Water Year 16 (Oct. 2021 – Sept. 2022) Island County Surface Water Quality Report

ISLAND COUNTY PUBLIC HEALTH
DEPARTMENT OF NATURAL RESOURCES
SURFACE WATER QUALITY MONITORING PROGRAM

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Table of Contents

INTRODUCTION

Island County is known for its exceptional scenery, abundant natural resources, and plentiful recreational opportunities. Island County has a unique mix of shoreline with private and commercial shellfish areas, and private and public lakes and beaches. Water Resources Inventory Area (WRIA) 6 encompasses all islands and water within Island County's geographic boundary. Centrally located within the Salish Sea at the junction of Puget Sound and the Strait of Juan de Fuca and Georgia Straight, Whidbey and Camano Island encompass more than 200 watersheds that contribute to surface water flow. Most of the watersheds are small and experience seasonal flow, but they all play an important role in local ecosystems and several watersheds have streams that demonstrate year-round flow. Monitoring the water quality of these watersheds is essential for protecting public health and community resources.

Island County's population is approximately 87,000 according to the 2020 census. Apart from those who live in three incorporated municipalities, most island residents live in rural settings or small, unincorporated communities. While only about 20% of U.S. homes are served by decentralized wastewater (onsite septic) systems (Ground Water 2022), the vast majority of Island County residents (more than 72%) utilize a septic system (*Onsite* n.d.). Although these systems can provide an effective means to treat wastewater, for many homeowners the systems are outdated or non-compliant. For more information click this link: https://co-island-wa.smartgovcommunity.com/Public/Home

The main goal of the Island County Surface Water Quality Monitoring Program (SWQMP) is to "protect human health and critical areas by monitoring water quality" by using local, state, and federal funding effectively and efficiently. Surface water quality resources are monitored throughout the year to produce consistent and quality data reports that can be used in evaluating habitat and impacts to human health. In the past, surface water data has been used in combination with the groundwater monitoring data, since Water quality monitoring efforts in recent times have been focused on regular monitoring of streams for non-point source pollution and coliform bacteria and are summarized in Source ID evaluations and Water Year annual reports. These water year reports can be used by outside agencies and other departments within Island County in their review of future development and projects, as well as in the evaluation of shellfish, salmon, and water recreational areas.

The U.S. Geological Survey (USGS) uses the term "water year" in reports that deal with surface-water supply. Water year is defined as the 12-month period beginning October 1st for any given year through September 30th of the following year. The water year is designated by the calendar year in which it ends, so the year ending September 30, 2022 is called the "2022" water year (Jian et al. 2022). The current Island County SWQMP has been in effect since 2006, so Water Year 2022 from October of 2021 to September of 2022 represents the 16th year of reporting (WY16).

The reason why a water year is different than a calendar year is that precipitation that happens at the end of a calendar year, perhaps as snowfall, often doesn't affect the level or flow of water in streams until the next spring or summer. Starting the water year a little earlier allows scientists to study how much water cycles through an area throughout a year. A local area's water year may be different from the USGS water year, as can be seen with Island County that experiences more rain than snow. Island County SWQ team is evaluating weather patterns and conditions to understand and possibly use the local water year in the future, but the convention is to use the nationwide standard water year from October to September.

During Water Year 2022 or WY16, Island County conducted surface water quality monitoring in 15 watersheds representing a range of land uses and ecological functions. Each sample site was sampled once per month except when surface flow was not present or when additional samples were required. Each site was assessed for temperature, pH, conductivity, dissolved oxygen, turbidity, *E. coli* bacteria, and discharge.

This report provides descriptions of each sample site as well as site-specific results from WY16. Results are presented in terms of annual and seasonal Geometric Means for *Escherichia coli* (*E. coli*). Recent changes to surface water quality standards from Washington State Department of Ecology (ECY) required a change in reporting from fecal coliform to *E. coli* starting in October of 2020, WY15 to present day. The bacterium *E. coli* is a type of fecal coliform bacteria associated with feces from warm-blooded animals and is considered an indicator of fecal pollution.

Data analysis and reporting for the SWQMP involves the creation of the annual water quality report to be made available for State agency review and made easily accessible to the public by posting online and by presenting to the Board of Island County Commissioners. Annual reports include site monitoring data, summary statistics and description of any data collection issues. These reports are encouraged to be used by other departments and as part of the Adaptive Management Process. Data analysis also includes submitting data to the ECY Environmental Information Management database (EIM). EIM is an ECY run program that "contains environmental monitoring data collected by our scientists and partners." (*EIM* n.d.). This publicly accessible database contains historical data from 2006 that we submit annually.

Washington State Water Quality Assessment

The Federal Clean Water Act, adopted in 1972, requires all states to restore their waters to be "fishable and swimmable" (*Assessment* n.d.*;* Encyclopedia 2012). Washington State Department of Ecology's (ECY) Water Quality Assessment lists the water quality status for all water bodies in the state. This assessment meets the federal requirements for a report under Sections 303(d) and 305(b) of the Clean Water Act, which is submitted to the federal Environmental Protection Agency (EPA). The assessment divides waterbodies into 5 different categories based on impairment. These impairments may result from high bacteria levels, increased temperature, and/or low dissolved oxygen. The most current assessment was finalized and approved by the EPA in December 2012, with the new assessment, including data analysis through 2016, to be finalized soon. Additional information about the State's assessment may be found at http://www.ecy.wa.gov/programs/wq/303d/index.html.

· Category 1: meets standard for clean waters
· Category 2: waters of concern (some evidence of problems)
· Category 3: insufficient data
· Category 4A: waterbodies that have an approved TMDL in place and are actively being implemented
· Category 4B: has a pollution control program other than a TMDL
· Category 5: polluted waters that require a TMDL; traditionally known as the 303(d) list

Holmes Harbor within WRIA 6 is an important shellfish area and has been classified as a Category 1 for Temperature, Category 2 for pH, and a Category 5 waterbody based on Dissolved Oxygen levels (updated Sept-2022).

https://apps.ecology.wa.gov/ApprovedWQA/ApprovedPages/ApprovedSearch.aspx
Search parameter: Holmes Harbor or Island County for a full list of all affected Island County areas.

