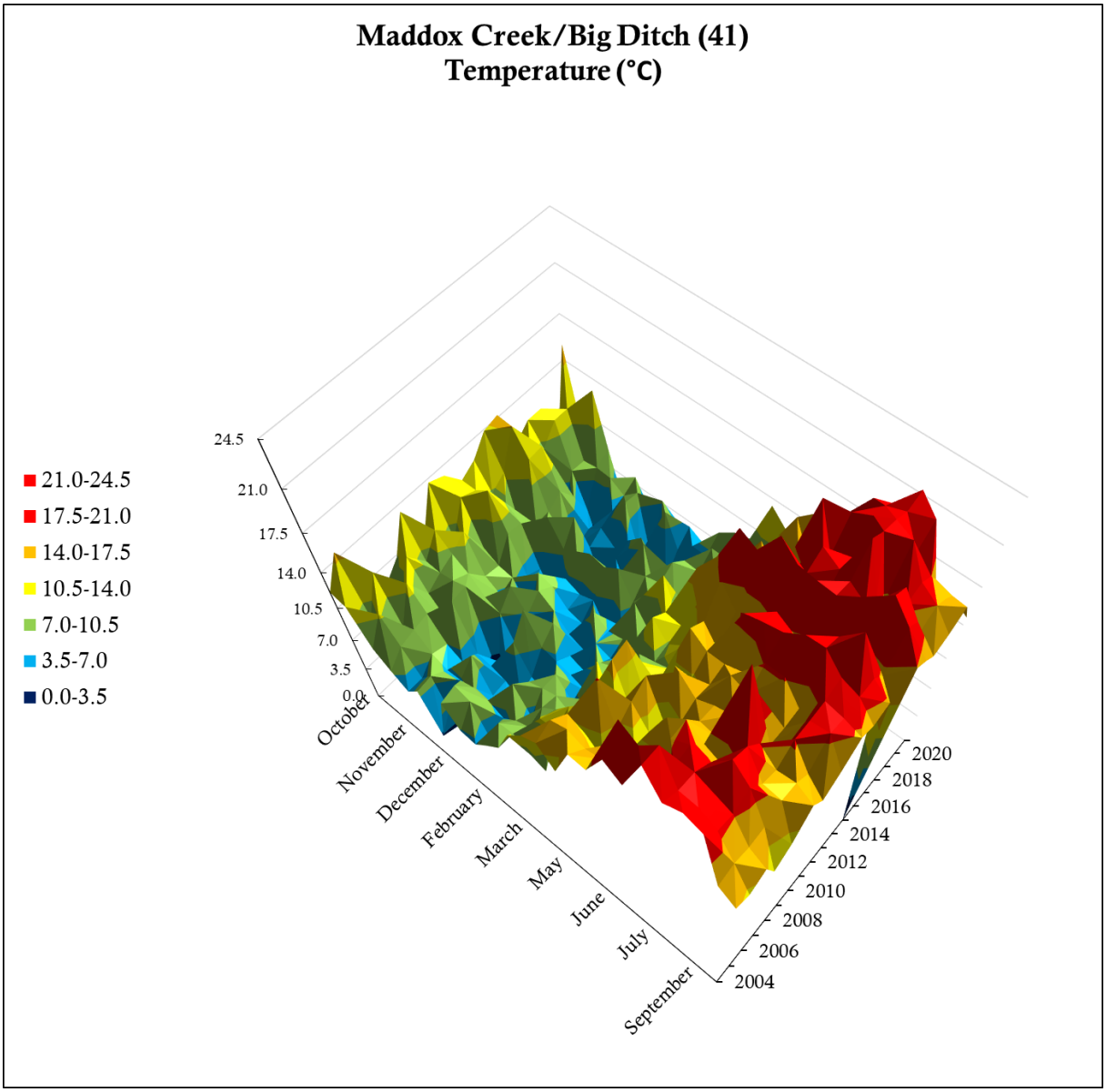
Dissolved oxygen is higher than it was 18 years ago and ten years ago. Water temperature is lower than it was 10 years ago. FC levels are higher than they were 18 years ago. WQI scores are consistently in the category of highest concern.

Site 41 rarely meets state standards for DO and exceeds state standards for water temperature during the warmer months. Annual bacterial levels pass the state standards for geomeans but fail the state standards for 90th percentiles

Site 41 is tied for 8th out of 39 sites for number of significant trends, with 13, and is tied for 26th out of 39 sites for positive trends, with 38%.

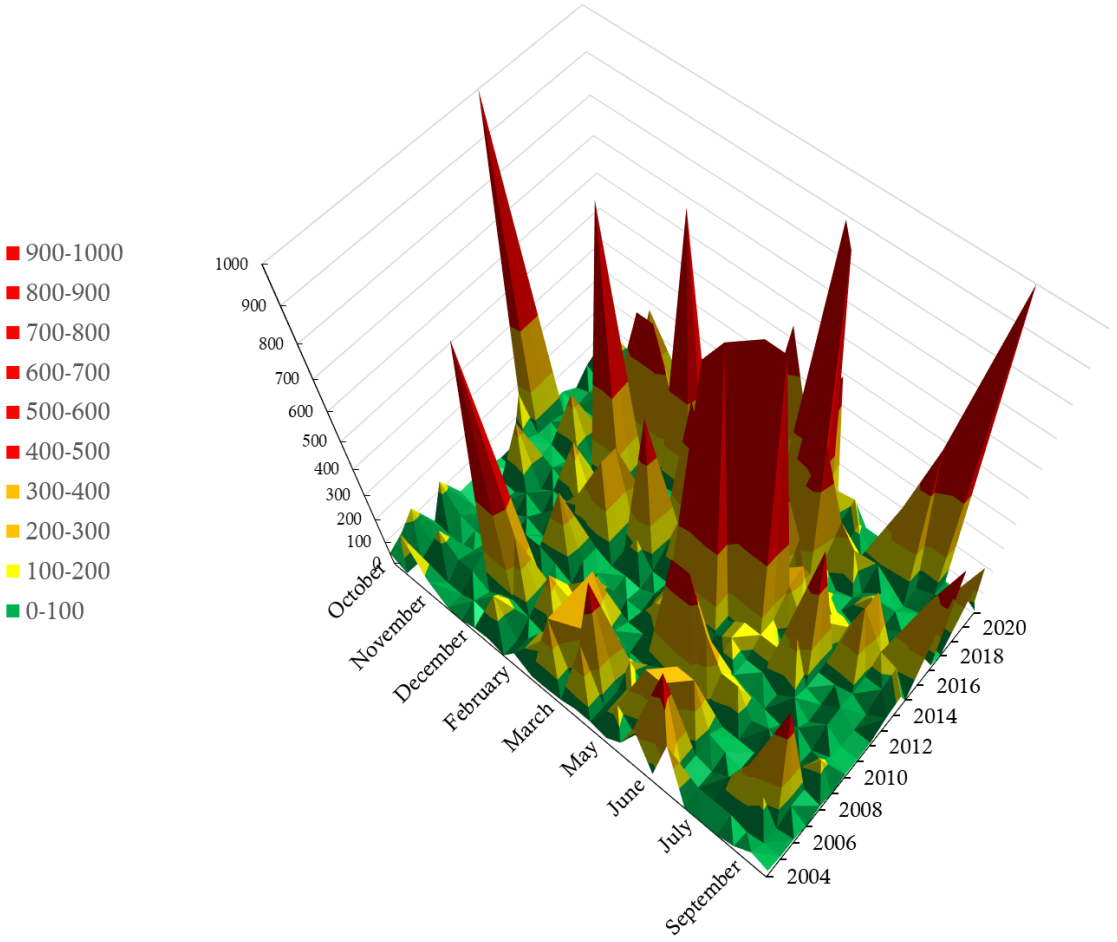


The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

Maddox Creek/Big Ditch (41)
Fecal Coliform (MPN/100 mL)

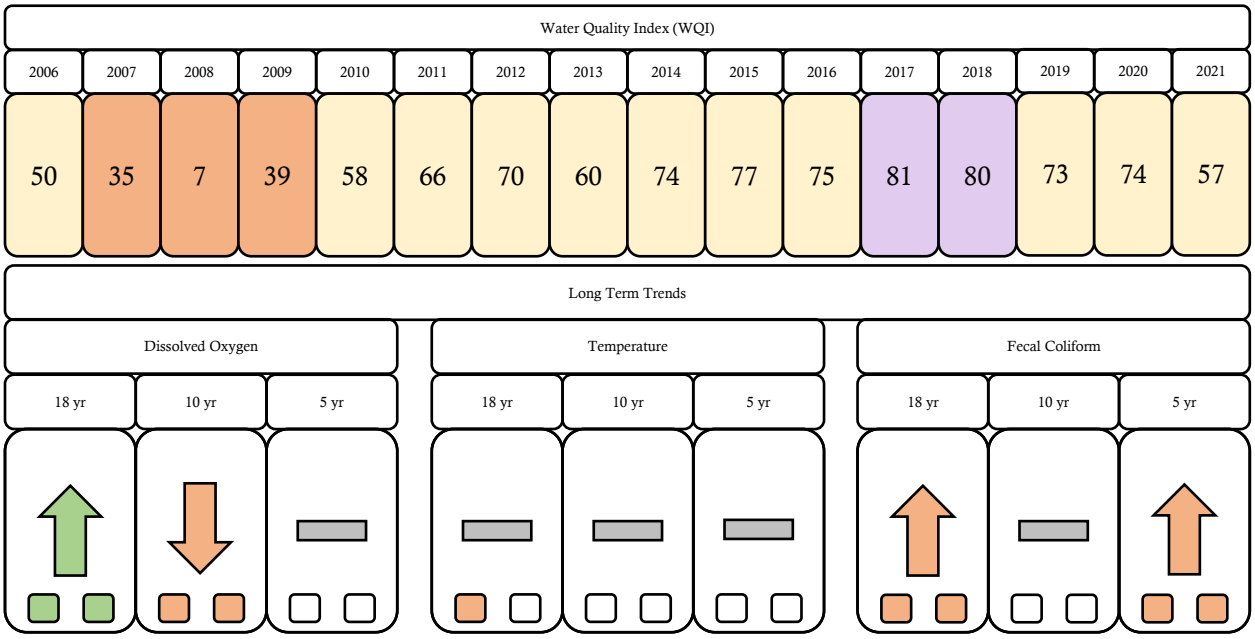


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

42

Hill Ditch
@ Cedardale Road

Downstream Ag

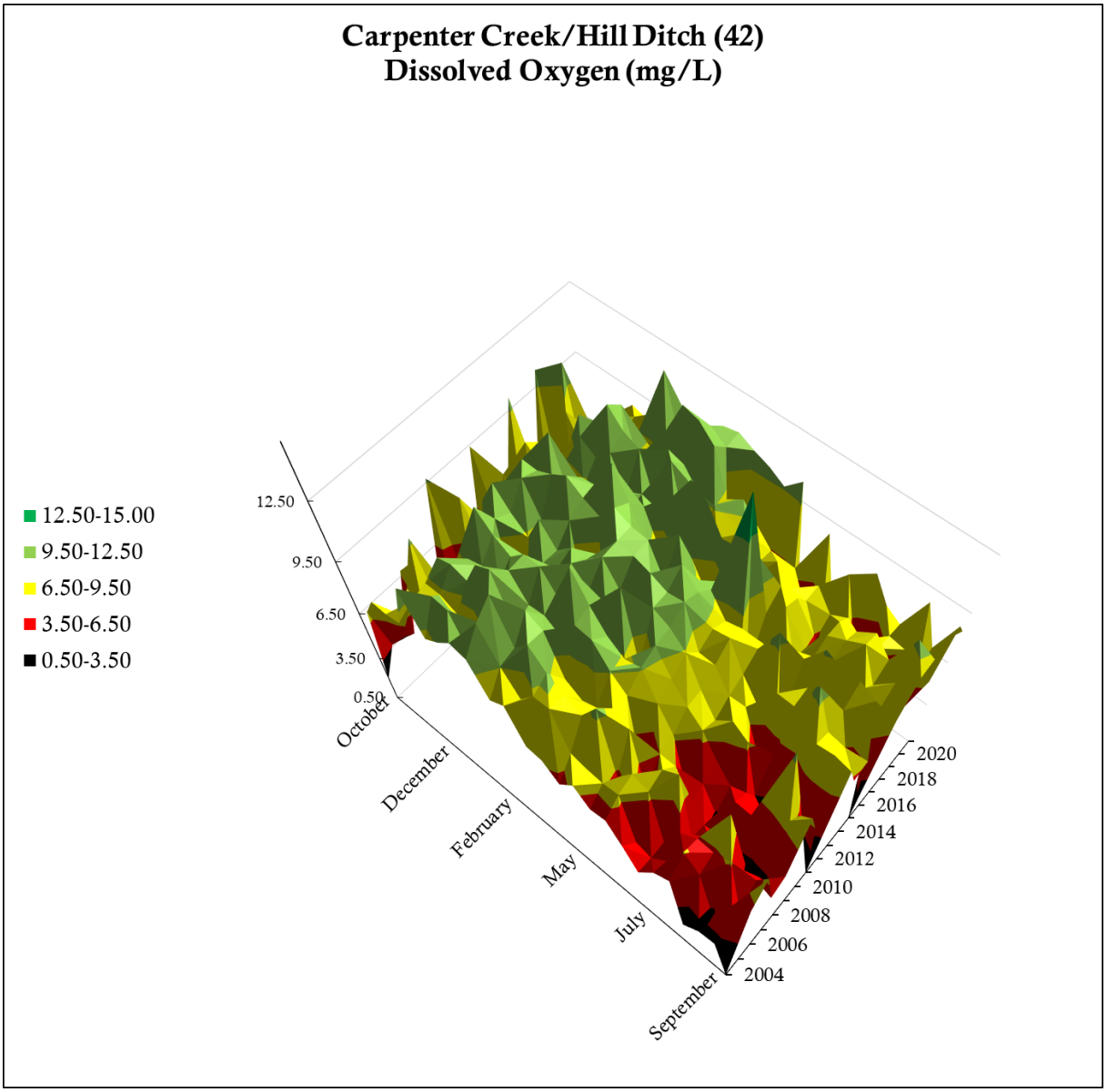


Site 42 is Carpenter Creek, or Hill Ditch, prior to being joined by Fisher Creek and entering Skagit Bay. This watercourse has urban, rural residential, and agricultural influences. This site is designated as core salmonid habitat.

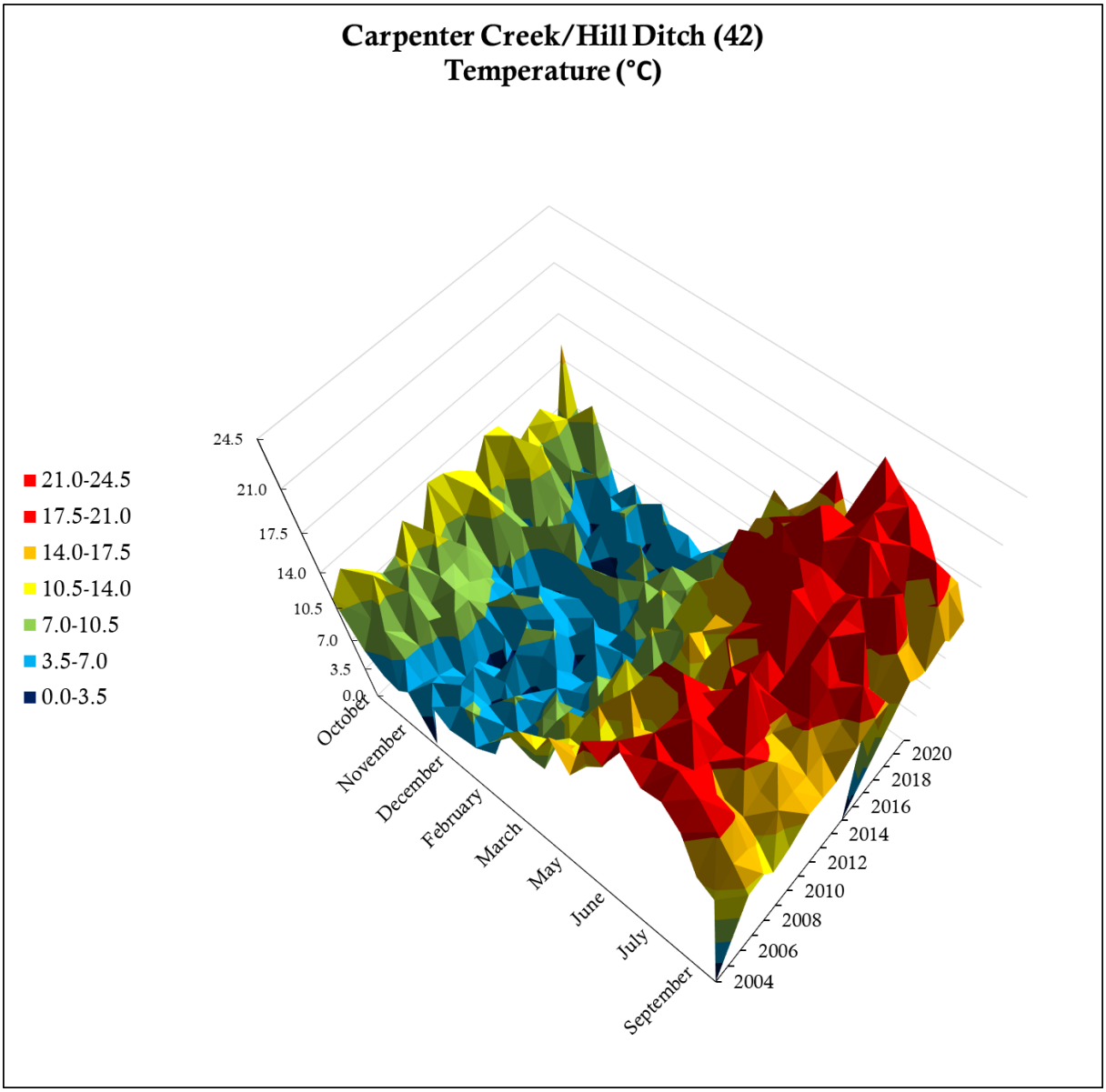
Dissolved oxygen is higher than it was 18 years ago, but it has decreased in the last 10 years. Fecal coliform counts are higher than they were at the beginning of this program, and as compared to five years ago. WQI scores have improved over the years from the category of highest concern to the category of moderate concern.

Site 42 fails state standards for DO about half of the year and fails state standards for water temperature during the warmer months. Annual FC levels for WY2021 failed to meet state standards. EC levels met the state geomean standard but failed for 90th percentile.

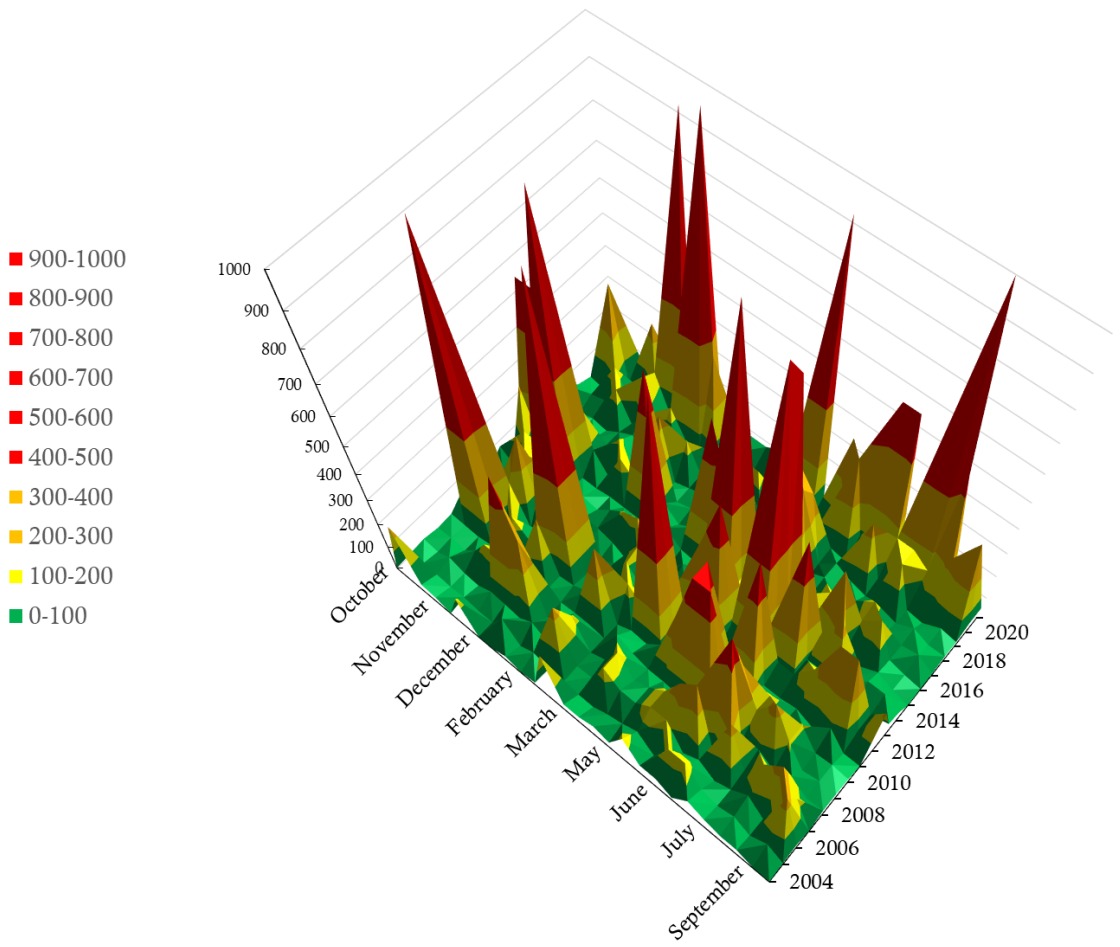
Site 42 is tied for 2nd out of 39 sites for number of significant trends, with 16, and is tied for 26th out of 39 sites for positive trends, with 38%.



The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

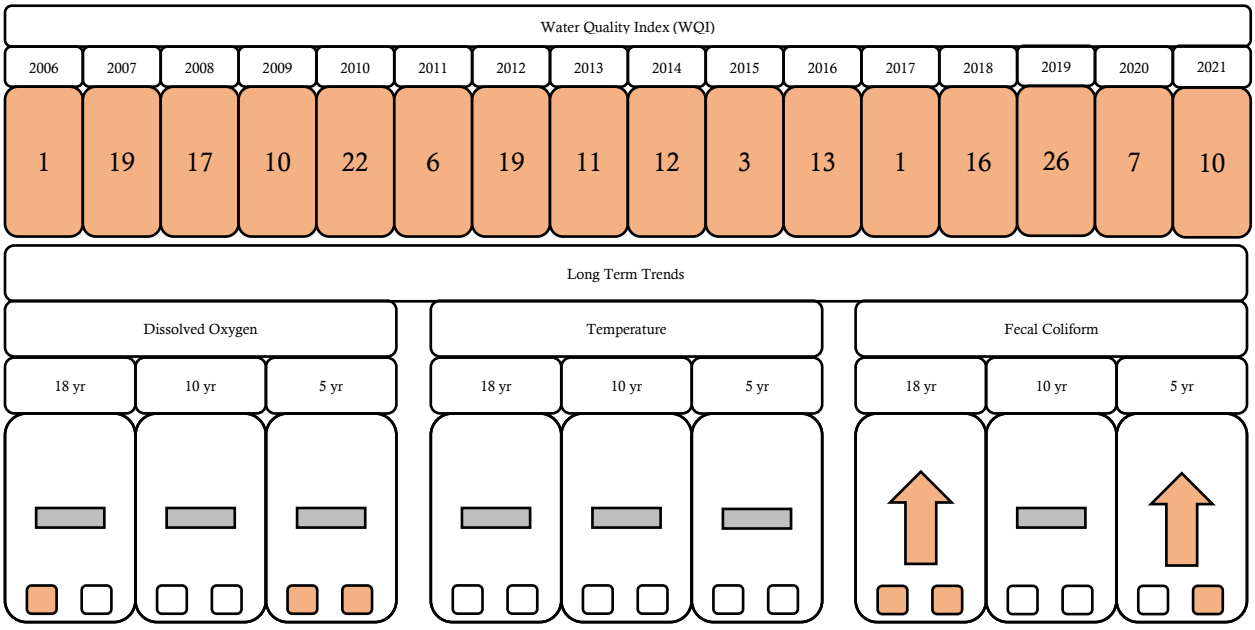


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

43

Wiley Slough
@ Wylie Road

Downstream Ag

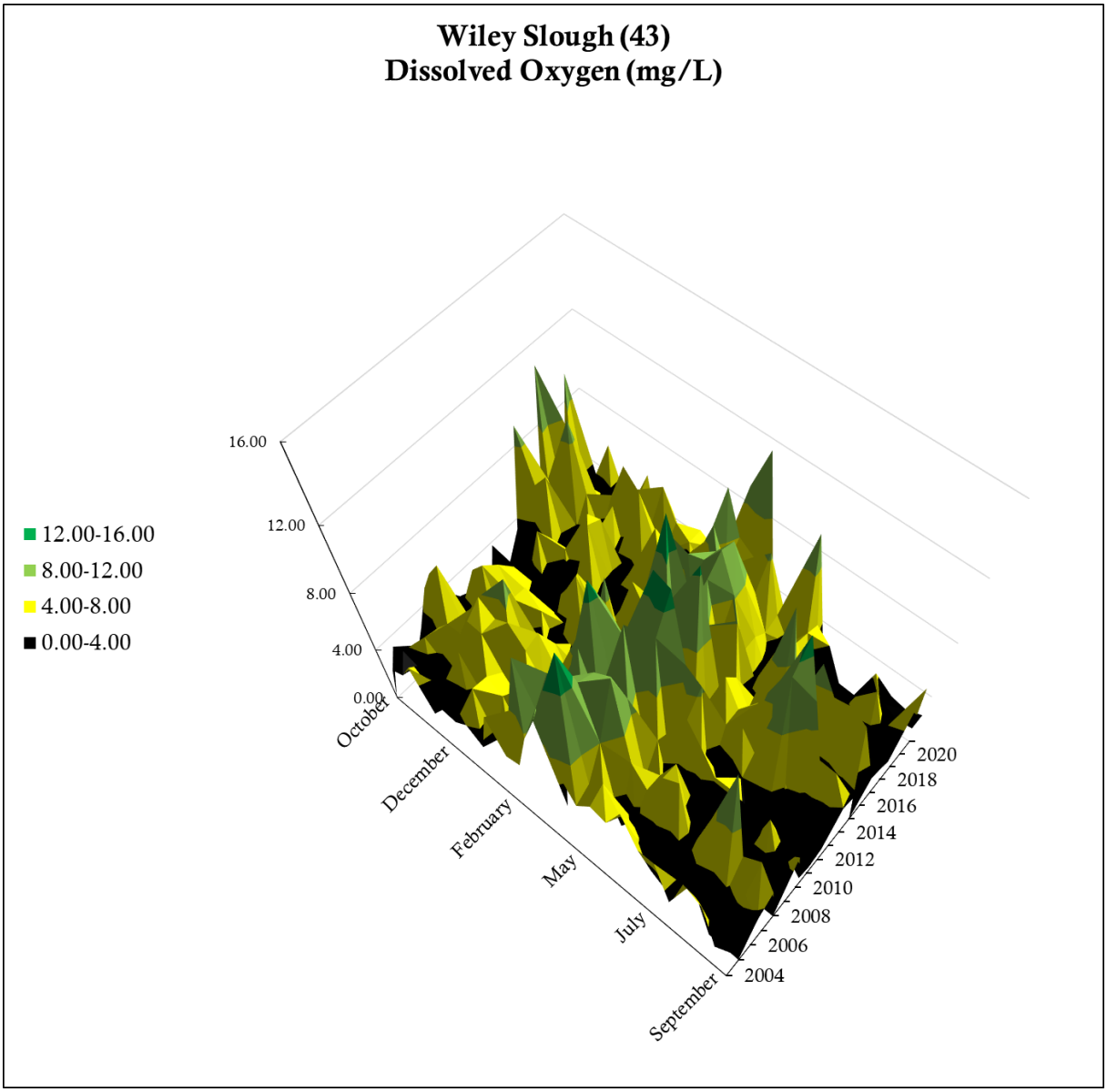


Site 43 is Wiley Slough, prior to its termination into the Skagit Wildlife Area wetlands and Skagit Bay. This site drains a large amount of agricultural area on Fir Island. Sites like this are characterized by being stagnant or slow-moving and are heavily tidally influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

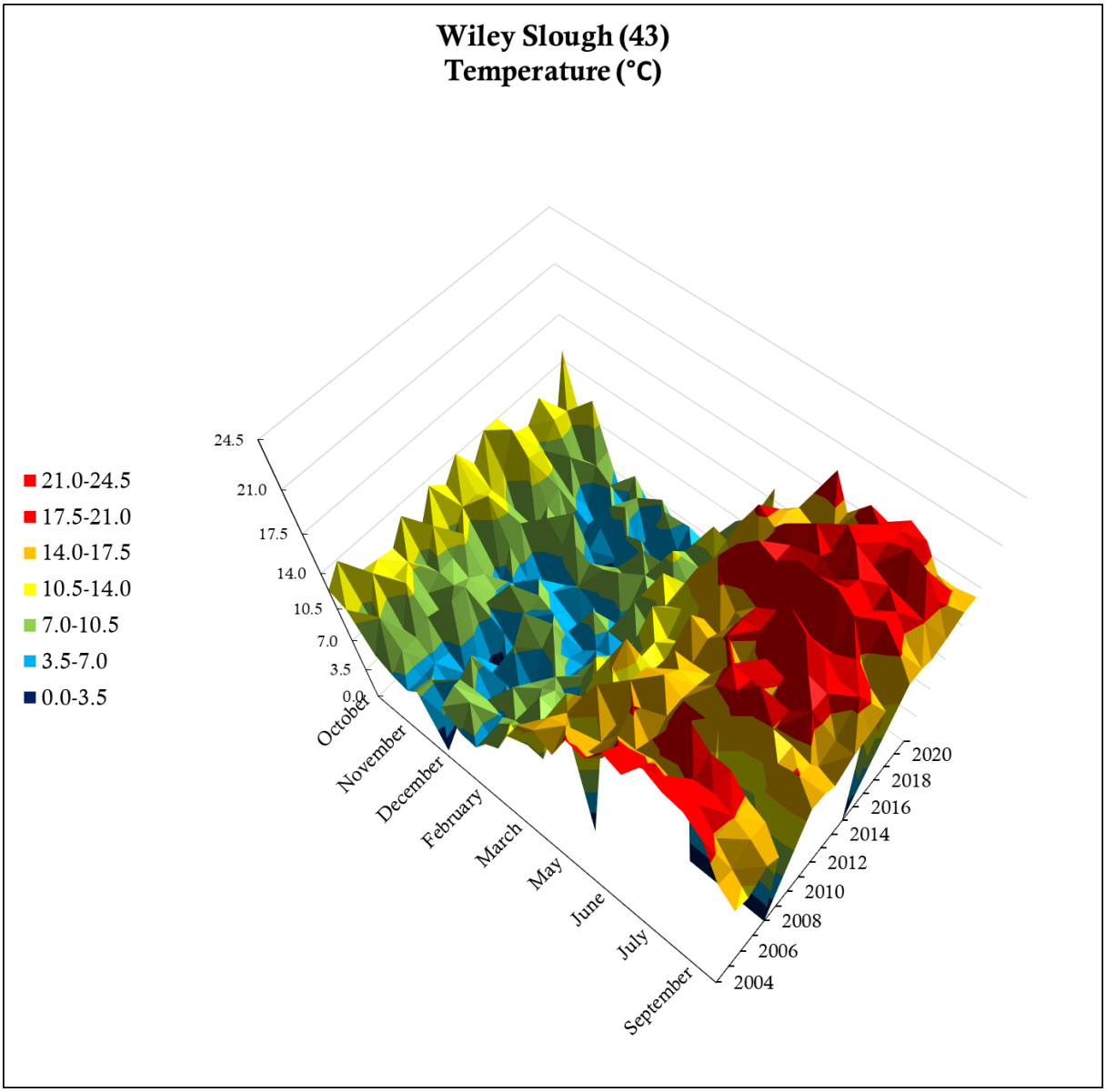
DO levels have decreased compared to 18 and 5 years ago. Fecal coliform levels are higher now than they were at the beginning of this program and compared to 5 years ago. WQI scores are consistently in the category of highest concern.

Site 43 rarely meets state standards for DO and fails to meet state standards for water temperature in the warmer months. Annual FC levels fail state standards. EC levels pass for both geomean and 90th percentile.

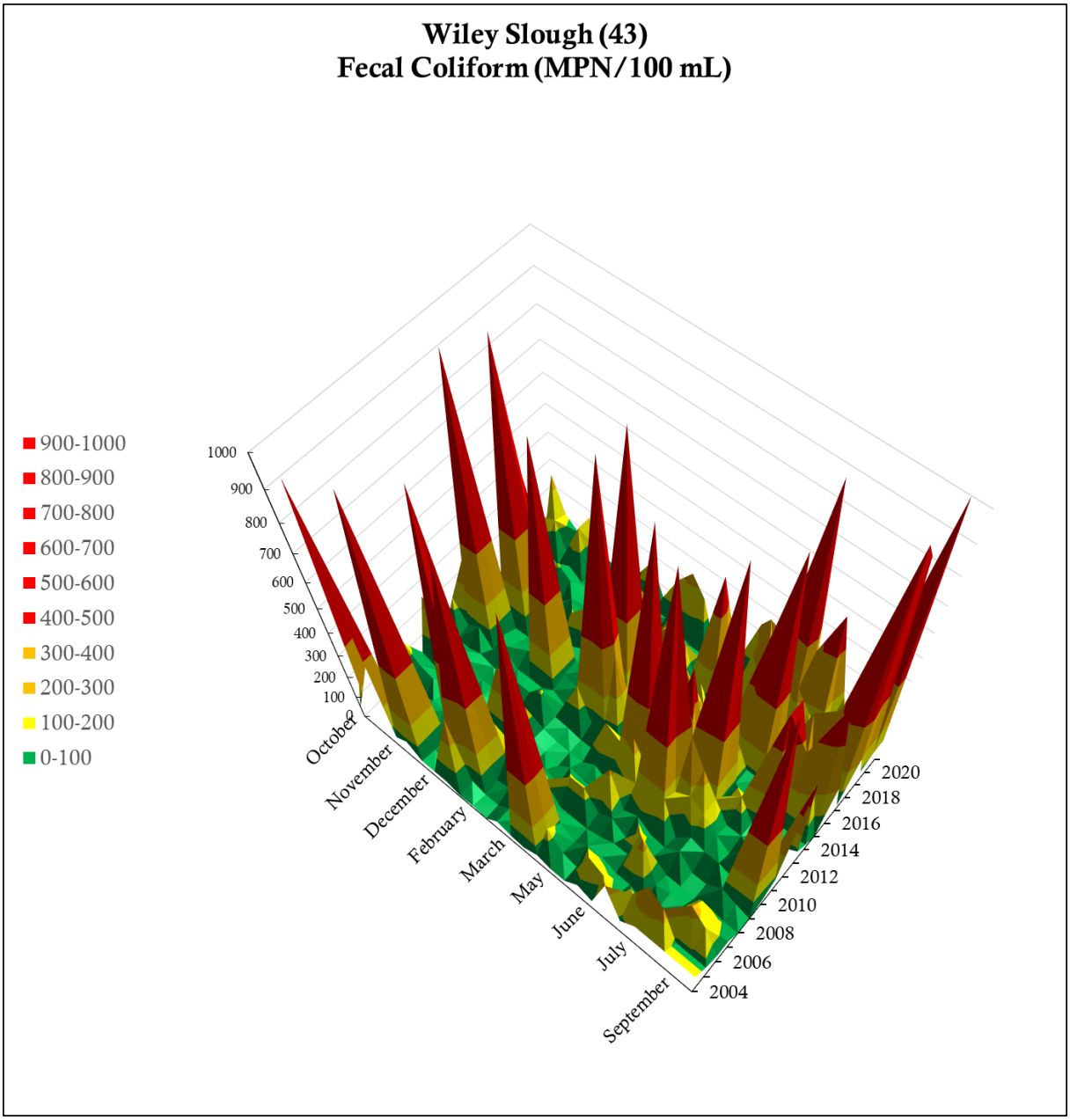
Site 43 is tied for 18th out of 39 sites for number of significant trends, with 10, and is tied for last out of 39 sites for positive trends, with 0%.



The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

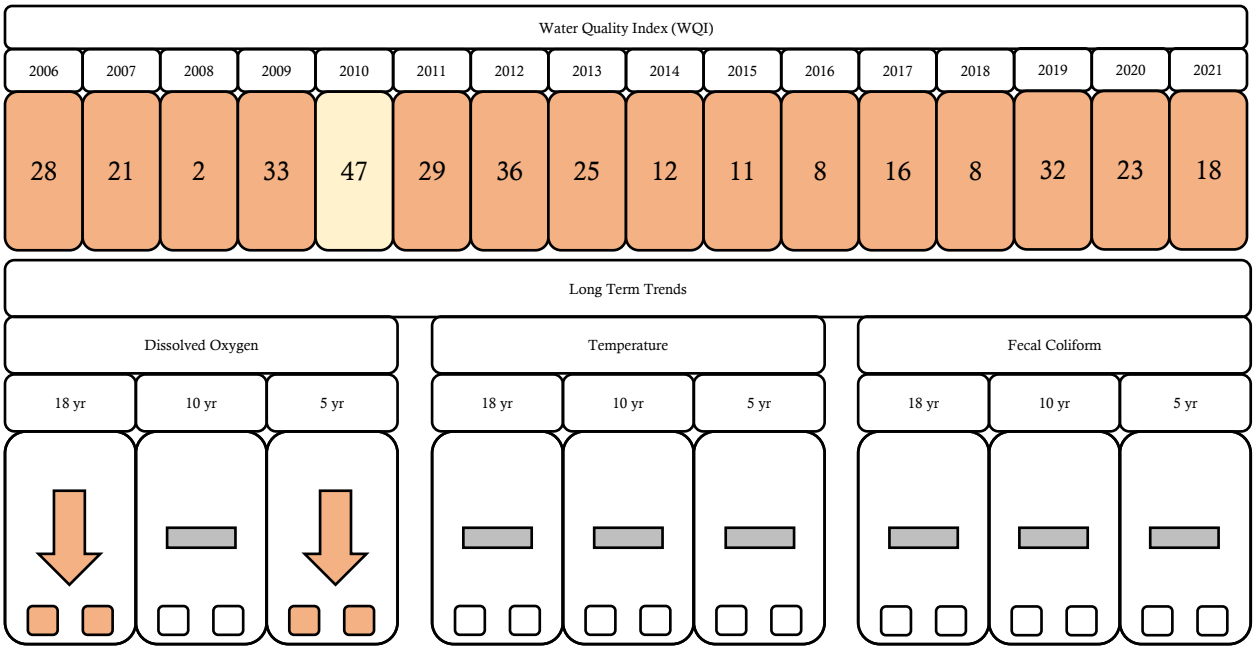


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

44

Sullivan Slough
@ La Conner-Whitney Road

Downstream Ag

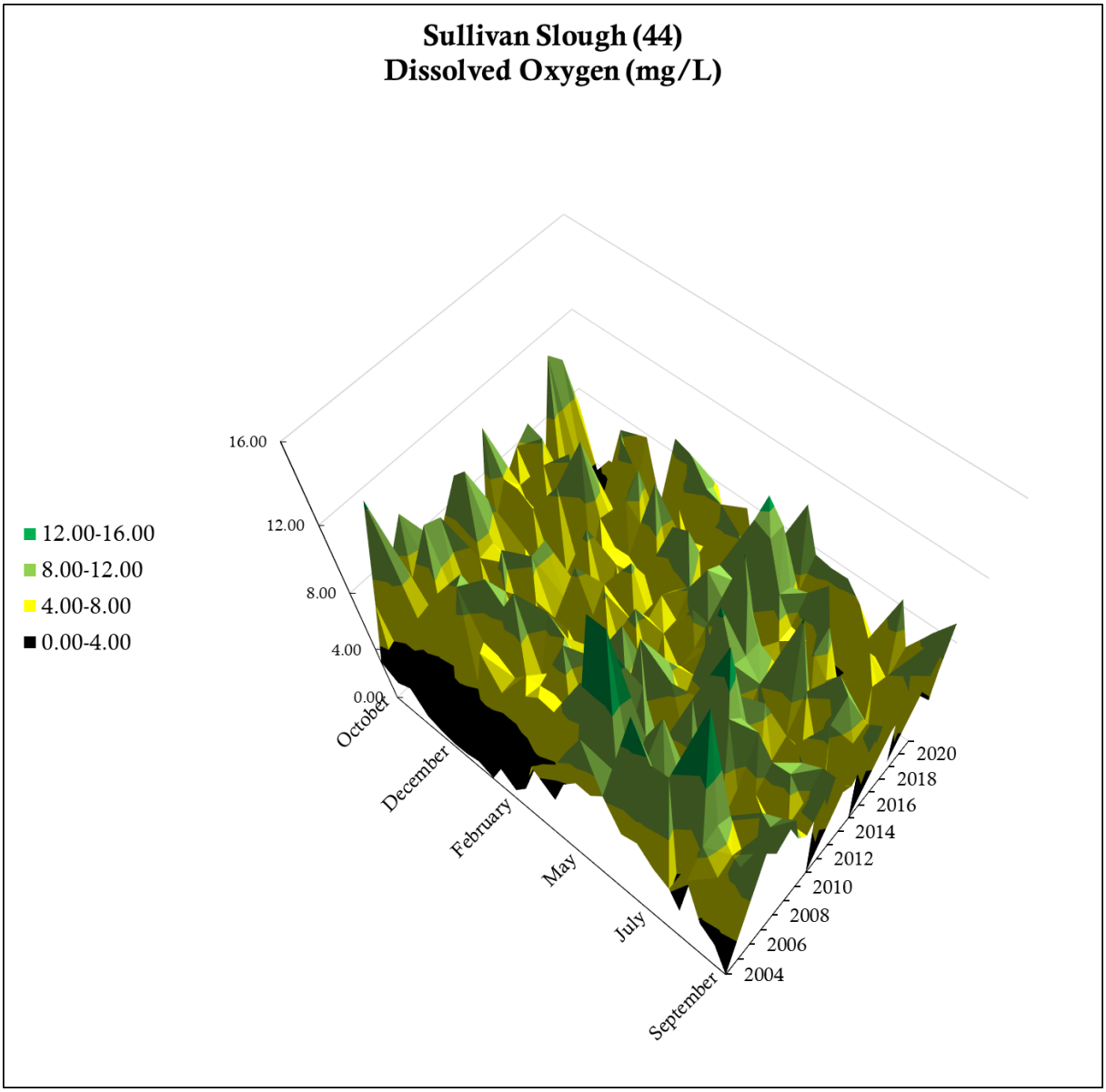


Site 44 is Sullivan Slough, at its west end, just prior to entering the Swinomish Channel. Sites like this are characterized by being stagnant or slow-moving and are heavily tidally influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

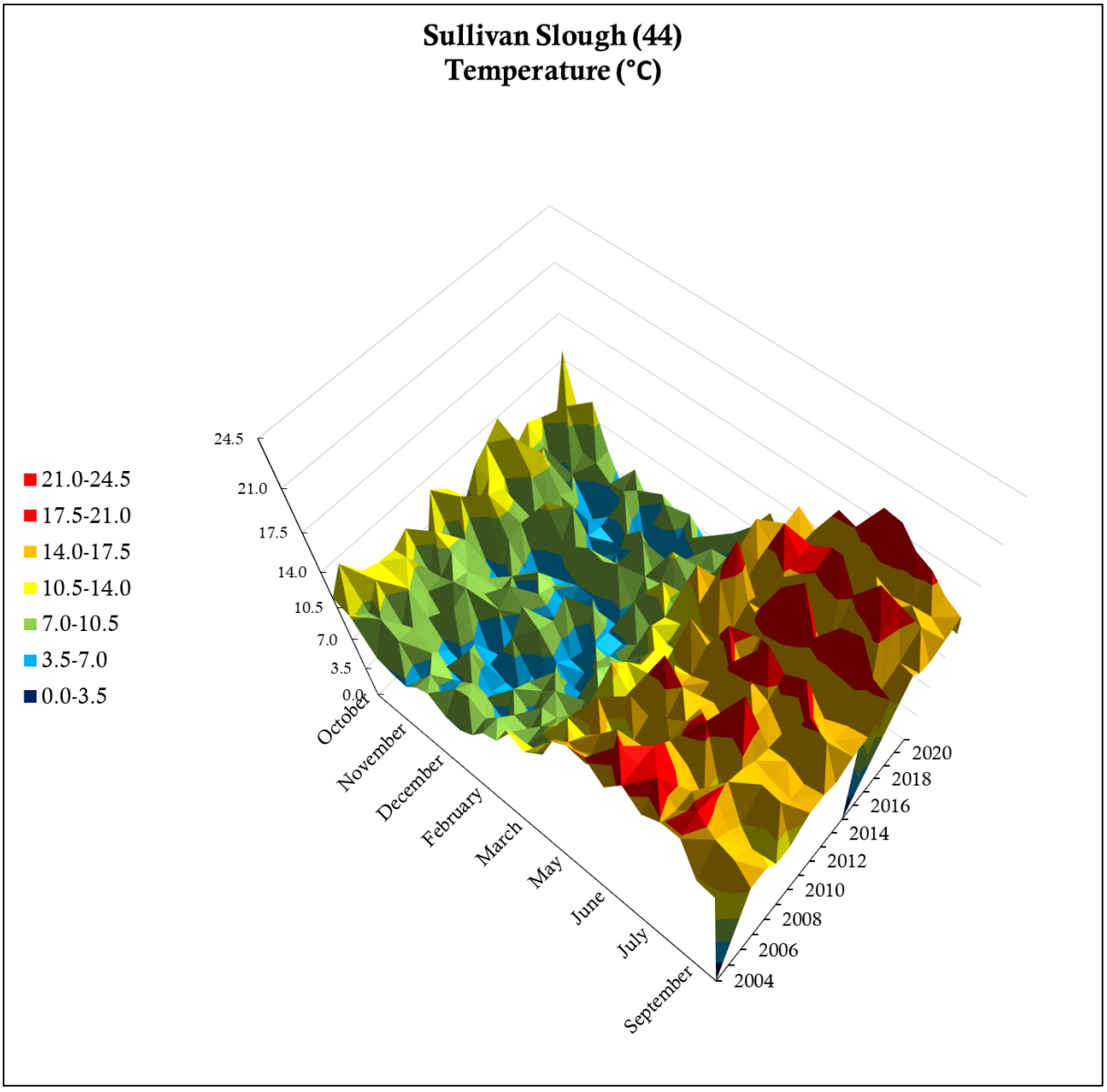
Dissolved oxygen is lower than it was 17 and 5 years ago. Fecal coliform counts have decreased over the last ten years and five years. WQI scores are consistently in the category of highest concern.

Site 44 spends most of the year below state standards for DO and fails to meet state standards for water temperature during the warmer months. Annual FC levels for WY2021 failed to meet state standards. Standards for EC were met.

Site 44 is tied for 23rd out of 39 sites for number of significant trends, with 9, and is tied for last out of 39 sites for positive trends, with 0%.

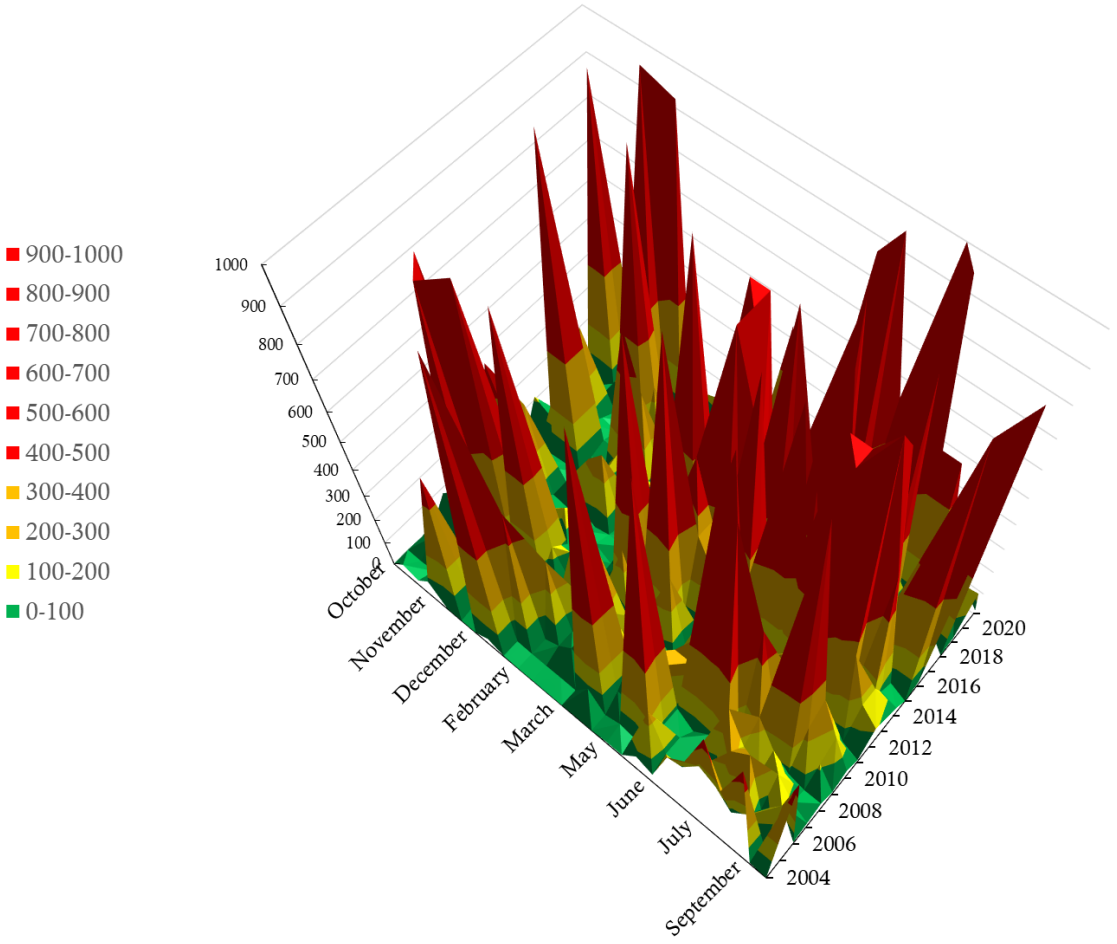


The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

Sullivan Slough (44)
Fecal Coliform (MPN/100 mL)



The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

45

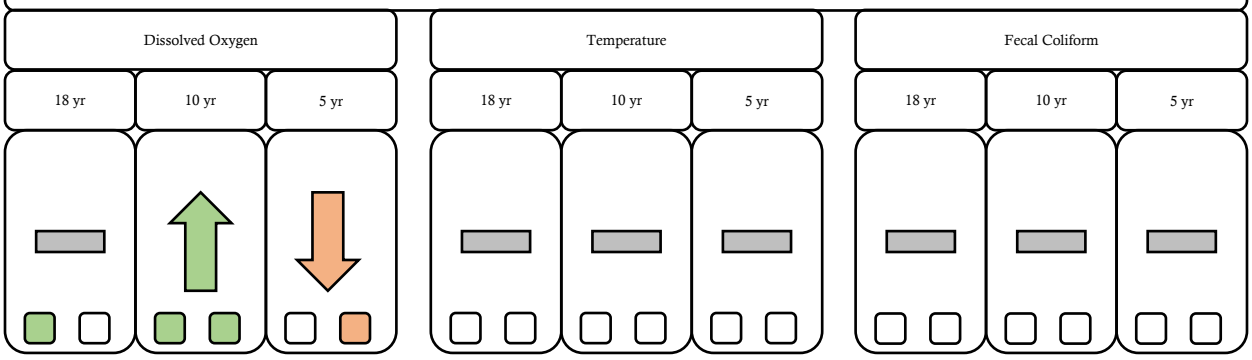
North Fork Skagit River
@ Moore Road

Skagit River – Lower, TMDL

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
78	71	88	95	95	95	80	86	85	93	89	89	89	88	93	86

Long Term Trends

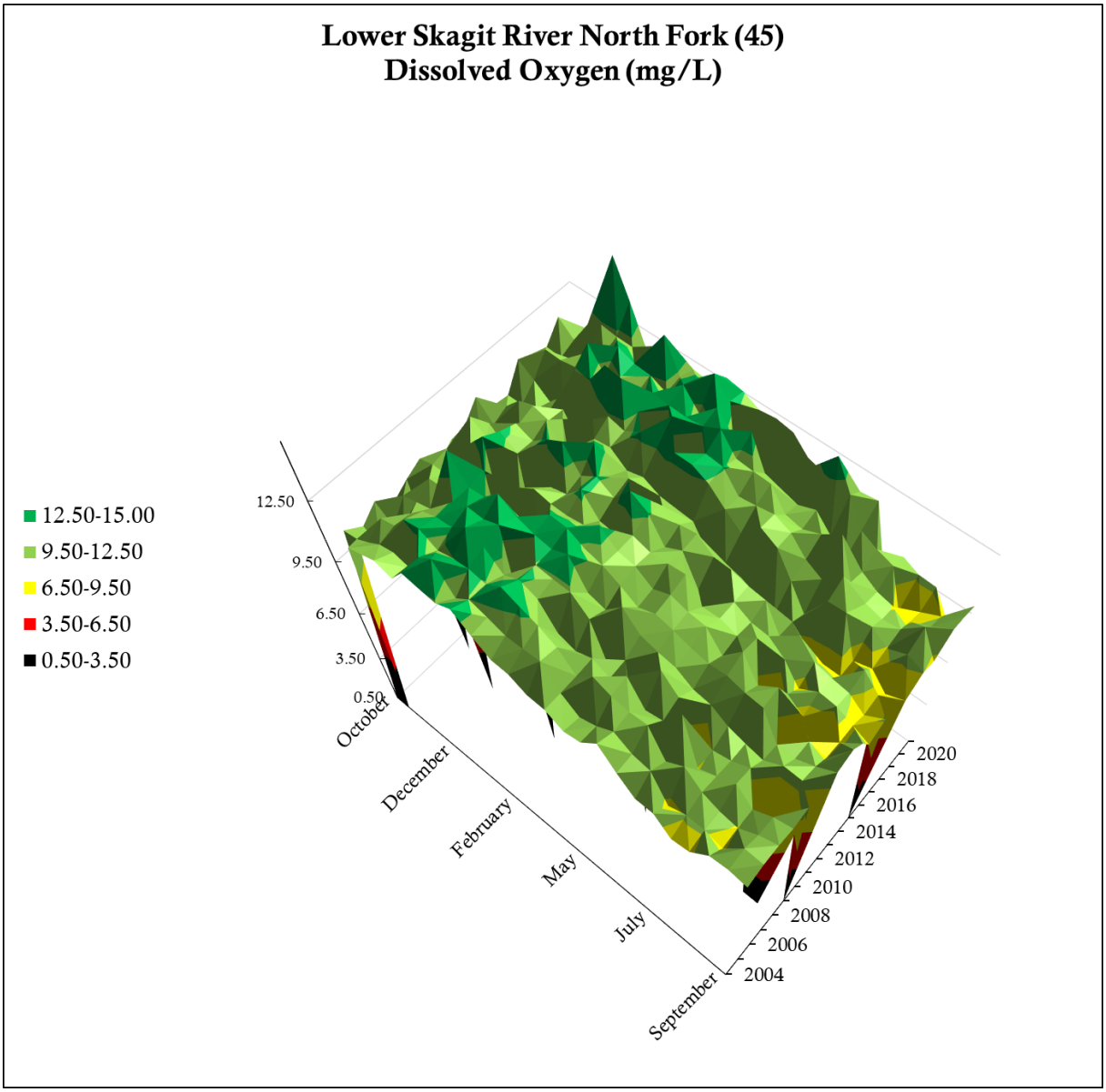


Site 45 is the north fork of the Skagit River, downstream of Mount Vernon. The river is designated as core salmonid habitat and as salmonid spawning, rearing, and migration (SRM) status.