View	10127	48122A5G3_01_01	Water	Dissolved Oxygen	5	HOLMES HARBOR	6-Island	10127
View	10128	48122A5G3_01_01	Water	pH	2	HOLMES HARBOR	6-Island	10128
View	10129	48122A5G3_01_01	Water	Temperature	1	HOLMES HARBOR	6-Island	10129

Site Selection and Monitoring

Several types of monitoring can be utilized to evaluate surface water quality: Core, Reconnaissance, Effectiveness, and Source ID. Each of these types of monitoring can be used for different reasons and evaluated based on area of need and different data interpretations.

Core Monitoring Sites

E. The core sites are located at watershed pour points (the point where the surface water meets the Puget Sound). Core monitoring sites were established in 2006 during the development of the Surface Water Monitoring Program (SWQMP) for Island County and were chosen to represent watersheds that were predominantly developed, agricultural, or natural land uses (Adamus & Eilers 2006). Table 1 outlines the sampling sites and their classification, and Figure 1 shows priority watersheds and sampling locations for WY16.

These sites have often moved upland over time in relation to private property, shoreline development, and tidal influences impacting access, as well as sediment load and salinity. Core sites were developed in 2006/2007 with the creation of the SWQMP. Effort was made to include all major streams and at least one location in all major watersheds. Core sites are traditionally conducted at previous baseline established sites that have the most consistent flow throughout the year, as well as being related to sensitive resources such as susceptible aquifers, shellfish beds, swim beaches, and salmon habitat.

Reconnaissance Monitoring Sites

Reconnaissance monitoring is conducted in areas based on risk of degradation of valuable resources. These resources include anadromous fish habitat, pocket estuaries, wetlands, swim-beaches, and shellfish beds. Over time, the goal is to conduct monitoring in every watershed in Island County and ensure that Washington State water quality standards are being met (Adamus & Eilers 2006).

Reconnaissance monitoring is conducted to explore water quality outside of the regular core watersheds and identify areas with water quality impairments that may need further investigation. Reconnaissance monitoring occurs at sampling locations containing priority resources and follows an estimation of the current risk of pollution and availability of resources. An example of reconnaissance monitoring would be English Boom, an Island County Park which has important recreational shellfish beds and a recently acquired Island County Conservation Futures property. Another example is the Double Bluff area where cautionary signs at the swim beach were recently recommended by Washington State Department of Health (WADOH) this past summer. Reconnaissance monitoring will also be conducted at potential future projects where outdated culverts may be replaced by fish passage culverts.

Effectiveness Monitoring Sites

Effectiveness monitoring is conducted to evaluate the impact of infrastructure modifications (i.e., implementation of Best Management Practices or BMPs, Island County Public Works projects, or a septic repair) on water quality. In areas where there is opportunity to look at the impacts of restoration or

development, the goal will be to take and evaluate water quality samples prior to and after changes have taken place. Effectiveness monitoring was intended to be used in coordination with other Island County departments: Public Works, Environmental Health, and other partners like local conservation districts to evaluate the effectiveness of a project. There are several projects under consideration at this time: Race Road culvert replacements, Keystone Farm restoration projects, Cornet Bay restoration projects, Cavalero tide gate and restoration, Crescent Harbor Navy salmon restoration, Ala Spit restoration, and future culvert replacements.

Source Identification Monitoring

Source ID monitoring is conducted when a core site demonstrates exceedances in water quality conditions based on parameters set by Washington State Department of Ecology (ECY) and the Environmental Protection Agency (EPA). Source ID is used to identify possible sources of pollution within a targeted watershed. This is accomplished by bracketing up a watershed from a point of known contamination to determine potential point sources of bacteria. Additional *E. coli* samples are taken when an exceedance of 320 MPN/100 mL or higher and/or a 90-day Coliform Geometric Mean (geomean) greater than 100 MPN/100 mL was reported.

While swim beaches are not regularly sampled as part of the SWQ monitoring plan, water quality and *E. coli* levels upstream of swim beaches are often documented. According to the ECY, "the geometric mean at swim beaches should not exceed 30 enterococci/100 mL, based on results from a minimum of five weekly samples and a maximum of 12 weekly samples. The statistical threshold value should not exceed 110 enterococci/100 mL, based on results from a minimum of five weekly samples and a maximum of 12 weekly samples. If either of these criteria is exceeded, a local health jurisdiction may consider issuing a permanent advisory at a particular beach" (*Swimming* n.d.*)*. The ECY issues a public swimming advisory when the *Enterococcus* levels exceed 104 enterococci/100 mL of water. Even though SWQ team members do not sample marine waters, upstream areas are highly important since they connect surface water with marine water and often contribute to sources of pollution that affect fish-bearing streams or marine water recreational use.

The original goal for Source ID was to conduct monitoring in watersheds that, due to the number of coliform exceedances and the presence of valuable resources such as shellfish protection priority areas, swim beaches, and salmon habitat, were considered priority watersheds of concern. These watersheds included Maxwelton, watersheds surrounding Penn Cove, and watersheds in the Freeland area. In the past considerable time and resources has been spent identifying the source of contamination to determine if the coliform originated from wildlife, septic or sewer systems, and/or agriculture through approved Pollution Identification and Correction (PIC) programs.

This report focuses mainly on Core and Rotational monitoring summary results and provides descriptions of each site as well as site-specific results from WY16. Results are presented in terms of Washington Water Quality Standards and both annual and 90-day seasonal geomean. Summaries of Reconnaissance, Source ID, and Effectiveness monitoring conducted during WY16 are included in the discussion of this report.