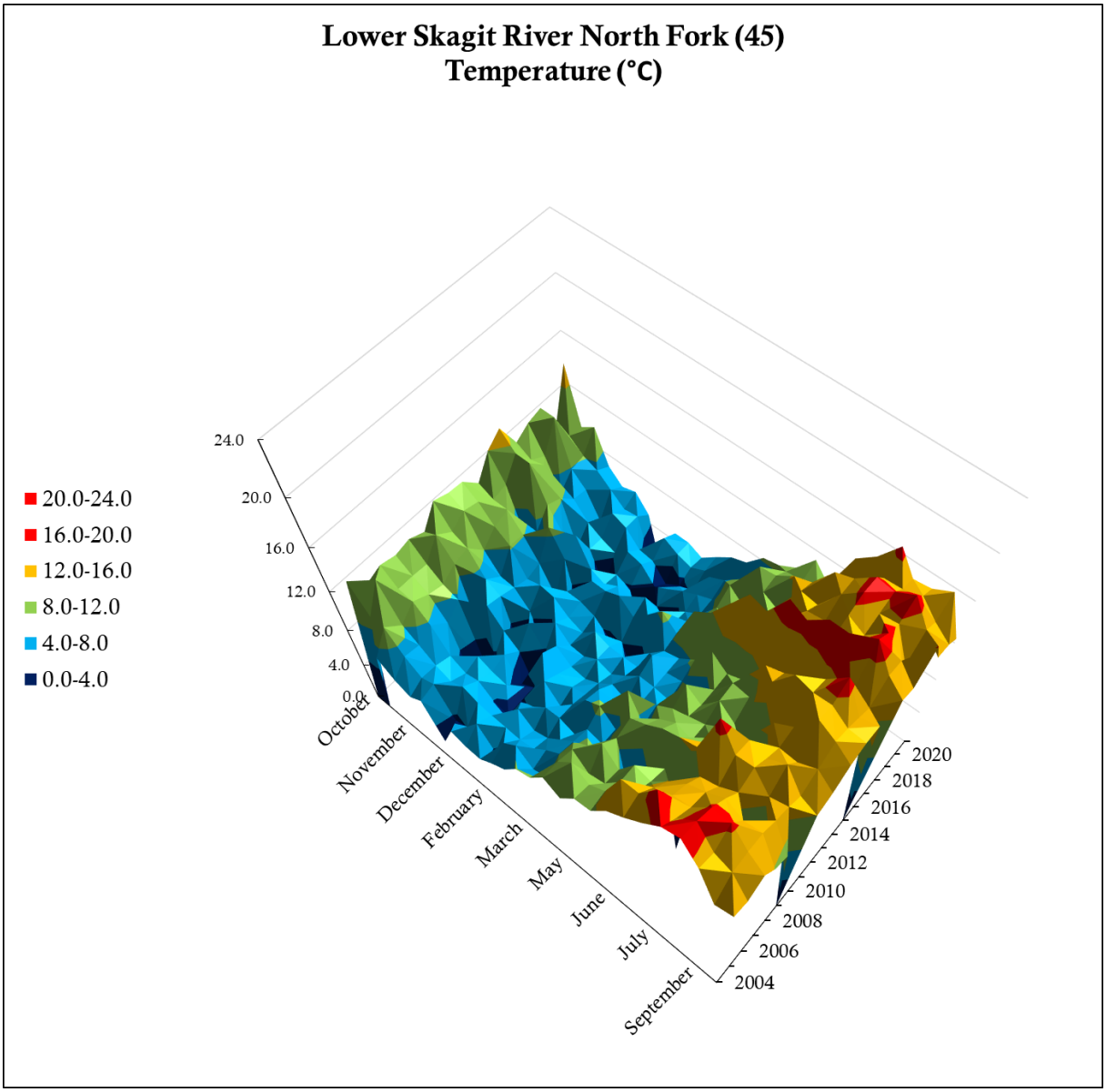
Dissolved oxygen has increased over the most recent ten years but decreased over the last 5 years. WQI scores are consistently in the category of least concern.

Site 45 rarely fails to meet state standards for DO and temperature. Annual bacterial counts easily meet state standards.

Site 45 is tied for 23rd out of 39 sites for number of significant trends, with 9, and is 3rd out of 39 sites for positive trends, with 89%.

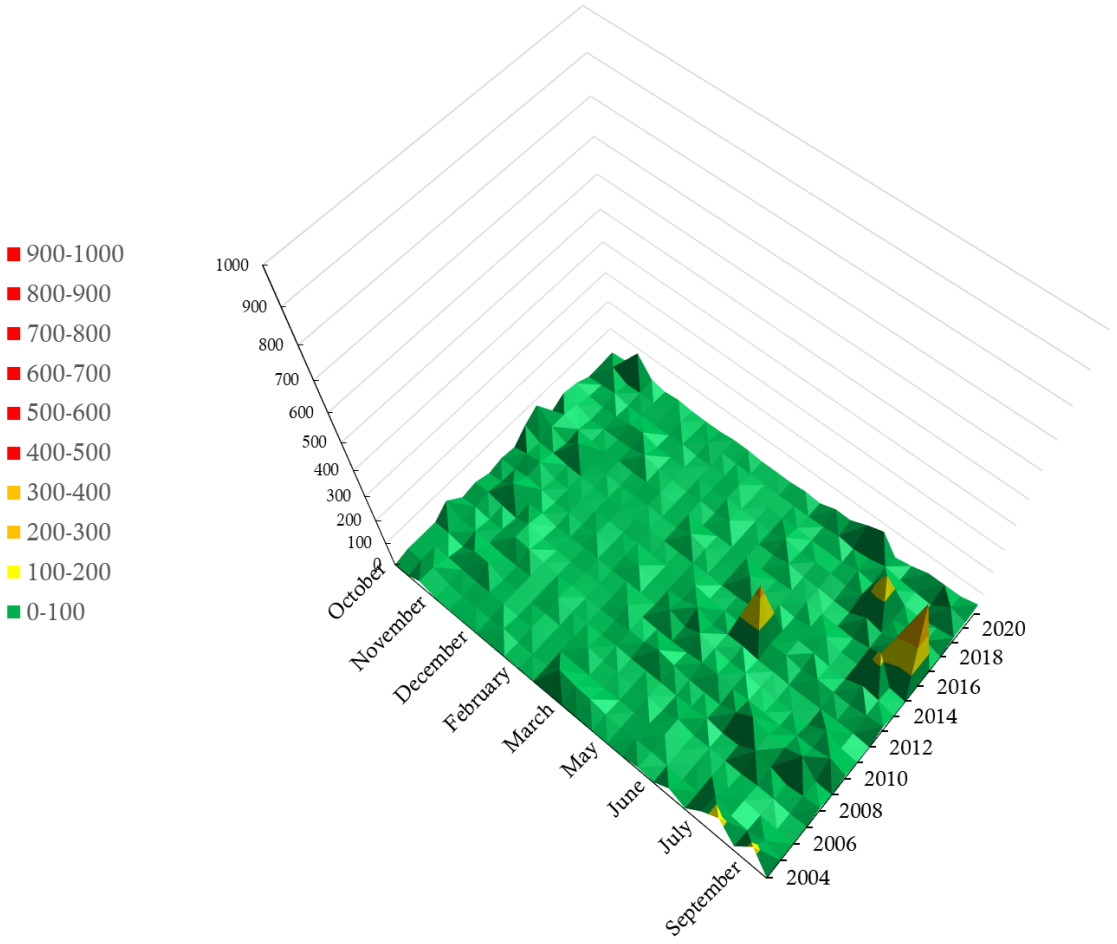


The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

Lower Skagit River North Fork (45)
Fecal Coliform (MPN/100 mL)

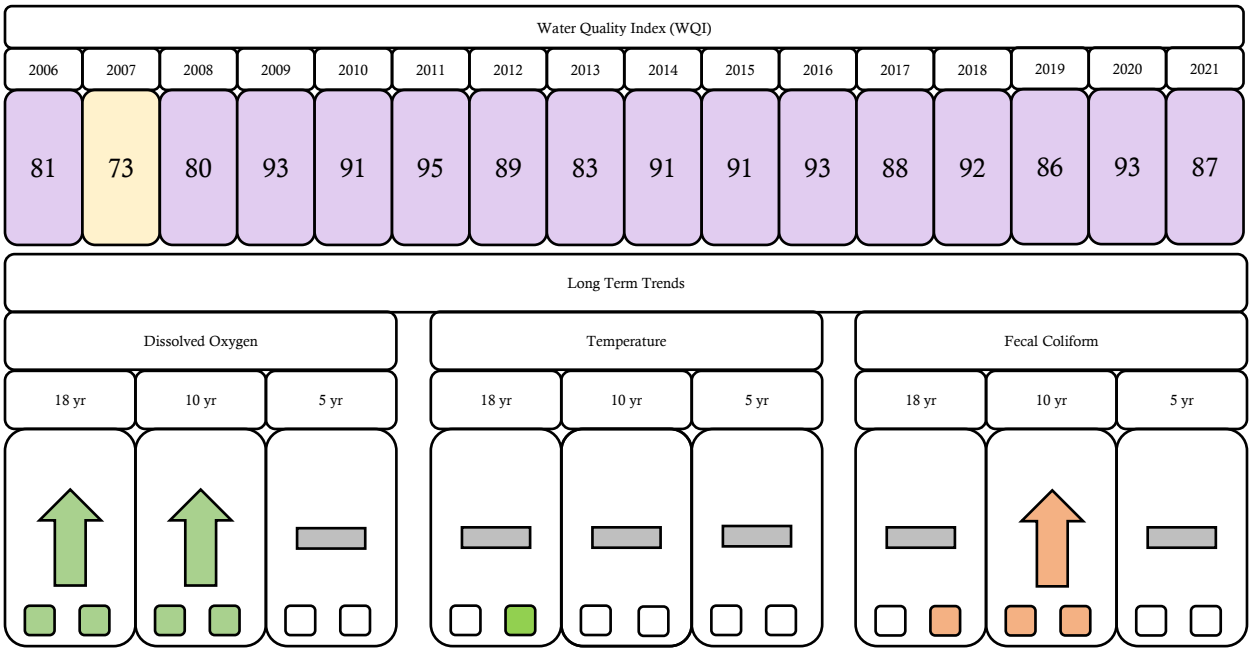


The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

46

South Fork Skagit River
@ Conway Bridge

Skagit River – Lower, TMDL

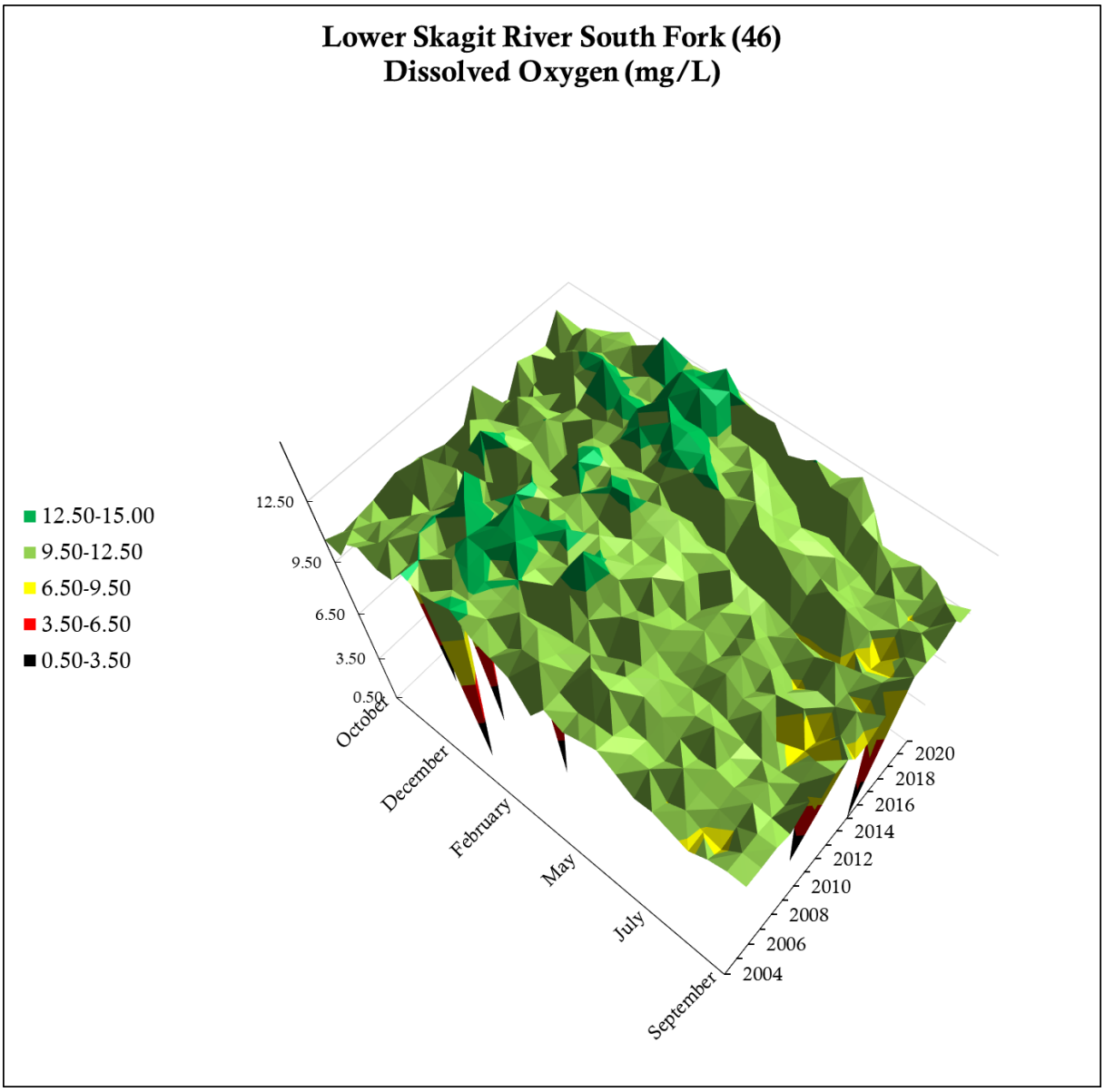


Site 46 is the south fork of the Skagit River, downstream of Mount Vernon. The river is designated as core salmonid habitat and as salmonid spawning, rearing, and migration (SRM) status.

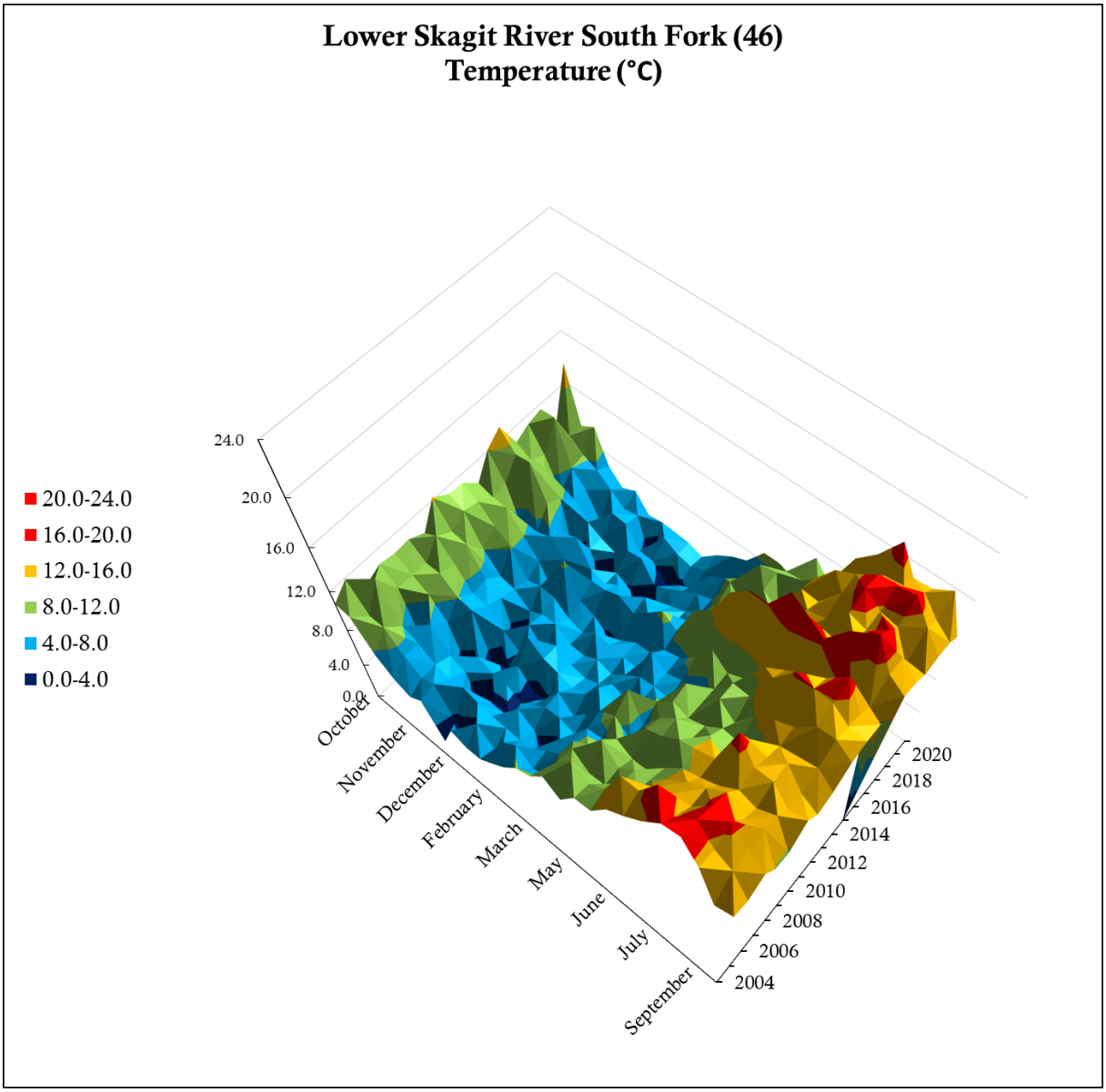
Dissolved oxygen has increased over the 18- and 10-year time periods. Fecal coliform counts are higher now than ten years ago. WQI scores are consistently in the category of least concern.

Site 46 rarely fails to meet state standards for DO and water temperature. Annual bacterial counts easily meet state standards.

Site 46 is tied for 18th out of 39 sites for number of significant trends, with 10, and is 8th out of 39 sites for positive trends, with 80%.

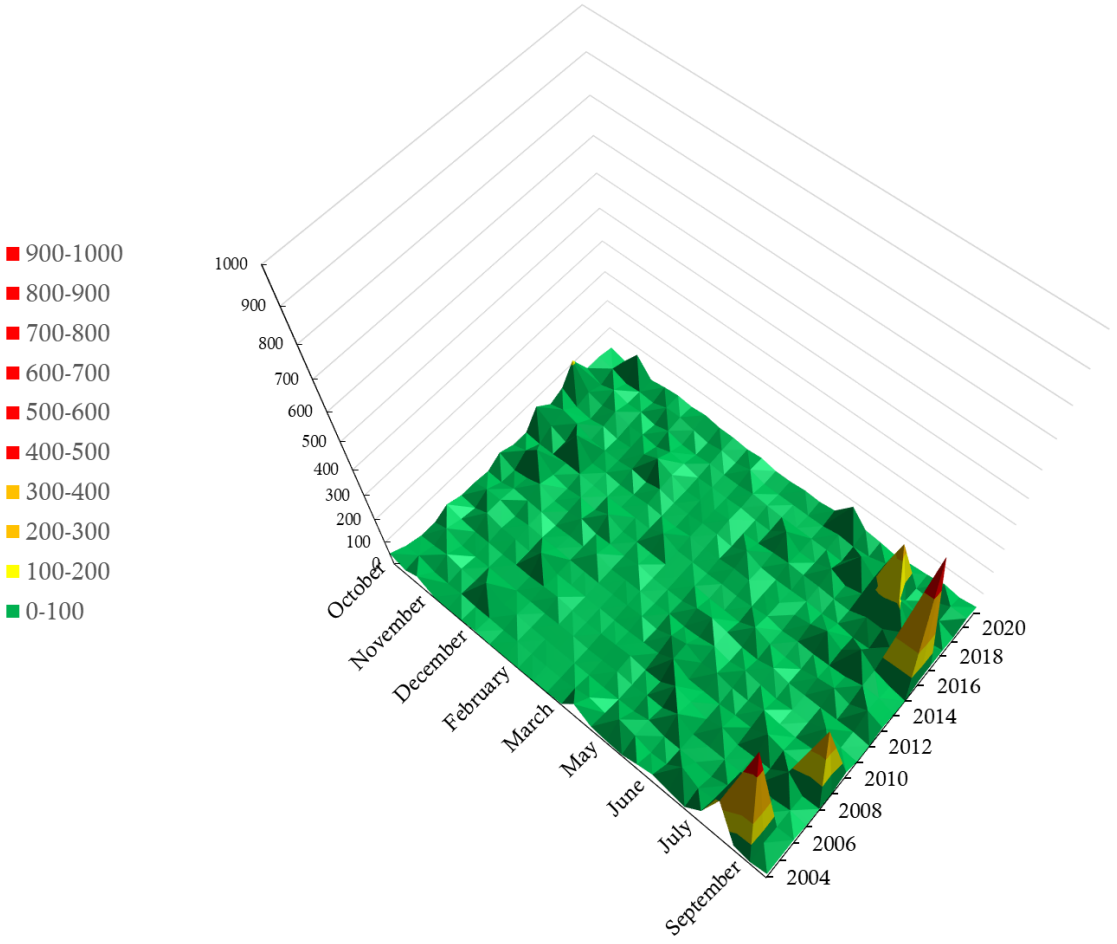


The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

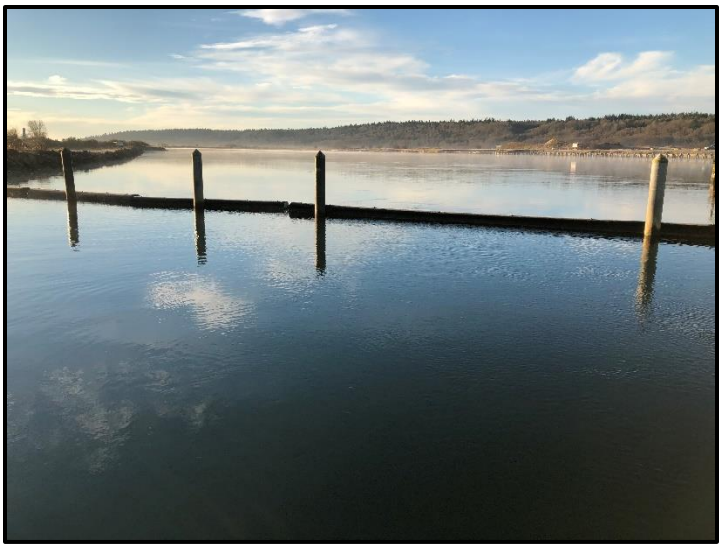


The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

Lower Skagit River South Fork (46)
Fecal Coliform (MPN/100 mL)



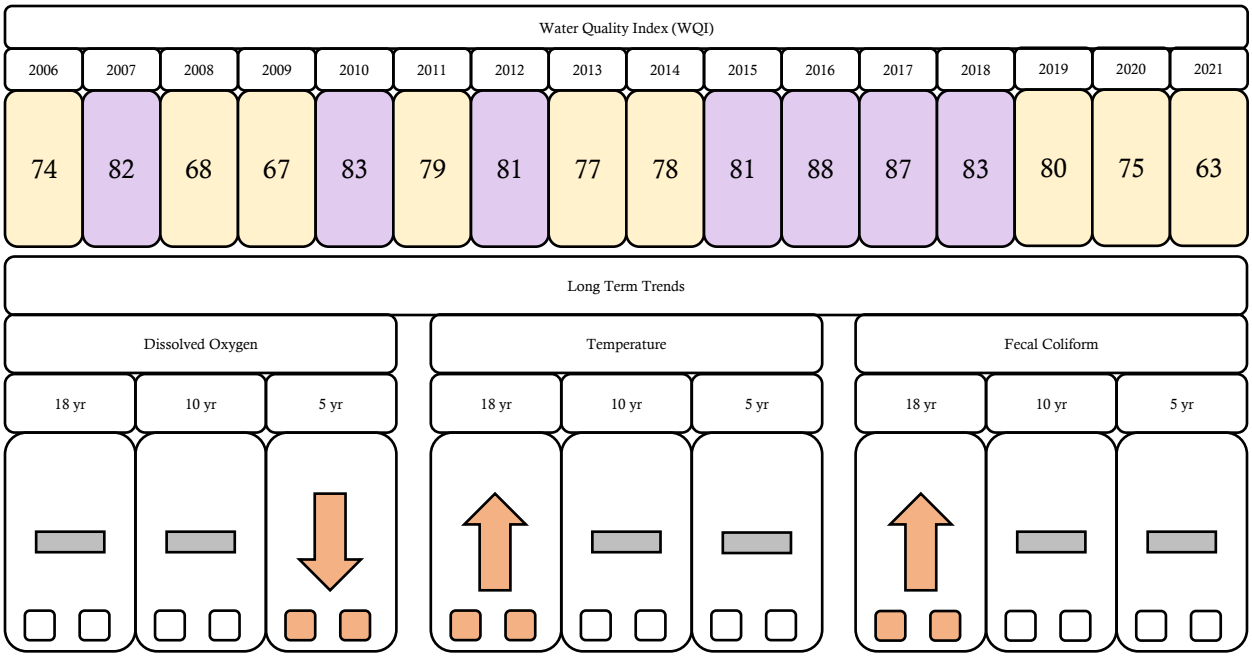
The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



47

Swinomish Channel
@ Berentson Bridge

Reference - Marine

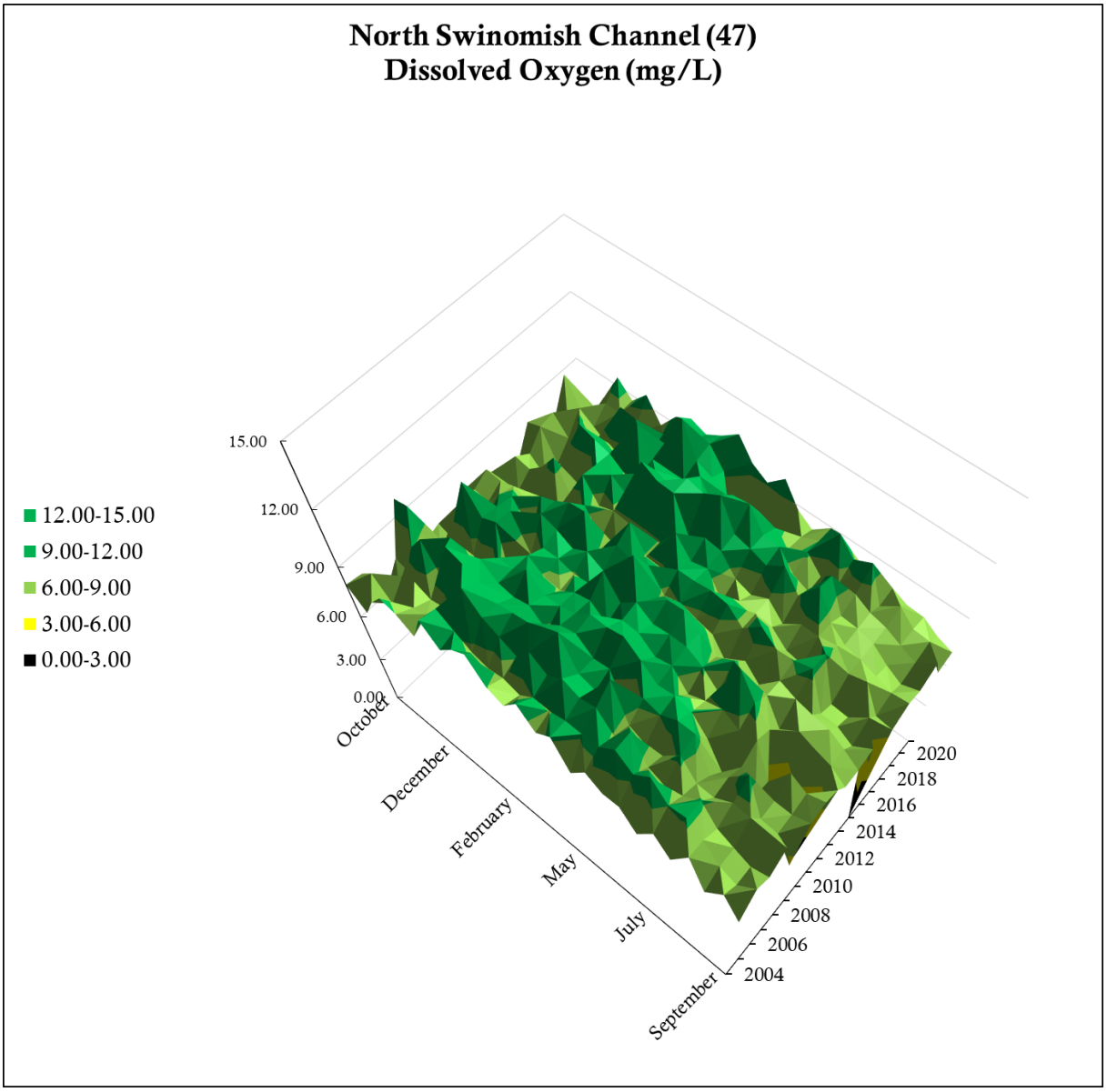


Site 47 is the Swinomish Channel, at the north end, just prior to Padilla Bay, and connects Padilla Bay to Skagit Bay. This site is designated as marine water.