Table 1. List of Sample Site Types and Locations

Camano Island		Whidbey Island	
Core	Rotational	Core	Rotational
55a Carp Creek 69a Chapman Creek 74a Cavalero Creek near Country Club outlet KC1- Kristoferson Creek	44a Brokaw at Rocky Point 108a South Camano new culvert	13a Crescent Creek near Navy restoration 58a Ebey's Reserve 134a – Freeland at dock Hhab – Freeland marsh outlet MWA2- Maxwelton Creek 157a Scatchet Head community 149a Glendale Creek	83a Cross Creek 159 Holmes Harbor outlet at Nichols
Reconnaissance	Effectiveness	Reconnaissance	Effectiveness
EB1, EB2 English Boom 81a Cama Beach	KC1 upstream and downstream	Double Bluff Beach 71a Race Road MWBeach Maxwelton Beach 132a Outdoor Classroom	Cornet1 Cornet Bay 5a Ala Spit

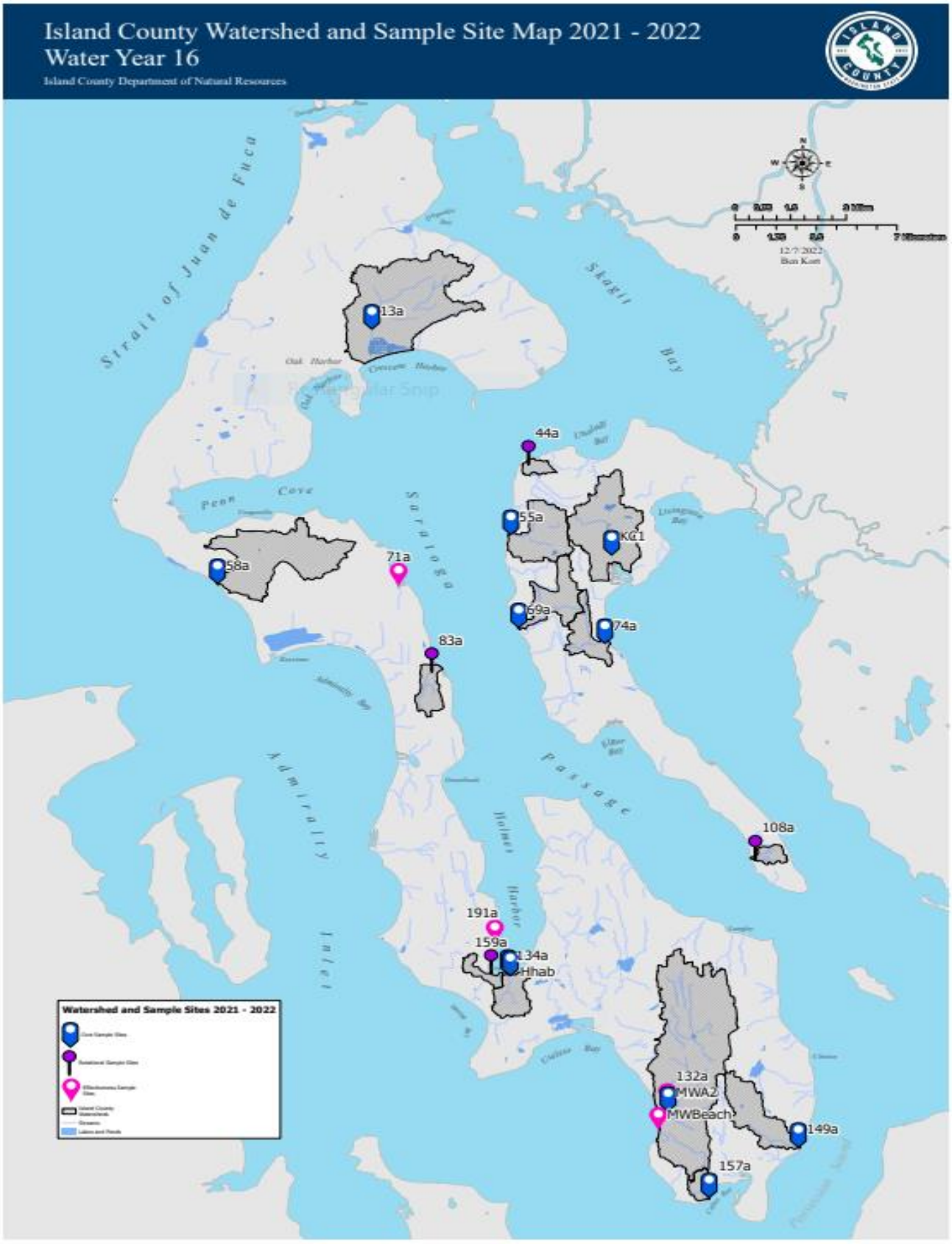

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Figure 1. Island County Watershed and Sample Site Map WY16

METHODS

Water Quality Index and Letter Grades

The Water Quality Index (WQI) is a statistical tool that was developed by Dave Hallock (2002) of the Washington Department of Ecology's Environmental Assessment Program in order to summarize water quality data by measuring the ability of a stream to sustain fish and wildlife as well as protect public health. WQI is an imperfect, unit-less number that synthesizes complex sets of water quality data for the sake of comparison. Indexes such as the WQI are commonly used to simplify technical information for non-technical readers. A WQI score is a number between 1 and 100, with 1 representing poor water quality and 100 representing excellent water quality.

Score Values:

- Scores 80 and above did not fail water quality standards or guidelines and are of "low concern".
- Scores 40 to 80 indicate "moderate concern",
- Scores below 40 are of "high concern".

For temperature, pH, fecal coliform bacteria, and dissolved oxygen, the index expresses results relative to levels required to maintain uses according to criteria specified in WAC 173-201A. For nutrient and sediment measures, where standards are not specific, results are expressed relative to expected conditions in this ecoregion. An ecoregion is a geographical area represented by abiotic and biotic phenomena that are generally similar. Multiple constituents are combined, and results aggregated over time to produce a single score for each sample site. WQI scores can fluctuate from year to year, which is common for environmental data. For example, an index score of 70 one year and 65 another year does not necessarily mean that water quality has undergone a significant change.

The 3-year Coliform Letter Grade (A, B, C, etc.) considers year-to-year variability. The grade is based on the frequency with which annual Geomeans and annual 90^{th} percentiles exceed state standards over the course of three consecutive years. Water Quality Index scores and Coliform Letter Grades cannot be calculated for sites that do not have three years of consecutive data.

Seasonal Kendall Test for Trends

Although not incorporated for WY16, in the future, Kendall analyses may be used to identify trends in water quality. The seasonal Kendall test was developed by the U.S. Geological Survey (USGS) to analyze trends in surface water quality throughout the United States (Helsel & Frans 2006) and accounts for seasonality of water flows. The seasonal Kendall test does not identify the strength of a trend, only whether there is one and whether it is trending up or down.

When using the seasonal Kendall test, individual seasons are defined to remove the effects of seasonality. Each season is then compared across years to see if a trend exists for the season (for example, if the month of January is defined as a season, data collected during the month of January over several years are compared). All seasons' trends are then combined to identify an overall trend. For streams that flow year-round, it is common practice to set each month as a season so that a year of data includes twelve seasons (October

through September). This method has been used by the Surface Water Quality Monitoring Program for streams that flow year-round.

Many Island County sampling sites have seasonal flow and may dry up at different times during the year. For sites that flow on average during eight to eleven months out of the year, four seasons are set with seasons starting in January, April, July and October. For sites whose dry period was long enough to leave one of the four seasons with no data, two seasons have been used starting in December and April.

Unlike the WQI, which calculates a single value representing all parameters of a site, the seasonal Kendall test is calculated for each parameter. Therefore, a single sampling site may have differing trends for each parameter. For example, a site may have a positive trend for temperature, a negative trend for pH, and no trend for dissolved oxygen. The trend analysis is used in conjunction with the WQI to aid in determining the overall water quality of a site.

Although in WY16 the SWQ team members focused on *E. coli* levels and geomeans, in the future, Kendall testing will be used to analyze all measured parameters for water quality, i.e., temperature, pH, turbidity, dissolved oxygen, salinity and conductivity.

Geometric Mean of *E. Coli* and Washington State Water Quality Standard

A site's annual Geometric Mean (geomean or GM) is calculated by multiplying monthly *E. coli* levels (n) and setting that product to the 1/nth power. The GM is a measure of the central tendency of coliform levels (measured in colony forming units (CFU)/100 mL) at a site.

Beginning in 2020, Washington state switched the requirements for reporting from fecal coliform to *E. coli*. Because there are only two years of *E. coli* data, state standards and statewide percentiles have not yet been established, therefore WQI and *E. coli* Letter Grades cannot be determined. Instead of WQI or Letter Grades, Island County SWQ team will be reporting annual and seasonal GMs for *E. coli*. These annual and seasonal guidelines have been adapted from guidelines used by neighboring Washington areas such as Jefferson, Kitsap and King counties. Sites were then classified as either Good, Moderate or Poor based on meeting or failing the two parts of the Washington State Water Quality Standard for *E. coli*.

Washington State Water Quality Standards

The Washington State Department of Ecology (ECY) is required by the Clean Water Act to adopt water quality standards to provide protection from bacteria in water bodies sufficient for full-immersion swimming. The appropriate surface waters in Island County are assigned a designation for recreational use, to compare water quality monitoring results to these ECY surface water quality standards (See Table 2).

Table 2: Water Quality Standards

Designated Use	Parameter	Standard
Core summer Salmonid habitat	Temperature	7-day average of the daily maximum temperatures no greater than 16°C (60.8°F)
	Dissolved Oxygen (DO)	9.5 mg/L minimum*
	pH	Between 6.5 and 8.5
	Turbidity	Shall not exceed 5 NTU over background when background turbidity is 50 NTU or less
Salmonid spawning, rearing and migration	Temperature	7-day average of the daily maximum temperatures no greater than 17.5°C (63.5°F)
	Dissolved Oxygen (DO)	8.0 mg/L minimum*
	pH	Between 6.5 and 8.5
	Turbidity	Shall not exceed 5 NTU over background when background turbidity is 50 NTU or less
Primary Contact Recreation	*E. Coli* (Most Probable Number MPN)	*E. coli* organism levels within an averaging period must not exceed a geometric mean value of 100 CFU or MPN per 100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained within the averaging period exceeding 320 CFU or MPN per 100 mL.

Washington State Standards for surface water (WAC 173-201A-200).

The ECY establishes standards for surface water quality. The state standard for *E. coli* contamination in primary contact recreation in freshwater is based on the geometric mean value (GMV) of *E. coli* bacteria identified in 100 milliliter (100 mL) water samples (*Swimming* n.d.). The geometric mean represents the central tendency of a dataset. Since bacterial concentrations can be highly variable, the geometric mean is useful for assessing trends in water quality and is more representative of overall fecal pollution in streams.