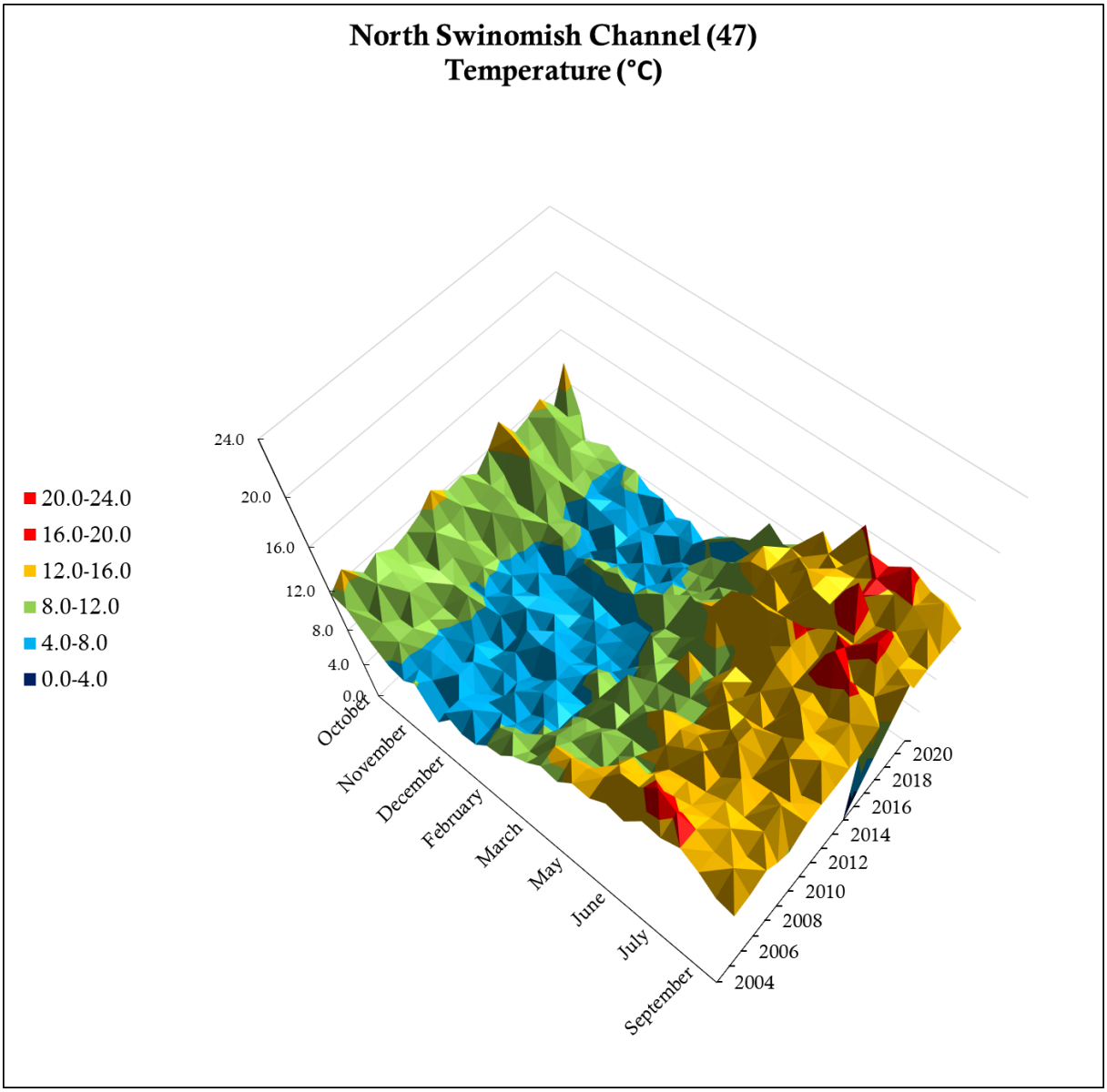
DO is lower than it was 5 years ago. Temperature and fecal coliform counts are higher now than they were at the beginning of this program. WQI scores are generally in the higher-scoring end of the moderate concern category, and often score as least concern.

Site 47 rarely fails to meet state standards for DO and water temperature. Annual FC counts easily meet state standards.

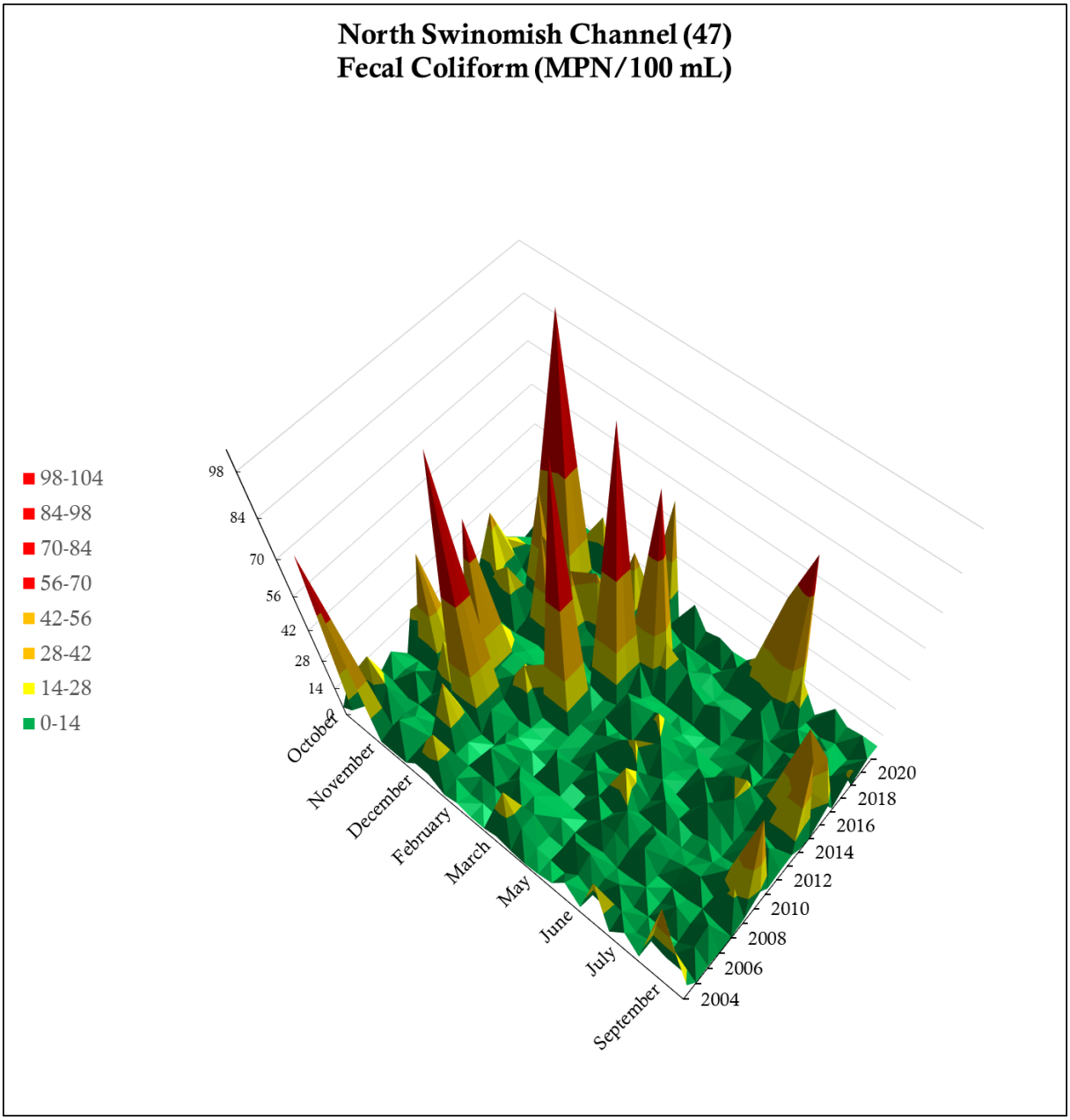
Site 47 is tied for 11th out of 39 sites for number of significant trends, with 12, and is tied for 35th out of 39 sites for positive trends, with 17%.



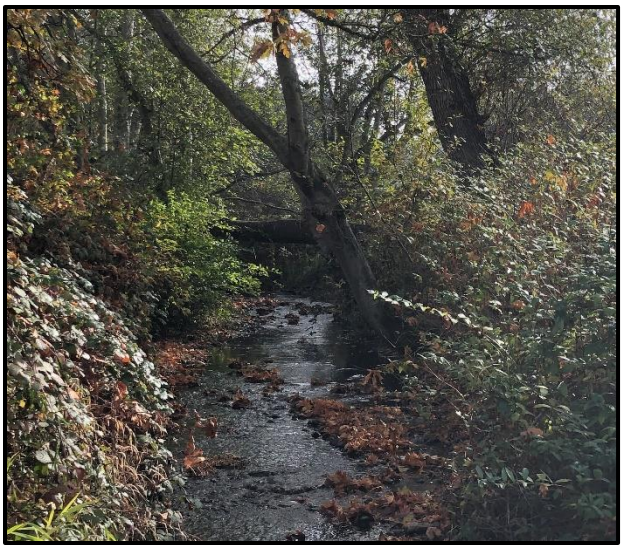
The dissolved oxygen (DO) standard for this site is 6.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.



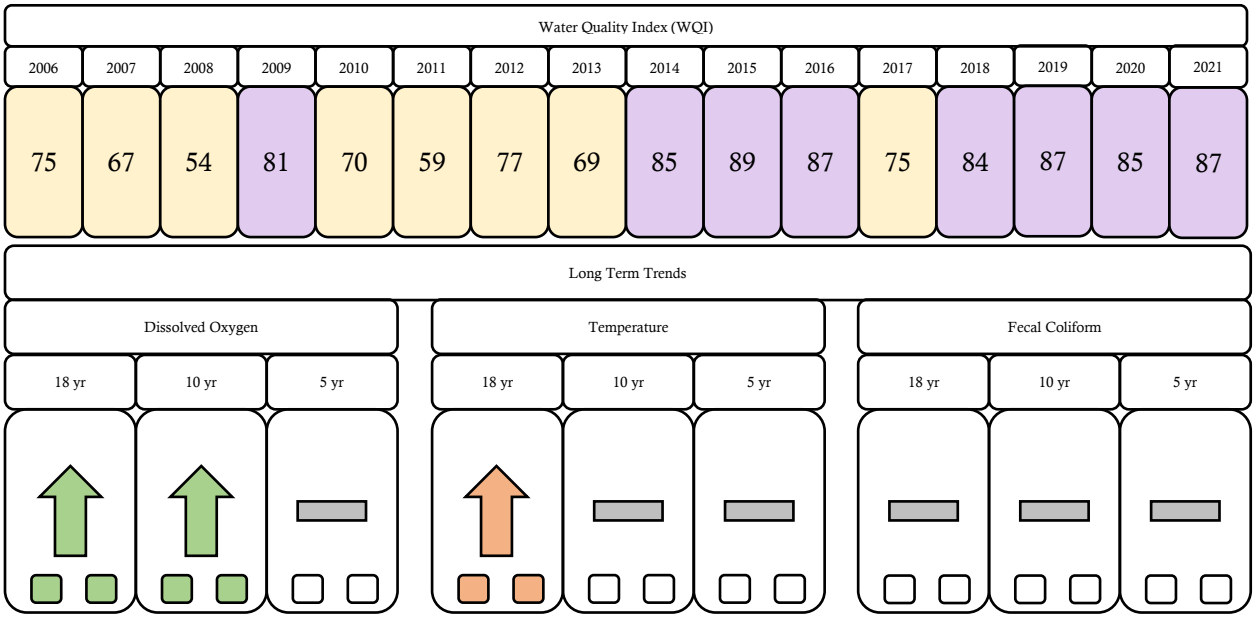
The fecal coliform (FC) standard for this site is 14 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



48

Fisher Creek
@ Franklin Road

Downstream Ag, TMDL

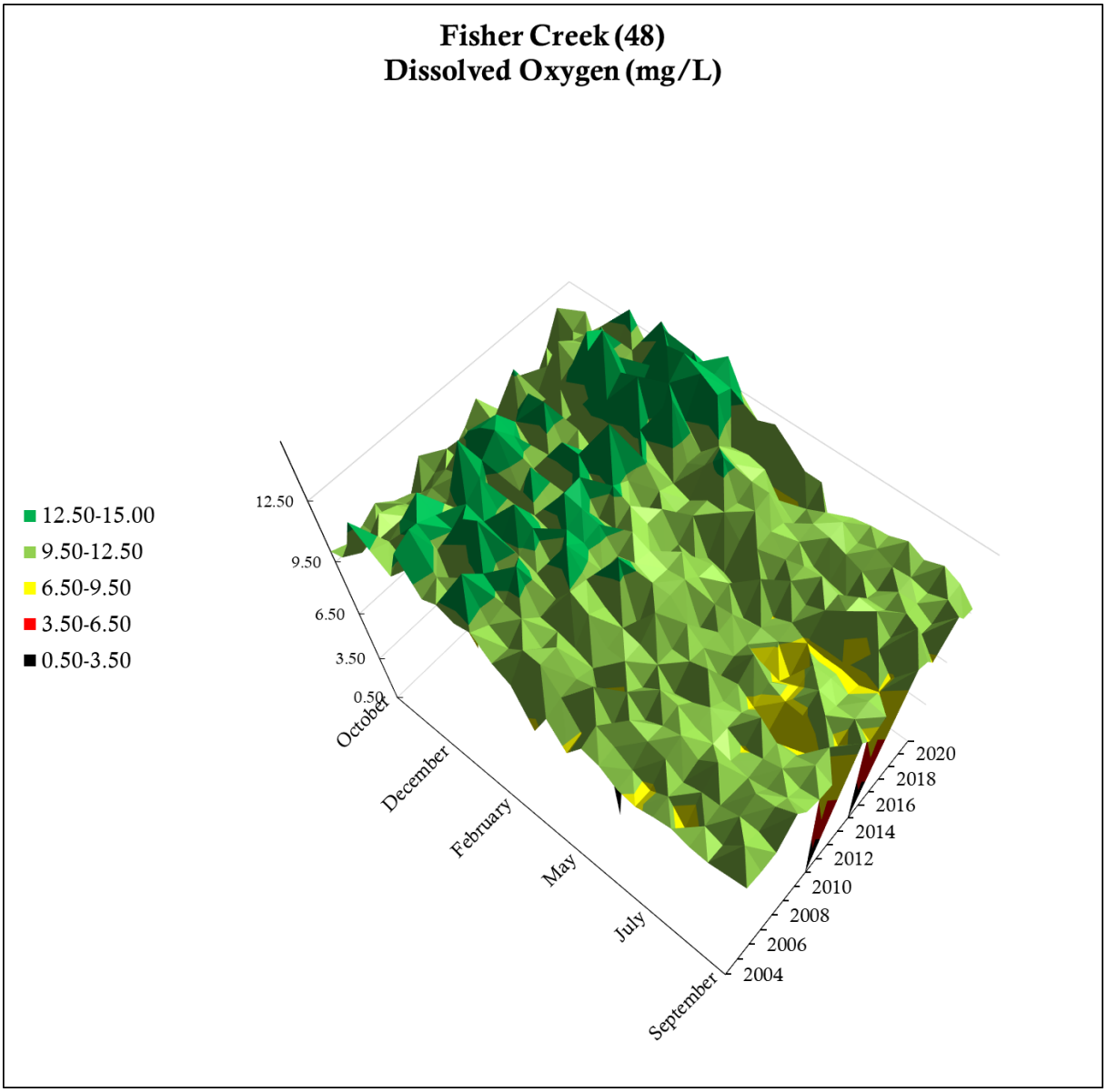


Site 48 is Fisher Creek, just prior to adjoining Carpenter Creek/Hill Ditch, and ultimately Skagit Bay. This site is influenced by rural residential and light agricultural activities. This site is designated as core salmonid habitat.

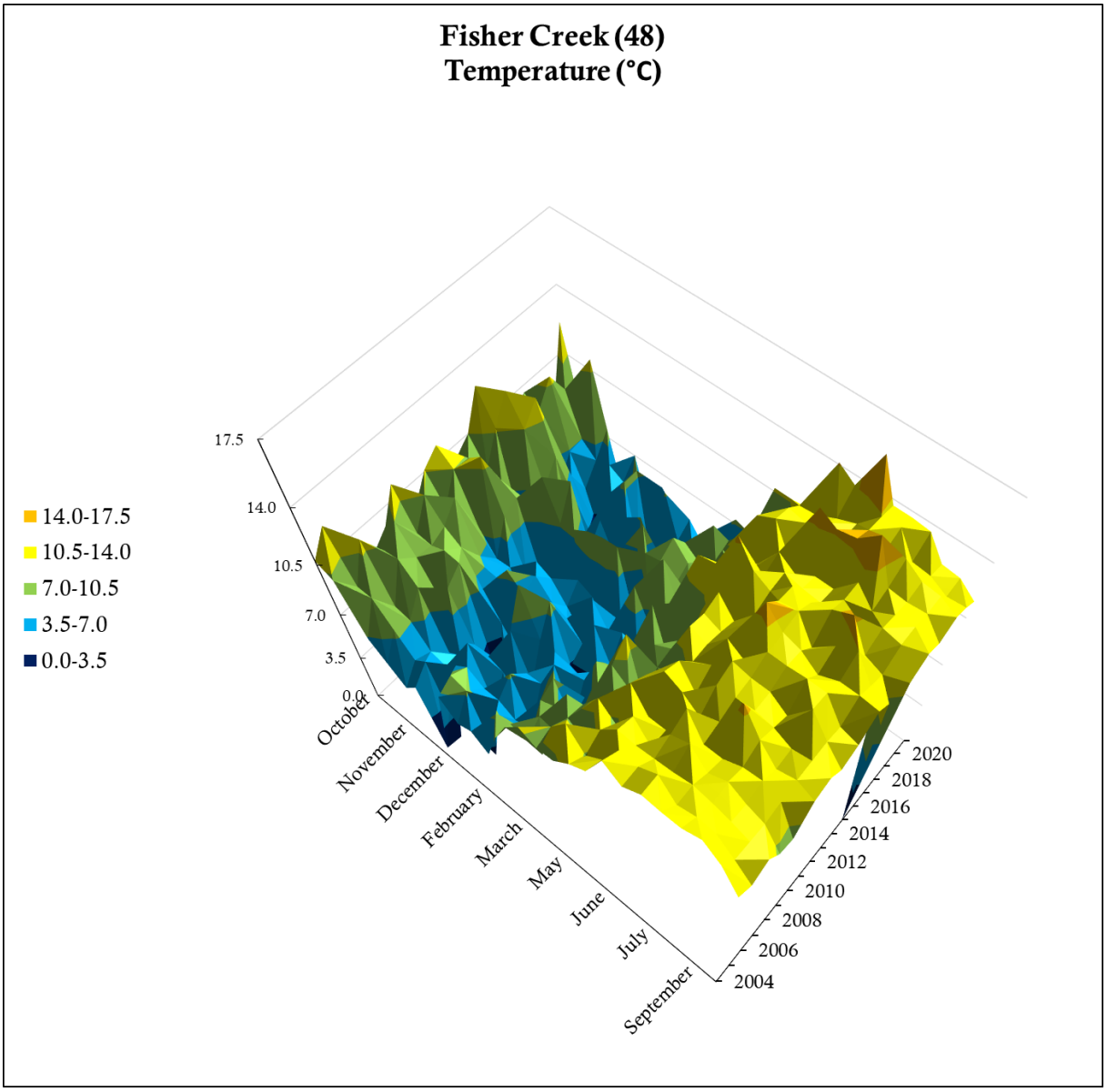
Dissolved oxygen has increased as compared to 17 years ago and ten years ago. Water temperature is higher than it was 17 years ago. WQI scores are generally in the higher-scoring end of the moderate concern category, and often score as least concern.

Site 48 rarely fails to meet state standards for DO and has never failed to meet state standards for water temperature across the life of this program. Annual bacterial levels for WY2021 passed state standards for geomeans but failed for 90th percentiles.

Site 48 is tied for 4th out of 39 sites for number of significant trends, with 14, and is 16th out of 39 sites for positive trends, with 64%.

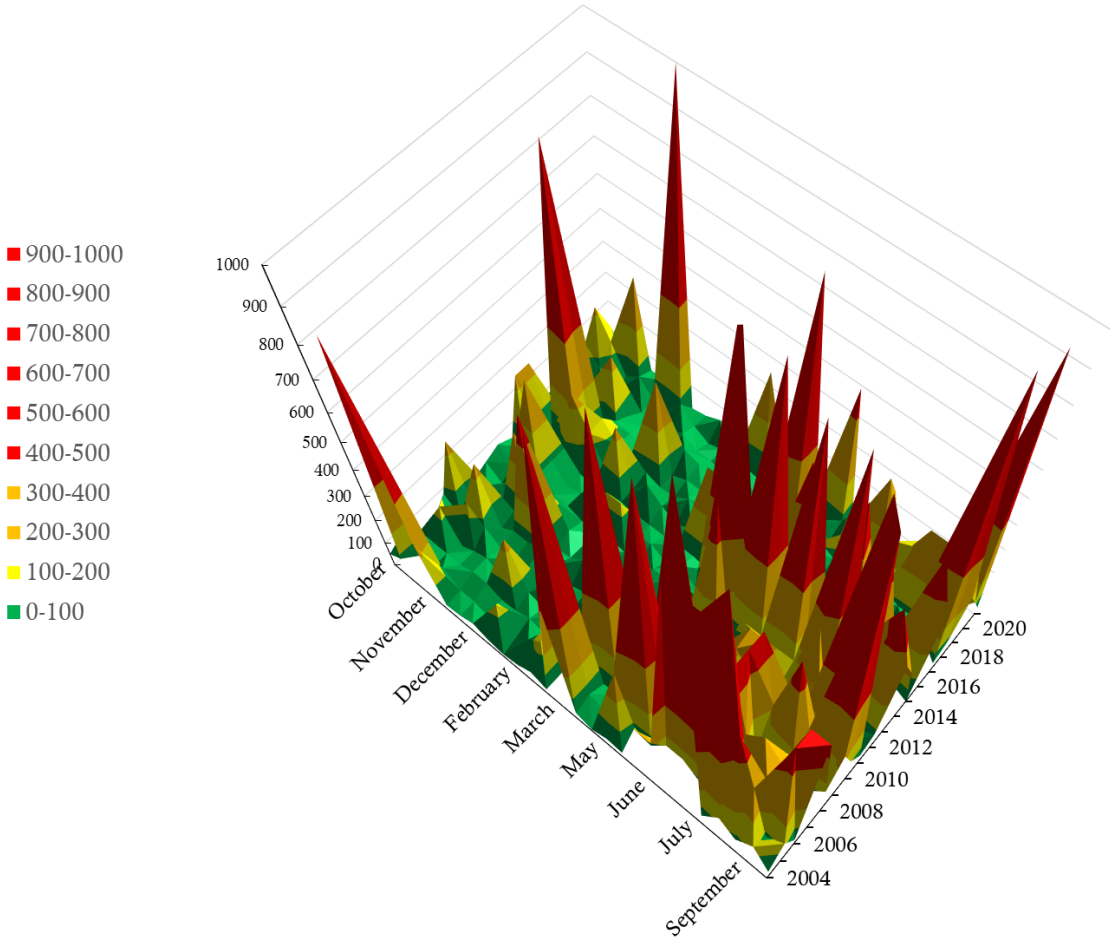


The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.