There are two parts to the Water Quality Standard:
Part 1: Annual Geometric Value (GMV) <100 *E. coli* per 100 mL
Part 2: Not more than 10% of all samples collected for calculating geomean >320 *E. coli*/100 mL

Watershed Prioritization:

Watershed prioritization is carried out annually by SWQ staff to determine the next water year's monitoring sample sites. The first step in prioritizing watersheds for annual monitoring will be identifying all waterbodies with demonstrated water quality impairments. Water quality data from the previous two water years will be used to rank these watersheds, and they will then be assessed and further ranked based upon risk and value (contain important or sensitive resources) attributes. Sample sites for WY18-20 will be sampled on a three-year rotation cycle and chosen based on the following criteria:

- Monitoring data from SWQMP showing that the water body does not meet the Washington State Primary Contact Standard for *E. coli*
- Areas listed as conditionally approved or restricted for commercial shellfish harvest by the Washington State Department of Health (WADOH) and/or the Island County Public Health
- An ongoing or intermittent health advisory issued by WADOH or Island County Public Health for recreational shellfish harvest or swimming restriction
- Island County PIC program focus

These prioritized watersheds are then assigned water quality points based upon data pertaining to the following:

4 points: Stream fails Part 1 of Primary Contact Standard for *E. coli* during previous two water years.

3 points: Stream fails Part 1 of Primary Contact Standard for *E. coli* during previous two dry seasons (Apr-Sept).

2 points for each of the following:

- Stream fails Part 1 of Primary Contact Standard for *E. coli* during a storm event (>/=0.25 in.) during the previous two water years.
- Stream fails Part 1 of Primary Contact Standard for *E. coli* during previous two wet seasons (Oct-Mar).

1 point for each of the following:

- Stream fails Part 2 of the Primary Contact Standard for *E. coli* during the previous two water years.
- Stream fails Part 2 of the Primary Contact Standard for *E. coli* during the previous two wet seasons.
- Stream fails Part 2 of the Primary Contact Standard for *E. coli* during the previous two dry seasons.

Once water quality points are assigned to each site, special circumstances and other ranking considerations may be applied. Each special circumstance applicable will receive an additional point towards the ranking. These circumstances may include, but are not limited to:

- WADOH Shellfish Classification Impairment
  - Downgraded by WADOH
  - "Threatened" list
  - DOH initial "prohibited" classification
  - "Unclassified" based on WADOH shoreline survey data
- Health Advisory posting
- Total Maximum Daily Load (TMDL) Study (303d or 4B listed site)
- Onsite sewage system failures or violations

Note that this may require coordination with other departments or partners to obtain or evaluate data outside the scope of the SWQMP. The resulting ranked list of sites may be used as a tool for updating the

Monitoring Plan annually (coinciding with the water year), including budget availability. If there are more priority sites than the program has capacity for, the higher priority sites may be selected for sampling in the current water year, and the remaining sites may be addressed as funding becomes available.

Also of importance to watershed prioritization listings are forage fish survey maps (See Figure 2). These areas are often found at the pour points of watersheds and are of critical importance to salmon restoration efforts. Attention will be given to report their contributions to salmon recovery and form connections between their health and possible sources of pollution found during Source ID and PIC investigations.

Figure 2. Island County Watersheds and Forage Fish Spawning Data

RESULTS

Table 3. shows both the annual *E. coli* geomeans (MPN/100 mL) for WY15 and WY16 for core and rotational sampling sites. Seasonal (three-month) geomeans based on two years of *E. coli* data are used to show trends within the water year. Several sample site locations had acceptable annual geomeans but had higher seasonal geomeans that caused them to fail Part 1 of the Water Quality Standard. Other sites showed exceedances of 320 MPN/100 mL for more than 10% of the samples, causing them to fail Part 2 of the Standard.

Seasonal geomeans showed definite trends during certain times of the year, and these trends will be discussed for each specific site's data. Only two sites had noticeable improvements in annual geomeans with a drop in the levels of *E. coli*. While two sites showed a slight increase, the majority of the other eleven sites showed an annual geomean increase of 100% or more. These sites were bracketed for Source ID and referred to the Adaptive Management Action Team (AMAT). The results for these sites and their Source ID investigations will be discussed further in subsequent sections of this report.

Table 3. Annual and Seasonal *E. coli* Geomeans for Island County Sampling Sites

Site Name	Site#	WY15 GEOMEAN	WY16 GEOMEAN	Oct - Dec Geomean	Jan - Mar Geomean	Apr - Jun Geomean	July - Sep Geomean
South Camano	108a	NA	6	6	5	10	5*
Freeland	134a	NA	19	5*	10*	55	5*
North Crescent	13a	384	57	80	113	154	119*
Glendale	149a	35	88	99	13	63	96
Scatchet Head	157a	41	99	20	21	70	235
Nichols	159a	NA	180	132*	378*	319	10*
Rocky at Brokaw	44a	NA	33	57	20	39	21
Carp Creek	55a	17	28	26	11	51	27
Ebeys	58a	43	77	39	11	123	253
Chapman	69a	25	49	42	12	39	79
Cavalero	74a	26	40	20	11	35	86
Crosscreek	83a	NA	18	5	5	29	68
Hhab	Hhab	177	121	*	55	183	377
Kristoferson Creek	KC1	14	37	5	10	68	304
Maxwelton	MWA2	36	86	23	14	47	307
*Low samples							

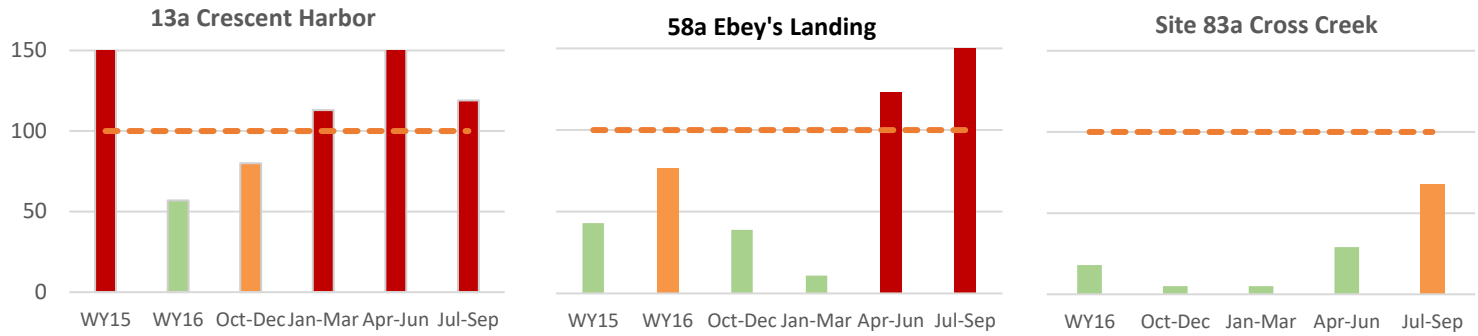


Figure 3. North Whidbey Island Annual vs Seasonal Geomeans MPN/100 mL
Green bars represent meeting the standard, orange bars represent approaching the state threshold, and red bars represent failing.