The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

Fisher Creek (48)
Fecal Coliform (MPN/100 mL)



The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

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Appendix B - Summary statistics for sample sites, Oct. 2003 – Sep. 2021

Fecal coliform (FC) means are geometric means, but the standard deviations were left in arithmetic form. Appendix B begins on the following page.

Metric	pH	DO	DO	Temp	Turb	Conductivity (°C compensated)	Salinity	Fecal Coliform	E. coli	Nitrite + Nitrate	Total Kjehldahl Nitrogen	Total Phosphorus	Ortho-Phosphate	Nitrate	Ammonia	TSS
	units	mg/L	% sat	°C	NTU	µs/cm	ppt	MPN/100mL	MPN/100 mL	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Site 3: Thomas Creek at Highway 99																
n	429	452	453	457	413	450	456	457	26	116	116	116	115	115	116	115
Mean	6.92	6.59	56.9	10.7	14.3	153.5	0.1	53	39	0.583	0.77	0.08	0.036	0.567	0.12	9
SD	0.24	3.20	25.5	4.7	13.5	96.2	0.0	4328	467	0.535	0.51	0.06	0.029	0.528	0.13	14
Max	7.59	12.45	114.5	20.2	113.0	1799.0	0.2	92000	1700	2.220	3.68	0.44	0.180	2.220	0.92	90
Min	6.17	0.03	0.4	0.9	1.0	49.9	0.0	1	2	0.005	0.25	0.05	0.005	0.005	0.01	2
Site 4: Thomas Creek at F&S Grade Road																
n	435	456	457	460	418	449	458	457	26	117	117	117	117	116	117	117
Mean	7.20	11.10	96.0	9.4	19.4	124.2	0.0	173	109	1.018	0.48	0.06	0.044	1.006	0.04	14
SD	0.32	1.28	6.9	3.8	28.9	50.3	0.0	1971	364	0.318	0.29	0.04	0.034	0.313	0.04	25
Max	8.20	15.17	128.4	16.6	291.0	222.1	0.1	23000	1600	2.110	2.22	0.35	0.160	2.100	0.25	147
Min	6.29	6.73	13.7	0.0	0.8	47.6	0.0	5	14	0.005	0.25	0.05	0.005	0.005	0.01	2
Site 6: Friday Creek at Prairie Road																
n	434	453	455	460	418	457	460	460	25	117	116	117	117	116	117	117
Mean	7.28	11.25	99.8	10.5	6.0	79.1	0.0	34	16	0.513	0.38	0.06	0.015	0.508	0.03	9
SD	0.38	1.26	6.8	4.7	9.9	21.0	0.0	278	17	0.293	0.24	0.05	0.014	0.294	0.03	27
Max	8.72	15.35	119.8	20.1	118.0	140.8	0.1	3000	78	1.640	1.92	0.40	0.070	1.640	0.16	238
Min	6.26	6.95	14.4	0.1	0.3	41.7	0.0	1	2	0.029	0.25	0.05	0.005	0.020	0.01	2
Site 8: Swede Creek at Grip Road																
n	435	457	458	461	419	448	462	461	26	117	117	117	117	116	117	117
Mean	7.15	10.74	92.8	9.6	13.4	68.8	0.0	59	29	0.449	0.45	0.06	0.025	0.428	0.04	12
SD	0.34	1.76	7.9	4.4	19.7	18.1	0.0	399	309	0.375	0.26	0.03	0.023	0.341	0.03	31
Max	10.43	15.14	112.0	18.2	224.0	161.4	0.1	5000	1600	2.170	1.94	0.26	0.140	1.580	0.17	282
Min	5.99	5.62	59.5	0.1	2.0	33.2	0.0	1	5	0.030	0.25	0.05	0.005	0.005	0.01	2
Site 11: Samish River at Highway 9																
No.	439	460	461	463	421	455	464	464	26	116	117	117	116	116	117	116
Mean	7.00	8.72	74.8	8.9	3.3	72.4	0.0	15	12	0.307	0.29	0.06	0.014	0.306	0.03	8
SD	0.31	1.32	7.8	3.4	8.9	19.7	0.0	241	21	0.117	0.12	0.04	0.013	0.117	0.03	34
Max	8.11	12.56	96.2	17.2	155.0	129.4	0.1	5000	79	0.790	1.36	0.36	0.070	0.790	0.12	333
Min	6.00	4.70	45.1	0.8	0.0	23.1	0.0	1	1	0.110	0.25	0.05	0.005	0.110	0.01	2

Metric	pH	DO	DO	Temp	Turb	Conductivity (°C compensated)	Salinity	Fecal Coliform	E. coli	Nitrite + Nitrate	Total Kjehldahl Nitrogen	Total Phosphorus	Ortho-Phosphate	Nitrate	Ammonia	TSS
	units	mg/L	% sat	°C	NTU	µs/cm	ppt	MPN/100mL	MPN/100 mL	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Site 12: Nookachamps Creek at Swan Road																
No.	410	433	435	438	404	436	438	437	26	112	112	112	112	111	112	112
Mean	7.17	9.11	81.0	11.1	7.8	106.0	0.0	64	53	0.378	0.50	0.06	0.022	0.372	0.08	9
SD	0.28	2.11	13.7	5.6	14.3	34.0	0.0	227	177	0.229	0.22	0.04	0.021	0.225	0.05	16
Max	8.07	13.79	139.5	24.8	208.0	221.5	0.1	2400	920	0.940	1.44	0.40	0.100	0.930	0.34	156
Min	6.40	1.90	22.0	1.1	1.5	11.0	0.0	2	8	0.010	0.25	0.05	0.005	0.010	0.01	2
Site 13: East Fork Nookachamps Creek at Highway 9																
No.	431	455	456	458	423	456	459	457	26	116	116	116	116	115	116	116
Mean	7.26	9.74	85.7	10.2	5.1	92.2	0.0	49	35	0.306	0.38	0.05	0.013	0.301	0.05	6
SD	0.31	1.70	11.1	5.1	8.1	28.3	0.0	284	174	0.214	0.16	0.01	0.012	0.209	0.04	12
Max	8.08	12.96	110.4	24.0	84.6	165.7	0.1	3000	540	0.970	0.92	0.10	0.060	0.960	0.24	113
Min	6.43	2.37	23.5	0.5	0.0	0.8	0.0	1	2	0.005	0.25	0.05	0.005	0.005	0.01	2
Site 14: College Way Creek at College Way																
No.	428	456	457	459	420	455	459	456	24	115	115	115	115	114	115	115
Mean	7.26	9.24	81.7	10.7	6.7	223.4	0.1	151	113	0.401	0.53	0.06	0.056	0.388	0.07	5
SD	0.30	2.29	14.9	4.2	24.9	51.6	0.0	1125	412	0.328	0.25	0.04	0.053	0.314	0.05	7
Max	8.00	13.50	114.0	20.8	489.0	336.8	0.2	16000	1700	1.570	1.55	0.40	0.280	1.570	0.25	60
Min	6.23	3.10	32.4	0.4	0.0	76.6	0.0	5	8	0.005	0.25	0.05	0.005	0.005	0.01	2
Site 15: Nookachamps Creek at Knapp Road																
No.	433	457	458	461	424	460	461	459	25	117	117	117	117	116	117	117
Mean	7.22	8.08	72.3	12.0	5.1	114.0	0.0	69	30	0.311	0.63	0.09	0.057	0.300	0.10	6
SD	0.28	3.39	26.4	5.5	3.9	37.6	0.0	422	73	0.275	0.27	0.06	0.091	0.272	0.08	4
Max	7.92	13.51	114.3	25.3	62.4	329.1	0.2	5400	280	1.010	1.72	0.38	0.870	1.010	0.54	32
Min	6.50	0.26	2.6	1.4	1.2	69.0	0.0	1	4	0.005	0.25	0.05	0.005	0.005	0.01	2
Site 16: East Fork Nookachamps Creek at Beaver Lake Road																
No.	434	458	459	462	425	458	462	459	26	116	116	116	116	115	116	116
Mean	7.41	11.45	99.2	9.5	3.9	89.9	0.0	26	27	0.337	0.31	0.05	0.013	0.330	0.03	6
SD	0.31	1.31	5.6	4.7	8.7	33.1	0.0	790	604	0.205	0.15	0.01	0.013	0.201	0.02	20
Max	8.38	14.29	116.4	20.5	82.6	179.7	0.1	16000	3100	1.090	1.31	0.10	0.060	1.090	0.10	190
Min	6.42	7.13	67.5	0.2	0.0	0.0	0.0	1	1	0.005	0.25	0.05	0.005	0.005	0.01	2

Metric	pH	DO	DO	Temp	Turb	Conductivity (°C compensated)	Salinity	Fecal Coliform	E. coli	Nitrite + Nitrate	Total Kjehldahl Nitrogen	Total Phosphorus	Ortho-Phosphate	Nitrate	Ammonia	TSS
	units	mg/L	% sat	°C	NTU	µs/cm	ppt	MPN/100mL	MPN/100 mL	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Site 17: Nookachamps Creek at Big Lake Outlet																
No.	431	458	459	462	424	460	462	458	26	117	117	117	117	116	117	117
Mean	7.42	9.92	91.8	12.8	2.5	87.3	0.0	13	16	0.234	0.43	0.05	0.016	0.230	0.05	3
SD	0.31	1.90	9.7	6.0	1.8	14.4	0.0	89	79	0.222	0.20	0.01	0.025	0.221	0.03	2
Max	8.46	14.38	123.9	26.9	12.9	221.5	0.1	900	350	0.900	1.23	0.12	0.230	0.900	0.18	19
Min	6.44	4.94	51.8	0.9	0.2	3.2	0.0	1	1	0.005	0.25	0.05	0.005	0.005	0.01	2
Site 18: Lake Creek at Highway 9																
No.	435	458	459	463	426	462	463	461	26	117	117	117	117	116	117	117
Mean	7.43	11.02	96.7	10.0	3.0	90.7	0.0	44	33	0.459	0.37	0.05	0.020	0.454	0.03	5
SD	0.31	1.34	5.5	4.1	4.3	25.6	0.0	884	212	0.206	0.31	0.01	0.020	0.203	0.02	10
Max	8.34	14.34	128.6	21.9	47.8	173.8	0.1	16000	920	0.970	3.22	0.10	0.110	0.970	0.10	72
Min	6.40	7.43	74.7	0.9	0.0	0.0	0.0	1	2	0.050	0.25	0.05	0.005	0.050	0.01	2
Site 19: Hansen Creek at Hoehn Road																
No.	412	433	434	435	397	423	435	434	21	112	112	113	112	112	112	112
Mean	7.08	10.30	88.4	9.1	13.9	81.5	0.0	76	40	0.423	0.41	0.08	0.024	0.418	0.04	39
SD	0.30	1.46	7.0	4.3	66.0	18.4	0.0	426	82	0.226	0.60	0.15	0.037	0.226	0.03	141
Max	8.64	14.34	110.0	19.0	848.0	228.9	0.1	5000	350	1.100	6.14	1.07	0.360	1.100	0.14	902
Min	6.06	4.71	48.0	0.1	0.2	39.3	0.0	1	7	0.030	0.25	0.05	0.005	0.030	0.01	2
Site 20: Hansen Creek at Northern State Hospital																
No.	434	457	458	459	415	453	459	457	26	117	117	117	117	116	117	117
Mean	7.12	11.17	96.0	9.0	14.4	79.4	0.0	43	22	0.470	0.36	0.11	0.022	0.465	0.03	58
SD	0.31	1.19	4.8	3.7	73.1	21.5	0.0	227	69	0.252	0.31	0.26	0.030	0.252	0.03	229
Max	8.18	14.67	115.6	16.2	900.0	199.1	0.1	3000	350	1.300	2.20	1.90	0.270	1.300	0.15	1720
Min	6.08	7.34	66.5	0.5	0.0	39.7	0.0	1	2	0.050	0.25	0.05	0.005	0.050	0.01	2
Site 21: Coal Creek at Hoehn Road																
No.	375	398	398	399	361	388	399	396	20	103	103	103	103	102	103	103
Mean	7.08	11.18	93.6	8.1	12.6	80.9	0.0	75	60	0.763	0.33	0.07	0.020	0.756	0.03	21
SD	0.29	1.48	5.7	4.1	61.2	23.5	0.2	632	391	0.308	0.18	0.07	0.030	0.309	0.04	68
Max	8.32	15.05	115.9	17.5	1005.0	229.5	3.9	5000	1600	2.090	1.30	0.49	0.230	2.090	0.26	438
Min	6.07	6.61	68.1	0.1	0.0	39.5	0.0	1	8	0.220	0.25	0.05	0.005	0.210	0.01	2

Metric	pH	DO	DO	Temp	Turb	Conductivity (°C compensated)	Salinity	Fecal Coliform	E. coli	Nitrite + Nitrate	Total Kjehldahl Nitrogen	Total Phosphorus	Ortho-Phosphate	Nitrate	Ammonia	TSS
	units	mg/L	% sat	°C	NTU	µs/cm	ppt	MPN/100mL	MPN/100 mL	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Site 22: Coal Creek at Highway 20																
No.	438	456	457	460	421	450	459	459	26	115	116	116	115	115	116	115
Mean	7.19	11.77	99.4	8.3	10.6	80.4	0.0	12	5	0.629	0.32	0.07	0.014	0.634	0.02	21
SD	0.44	1.20	4.6	3.9	63.8	22.0	0.0	276	26	0.318	0.20	0.11	0.019	0.324	0.02	87
Max	8.29	15.60	137.0	15.7	1138.0	158.6	0.1	5000	130	2.230	1.50	0.79	0.120	2.230	0.15	650
Min	5.54	8.33	73.2	0.0	0.0	18.3	0.0	1	1	0.005	0.25	0.05	0.005	0.160	0.01	2
Site 23: Wiseman Creek at Minkler Road																
No.	389	410	412	413	375	407	413	411	22	108	109	109	109	107	109	108
Mean	7.22	11.91	100.3	8.0	13.1	74.2	0.0	12	10	0.933	0.33	0.08	0.017	0.926	0.02	26
SD	0.36	1.04	5.3	3.4	81.0	18.6	0.0	304	49	0.323	0.20	0.12	0.023	0.323	0.03	106
Max	8.52	15.77	157.7	16.2	1072.0	217.9	0.1	5000	170	2.210	1.52	0.91	0.159	2.100	0.33	640
Min	6.06	8.87	87.2	0.7	0.0	15.0	0.0	1	1	0.400	0.25	0.05	0.005	0.220	0.01	2
Site 24: Mannser Creek at Lyman-Hamilton Highway																
No.	440	458	459	461	420	455	462	457	26	117	117	117	117	116	117	117
Mean	6.92	6.82	58.3	8.7	2.0	107.6	0.1	15	12	0.229	0.35	0.05	0.033	0.227	0.02	4
SD	0.30	1.46	11.9	3.0	1.9	21.9	0.0	90	26	0.122	0.54	0.03	0.062	0.122	0.02	5
Max	7.97	12.40	104.2	15.3	25.7	407.6	0.2	920	79	0.560	6.00	0.33	0.590	0.560	0.08	36
Min	5.98	1.97	18.5	0.8	0.0	1.4	0.0	1	1	0.005	0.25	0.05	0.005	0.005	0.01	2
Site 25: Red Cabin Creek at Hamilton Cemetery Road																
No.	356	369	371	372	340	370	371	369	20	97	97	97	97	96	97	97
Mean	7.21	11.82	98.7	7.5	3.2	67.2	0.0	8	4	0.531	0.29	0.06	0.016	0.519	0.02	9
SD	0.41	0.79	4.8	2.4	21.1	21.3	0.0	166	14	0.205	0.15	0.04	0.016	0.189	0.02	43
Max	8.35	14.40	133.8	13.9	291.0	110.0	0.1	2400	49	1.400	1.18	0.44	0.090	1.050	0.16	410
Min	6.05	9.38	84.0	1.9	0.0	17.2	0.0	1	1	0.240	0.25	0.05	0.005	0.230	0.01	2
Site 28: Brickyard Creek at Highway 20																
No.	312	325	326	327	299	321	328	326	14	86	86	86	86	85	86	86
Mean	7.07	9.30	79.0	8.7	8.2	107.3	0.1	47	30	0.634	0.54	0.05	0.033	0.619	0.07	4
SD	0.47	1.83	10.3	4.0	6.7	34.4	0.0	288	63	0.344	0.25	0.01	0.041	0.310	0.07	6
Max	8.42	13.31	110.4	18.6	60.6	208.9	0.1	1600	240	2.040	1.68	0.11	0.230	1.410	0.51	46
Min	5.35	4.03	41.0	0.0	0.5	20.7	0.0	1	9	0.005	0.25	0.05	0.005	0.005	0.01	2

Metric	pH	DO	DO	Temp	Turb	Conductivity (°C compensated)	Salinity	Fecal Coliform	E. coli	Nitrite + Nitrate	Total Kjehldahl Nitrogen	Total Phosphorus	Ortho-Phosphate	Nitrate	Ammonia	TSS
	units	mg/L	% sat	°C	NTU	µs/cm	ppt	MPN/100mL	MPN/100 mL	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Site 29: Skagit River at River Bend																
No.	433	455	456	461	422	457	461	455	25	115	115	114	115	114	115	115
Mean	7.25	11.15	95.9	9.1	11.9	54.9	0.0	9	9	0.081	0.32	0.06	0.012	0.077	0.04	23
SD	0.50	1.06	4.9	3.7	36.8	12.0	0.0	118	89	0.049	0.24	0.05	0.015	0.047	0.25	57
Max	8.84	14.59	110.3	17.6	608.0	113.9	0.1	1600	350	0.200	2.10	0.40	0.100	0.190	2.65	383
Min	5.81	7.63	78.1	0.9	0.8	28.6	0.0	1	1	0.005	0.25	0.05	0.005	0.005	0.01	2
Site 30: Skagit River at Cape Horn Road																
No.	442	460	461	463	421	461	463	455	26	116	116	116	116	115	116	116
Mean	7.13	11.27	96.2	8.6	8.9	57.3	0.0	4	4	0.081	0.28	0.06	0.014	0.080	0.02	21
SD	0.38	1.07	4.7	3.4	21.9	12.7	0.0	32	9	0.068	0.13	0.06	0.021	0.069	0.01	58
Max	8.49	14.24	118.0	16.3	238.0	132.2	0.1	540	33	0.650	1.34	0.49	0.170	0.650	0.07	501
Min	5.94	7.64	72.5	0.0	0.0	27.7	0.0	1	1	0.005	0.25	0.05	0.005	0.005	0.01	2
Site 31: Drainage District 20 ditch at floodgate																
No.	189	195	195	198	178	192	197	196	NA	59	59	59	59	59	59	59
Mean	7.14	7.70	64.9	8.5	10.6	212.2	0.1	178	NA	0.486	1.00	0.09	0.041	0.472	0.15	13
SD	0.44	2.88	23.0	4.0	15.1	86.4	0.1	693	NA	0.390	1.27	0.08	0.038	0.385	0.17	21
Max	8.17	15.70	131.0	19.4	131.0	455.3	0.2	9000	NA	1.500	9.80	0.48	0.200	1.490	1.16	147
Min	6.02	0.40	5.3	0.8	0.0	45.0	0.0	1	NA	0.005	0.25	0.03	0.005	0.005	0.02	2
Site 32: Samish River at Thomas Road																
No.	432	454	456	462	419	459	461	463	25	116	118	118	116	116	118	116
Mean	7.50	10.86	97.5	10.8	10.8	96.5	0.0	52	27	0.600	0.38	0.07	0.026	0.601	0.06	19
SD	0.46	1.18	9.5	4.7	18.2	25.4	0.1	860	40	0.210	0.24	0.07	0.026	0.201	0.08	39
Max	8.73	14.99	150.0	21.6	181.0	142.0	0.8	17000	170	1.690	1.60	0.47	0.160	1.650	0.68	229
Min	6.50	2.58	14.1	1.2	0.8	45.3	0.0	2	2	0.005	0.25	0.05	0.005	0.330	0.01	2
Site 33: Alice Bay Pump Station																
No.	430	433	452	457	416	448	456	455	26	113	114	114	113	113	114	113
Mean	7.17	9.22	109.3	13.4	27.4	25225.7	15.6	48	24	0.738	2.91	0.54	0.285	0.690	1.19	42
SD	0.82	4.56	73.7	6.5	55.4	13713.9	9.0	367	65	1.183	1.84	0.51	0.340	1.189	0.83	29
Max	8.88	23.93	348.6	27.2	910.0	52822.0	29.7	5000	280	10.000	17.80	2.59	1.710	10.000	3.94	160
Min	5.66	0.41	4.0	0.4	2.7	204.5	0.1	1	2	0.005	0.74	0.05	0.005	0.005	0.01	2

Metric	pH	DO	DO	Temp	Turb	Conductivity (°C compensated)	Salinity	Fecal Coliform	E. coli	Nitrite + Nitrate	Total Kjehldahl Nitrogen	Total Phosphorus	Ortho-Phosphate	Nitrate	Ammonia	TSS
	units	mg/L	% sat	°C	NTU	µs/cm	ppt	MPN/100mL	MPN/100 mL	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Site 34: Noname Slough at Bayview-Edison Road																
No.	426	449	449	453	416	443	451	448	26	114	114	114	114	113	114	114
Mean	6.99	6.82	62.3	11.9	15.8	16143.0	10.2	108	52	0.487	1.39	0.55	0.451	0.470	0.27	25
SD	0.54	3.73	33.1	6.2	16.1	18094.5	11.8	1287	106	0.715	0.70	0.81	0.963	0.699	0.29	31
Max	8.58	22.31	224.8	27.0	211.0	56800.0	38.0	16000	350	4.140	5.34	4.62	7.500	4.140	1.70	233
Min	5.67	0.00	0.0	0.1	0.9	30.8	0.0	1	5	0.005	0.25	0.05	0.005	0.005	0.01	2
Site 35: Joe Leary Slough at D'Arcy Road																
No.	420	443	443	447	405	445	447	442	26	110	110	111	109	111	110	109
Mean	7.22	5.40	50.5	12.1	37.3	477.4	0.2	93	42	0.941	1.21	0.22	0.115	0.918	0.60	19
SD	0.52	1.47	14.6	4.4	27.4	1073.7	0.6	778	204	0.802	0.42	0.16	0.083	0.786	0.27	23
Max	9.05	11.63	121.6	24.0	275.0	19280.0	11.7	9000	920	4.850	2.63	1.04	0.480	4.780	1.15	151
Min	6.25	1.85	17.2	3.5	2.9	5.3	0.0	1	4	0.005	0.25	0.05	0.005	0.130	0.01	2
Site 36: Edison Slough at Edison Elementary School																
No.	430	448	455	459	415	446	457	460	26	116	116	116	116	115	116	116
Mean	7.30	9.09	98.0	13.7	9.7	13701.8	8.4	66	33	0.492	1.24	0.47	0.340	0.486	0.23	20
SD	0.72	3.51	57.3	7.8	6.4	15795.4	10.0	592	211	1.028	0.70	0.62	0.527	1.033	0.33	20
Max	9.58	26.00	359.2	32.4	49.3	44950.0	29.1	9200	920	10.000	4.82	2.81	2.730	10.000	2.51	95
Min	5.98	2.32	21.3	0.1	0.6	52.6	0.0	1	5	0.005	0.59	0.05	0.005	0.005	0.01	2
Site 37: Edison Drainage in Edison																
No.	428	435	452	456	416	451	454	458	26	116	116	116	116	115	116	116
Mean	7.32	7.02	81.2	13.5	44.1	11159.0	6.6	160	60	0.856	3.42	0.86	0.485	0.829	1.48	43
SD	0.67	4.13	68.2	6.7	116.3	11582.8	7.3	980	232	1.305	5.29	0.85	0.598	1.312	1.04	47
Max	9.35	24.72	387.3	27.5	1567.0	44758.0	28.9	16000	920	9.630	58.30	4.26	3.220	9.630	6.71	250
Min	6.16	0.04	0.6	1.8	4.2	172.4	0.1	1	2	0.005	0.25	0.17	0.005	0.005	0.01	7
Site 38: North Edison drainage at Smith Road																
No.	425	425	441	452	411	446	451	453	25	115	114	115	115	114	115	115
Mean	7.24	7.06	84.6	12.9	40.5	17773.2	10.8	148	113	0.523	2.93	0.91	0.560	0.486	1.23	54
SD	0.84	4.73	79.8	5.8	130.4	13861.4	9.0	2115	1133	0.991	1.02	0.82	0.683	0.996	0.75	72
Max	9.20	37.78	455.1	26.1	2300.0	45531.0	29.7	30000	5400	9.540	7.04	3.78	3.190	9.540	4.24	524
Min	5.60	0.00	0.0	1.7	1.8	111.9	0.0	1	5	0.005	1.00	0.05	0.005	0.005	0.02	5

Metric	pH	DO	DO	Temp	Turb	Conductivity (°C compensated)	Salinity	Fecal Coliform	E. coli	Nitrite + Nitrate	Total Kjehldahl Nitrogen	Total Phosphorus	Ortho-Phosphate	Nitrate	Ammonia	TSS
	units	mg/L	% sat	°C	NTU	µs/cm	ppt	MPN/100mL	MPN/100 mL	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Site 39: Colony Creek near Colony Road																
No.	432	455	457	461	416	450	461	461	26	116	116	116	116	115	116	116
Mean	7.18	10.80	93.8	9.8	15.6	132.6	0.0	67	36	0.890	0.59	0.10	0.056	0.871	0.06	37
SD	0.31	1.78	7.9	4.4	37.0	85.3	0.1	1660	269	0.637	0.65	0.17	0.050	0.620	0.05	194
Max	7.97	15.06	111.6	20.5	377.0	397.9	0.2	16000	920	3.020	4.96	1.70	0.210	3.010	0.34	1996
Min	6.19	6.11	58.3	0.0	0.3	44.5	0.0	1	2	0.100	0.25	0.01	0.005	0.190	0.01	2
Site 40: Big Indian Slough at Highway 20 truck scales																
No.	427	450	450	453	416	452	452	449	26	112	113	113	112	113	113	112
Mean	6.76	4.97	43.8	10.9	23.5	437.9	0.2	57	44	0.734	0.99	0.12	0.086	0.702	0.36	9
SD	0.33	2.08	16.5	4.0	14.5	2001.3	1.3	7565	1794	0.502	0.38	0.07	0.077	0.489	0.22	8
Max	7.92	11.97	124.6	22.1	150.0	42784.0	27.8	160000	9200	2.250	2.10	0.31	0.490	2.220	0.84	54
Min	5.42	0.33	3.7	2.4	2.5	93.4	0.0	1	8	0.005	0.25	0.05	0.005	0.005	0.01	2
Site 41: Maddox Creek/Big Ditch at Milltown Road																
No.	435	459	460	464	426	460	464	462	26	117	117	117	116	116	117	117
Mean	7.18	6.20	57.7	12.0	18.4	510.1	0.2	58	56	1.040	1.18	0.17	0.084	1.002	0.37	10
SD	0.35	2.15	21.6	5.1	28.0	484.9	0.3	578	326	1.055	0.73	0.12	0.073	1.030	0.36	14
Max	8.80	12.32	118.8	23.7	268.0	8358.0	4.7	9200	1600	3.460	2.79	0.62	0.340	3.460	1.49	91
Min	6.20	0.05	0.6	0.8	1.9	40.7	0.0	1	7	0.005	0.25	0.05	0.005	0.005	0.01	2
Site 42: Carpenter Creek/Hill Ditch at Cedardale Road																
No.	433	458	459	462	424	459	462	457	26	117	117	117	117	115	117	117
Mean	7.30	8.18	73.3	11.4	3.8	188.9	0.1	52	52	0.581	0.56	0.07	0.045	0.574	0.07	3
SD	0.32	2.32	17.9	5.7	3.9	51.5	0.0	885	167	0.511	0.25	0.06	0.039	0.506	0.04	2
Max	8.74	14.37	159.1	23.1	47.2	364.7	0.2	16000	540	1.960	1.78	0.46	0.210	1.940	0.30	16
Min	6.30	2.05	19.1	0.1	0.0	53.3	0.0	1	5	0.005	0.25	0.02	0.005	0.005	0.01	2
Site 43: Wiley Slough at Wylie Road																
No.	426	451	452	454	417	452	454	447	24	113	113	128	113	112	113	113
Mean	7.15	4.87	45.4	12.1	22.5	2919.8	1.5	68	65	1.331	1.50	0.26	0.185	1.288	0.52	17
SD	0.42	2.81	27.2	5.1	51.2	2825.1	1.5	375	317	1.763	0.85	0.39	0.275	1.699	0.42	31
Max	8.98	14.16	147.0	21.9	612.0	21560.0	9.5	3500	1600	7.060	7.04	2.10	1.560	6.960	1.93	264
Min	6.08	0.12	1.4	0.8	1.3	59.7	0.0	1	2	0.005	0.25	0.01	0.005	0.005	0.01	2