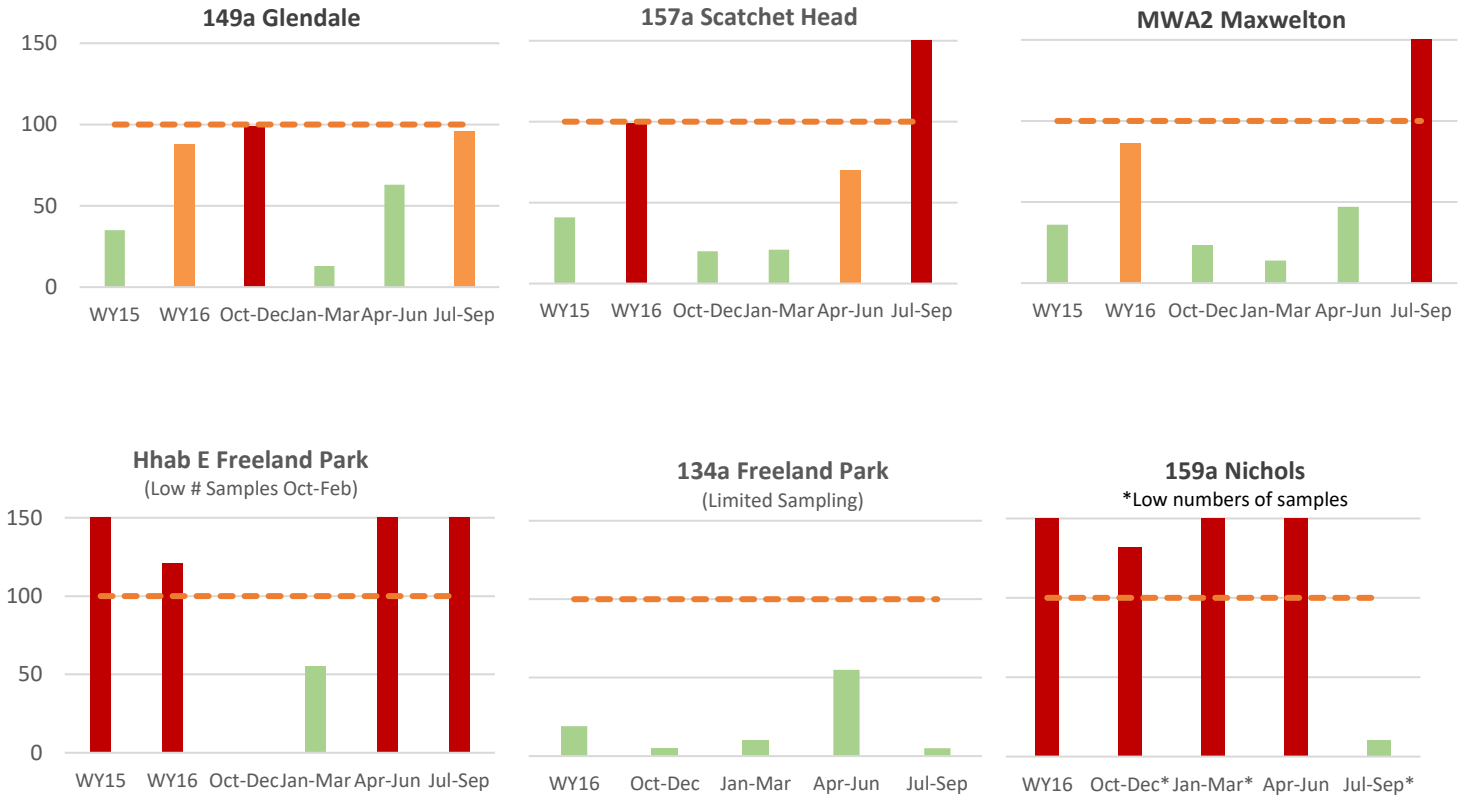


Figure 4. South Whidbey Island Annual vs Seasonal Geomeans (MPN/100 mL)
Green bars represent meeting the standard, orange bars represent approaching the state threshold, and red bars represent failing.