Metric	pH	DO	DO	Temp	Turb	Conductivity (°C compensated)	Salinity	Fecal Coliform	E. coli	Nitrite + Nitrate	Total Kjehldahl Nitrogen	Total Phosphorus	Ortho-Phosphate	Nitrate	Ammonia	TSS
	units	mg/L	% sat	°C	NTU	µs/cm	ppt	MPN/100mL	MPN/100 mL	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Site 44: Sullivan Slough																
No.	433	453	456	460	423	457	460	456	26	116	117	117	116	116	117	116
Mean	7.21	6.80	66.1	11.5	35.8	9135.2	5.4	80	52	0.659	1.45	0.27	0.132	0.629	0.66	27
SD	0.46	2.73	31.0	4.4	89.3	8663.6	5.5	355	126	1.030	0.75	0.49	0.327	1.003	0.58	37
Max	9.08	19.82	237.9	21.7	1345.0	40199.0	26.5	2400	540	7.210	4.50	5.00	3.500	7.160	3.10	280
Min	5.80	0.09	0.8	0.5	1.5	200.7	0.1	1	7	0.005	0.25	0.05	0.005	0.005	0.01	4
Site 45: North Fork Skagit River near Moore Road																
No.	419	440	440	447	412	442	443	442	25	113	113	113	113	113	113	113
Mean	7.65	11.26	97.4	9.4	10.8	55.3	0.0	7	7	0.080	0.29	0.06	0.013	0.077	0.02	19
SD	0.45	1.18	4.9	3.9	32.9	10.4	0.0	27	19	0.049	0.17	0.06	0.018	0.048	0.02	47
Max	9.10	14.61	120.1	18.1	576.0	96.3	0.1	350	79	0.190	1.34	0.60	0.160	0.180	0.10	452
Min	5.93	7.35	76.0	1.4	0.6	30.8	0.0	1	1	0.005	0.25	0.05	0.005	0.005	0.01	2
Site 46: South Fork Skagit River at Conway boat ramp																
No.	425	450	451	454	420	452	453	454	26	114	114	114	114	113	114	114
Mean	7.58	11.27	97.8	9.5	8.7	57.1	0.0	10	9	0.087	0.28	0.06	0.012	0.081	0.02	16
SD	0.40	1.09	4.1	3.9	11.6	34.6	0.3	44	14	0.064	0.17	0.03	0.011	0.049	0.02	28
Max	8.91	13.73	112.3	18.3	109.0	687.0	6.9	540	70	0.510	1.66	0.23	0.050	0.210	0.10	231
Min	6.38	8.40	83.9	1.4	0.9	29.5	0.0	1	1	0.005	0.25	0.05	0.005	0.005	0.01	2
Site 47: Swinomish Channel at County boat ramp																
No.	436	460	461	464	425	464	464	458	25	117	117	117	117	116	117	117
Mean	7.26	8.72	88.9	10.7	5.4	33754.5	21.2	5	4	0.193	0.32	0.08	0.049	0.188	0.06	31
SD	0.62	1.08	9.6	3.3	6.2	6277.3	4.3	15	10	0.115	0.23	0.04	0.077	0.114	0.03	21
Max	8.11	11.41	115.4	18.5	80.2	45590.0	29.1	130	49	0.690	1.84	0.40	0.830	0.690	0.17	140
Min	5.29	5.48	7.3	3.3	0.6	11027.0	6.4	1	1	0.005	0.25	0.05	0.005	0.005	0.01	2
Site 48: Fisher Creek at Franklin Road																
No.	436	459	460	463	426	461	464	458	26	117	116	117	117	116	117	117
Mean	7.49	11.14	96.0	9.1	3.0	167.9	0.1	73	44	0.640	0.62	0.20	0.206	0.627	0.08	5
SD	0.32	1.31	5.2	3.4	4.5	114.1	0.1	813	423	0.504	0.28	0.18	0.188	0.502	0.04	11
Max	8.18	14.87	114.7	15.8	40.7	2215.0	1.1	16000	2000	2.250	1.38	0.81	0.630	2.250	0.17	98
Min	6.56	7.53	62.4	0.3	0.0	60.9	0.0	1	1	0.005	0.25	0.05	0.005	0.005	0.01	2

Appendix C - Summary of Seasonal Kendall's results for the Water Year 2021

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
3	18	pH	428	-0.0056	-0.101	-2.567	Yes	95
		mpH	226	-0.0066	-0.119	-2.365	Yes	95
		DO	452	0.0176	0.316	1.108	No	< 80
		mDO	230	0.0042	0.076	0.098	No	< 80
		DO % sat	453	0.1529	2.752	1.196	No	< 80
		mDO % sat	231	-0.0086	-0.154	-0.039	No	< 80
		Temp	457	0.0182	0.327	1.200	No	< 80
		mTemp	230	0.0201	0.361	1.032	No	< 80
		Turb	413	0.1003	1.805	2.036	Yes	95
		mTurb	217	0.03646	0.656	0.730	No	< 80
		FC	456	-0.2470	-4.446	-2.121	Yes	95
		mFC	229	-0.0355	-0.639	-1.661	No	90
		NO3+NO2	116	-0.0074	-0.134	-2.401	Yes	95
		TKN	116	-0.0122	-0.220	-2.283	Yes	95
		TP	116	0.0005	0.008	4.457	Yes	95
		OP	115	0.0011	0.020	2.677	Yes	95
		NH3	116	-0.0035	-0.064	-3.226	Yes	95
		TSS	115	0.0000	0.000	1.193	No	< 80
	10	DO	250	-0.2109	-2.109	-4.935	Yes	95
		mDO	128	-0.2648	-2.648	-4.559	Yes	95
		Temp	252	0.0000	0.000	-0.079	No	< 80
		mTemp	128	0.0251	0.251	0.811	No	< 80
		FC	253	0.0000	0.000	0.000	No	< 80
		mFC	127	0.7892	7.892	0.609	No	< 80
	5	DO	120	-0.1250	-0.625	-1.041	No	< 80
		mDO	63	-0.1788	-0.894	-1.598	No	80
		Temp	122	0.0502	0.251	0.355	No	< 80
		mTemp	63	-0.0125	-0.063	0.000	No	< 80
		FC	123	-1.4310	-7.155	-1.178	No	< 80
		mFC	62	0.0125	0.063	0.000	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
4	18	pH	435	-0.0297	-0.535	-11.140	Yes	95
		mpH	228	-0.0276	-0.497	-8.320	Yes	95
		DO	456	0.0398	0.716	6.522	Yes	95
		mDO	232	0.0396	0.713	5.184	Yes	95
		DO % sat	457	0.2838	5.108	7.958	Yes	95
		mDO % sat	232	0.2759	4.966	6.303	Yes	95
		Temp	460	0.0000	0.000	0.376	No	< 80
		mTemp	232	0.0125	0.225	0.923	No	< 80
		Turb	418	-0.2443	-4.397	-5.542	Yes	95
		mTurb	218	-0.3475	-6.255	-4.883	Yes	95
		FC	457	-6.6850	-120.330	-5.956	Yes	95
		mFC	230	-11.9200	-214.560	-5.152	Yes	95
		NO3+NO2	117	-0.0120	-0.216	-2.971	Yes	95
		TKN	117	-0.0015	-0.028	-1.488	No	80
		TP	117	0.0000	0.000	2.200	Yes	95
		OP	117	0.0000	0.000	0.998	No	< 80
		NH3	117	-0.0014	-0.025	-2.918	Yes	95
		TSS	117	0.0000	0.000	-1.526	No	80
	10	DO	251	0.0488	0.488	3.298	Yes	95
		mDO	128	0.0260	0.260	1.598	No	80
		Temp	253	-0.0446	-0.446	-1.059	No	< 80
		mTemp	128	0.0100	0.100	0.418	No	< 80
		FC	252	0.0000	0.000	0.739	No	< 80
		mFC	128	2.3830	23.830	1.137	No	< 80
	5	DO	121	-0.0443	-0.221	-1.108	No	< 80
		mDO	63	-0.0275	-0.138	-0.769	No	< 80
		Temp	123	0.0000	0.000	0.050	No	< 80
		mTemp	63	0.0146	0.073	0.322	No	< 80
		FC	123	5.7940	28.970	1.365	No	80
		mFC	63	7.0290	35.145	0.706	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
6	18	pH	433	-0.0198	-0.356	-7.165	Yes	95
		mpH	228	-0.0200	-0.360	-5.882	Yes	95
		DO	453	0.0287	0.517	4.322	Yes	95
		mDO	231	0.0251	0.451	3.240	Yes	95
		DO % sat	455	0.3033	5.459	7.806	Yes	95
		mDO % sat	231	0.3006	5.411	5.810	Yes	95
		Temp	460	0.0285	0.513	1.942	No	90
		mTemp	232	0.0499	0.899	2.342	Yes	95
		Turb	418	0.0075	0.135	0.492	No	< 80
		mTurb	218	-0.01997	-0.359	-0.885	No	< 80
		FC	460	0.0000	0.000	-1.583	No	80
		mFC	232	-0.4180	-7.524	-1.760	No	90
		NO3+NO2	117	-0.0134	-0.241	-4.678	Yes	95
		TKN	117	0.0000	0.000	0.099	No	< 80
		TP	117	0.0000	0.000	-4.167	Yes	95
		OP	117	0.0000	0.000	2.229	Yes	95
		NH3	117	0.0000	0.000	-2.620	Yes	95
		TSS	117	0.0000	0.000	-0.424	No	< 80
	10	DO	250	0.0804	0.804	5.024	Yes	95
		mDO	127	0.0751	0.751	3.502	Yes	95
		Temp	254	-0.0155	-0.155	-0.457	No	< 80
		mTemp	128	0.0623	0.623	0.975	No	< 80
		FC	253	0.0000	0.000	-1.551	No	80
		mFC	128	-0.1776	-1.776	-0.558	No	< 80
	5	DO	120	-0.0441	-0.220	-0.937	No	< 80
		mDO	62	-0.0202	-0.101	-0.325	No	< 80
		Temp	124	0.0337	0.168	0.248	No	< 80
		mTemp	63	0.0626	0.313	0.321	No	< 80
		FC	124	0.0000	0.000	-0.226	No	< 80
		mFC	63	0.4179	2.090	0.449	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
8	18	pH	435	-0.0092	-0.165	-3.335	Yes	95
		mpH	228	-0.0093	-0.167	-2.637	Yes	95
		DO	457	-0.0114	-0.206	-1.460	No	80
		mDO	232	-0.0237	-0.427	-2.330	Yes	95
		DO % sat	458	-0.0907	-1.633	-1.931	No	90
		mDO % sat	232	-0.1166	-2.099	-2.114	Yes	95
		Temp	461	0.0154	0.276	0.928	No	< 80
		mTemp	232	0.0345	0.621	1.826	No	90
		Turb	419	-0.1226	-2.207	-4.160	Yes	95
		mTurb	219	-0.1999	-3.598	-3.937	Yes	95
		FC	461	-1.4610	-26.298	-5.090	Yes	95
		mFC	232	-2.5380	-45.684	-3.788	Yes	95
		NO3+NO2	116	-0.0108	-0.194	-4.735	Yes	95
		TKN	116	0.0000	0.000	0.356	No	< 80
		TP	116	0.0000	0.000	0.285	No	< 80
		OP	116	0.0004	0.007	2.927	Yes	95
		NH3	116	-0.0029	-0.052	-4.850	Yes	95
		TSS	116	0.0000	0.000	-0.445	No	< 80
	10	DO	251	0.0419	0.419	2.473	Yes	95
		mDO	128	0.0116	0.116	0.347	No	< 80
		Temp	252	-0.0563	-0.563	-1.143	No	< 80
		mTemp	128	0.0091	0.091	0.325	No	< 80
		FC	253	0.0000	0.000	-0.576	No	< 80
		mFC	128	0.0354	0.000	0.093	No	< 80
	5	DO	122	0.0718	0.359	1.278	No	< 80
		mDO	63	0.0624	0.312	0.831	No	< 80
		Temp	123	-0.1247	-0.624	-0.780	No	< 80
		mTemp	63	0.0000	0.000	0.000	No	< 80
		FC	125	0.8774	4.387	0.839	No	< 80
		mFC	63	6.6850	33.425	1.153	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
11	18	pH	439	0.0067	0.120	2.453	Yes	95
		mpH	228	0.0060	0.108	1.960	No	90
		DO	460	0.0493	0.888	5.738	Yes	95
		mDO	232	0.0455	0.819	4.184	Yes	95
		DO % sat	461	0.3737	6.727	6.059	Yes	95
		mDO % sat	232	0.3625	6.525	4.799	Yes	95
		Temp	463	-0.0249	-0.447	-1.795	No	90
		mTemp	232	-0.0172	-0.309	-0.972	No	< 80
		Turb	421	-0.0277	-0.499	-2.871	Yes	95
		mTurb	218	-0.0376	-0.676	-2.836	Yes	95
		FC	463	0.0000	0.000	-2.117	Yes	95
		mFC	230	-0.2206	-3.971	-1.911	No	90
		NO3+NO2	115	-0.0033	-0.059	-1.775	No	90
		TKN	116	0.0000	0.000	0.725	No	< 80
		TP	116	0.0000	0.000	-3.373	Yes	95
		OP	115	0.0000	0.000	1.385	No	80
		NH3	116	0.0000	0.000	-1.272	No	< 80
		TSS	115	0.0000	0.000	-1.551	No	80
	10	DO	252	0.1140	1.140	4.894	Yes	95
		mDO	128	0.0869	0.869	3.241	Yes	95
		Temp	254	-0.0891	-0.891	-2.478	Yes	95
		mTemp	128	-0.0496	-0.496	-1.390	No	80
		FC	255	0.0000	0.000	0.876	No	< 80
		mFC	127	0.5014	5.014	1.637	No	80
	5	DO	123	-0.0421	-0.211	-0.629	No	< 80
		mDO	63	-0.0201	-0.100	-0.192	No	< 80
		Temp	125	0.0334	0.167	0.417	No	< 80
		mTemp	63	0.0000	0.000	0.000	No	< 80
		FC	126	0.1695	0.848	1.274	No	< 80
		mFC	63	1.7970	8.985	1.794	No	90