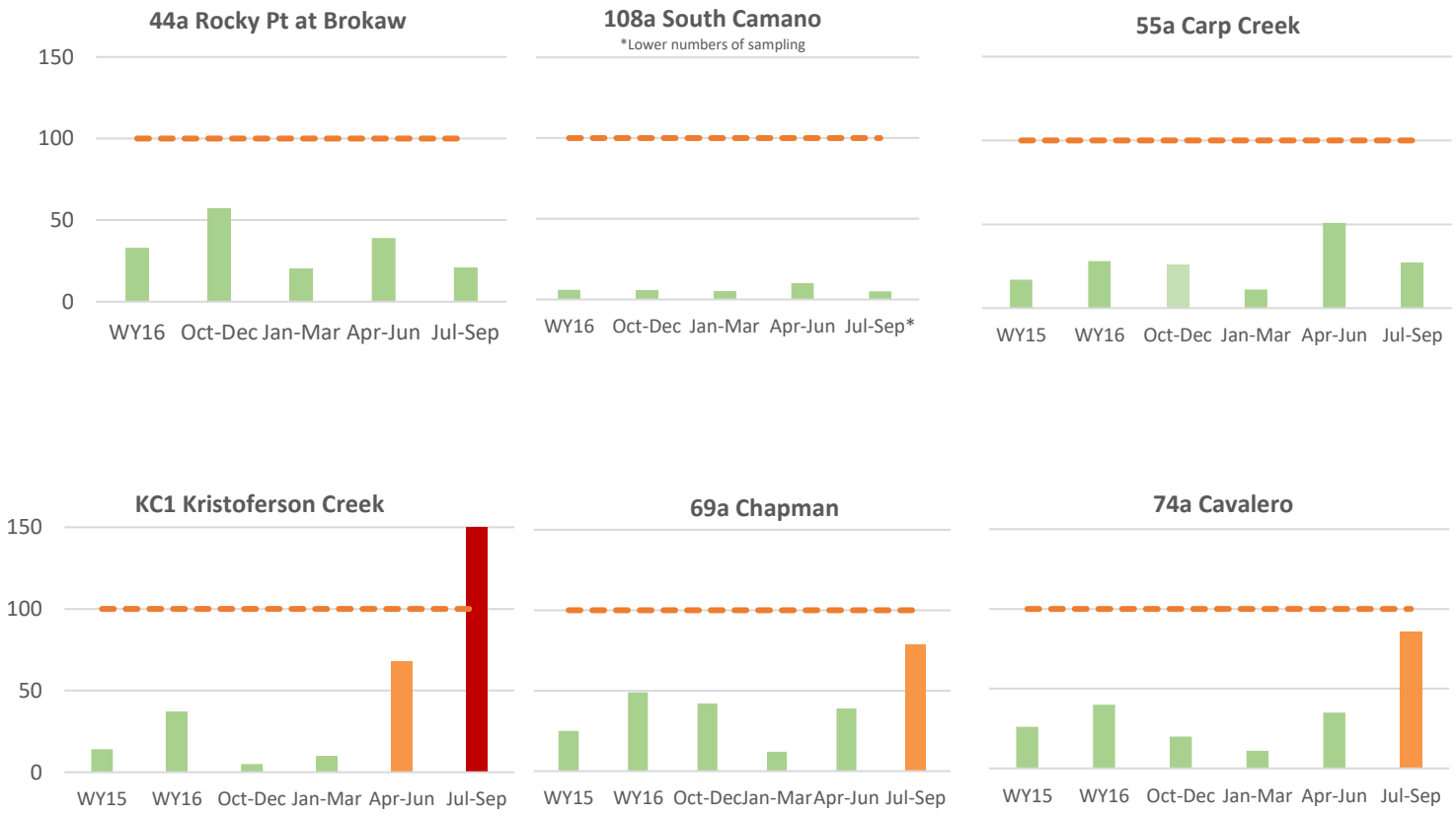


Figure 5. Camano Island Annual vs Seasonal Geomeans (MPN/100 mL)
Green bars represent meeting the standard, orange bars represent approaching the state threshold, and red bars represent failing.

Table 4 details how Island County streams were evaluated based on whether they met all or part of the Washington State Water Quality Standard. Streams received either a "Met" or "Failed" status for the standard and were categorized as follows:

- Met standard: Stream had low bacteria levels and met both parts of the standard.
- Met one part of standard: The stream had either periodic high bacteria levels or had a geomean above 100.
- Failed standard: Stream had high bacteria levels and failed both parts of the standard.

Seven of the fifteen of Island County's streams sampled in WY16 met the Washington State Water Quality standard. Four streams met one part of the standard, while four streams failed both parts of the standard and were categorized as failing. Failing streams were investigated and referred to Source ID and AMAT.

Table 4. Water Quality Status of Island County Streams

Sample Site	Part 1 (Failed if GM during 90-day averaging period >100)	Part 2 (Failed if >10% of samples above 320)	Water Quality Status
13a Crescent Creek	Failed	0%*	
58a Ebey's Reserve	Failed	37%	
83a Cross Creek	Met Standard	6%	
149a – Glendale	Failed	19%	
157a – Scatchet	Failed	5%	
MWA2 – French Road	Failed	33%	
Hhab – E Freeland Park	Failed	6%*	
134a – Freeland Park	Met Standard	8%*	
159a Nichols	Failed	13%	
55a Carp Creek	Met	0%	
69a Chapman Creek	Met Standard	0%	
74a Cavalero Creek	Met Standard	0%	
KC1- Kristoferson Creek	Failed	0%*	
44a Brokaw at Rocky Point	Met Standard	8%	
108a South Camano	Met Standard	0%*	
*Low numbers of samples			

The following sections illustrate the results from data analysis of water quality parameters monitored at all the core and rotational sample sites for WY16. The fifteen monitored sites are organized by geographic area: North Whidbey (Figure 6), South Whidbey (Figure 7), and Camano Island (Figure 8).

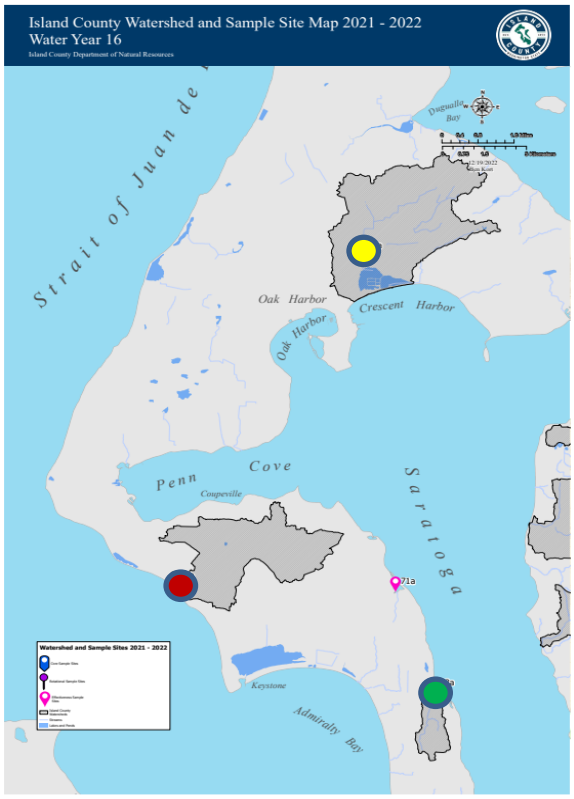
North Whidbey Area Results

Table 5 summarizes the North Whidbey monitoring results for *E. coli*. Subsequent pages provide greater detail for each site within the North Whidbey area, including a brief description of the monitoring site.