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
12	18	pH	409	0.0066	0.120	2.546	Yes	95
		mpH	220	0.0069	0.124	1.894	No	90
		DO	432	-0.0150	-0.270	-1.303	No	80
		mDO	229	-0.0208	-0.374	-1.368	No	80
		DO % sat	434	-0.1318	-2.372	-1.558	No	80
		mDO % sat	228	-0.1004	-1.807	-0.857	No	< 80
		Temp	437	0.0272	0.490	1.758	No	90
		mTemp	230	0.0363	0.654	1.629	No	80
		Turb	403	-0.0541	-0.974	-2.289	Yes	95
		mTurb	216	-0.0358	-0.645	-1.359	No	80
		FC	436	0.0000	0.000	-1.385	No	80
		mFC	230	-0.0830	-1.495	-0.326	No	< 80
		NO3+NO2	112	-0.0143	-0.258	-3.759	Yes	95
		TKN	111	0.0000	0.000	-0.907	No	< 80
		TP	112	0.0000	0.000	4.963	Yes	95
		OP	112	0.0008	0.015	4.810	Yes	95
		NH3	112	-0.0027	-0.048	-3.186	Yes	95
		TSS	112	-0.1313	-2.363	-2.326	Yes	95
	10	DO	242	0.0195	0.195	0.837	No	< 80
		mDO	126	0.0685	0.685	1.617	No	80
		Temp	243	-0.0330	-0.330	-0.789	No	< 80
		mTemp	127	-0.0831	-0.831	-1.605	No	80
		FC	243	0.0000	0.000	0.204	No	< 80
		mFC	127	-0.7044	-7.044	-0.520	No	< 80
	5	DO	118	0.1163	0.582	1.242	No	< 80
		mDO	61	0.1166	0.583	0.329	No	< 80
		Temp	119	0.0000	0.000	-0.288	No	< 80
		mTemp	62	0.0626	0.313	0.518	No	< 80
		FC	119	0.3259	1.630	1.087	No	< 80
		mFC	62	2.0150	10.075	0.648	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
13	18	pH	431	0.0020	0.036	0.820	No	< 80
		mpH	225	0.0021	0.037	0.561	No	< 80
		DO	455	-0.0328	-0.591	-3.080	Yes	95
		mDO	232	-0.0339	-0.611	-2.572	Yes	95
		DO % sat	456	-0.1754	-3.157	-2.249	Yes	95
		mDO % sat	232	-0.2003	-3.605	-2.286	Yes	95
		Temp	458	0.0492	0.885	2.776	Yes	95
		mTemp	232	0.0502	0.904	2.662	Yes	95
		Turb	423	0.0027	0.049	0.141	No	< 80
		mTurb	218	0.0015	0.027	0.064	No	< 80
		FC	457	-0.1243	-2.237	-2.322	Yes	95
		mFC	232	-0.4981	-8.966	-1.463	No	80
		NO3+NO2	116	-0.0050	-0.090	-2.179	Yes	95
		TKN	115	0.0000	0.000	0.519	No	< 80
		TP	116	0.0000	0.000	1.662	No	90
		OP	116	0.0000	0.000	3.861	Yes	95
		NH3	116	-0.0025	-0.044	-3.782	Yes	95
		TSS	116	0.0000	0.000	-1.182	No	< 80
	10	DO	253	-0.0183	-0.183	-0.495	No	< 80
		mDO	128	0.0096	0.096	0.187	No	< 80
		Temp	253	0.0184	0.184	0.521	No	< 80
		mTemp	128	-0.0498	-0.498	-0.911	No	< 80
		FC	253	0.0000	0.000	-1.348	No	80
		mFC	128	-1.6560	-16.560	-1.425	No	80
	5	DO	123	-0.2552	-1.276	-3.178	Yes	95
		mDO	63	-0.2000	-1.000	-2.651	Yes	95
		Temp	124	0.0334	0.167	0.322	No	< 80
		mTemp	63	0.0501	0.251	0.699	No	< 80
		FC	124	1.0440	5.220	1.448	No	80
		mFC	63	3.1260	15.630	1.527	No	80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
14	18	pH	429	-0.0286	-0.514	-10.450	Yes	95
		mpH	226	-0.0290	-0.522	-7.884	Yes	95
		DO	454	0.0229	0.412	2.230	Yes	95
		mDO	231	0.0236	0.425	1.988	Yes	95
		DO % sat	456	0.1239	2.230	1.865	No	90
		mDO % sat	231	0.1422	2.560	1.652	No	90
		Temp	459	0.0166	0.299	1.030	No	< 80
		mTemp	232	0.0261	0.469	1.805	No	90
		Turb	421	-0.0838	-1.508	-5.247	Yes	95
		mTurb	217	-0.1014	-1.825	-3.847	Yes	95
		FC	456	0.0000	0.000	-1.071	No	< 80
		mFC	232	-0.3225	-5.805	-0.507	No	< 80
		NO3+NO2	115	-0.0058	-0.105	-2.883	Yes	95
		TKN	114	-0.0071	-0.127	-1.588	No	80
		TP	115	0.0000	0.000	1.926	No	90
		OP	115	0.0000	0.000	0.561	No	< 80
		NH3	115	-0.0038	-0.069	-5.617	Yes	95
		TSS	115	0.0000	0.000	-1.068	No	< 80
	10	DO	249	0.0941	0.941	3.627	Yes	95
		mDO	127	0.1110	1.110	4.399	Yes	95
		Temp	251	0.0000	0.000	0.079	No	< 80
		mTemp	128	-0.0265	-0.265	-0.631	No	< 80
		FC	250	3.9610	39.610	2.581	Yes	95
		mFC	128	3.6250	36.250	1.518	No	80
	5	DO	120	-0.1137	-0.569	-1.346	No	80
		mDO	62	-0.1437	-0.719	-1.540	No	80
		Temp	122	0.1338	0.669	1.319	No	80
		mTemp	63	0.1253	0.627	1.202	No	< 80
		FC	122	3.9740	19.870	1.177	No	< 80
		mFC	63	15.4400	77.200	1.455	No	80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
15	18	pH	433	0.0050	0.090	1.825	No	90
		mpH	226	0.0057	0.102	1.660	No	90
		DO	456	0.0266	0.479	2.619	Yes	95
		mDO	232	0.0208	0.374	1.130	No	< 80
		DO % sat	457	0.2431	4.376	3.367	Yes	95
		mDO % sat	232	0.2461	4.430	2.052	Yes	95
		Temp	460	0.0248	0.447	1.653	No	90
		mTemp	232	0.0482	0.868	2.282	Yes	95
		Turb	424	-0.0071	-0.127	-0.506	No	< 80
		mTurb	218	-0.0180	-0.323	-1.023	No	< 80
		FC	458	-0.4367	-7.861	-2.840	Yes	95
		mFC	232	1.1240	20.232	1.804	No	90
		NO3+NO2	117	0.0000	-0.001	-0.341	No	< 80
		TKN	116	-0.0053	-0.096	-1.586	No	80
		TP	117	0.0020	0.036	6.253	Yes	95
		OP	117	0.0025	0.044	4.996	Yes	95
		NH3	117	-0.0027	-0.048	-3.252	Yes	95
		TSS	117	0.0000	0.000	-0.283	No	< 80
	10	DO	251	-0.0143	-0.143	-0.387	No	< 80
		mDO	128	0.0598	0.598	1.212	No	< 80
		Temp	252	-0.0499	-0.499	-1.163	No	< 80
		mTemp	128	-0.1138	-1.138	-1.750	No	90
		FC	252	-0.9995	-9.995	-1.743	No	90
		mFC	128	-3.8970	-38.970	-2.008	Yes	95
	5	DO	122	-0.1186	-0.593	-1.526	No	80
		mDO	63	-0.1705	-0.853	-2.146	Yes	95
		Temp	123	0.0000	0.000	0.050	No	< 80
		mTemp	63	0.0836	0.418	0.761	No	< 80
		FC	123	0.0000	0.000	-0.405	No	< 80
		mFC	63	-5.4670	-27.335	-0.757	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
16	18	pH	433	-0.0082	-0.148	-2.994	Yes	95
		mpH	226	-0.0065	-0.118	-1.832	No	90
		DO	458	0.0193	0.347	2.968	Yes	95
		mDO	232	0.0169	0.304	1.900	No	90
		DO % sat	459	0.1999	3.598	5.047	Yes	95
		mDO % sat	232	0.2153	3.875	4.143	Yes	95
		Temp	462	0.0357	0.642	2.259	Yes	95
		mTemp	232	0.0361	0.650	1.902	No	90
		Turb	425	0.0182	0.328	2.537	Yes	95
		mTurb	218	0.0174	0.312	1.737	No	90
		FC	458	0.0000	0.000	-0.792	No	< 80
		mFC	231	0.0000	0.000	0.089	No	< 80
		NO3+NO2	116	-0.0022	-0.039	-1.008	No	< 80
		TKN	115	0.0000	0.000	0.998	No	< 80
		TP	116	0.0000	0.000	-0.870	No	< 80
		OP	116	0.0000	0.000	2.791	Yes	95
		NH3	116	0.0000	0.000	-0.801	No	< 80
		TSS	116	0.0000	0.000	1.109	No	< 80
	10	DO	253	0.0834	0.834	5.379	Yes	95
		mDO	128	0.1007	1.007	4.849	Yes	95
		Temp	254	0.0000	0.000	-0.328	No	< 80
		mTemp	128	-0.0503	-0.503	-1.658	No	90
		FC	252	0.0000	0.000	-0.044	No	< 80
		mFC	127	0.0000	0.000	0.000	No	< 80
	5	DO	123	-0.0033	-0.016	-0.075	No	< 80
		mDO	63	0.0300	0.150	0.379	No	< 80
		Temp	124	0.0000	0.000	0.000	No	< 80
		mTemp	63	0.0125	0.063	0.191	No	< 80
		FC	124	0.0000	0.000	0.424	No	< 80
		mFC	63	3.6500	18.250	1.014	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
17	18	pH	431	-0.0084	-0.150	-3.085	Yes	95
		mpH	226	-0.0088	-0.158	-2.419	Yes	95
		DO	458	0.0058	0.105	0.874	No	< 80
		mDO	232	-0.0034	-0.062	-0.400	No	< 80
		DO % sat	459	0.0942	1.695	1.610	No	80
		mDO % sat	232	0.0330	0.593	0.447	No	< 80
		Temp	462	0.0330	0.594	1.964	Yes	95
		mTemp	232	0.0548	0.987	2.204	Yes	95
		Turb	424	0.0501	0.903	6.109	Yes	95
		mTurb	218	0.0535	0.963	4.817	Yes	95
		FC	458	0.0000	0.000	0.833	No	< 80
		mFC	231	0.1065	1.917	1.002	No	< 80
		NO3+NO2	117	0.0000	0.000	0.446	No	< 80
		TKN	116	0.0000	0.000	-0.278	No	< 80
		TP	117	0.0000	0.000	-0.641	No	< 80
		OP	117	0.0000	0.000	3.784	Yes	95
		NH3	117	-0.0008	-0.014	-2.371	Yes	95
		TSS	117	0.0000	0.000	0.267	No	< 80
	10	DO	253	0.0334	0.334	1.856	No	90
		mDO	128	0.0513	0.513	2.378	Yes	95
		Temp	254	-0.0222	-0.222	-0.646	No	< 80
		mTemp	128	-0.1107	-1.107	-1.703	No	90
		FC	254	0.0000	0.000	1.453	No	80
		mFC	128	0.5227	5.227	1.354	No	80
	5	DO	123	-0.0726	-0.363	-1.568	No	80
		mDO	63	-0.0765	-0.382	-1.767	No	90
		Temp	124	0.1001	0.501	1.255	No	< 80
		mTemp	63	0.1171	0.586	0.887	No	< 80
		FC	124	0.2631	1.316	0.944	No	< 80
		mFC	63	0.8349	4.175	0.569	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
18	18	pH	435	0.0000	0.000	-0.303	No	<80
		mpH	226	-0.0021	-0.037	-0.486	No	< 80
		DO	458	0.0042	0.075	0.713	No	< 80
		mDO	232	0.0016	0.028	0.341	No	< 80
		DO % sat	459	0.0463	0.833	1.052	No	< 80
		mDO % sat	232	0.0580	1.043	1.128	No	< 80
		Temp	463	0.0272	0.490	1.921	No	90
		mTemp	232	0.0360	0.647	2.176	Yes	95
		Turb	426	0.0299	0.537	3.498	Yes	95
		mTurb	218	0.0216	0.388	1.737	No	90
		FC	461	-0.2502	-4.504	-2.745	Yes	95
		mFC	232	-0.6038	-10.868	-1.823	No	90
		NO3+NO2	117	0.0023	0.041	0.933	No	< 80
		TKN	116	0.0000	0.000	-0.766	No	< 80
		TP	117	0.0000	0.000	-1.759	No	90
		OP	117	0.0000	0.000	2.412	Yes	95
		NH3	117	0.0000	0.000	-3.415	Yes	95
		TSS	117	0.0000	0.000	1.220	No	< 80
	10	DO	253	0.0730	0.730	5.303	Yes	95
		mDO	128	0.0927	0.927	4.662	Yes	95
		Temp	255	-0.0124	-0.124	-0.361	No	< 80
		mTemp	128	-0.0501	-0.501	-1.332	No	80
		FC	255	0.0000	0.000	-0.381	No	< 80
		mFC	128	0.0000	0.000	-0.057	No	< 80
	5	DO	123	0.0112	0.056	0.225	No	< 80
		mDO	63	-0.0083	-0.042	0.000	No	< 80
		Temp	125	0.0999	0.500	0.734	No	< 80
		mTemp	63	0.1000	0.500	0.825	No	< 80
		FC	125	1.3550	6.775	1.660	No	90
		mFC	63	2.8390	14.195	1.389	No	80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
19	18	pH	409	-0.0114	-0.206	-4.111	Yes	95
		mpH	217	-0.0115	-0.208	-3.540	Yes	95
		DO	432	-0.0367	-0.660	-4.903	Yes	95
		mDO	223	-0.0424	-0.763	-4.334	Yes	95
		DO % sat	432	-0.2157	-3.883	-5.091	Yes	95
		mDO % sat	223	-0.2321	-4.178	-4.049	Yes	95
		Temp	434	0.0664	1.196	3.549	Yes	95
		mTemp	224	0.0749	1.349	3.144	Yes	95
		Turb	396	-0.0420	-0.756	-2.204	Yes	95
		mTurb	211	-0.0864	-1.555	-2.895	Yes	95
		FC	433	0.0000	0.000	-1.321	No	80
		mFC	223	-1.4490	-26.082	-2.051	Yes	95
		NO3+NO2	112	-0.0100	-0.181	-3.690	Yes	95
		TKN	112	0.0000	0.000	1.415	No	80
		TP	113	0.0000	0.000	-2.190	Yes	95
		OP	112	0.0000	0.000	1.253	No	< 80
		NH3	112	0.0000	0.000	-1.339	No	80
		TSS	113	0.0000	0.000	-1.396	No	80
	10	DO	226	0.0097	0.097	0.440	No	< 80
		mDO	119	-0.0192	-0.192	-0.799	No	< 80
		Temp	227	0.1146	1.146	2.422	Yes	95
		mTemp	120	0.1809	1.809	3.040	Yes	95
		FC	227	-1.9940	-19.940	-2.284	Yes	95
		mFC	119	-3.3990	-33.990	-2.202	Yes	95
	5	DO	104	0.0201	0.100	0.323	No	< 80
		mDO	56	-0.0131	-0.065	-0.103	No	< 80
		Temp	105	0.1003	0.502	0.576	No	< 80
		mTemp	56	0.0779	0.389	0.465	No	< 80
		FC	106	0.0000	0.000	0.000	No	< 80
		mFC	56	0.0000	0.000	0.103	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
20	18	pH	434	-0.0143	-0.258	-5.111	Yes	95
		mpH	228	-0.0131	-0.235	-3.722	Yes	95
		DO	457	0.0290	0.521	4.995	Yes	95
		mDO	232	0.0263	0.473	3.592	Yes	95
		DO % sat	458	0.2267	4.081	6.475	Yes	95
		mDO % sat	232	0.2442	4.396	5.294	Yes	95
		Temp	459	0.0000	0.000	-0.298	No	< 80
		mTemp	232	0.0000	0.000	0.117	No	< 80
		Turb	415	-0.0176	-0.316	-1.797	No	90
		mTurb	218	-0.0316	-0.568	-2.175	Yes	95
		FC	456	0.0000	0.000	-0.091	No	< 80
		mFC	231	-0.0400	-0.721	-0.186	No	< 80
		NO3+NO2	117	-0.0015	-0.028	-0.803	No	< 80
		TKN	117	0.0000	0.000	-1.428	No	80
		TP	117	0.0000	0.000	-4.154	Yes	95
		OP	117	0.0000	0.000	1.063	No	< 80
		NH3	117	0.0000	0.000	-1.815	No	90
		TSS	117	0.0000	0.000	-1.713	No	90
	10	DO	250	0.0810	0.810	5.487	Yes	95
		mDO	128	0.0640	0.640	3.126	Yes	95
		Temp	251	0.0000	0.000	-0.360	No	< 80
		mTemp	128	0.0224	0.224	0.743	No	< 80
		FC	250	0.0000	0.000	0.651	No	< 80
		mFC	127	1.5720	15.720	1.557	No	80
	5	DO	122	-0.0152	-0.076	-0.510	No	< 80
		mDO	63	-0.0347	-0.174	-0.769	No	< 80
		Temp	123	0.0000	0.000	0.000	No	< 80
		mTemp	63	0.0000	0.000	0.129	No	< 80
		FC	124	0.0000	0.000	-0.176	No	< 80
		mFC	63	1.5790	7.895	0.256	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
21	18	pH	373	-0.0112	-0.201	-3.787	Yes	95
		mpH	206	-0.0117	-0.210	-3.321	Yes	95
		DO	396	0.0171	0.309	2.076	Yes	95
		mDO	211	0.0200	0.359	1.965	Yes	95
		DO % sat	396	0.1662	2.992	4.207	Yes	95
		mDO % sat	212	0.1663	2.993	3.446	Yes	95
		Temp	397	0.0167	0.301	1.005	No	< 80
		mTemp	211	0.0251	0.451	1.154	No	< 80
		Turb	359	-0.5547	-9.985	-2.061	Yes	95
		mTurb	198	-0.0904	-1.627	-3.052	Yes	95
		FC	395	-0.5011	-9.020	-2.560	Yes	95
		mFC	211	-1.1650	-20.970	-1.913	No	90
		NO3+NO2	103	-0.0049	-0.089	-1.117	No	< 80
		TKN	103	0.0000	0.000	1.311	No	80
		TP	103	0.0000	0.000	1.876	No	90
		OP	103	0.0000	0.000	2.523	Yes	95
		NH3	103	0.0000	0.000	-0.403	No	< 80
		TSS	103	0.0000	0.000	-0.777	No	< 80
	10	DO	208	0.0564	0.564	2.748	Yes	95
		mDO	114	0.0521	0.521	2.326	Yes	95
		Temp	209	0.0200	0.200	0.537	No	< 80
		mTemp	114	0.0685	0.685	1.228	No	< 80
		FC	208	0.0000	0.000	-0.621	No	< 80
		mFC	114	0.6386	6.386	0.333	No	< 80
	5	DO	100	-0.0251	-0.125	-0.351	No	< 80
		mDO	54	-0.0150	-0.075	-0.078	No	< 80
		Temp	101	0.0727	0.364	0.295	No	< 80
		mTemp	54	0.0860	0.430	0.444	No	< 80
		FC	100	1.5190	7.595	0.993	No	< 80
		mFC	54	4.5750	22.875	0.967	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
22	18	pH	438	-0.0257	-0.463	-6.222	Yes	95
		mpH	226	-0.0249	-0.449	-4.784	Yes	95
		DO	457	-0.0030	-0.054	-0.429	No	< 80
		mDO	231	-0.0100	-0.179	-0.146	No	< 80
		DO % sat	458	0.0182	0.400	0.572	No	< 80
		mDO % sat	232	0.0425	0.765	1.057	No	< 80
		Temp	460	0.0251	0.451	1.739	No	90
		mTemp	231	0.0300	0.539	1.755	No	90
		Turb	421	-0.0100	-0.179	-1.045	No	< 80
		mTurb	217	-0.0343	-0.617	-1.833	No	90
		FC	459	0.0000	0.000	0.984	No	< 80
		mFC	229	0.1022	1.840	1.531	No	80
		NO3+NO2	115	-0.0021	-0.037	-0.708	No	< 80
		TKN	116	0.0000	0.000	-2.120	Yes	95
		TP	116	0.0000	0.000	-2.983	Yes	95
		OP	115	0.0000	0.000	2.309	Yes	95
		NH3	116	0.0000	0.000	-2.239	Yes	95
		TSS	115	0.0000	0.000	-2.344	Yes	95
	10	DO	251	0.0553	0.553	4.091	Yes	95
		mDO	128	0.0394	0.394	2.524	Yes	95
		Temp	252	0.0199	0.199	0.575	No	< 80
		mTemp	128	0.0544	0.544	1.322	No	80
		FC	253	-0.2457	-2.457	-3.183	Yes	95
		mFC	127	-0.2227	-2.227	-0.845	No	< 80
	5	DO	122	0.0083	0.008	0.176	No	< 80
		mDO	63	-0.0025	-0.013	0.000	No	< 80
		Temp	123	0.0000	0.000	0.050	No	< 80
		mTemp	63	0.0502	0.251	0.193	No	< 80
		FC	125	-0.5007	-2.504	-2.852	Yes	95
		mFC	63	-0.5021	-2.511	-1.297	No	80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
23	18	pH	390	-0.0276	-0.496	-8.456	Yes	95
		mpH	200	-0.0255	-0.459	-6.375	Yes	95
		DO	411	0.0108	0.194	1.781	No	90
		mDO	206	0.0111	0.199	1.425	No	80
		DO % sat	413	0.1199	2.158	3.382	Yes	95
		mDO % sat	208	0.1134	2.041	2.632	Yes	95
		Temp	414	0.0000	0.000	-0.207	No	< 80
		mTemp	207	0.0000	0.000	-0.179	No	< 80
		Turb	376	0.0078	0.140	0.903	No	< 80
		mTurb	195	-0.0067	-0.120	-0.619	No	< 80
		FC	413	0.0000	0.000	0.708	No	< 80
		mFC	206	0.0345	0.622	0.461	No	< 80
		NO3+NO2	108	-0.0249	-0.448	-4.700	Yes	95
		TKN	109	0.0000	0.000	0.788	No	< 80
		TP	109	0.0000	0.000	-3.917	Yes	95
		OP	109	0.0000	0.000	1.988	Yes	95
		NH3	109	0.0000	0.000	-0.183	No	< 80
		TSS	108	0.0000	0.000	-1.832	No	90
	10	DO	219	0.0552	0.552	3.215	Yes	95
		mDO	106	0.0290	0.290	1.107	No	< 80
		Temp	220	0.0000	0.000	0.127	No	< 80
		mTemp	106	0.0579	0.579	1.459	No	80
		FC	221	0.0000	0.000	0.425	No	< 80
		mFC	106	0.4722	4.722	1.635	No	80
	5	DO	110	-0.0197	-0.098	-0.666	No	< 80
		mDO	58	-0.0701	-0.351	-1.292	No	80
		Temp	111	0.0335	0.167	0.159	No	< 80
		mTemp	58	0.1505	0.753	1.040	No	< 80
		FC	112	0.0000	0.000	0.799	No	< 80
		mFC	58	1.0590	5.295	1.141	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
24	18	pH	439	-0.0098	-0.176	-3.454	Yes	95
		mpH	229	-0.0100	-0.181	-2.731	Yes	95
		DO	457	0.0720	1.296	5.752	Yes	95
		mDO	233	0.0759	1.366	4.502	Yes	95
		DO % sat	458	0.6014	10.825	6.405	Yes	95
		mDO % sat	232	0.6473	11.651	4.983	Yes	95
		Temp	460	0.0065	0.116	0.743	No	< 80
		mTemp	232	0.0064	0.116	0.661	No	< 80
		Turb	419	0.0521	0.938	7.157	Yes	95
		mTurb	218	0.0496	0.892	5.072	Yes	95
		FC	456	-0.0995	-1.791	-2.889	Yes	95
		mFC	231	-0.2957	-5.323	-2.265	Yes	95
		NO3+NO2	117	0.0000	0.000	0.416	No	< 80
		TKN	116	0.0000	0.000	0.772	No	< 80
		TP	117	0.0000	0.000	-0.299	No	< 80
		OP	117	0.0000	0.000	0.546	No	< 80
		NH3	117	0.0000	0.000	0.420	No	< 80
		TSS	117	0.0000	0.000	1.778	No	90
	10	DO	249	0.2211	2.211	8.019	Yes	95
		mDO	129	0.2207	2.207	6.321	Yes	95
		Temp	251	0.0000	0.000	0.000	No	< 80
		mTemp	128	0.0499	0.499	1.300	No	80
		FC	251	0.0000	0.000	0.677	No	< 80
		mFC	128	0.2005	2.005	0.510	No	< 80
	5	DO	121	-0.0134	-0.067	-0.232	No	< 80
		mDO	64	0.0401	0.201	0.313	No	< 80
		Temp	122	0.2502	1.251	2.122	Yes	95
		mTemp	63	0.2676	1.338	2.387	Yes	95
		FC	122	0.0000	0.000	0.751	No	< 80
		mFC	63	1.1250	5.625	1.031	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
25	18	pH	356	-0.0279	-0.503	-6.924	Yes	95
		mpH	187	-0.0277	-0.498	-5.464	Yes	95
		DO	371	0.0129	0.232	1.982	Yes	95
		mDO	190	0.0113	0.203	1.222	No	< 80
		DO % sat	371	0.1159	2.086	3.261	Yes	95
		mDO % sat	191	0.0846	1.523	1.778	No	90
		Temp	372	0.0062	0.112	0.519	No	< 80
		mTemp	190	0.0000	0.000	-0.008	No	< 80
		Turb	340	0.0228	0.410	6.416	Yes	95
		mTurb	178	0.0175	0.315	3.082	Yes	95
		FC	369	0.0000	0.000	0.082	No	< 80
		mFC	189	0.0000	0.000	0.245	No	< 80
		NO3+NO2	97	-0.0036	-0.064	-0.991	No	< 80
		TKN	97	0.0000	0.000	-2.513	Yes	95
		TP	97	0.0000	0.000	-3.326	Yes	95
		OP	97	0.0000	0.000	2.282	Yes	95
		NH3	97	0.0000	0.000	0.062	No	< 80
		TSS	97	0.0000	0.000	-1.078	No	< 80
	10	DO	196	0.0562	0.562	3.449	Yes	95
		mDO	98	0.0248	0.248	1.285	No	80
		Temp	197	0.0125	0.125	0.392	No	< 80
		mTemp	98	0.0508	0.508	1.139	No	< 80
		FC	197	0.0000	0.000	0.431	No	< 80
		mFC	98	0.0550	0.550	0.566	No	< 80
	5	DO	95	-0.1049	-0.525	-2.763	Yes	95
		mDO	53	-0.1008	-0.504	-1.633	No	80
		Temp	96	0.0992	0.496	0.652	No	< 80
		mTemp	53	0.1372	0.686	0.831	No	< 80
		FC	96	0.0000	0.000	-0.067	No	< 80
		mFC	53	0.0000	0.000	-0.298	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
28	18	pH	312	-0.0092	-0.165	-1.576	No	80
		mpH	169	-0.0117	-0.210	-1.425	No	80
		DO	325	-0.0062	-0.112	-0.510	No	< 80
		mDO	173	-0.0071	-0.129	-0.558	No	< 80
		DO % sat	326	-0.0786	-1.414	-1.058	No	< 80
		mDO % sat	169	-0.1003	-1.805	-0.946	No	< 80
		Temp	327	0.0000	0.000	-0.346	No	< 80
		mTemp	173	-0.0083	-0.150	-0.350	No	< 80
		Turb	299	-0.0552	-0.993	-1.935	No	90
		mTurb	163	-0.0888	-1.599	-1.827	No	90
		FC	326	0.0000	0.000	0.847	No	< 80
		mFC	173	-0.2915	-5.247	-0.610	No	< 80
		NO3+NO2	86	-0.0118	-0.212	-1.756	No	90
		TKN	86	-0.0131	-0.235	-2.862	Yes	95
		TP	86	0.0000	0.000	2.428	Yes	95
		OP	86	0.0004	0.008	2.242	Yes	95
		NH3	86	-0.0033	-0.060	-4.553	Yes	95
		TSS	86	0.0000	0.000	0.000	No	< 80
	10	DO	171	0.0087	0.087	0.282	No	< 80
		mDO	86	-0.0327	-0.327	-0.953	No	< 80
		Temp	172	-0.0987	-0.987	-1.452	No	80
		mTemp	86	-0.0483	-0.483	-0.696	No	< 80
		FC	173	0.0000	0.000	-0.746	No	< 80
		mFC	86	-1.9780	-19.780	-1.172	No	< 80
	5	DO	Insufficient Data					
		mDO						
		Temp						
		mTemp						
		FC						
		mFC						

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
29	18	pH	423	0.0046	0.083	1.025	No	< 80
		mpH	228	0.0029	0.053	0.541	No	< 80
		DO	444	0.0102	0.184	2.177	Yes	95
		mDO	231	0.0067	0.120	1.049	No	< 80
		DO % sat	445	0.0557	1.002	1.458	No	80
		mDO % sat	232	0.0714	1.285	1.333	No	80
		Temp	450	0.0000	0.000	0.103	No	< 80
		mTemp	232	0.0077	0.138	0.625	No	< 80
		Turb	411	-0.1384	-2.491	-4.141	Yes	95
		mTurb	218	-0.1739	-3.130	-3.560	Yes	95
		FC	444	0.0000	0.000	-0.372	No	< 80
		mFC	232	0.0000	0.000	0.000	No	< 80
		NO3+NO2	115	0.0000	0.000	0.825	No	< 80
		TKN	114	0.0000	0.000	-1.725	No	90
		TP	114	0.0000	0.000	-1.340	No	80
		OP	115	0.0000	0.000	2.723	Yes	95
		NH3	115	0.0000	0.000	1.293	No	80
		TSS	115	0.0000	0.000	0.708	No	< 80
	10	DO	242	0.0400	0.400	3.161	Yes	95
		mDO	128	0.0451	0.451	2.519	Yes	95
		Temp	242	0.0000	0.000	0.352	No	< 80
		mTemp	128	-0.0393	-0.393	-1.190	No	< 80
		FC	241	0.1236	1.236	2.167	Yes	95
		mFC	128	0.0315	0.315	0.304	No	< 80
	5	DO	123	-0.0234	-0.117	-0.474	No	< 80
		mDO	63	-0.0702	-0.351	-0.757	No	< 80
		Temp	123	0.0000	0.000	0.200	No	< 80
		mTemp	63	0.1995	0.998	1.136	No	< 80
		FC	122	0.1671	0.836	1.126	No	< 80
		mFC	63	0.7280	3.640	0.696	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
30	18	pH	442	-0.0162	-0.292	-4.798	Yes	95
		mpH	228	-0.0138	-0.248	-3.411	Yes	95
		DO	460	0.0110	0.199	2.251	Yes	95
		mDO	232	0.0096	0.173	1.823	No	90
		DO % sat	461	0.1194	2.149	3.486	Yes	95
		mDO % sat	232	0.1260	2.268	2.793	Yes	95
		Temp	463	0.0111	0.200	1.210	No	< 80
		mTemp	232	0.0125	0.225	1.282	No	80
		Turb	421	-0.0963	-1.734	-3.526	Yes	95
		mTurb	218	-0.1689	-3.040	-3.409	Yes	95
		FC	457	0.0000	0.000	0.639	No	< 80
		mFC	229	0.0000	0.000	-0.348	No	< 80
		NO3+NO2	116	0.0000	0.000	-0.415	No	< 80
		TKN	116	0.0000	0.000	-0.893	No	< 80
		TP	116	0.0000	0.000	-2.660	Yes	95
		OP	116	0.0000	0.000	2.806	Yes	95
		NH3	116	0.0000	0.000	-1.776	No	90
		TSS	116	0.0000	0.000	-2.262	Yes	95
	10	DO	253	0.0552	0.552	3.988	Yes	95
		mDO	128	0.0321	0.321	1.899	No	90
		Temp	255	0.0401	0.401	1.391	No	80
		mTemp	128	0.0668	0.668	2.763	Yes	95
		FC	255	0.0000	0.000	0.080	No	< 80
		mFC	128	0.0000	0.000	0.188	No	< 80
	5	DO	124	-0.0703	-0.351	-2.269	Yes	95
		mDO	63	-0.0566	-0.283	-1.982	Yes	95
		Temp	126	0.0991	0.496	0.919	No	< 80
		mTemp	63	0.0503	0.252	1.091	No	< 80
		FC	126	0.0000	0.000	0.853	No	< 80
		mFC	63	0.1672	0.836	0.909	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
32	18	pH	432	0.0063	0.113	1.932	No	90
		mpH	229	0.0045	0.082	1.022	No	< 80
		DO	454	0.0340	0.612	4.537	Yes	95
		mDO	233	0.0343	0.617	3.699	Yes	95
		DO % sat	457	0.3219	5.794	6.701	Yes	95
		mDO % sat	233	0.3119	5.614	5.221	Yes	95
		Temp	463	0.0308	0.554	1.786	No	90
		mTemp	233	0.0400	0.719	1.915	No	90
		Turb	420	-0.0581	-1.045	-3.303	Yes	95
		mTurb	221	-0.1108	-1.994	-3.794	Yes	95
		FC	463	-0.1247	-2.245	-2.349	Yes	95
		mFC	229	-0.8545	-15.381	-1.976	Yes	95
		NO3+NO2	116	-0.0058	-0.105	-2.740	Yes	95
		TKN	118	0.0000	0.000	0.964	No	< 80
		TP	118	0.0000	0.000	-0.439	No	< 80
		OP	116	0.0000	0.000	1.145	No	<80
		NH3	118	-0.0035	-0.064	-5.794	Yes	95
		TSS	116	-0.1334	-2.401	-2.651	Yes	95
	10	DO	249	0.0955	0.955	5.425	Yes	95
		mDO	128	0.0802	0.802	4.330	Yes	95
		Temp	255	0.0000	0.000	0.000	No	< 80
		mTemp	128	0.0501	0.501	0.927	No	< 80
		FC	255	0.0000	0.000	0.294	No	< 80
		mFC	128	1.4320	14.320	1.280	No	< 80
	5	DO	122	-0.0300	-0.150	-0.634	No	< 80
		mDO	63	-0.0075	-0.038	-0.128	No	< 80
		Temp	125	0.0963	0.482	0.614	No	< 80
		mTemp	63	0.0293	0.146	0.128	No	< 80
		FC	126	2.0050	10.025	1.298	No	< 80
		mFC	63	3.7950	18.975	1.614	No	80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
33	18	pH	431	-0.0252	-0.454	-6.262	Yes	95
		mpH	227	-0.0244	-0.440	-4.877	Yes	95
		DO	435	-0.0145	-0.262	-0.519	No	< 80
		mDO	229	-0.0148	-0.266	-0.483	No	< 80
		DO % sat	454	-0.3637	-6.547	-1.229	No	< 80
		mDO % sat	234	-0.5266	-9.479	-1.606	No	80
		Temp	459	0.0000	0.000	-0.169	No	< 80
		mTemp	232	0.0167	0.300	0.494	No	< 80
		Turb	417	-0.4373	-7.871	-6.108	Yes	95
		mTurb	217	-0.4579	-8.242	-5.056	Yes	95
		FC	460	-0.6343	-11.417	-2.771	Yes	95
		mFC	231	-1.4290	-25.722	-1.876	No	90
		NO3+NO2	113	0.0000	0.000	0.382	No	< 80
		TKN	114	0.0093	0.167	0.671	No	< 80
		TP	114	0.0109	0.197	1.688	No	90
		OP	113	0.0092	0.165	2.829	Yes	95
		NH3	114	-0.0146	-0.264	-1.467	No	80
		TSS	113	-1.2270	-22.086	-2.934	Yes	95
	10	DO	241	0.0937	0.937	1.375	No	80
		mDO	127	0.0846	0.846	0.889	No	< 80
		Temp	249	-0.0868	-0.868	-1.411	No	80
		mTemp	128	0.0000	0.000	-0.070	No	< 80
		FC	249	-0.5000	-5.000	-1.218	No	< 80
		mFC	127	-1.6190	-16.190	-1.037	No	< 80
	5	DO	119	-0.0226	-0.113	-0.026	No	< 80
		mDO	63	0.0889	0.445	0.192	No	< 80
		Temp	121	0.0500	0.250	0.384	No	< 80
		mTemp	63	0.1504	0.752	0.831	No	< 80
		FC	122	7.4600	37.300	3.235	Yes	95
		mFC	62	5.9500	29.750	2.468	Yes	95

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
34	18	pH	426	-0.0401	-0.722	-9.387	Yes	95
		mpH	223	-0.0368	-0.662	-6.557	Yes	95
		DO	449	0.0467	0.840	2.576	Yes	95
		mDO	229	0.0462	0.832	1.926	No	90
		DO % sat	448	0.4989	8.980	3.052	Yes	95
		mDO % sat	230	0.5037	9.067	2.054	Yes	95
		Temp	453	0.0996	1.794	4.057	Yes	95
		mTemp	230	0.1144	2.059	4.492	Yes	95
		Turb	416	-0.4325	-7.785	-7.506	Yes	95
		mTurb	216	-0.5619	-10.114	-6.915	Yes	95
		FC	448	-2.4180	-43.524	-3.474	Yes	95
		mFC	217	-4.4810	-80.658	-2.263	Yes	95
		NO3+NO2	114	-0.0010	-0.018	-2.153	Yes	95
		TKN	113	-0.0166	-0.298	-2.727	Yes	95
		TP	114	0.0051	0.092	3.693	Yes	95
		OP	114	0.0033	0.060	2.742	Yes	95
		NH3	114	-0.0134	-0.241	-6.804	Yes	95
		TSS	114	-0.2252	-4.054	-1.211	No	< 80
	10	DO	245	0.0885	0.885	2.165	Yes	95
		mDO	127	0.1411	1.411	2.305	Yes	95
		Temp	247	0.1491	1.491	2.636	Yes	95
		mTemp	127	0.0855	0.855	1.623	No	80
		FC	245	0.0000	0.000	-0.865	No	< 80
		mFC	113	0.0000	0.000	0.000	No	< 80
	5	DO	117	-0.2286	-1.143	-1.466	No	80
		mDO	63	-0.0801	-0.400	-0.757	No	< 80
		Temp	119	0.2049	1.025	1.147	No	< 80
		mTemp	63	0.2509	1.255	1.515	No	80
		FC	118	0.0000	0.000	0.291	No	< 80
		mFC	63	0.0000	0.000	0.000	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
35	18	pH	419	0.0129	0.232	3.544	Yes	95
		mpH	223	0.0128	0.231	3.189	Yes	95
		DO	442	0.0366	0.660	2.625	Yes	95
		mDO	227	0.0343	0.618	2.465	Yes	95
		DO % sat	442	0.3780	6.804	2.788	Yes	95
		mDO % sat	229	0.3033	5.459	2.454	Yes	95
		Temp	446	0.0462	0.832	2.883	Yes	95
		mTemp	227	0.0334	0.602	1.578	No	80
		Turb	404	-0.8204	-14.767	-6.570	Yes	95
		mTurb	213	-1.0900	-19.620	-5.770	Yes	95
		FC	441	0.0000	0.000	-0.879	No	< 80
		mFC	227	-0.0418	-0.752	-0.152	No	< 80
		NO3+NO2	110	-0.0043	-0.078	-0.703	No	< 80
		TKN	110	-0.0098	-0.176	-1.365	No	80
		TP	111	0.0004	0.008	0.495	No	< 80
		OP	109	-0.0021	-0.038	-0.966	No	< 80
		NH3	110	-0.0066	-0.120	-1.335	No	80
		TSS	109	-0.1659	-2.986	-1.254	No	< 80
	10	DO	243	0.1247	1.247	3.415	Yes	95
		mDO	128	0.1102	1.102	3.032	Yes	95
		Temp	246	0.0820	0.820	1.729	No	90
		mTemp	128	0.1267	1.267	2.412	Yes	95
		FC	247	0.0000	0.000	0.841	No	< 80
		mFC	128	1.1330	11.330	0.348	No	< 80
	5	DO	119	0.3727	1.864	3.363	Yes	95
		mDO	63	0.2737	1.369	3.516	Yes	95
		Temp	121	0.1308	0.654	0.979	No	< 80
		mTemp	63	0.1629	0.815	1.091	No	< 80
		FC	122	0.0000	0.000	0.000	No	< 80
		mFC	63	2.4230	12.115	0.192	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
36	18	pH	432	-0.0244	-0.438	-7.314	Yes	95
		mpH	229	-0.0264	-0.475	-5.121	Yes	95
		DO	448	0.0249	0.449	1.207	No	< 80
		mDO	231	0.0336	0.604	1.200	No	< 80
		DO % sat	455	0.3001	5.402	1.403	No	80
		mDO % sat	233	0.2378	4.280	1.118	No	< 80
		Temp	459	0.0248	0.447	0.963	No	< 80
		mTemp	232	0.0501	0.902	1.492	No	80
		Turb	415	-0.0643	-1.157	-1.607	No	80
		mTurb	218	-0.0869	-1.565	-1.683	No	90
		FC	461	0.6131	11.036	2.466	Yes	95
		mFC	232	1.1030	19.854	1.589	No	80
		NO3+NO2	116	0.0000	0.000	-1.271	No	< 80
		TKN	116	-0.0152	-0.273	-2.493	Yes	95
		TP	116	0.0043	0.078	2.808	Yes	95
		OP	116	0.0038	0.068	2.893	Yes	95
		NH3	116	-0.0093	-0.168	-5.331	Yes	95
		TSS	116	0.0000	0.000	0.454	No	< 80
	10	DO	247	0.0705	0.705	1.720	No	90
		mDO	128	0.0488	0.488	0.578	No	< 80
		Temp	254	0.0332	0.332	0.474	No	< 80
		mTemp	128	0.1277	1.277	1.550	No	80
		FC	255	0.0000	0.000	-0.147	No	< 80
		mFC	128	0.0000	0.000	0.093	No	< 80
	5	DO	122	-0.2195	-1.098	-1.501	No	80
		mDO	63	-0.1898	-0.949	-1.409	No	80
		Temp	124	0.2992	1.496	1.191	No	< 80
		mTemp	63	0.2836	1.418	0.641	No	< 80
		FC	124	0.0000	0.000	-0.100	No	< 80
		mFC	62	3.1940	15.970	1.046	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
37	18	pH	428	-0.0169	-0.305	-5.601	Yes	95
		mpH	227	-0.0161	-0.291	-3.570	Yes	95
		DO	435	0.0113	0.204	0.516	No	< 80
		mDO	228	0.0191	0.344	0.686	No	< 80
		DO % sat	452	-0.0334	-0.602	-0.136	No	< 80
		mDO % sat	232	-0.1474	-2.653	-0.523	No	< 80
		Temp	456	0.0313	0.563	1.216	No	< 80
		mTemp	231	0.0490	0.882	1.860	No	90
		Turb	416	-0.1719	-3.094	-2.181	Yes	95
		mTurb	218	-0.3872	-6.970	-3.564	Yes	95
		FC	459	4.5230	81.414	3.845	Yes	95
		mFC	230	8.4730	152.514	3.492	Yes	95
		NO3+NO2	116	-0.0044	-0.079	-1.554	No	80
		TKN	116	0.0193	0.348	1.270	No	< 80
		TP	116	0.0067	0.121	1.652	No	90
		OP	116	0.0083	0.150	2.085	Yes	95
		NH3	116	-0.0083	-0.149	-0.607	No	< 80
		TSS	116	-0.0908	-1.635	-0.402	No	< 80
	10	DO	240	0.0502	0.502	0.654	No	< 80
		mDO	126	0.0265	0.265	0.331	No	< 80
		Temp	249	-0.0154	-0.154	-0.249	No	< 80
		mTemp	127	0.0251	0.251	0.772	No	< 80
		FC	249	3.2280	32.280	1.284	No	80
		mFC	126	11.2800	112.800	1.299	No	80
	5	DO	120	-0.2978	-1.489	-1.394	No	80
		mDO	63	-0.3389	-1.695	-2.110	Yes	95
		Temp	122	0.2007	1.004	1.768	No	90
		mTemp	63	0.3383	1.692	1.726	No	90
		FC	123	-9.6840	-48.420	-1.149	No	< 80
		mFC	63	-30.0400	-150.200	-1.343	No	80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
38	18	pH	424	-0.0255	-0.459	-6.767	Yes	95
		mpH	227	-0.0253	-0.455	-5.053	Yes	95
		DO	424	-0.0397	-0.715	-1.460	No	80
		mDO	224	-0.0681	-1.225	-2.006	Yes	95
		DO % sat	441	-0.4174	-7.513	-1.625	No	80
		mDO % sat	232	-0.5795	-10.431	-2.122	Yes	95
		Temp	452	0.0142	0.256	0.653	No	< 80
		mTemp	231	0.0218	0.392	0.692	No	< 80
		Turb	411	-0.3536	-6.365	-4.269	Yes	95
		mTurb	217	-0.4500	-8.100	-4.360	Yes	95
		FC	452	1.1780	21.204	2.377	Yes	95
		mFC	230	2.2730	40.914	1.821	No	90
		NO3+NO2	115	0.0032	0.057	2.198	Yes	95
		TKN	115	0.0182	0.327	1.397	No	80
		TP	115	0.0166	0.299	2.587	Yes	95
		OP	115	0.0173	0.312	4.275	Yes	95
		NH3	115	-0.0033	-0.060	-0.189	No	< 80
		TSS	115	-0.4990	-8.982	-1.295	No	80
	10	DO	234	-0.0579	-0.579	-0.836	No	< 80
		mDO	124	-0.1120	-1.120	-1.185	No	< 80
		Temp	250	-0.1000	-1.000	-1.571	No	80
		mTemp	128	-0.0424	-0.424	-0.788	No	< 80
		FC	250	-1.9870	-19.870	-1.501	No	80
		mFC	128	-6.5310	-65.310	-1.065	No	< 80
	5	DO	119	-0.7491	-3.746	-2.974	Yes	95
		mDO	63	-0.7255	-3.628	-3.133	Yes	95
		Temp	121	0.0000	0.000	0.000	No	< 80
		mTemp	63	0.0249	0.125	0.064	No	< 80
		FC	122	0.0000	0.000	0.587	No	< 80
		mFC	63	13.2400	66.200	1.087	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
39	18	pH	431	-0.0198	-0.356	-7.503	Yes	95
		mpH	229	-0.0191	-0.343	-5.024	Yes	95
		DO	454	0.0050	0.090	0.691	No	< 80
		mDO	232	-0.0013	-0.023	-0.116	No	< 80
		DO % sat	456	0.0334	0.601	0.820	No	< 80
		mDO % sat	234	0.0250	0.450	0.335	No	< 80
		Temp	460	-0.0091	-0.164	-0.774	No	< 80
		mTemp	233	0.0036	0.064	0.289	No	< 80
		Turb	415	-0.0441	-0.794	-1.519	No	80
		mTurb	218	-0.0997	-1.794	-2.064	Yes	95
		FC	460	-0.4982	-8.968	-2.545	Yes	95
		mFC	232	-1.3700	-24.660	-2.220	Yes	95
		NO3+NO2	116	-0.0041	-0.074	-1.224	No	< 80
		TKN	116	-0.0010	-0.018	-1.311	No	80
		TP	116	0.0000	0.000	3.566	Yes	95
		OP	116	0.0019	0.033	4.637	Yes	95
		NH3	116	-0.0008	-0.015	-1.665	No	90
		TSS	115	0.0000	0.000	-1.441	No	80
	10	DO	248	0.0427	0.427	2.034	Yes	95
		mDO	129	0.0033	0.033	0.252	No	< 80
		Temp	251	-0.0597	-0.597	-1.702	No	90
		mTemp	129	0.0000	0.000	0.000	No	< 80
		FC	251	0.0000	0.000	-0.996	No	< 80
		mFC	129	0.8250	8.250	0.573	No	< 80
	5	DO	121	-0.0502	-0.251	-0.872	No	< 80
		mDO	63	-0.0827	-0.413	-0.959	No	< 80
		Temp	123	-0.0494	-0.247	-0.401	No	< 80
		mTemp	63	0.0125	0.063	0.064	No	< 80
		FC	124	0.0000	0.000	-0.547	No	< 80
		mFC	63	-0.7116	0.000	-0.064	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
40	18	pH	404	-0.0185	-0.333	-5.937	Yes	95
		mpH	209	-0.0170	-0.306	-3.970	Yes	95
		DO	428	-0.0115	-0.206	-0.787	No	< 80
		mDO	213	0.0072	0.130	0.462	No	< 80
		DO % sat	428	-0.0984	-1.771	-0.636	No	< 80
		mDO % sat	215	0.0810	1.458	0.619	No	< 80
		Temp	430	0.0142	0.255	0.909	No	< 80
		mTemp	215	-0.0336	-0.604	-2.032	Yes	95
		Turb	393	-0.0447	-0.805	-0.513	No	< 80
		mTurb	200	-0.0276	-0.496	-0.279	No	< 80
		FC	425	0.0000	0.000	0.975	No	< 80
		mFC	213	0.6667	12.001	0.834	No	< 80
		NO3+NO2	108	-0.0070	-0.126	-1.251	No	< 80
		TKN	109	-0.0052	-0.093	-0.927	No	< 80
		TP	109	0.0014	0.025	3.942	Yes	95
		OP	108	-0.0018	-0.033	-0.901	No	< 80
		NH3	109	-0.0067	-0.121	-1.821	No	90
		TSS	108	0.0000	0.000	-0.107	No	< 80
	10	DO	225	-0.0602	-0.602	-1.335	No	80
		mDO	113	-0.0075	-0.075	-0.055	No	< 80
		Temp	225	0.1003	1.003	2.407	Yes	95
		mTemp	113	0.0251	0.251	0.556	No	< 80
		FC	224	2.1530	21.530	2.078	Yes	95
		mFC	112	4.6020	46.020	2.381	Yes	95
	5	DO	95	0.1025	0.513	0.936	No	< 80
		mDO	49	0.1583	0.792	1.243	No	< 80
		Temp	95	0.1736	0.868	0.975	No	< 80
		mTemp	49	0.1629	0.815	1.277	No	< 80
		FC	94	6.1620	30.810	1.681	No	90
		mFC	48	10.5600	52.800	1.276	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
41	18	pH	435	-0.0071	-0.128	-2.606	Yes	95
		mpH	227	-0.0060	-0.109	-1.530	No	80
		DO	459	0.0468	0.842	2.418	Yes	95
		mDO	230	0.0476	0.857	1.941	No	90
		DO % sat	460	0.3607	6.493	2.146	Yes	95
		mDO % sat	232	0.3160	5.688	1.449	No	80
		Temp	464	-0.0071	-0.129	-0.396	No	< 80
		mTemp	231	0.0000	0.000	0.000	No	< 80
		Turb	426	0.2617	4.711	6.119	Yes	95
		mTurb	217	0.2508	4.514	3.732	Yes	95
		FC	462	1.2270	22.086	2.939	Yes	95
		mFC	231	1.7070	30.726	2.333	Yes	95
		NO3+NO2	117	0.0000	0.000	-0.646	No	< 80
		TKN	116	-0.0049	-0.089	-1.077	No	< 80
		TP	117	0.0048	0.087	4.390	Yes	95
		OP	117	0.0036	0.065	4.871	Yes	95
		NH3	117	-0.0056	-0.100	-2.696	Yes	95
		TSS	117	0.0733	1.319	3.190	Yes	95
	10	DO	254	0.1018	1.018	2.165	Yes	95
		mDO	128	0.0716	0.716	1.468	No	80
		Temp	256	-0.0712	-0.712	-1.537	No	80
		mTemp	128	-0.1147	-1.147	-2.030	Yes	95
		FC	256	0.0000	0.000	-1.517	No	80
		mFC	128	-2.5840	-25.840	-1.565	No	80
	5	DO	123	-0.3009	-1.505	-1.898	No	90
		mDO	63	-0.2171	-1.086	-1.641	No	80
		Temp	125	0.0000	0.000	0.000	No	< 80
		mTemp	63	0.0501	0.251	0.696	No	< 80
		FC	125	0.0000	0.000	0.123	No	< 80
		mFC	63	-3.3490	-16.745	-0.569	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
42	18	pH	433	-0.0063	-0.113	-2.317	Yes	95
		mpH	224	-0.0071	-0.128	-1.907	No	90
		DO	457	0.0804	1.448	5.724	Yes	95
		mDO	229	0.0943	1.698	5.028	Yes	95
		DO % sat	459	0.6153	11.075	5.878	Yes	95
		mDO % sat	231	0.6891	12.404	5.281	Yes	95
		Temp	462	0.0375	0.675	2.097	Yes	95
		mTemp	230	-0.0178	-0.321	-1.048	No	< 80
		Turb	423	0.0459	0.826	3.698	Yes	95
		mTurb	216	0.0528	0.950	2.759	Yes	95
		FC	457	2.0050	36.090	5.360	Yes	95
		mFC	230	2.9350	52.830	4.181	Yes	95
		NO3+NO2	117	0.0000	0.000	-0.417	No	< 80
		TKN	116	-0.0085	-0.152	-2.012	Yes	95
		TP	117	0.0000	0.000	1.032	No	< 80
		OP	117	0.0007	0.012	1.802	No	90
		NH3	117	-0.0028	-0.051	-3.395	Yes	95
		TSS	117	0.0000	0.000	1.794	No	90
	10	DO	253	-0.1105	-1.105	-3.692	Yes	95
		mDO	128	-0.0909	-0.909	-2.471	Yes	95
		Temp	255	0.0000	0.000	-0.180	No	< 80
		mTemp	128	-0.0662	-0.662	-1.566	No	80
		FC	255	0.0000	0.000	0.537	No	< 80
		mFC	128	3.3290	33.290	1.167	No	< 80
	5	DO	124	-0.1480	-0.740	-1.685	No	90
		mDO	63	-0.1657	-0.829	-1.075	No	< 80
		Temp	125	0.1242	0.621	0.662	No	< 80
		mTemp	63	0.1508	0.754	0.953	No	< 80
		FC	125	10.5400	52.700	3.522	Yes	95
		mFC	63	22.0600	110.300	3.041	Yes	95

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
43	18	pH	426	-0.0247	-0.444	-7.821	Yes	95
		mpH	222	-0.0255	-0.460	-6.050	Yes	95
		DO	451	-0.0447	-0.804	-2.316	Yes	95
		mDO	225	-0.0390	-0.701	-1.638	No	80
		DO % sat	453	-0.4294	-7.729	-2.155	Yes	95
		mDO % sat	229	-0.3571	-6.428	-1.563	No	80
		Temp	455	0.0000	0.000	0.476	No	< 80
		mTemp	227	0.0180	0.324	1.293	No	80
		Turb	418	0.3230	5.814	6.454	Yes	95
		mTurb	213	0.3112	5.602	4.600	Yes	95
		FC	448	0.9989	17.980	3.079	Yes	95
		mFC	227	2.6700	48.060	3.120	Yes	95
		NO3+NO2	114	0.0000	0.000	-0.323	No	< 80
		TKN	113	0.0000	0.000	-0.010	No	< 80
		TP	114	0.0026	0.047	1.842	No	90
		OP	114	0.0000	0.000	0.155	No	< 80
		NH3	114	0.0014	0.026	0.434	No	< 80
		TSS	114	0.0830	1.495	1.114	No	< 80
	10	DO	254	-0.0430	-0.430	-0.742	No	< 80
		mDO	127	-0.0303	-0.303	-0.235	No	< 80
		Temp	256	0.0000	0.000	-0.256	No	< 80
		mTemp	128	-0.0571	-0.571	-1.027	No	< 80
		FC	253	0.0000	0.000	1.180	No	< 80
		mFC	128	1.2890	12.890	0.513	No	< 80
	5	DO	124	-0.2880	-1.440	-2.098	Yes	95
		mDO	63	-0.3092	-1.546	-1.894	No	90
		Temp	125	0.0669	0.334	0.537	No	< 80
		mTemp	63	0.0503	0.251	0.190	No	< 80
		FC	122	3.2970	16.485	1.485	No	80
		mFC	63	13.0500	65.250	2.087	Yes	95

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
44	18	pH	391	-0.0489	-0.881	-11.850	Yes	95
		mpH	205	-0.0492	-0.885	-9.005	Yes	95
		DO	411	-0.1176	-2.117	-5.150	Yes	95
		mDO	208	-0.1116	-2.009	-4.071	Yes	95
		DO % sat	414	-1.1330	-20.394	-5.017	Yes	95
		mDO % sat	210	-1.0740	-19.332	-3.603	Yes	95
		Temp	418	-0.0067	-0.120	-0.432	No	< 80
		mTemp	210	0.0100	0.181	0.403	No	< 80
		Turb	381	-0.0678	-1.220	-0.979	No	< 80
		mTurb	197	-0.1203	-2.165	-1.451	No	80
		FC	415	0.0000	0.000	0.575	No	< 80
		mFC	210	0.0728	1.311	0.157	No	< 80
		NO3+NO2	95	-0.0014	-0.026	-1.406	No	80
		TKN	95	-0.0218	-0.393	-1.874	No	90
		TP	96	0.0079	0.142	4.751	Yes	95
		OP	95	-0.0016	-0.029	-1.259	No	< 80
		NH3	96	-0.0056	-0.102	-1.435	No	80
		TSS	95	-0.0905	-1.629	-0.467	No	< 80
	10	DO	252	-0.0600	-0.600	-1.334	No	80
		mDO	127	-0.0652	-0.652	-0.988	No	< 80
		Temp	253	-0.0503	-0.503	-1.259	No	< 80
		mTemp	128	-0.0914	-0.914	-1.097	No	< 80
		FC	253	-1.0010	-10.010	-1.556	No	80
		mFC	128	-4.4350	-44.350	-1.424	No	80
	5	DO	121	-0.3236	-1.618	-2.252	Yes	95
		mDO	62	-0.3540	-3.540	-1.992	Yes	95
		Temp	122	-0.0993	-0.496	-1.002	No	< 80
		mTemp	63	0.0167	0.084	0.000	No	< 80
		FC	122	0.0000	0.000	0.278	No	< 80
		mFC	63	-3.0040	-15.020	-0.316	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
45	18	pH	418	0.0093	0.168	2.088	Yes	95
		mpH	225	0.0085	0.153	1.649	No	90
		DO	438	0.0122	0.219	2.455	Yes	95
		mDO	227	0.0082	0.148	1.291	No	80
		DO % sat	438	0.0815	1.466	2.182	Yes	95
		mDO % sat	230	0.0661	1.190	1.236	No	< 80
		Temp	446	0.0000	0.000	0.154	No	< 80
		mTemp	230	0.0088	0.159	0.799	No	< 80
		Turb	411	-0.1522	-2.740	-4.138	Yes	95
		mTurb	214	-0.1959	-3.526	-3.294	Yes	95
		FC	440	0.0000	0.000	-0.530	No	< 80
		mFC	230	-0.0503	-0.905	-1.215	No	< 80
		NO3+NO2	112	0.0000	0.000	0.921	No	< 80
		TKN	112	0.0000	0.000	-1.149	No	< 80
		TP	112	0.0000	0.000	-2.785	Yes	95
		OP	112	0.0000	0.000	3.444	Yes	95
		NH3	112	0.0000	0.000	-0.402	No	< 80
		TSS	112	-0.2223	-4.001	-2.239	Yes	95
	10	DO	245	0.0474	0.474	3.658	Yes	95
		mDO	128	0.0619	0.619	3.678	Yes	95
		Temp	247	0.0000	0.000	0.135	No	< 80
		mTemp	128	-0.0437	-0.437	-1.285	No	80
		FC	246	0.0000	0.000	0.886	No	< 80
		mFC	128	0.0000	0.000	0.070	No	< 80
	5	DO	122	-0.4592	-2.296	-1.672	No	90
		mDO	63	-0.0928	-0.464	-2.272	Yes	95
		Temp	123	0.0334	0.167	0.478	No	< 80
		mTemp	63	0.1995	0.998	1.400	No	80
		FC	123	0.0000	0.000	0.154	No	< 80
		mFC	63	-0.0502	-0.251	-0.382	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
46	18	pH	425	0.0033	0.060	0.989	No	< 80
		mpH	223	0.0025	0.045	0.467	No	< 80
		DO	450	0.0133	0.240	3.091	Yes	95
		mDO	229	0.0225	0.404	3.620	Yes	95
		DO % sat	451	0.0875	1.575	2.716	Yes	95
		mDO % sat	231	0.0778	1.400	1.885	No	90
		Temp	454	0.0000	0.000	0.299	No	< 80
		mTemp	230	-0.0248	-0.447	-1.707	No	90
		Turb	420	-0.1544	-2.779	-4.300	Yes	95
		mTurb	216	-0.1826	-3.287	-3.264	Yes	95
		FC	453	0.0000	0.000	1.702	No	90
		mFC	230	0.1897	3.415	1.937	No	90
		NO3+NO2	114	0.0007	0.013	1.364	No	80
		TKN	113	0.0000	0.000	0.537	No	< 80
		TP	114	0.0000	0.000	-1.282	No	< 80
		OP	114	0.0000	0.000	3.150	Yes	95
		NH3	114	0.0000	0.000	2.755	Yes	95
		TSS	113	-0.2228	-4.010	-2.228	Yes	95
	10	DO	251	0.0463	0.463	3.731	Yes	95
		mDO	128	0.0655	0.655	3.778	Yes	95
		Temp	252	0.0134	0.134	0.542	No	< 80
		mTemp	128	-0.0416	-0.416	-1.121	No	< 80
		FC	253	0.4172	4.172	2.819	Yes	95
		mFC	128	0.6332	6.332	2.478	Yes	95
	5	DO	122	-0.0483	-0.241	-1.241	No	< 80
		mDO	63	-0.0652	-0.326	-1.455	No	80
		Temp	123	0.0000	0.000	0.251	No	< 80
		mTemp	63	0.1512	0.756	1.460	No	80
		FC	125	0.0000	0.000	0.174	No	< 80
		mFC	63	0.4033	2.017	0.319	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
47	18	pH	436	-0.0730	-1.314	-15.600	Yes	95
		mpH	227	-0.0739	-1.330	-11.780	Yes	95
		DO	460	-0.0010	-0.019	-0.165	No	< 80
		mDO	230	-0.0055	-0.099	-0.702	No	< 80
		DO % sat	461	0.0218	0.393	0.375	No	< 80
		mDO % sat	232	0.0414	0.745	0.720	No	< 80
		Temp	464	0.0222	0.399	2.327	Yes	95
		mTemp	231	0.0299	0.537	2.738	Yes	95
		Turb	425	-0.0157	-0.283	-0.932	No	< 80
		mTurb	217	-0.0125	-0.224	-0.761	No	< 80
		FC	457	0.0000	0.000	2.693	Yes	95
		mFC	230	0.1253	2.255	2.665	Yes	95
		NO3+NO2	117	0.0055	0.099	3.152	Yes	95
		TKN	116	0.0000	0.000	2.235	Yes	95
		TP	117	0.0009	0.017	4.678	Yes	95
		OP	117	0.0025	0.044	5.192	Yes	95
		NH3	117	-0.0010	-0.018	-2.721	Yes	95
		TSS	117	-0.8648	-15.566	-2.581	Yes	95
	10	DO	255	0.0134	0.134	0.841	No	< 80
		mDO	128	0.0232	0.232	1.236	No	< 80
		Temp	256	0.0499	0.499	1.908	No	90
		mTemp	128	0.0153	0.153	0.514	No	< 80
		FC	253	0.0000	0.000	-0.547	No	< 80
		mFC	127	-0.0142	-0.142	-0.307	No	< 80
	5	DO	124	-0.0753	-0.377	-2.029	Yes	95
		mDO	63	-0.1398	-0.699	-2.720	Yes	95
		Temp	125	-0.0251	-0.125	-0.417	No	< 80
		mTemp	63	0.0501	0.251	0.698	No	< 80
		FC	123	0.0000	0.000	-0.631	No	< 80
		mFC	62	-0.1008	-0.504	-0.194	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
48	17	pH	436	-0.0222	-0.377	-7.696	Yes	95
		mpH	227	-0.0211	-0.359	-5.902	Yes	95
		DO	459	0.0266	0.452	4.431	Yes	95
		mDO	230	0.0241	0.409	3.590	Yes	95
		DO % sat	460	0.2181	3.708	6.054	Yes	95
		mDO % sat	232	0.2226	3.784	4.748	Yes	95
		Temp	463	0.0291	0.494	2.697	Yes	95
		mTemp	231	0.0324	0.550	2.677	Yes	95
		Turb	426	0.0055	0.094	0.603	No	< 80
		mTurb	217	0.0016	0.027	0.043	No	< 80
		FC	457	0.0000	0.000	-1.165	No	< 80
		mFC	230	-0.7926	-13.474	-1.330	No	80
		NO3+NO2	117	-0.0043	-0.073	-2.457	Yes	95
		TKN	115	-0.0097	-0.165	-2.984	Yes	95
		TP	117	0.0020	0.034	4.737	Yes	95
		OP	117	0.0000	0.000	0.564	No	< 80
		NH3	116	-0.0050	-0.085	-7.740	Yes	95
		TSS	117	0.0000	0.000	0.036	No	< 80
	10	DO	255	0.0785	0.785	5.066	Yes	95
		mDO	128	0.0845	0.845	4.476	Yes	95
		Temp	255	0.0000	0.000	-0.069	No	< 80
		mTemp	128	-0.0499	-0.499	-1.517	No	80
		FC	253	0.0000	0.000	-0.754	No	< 80
		mFC	127	-1.1070	-11.070	-0.518	No	< 80
	5	DO	125	-0.0103	-0.052	-0.417	No	< 80
		mDO	63	-0.0827	-0.414	-1.641	No	80
		Temp	126	0.0819	0.409	0.484	No	< 80
		mTemp	63	0.0501	0.250	0.505	No	< 80
		FC	125	0.0000	0.000	-0.149	No	< 80
		mFC	63	4.3130	21.565	0.444	No	< 80