Table 5. North Whidbey Results

Site	WY15 GEOMEAN	WY16 GEOMEAN	Oct - Dec Geomean	Jan - Mar Geomean	Apr - Jun Geomean	July - Sep Geomean
13a Crescent Creek	384	57	80	113	154	119*
58a Ebey's Landing	43	77	39	11	123	253
83a Cross Creek (North Bluff)	NA	18	5	5	29	68

Figure 6 shows the location of North Whidbey samples sites and their water quality status. Of the three streams in North Whidbey, only one had acceptable levels for low geomeans for *E. coli* and met the state standard, while the other two failed either one part or both parts of the Water Quality Standard. The higher hits trended towards spring and summer months, with geomeans of 150% or higher than the state threshold value of 100 MPN/100 mL.



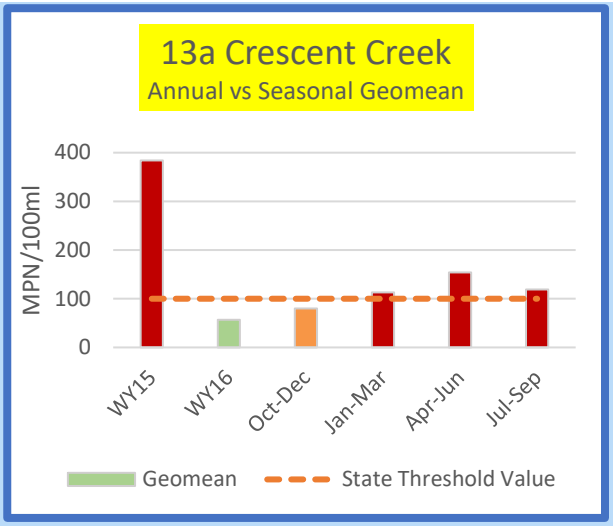
- Met standard: Stream had low bacteria levels and met both parts of the standard.
- Met one part of standard: The stream had either periodic high bacteria levels or had a geomean above 100.
- Failed standard: Stream had high bacteria levels and failed both parts of the standard.

Figure 6. North Whidbey Water Quality Status

13a – Crescent Creek (North Crescent Bay)

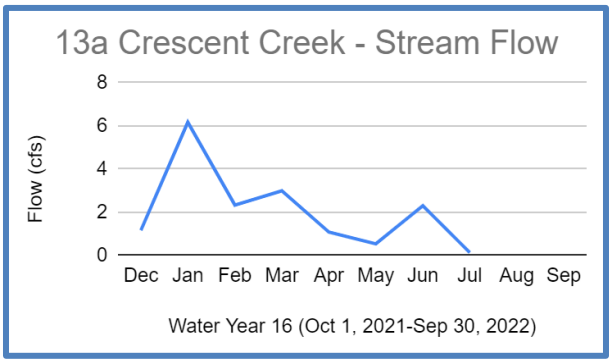
Water quality was Moderate based on data collected in WY16.

- The annual geomean was 57 MPN/100 mL, but the seasonal geomeans frequently exceeded state standards of 100 MPN/100 mL. The percentage of samples that exceeded the state limit of 320 MPN/100 mL was 0%
- Failed Part 1 of the Water Quality standard
- This stream ran 83% of the year or 10 out of 12 months and 81% of the samples could be taken (13 samples out of 16 possible). During the months of August and September samples were unable to be taken due to water stagnation.



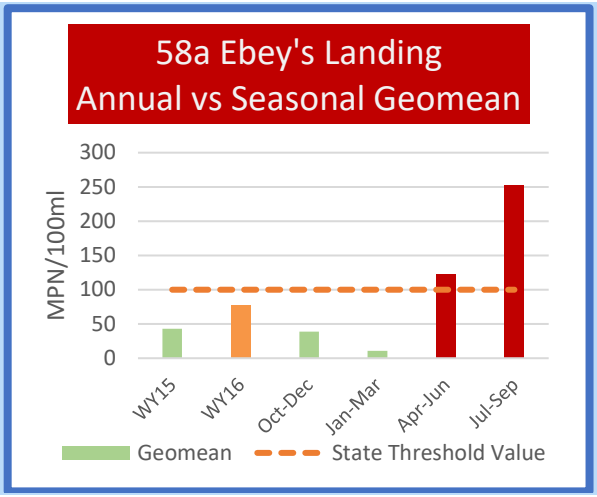
Samples taken for the North Crescent Bay site are pulled upstream from the main channel that flows under Crescent Harbor Road, west of the intersection with Hunt Road about a half-a-mile east of Torpedo Road. The area immediately upstream from the sampling site is zoned for rural commercial agricultural use. During February of this year the SWQ team was very lucky to have the opportunity to tour the Navy's newly completed salmon stream restoration site which is downstream of the sample location. Proposals have been submitted for habitat restoration in this area and salmon restoration projects near the sample site are ongoing.

This site was able to be consistently sampled until August and September when it became stagnated. Water quality has improved since WY15 but still shows seasonal high hits. During the last two years in winter, spring, and summer months (January through September) *E. coli* levels exceeded the state standard for geomeans.



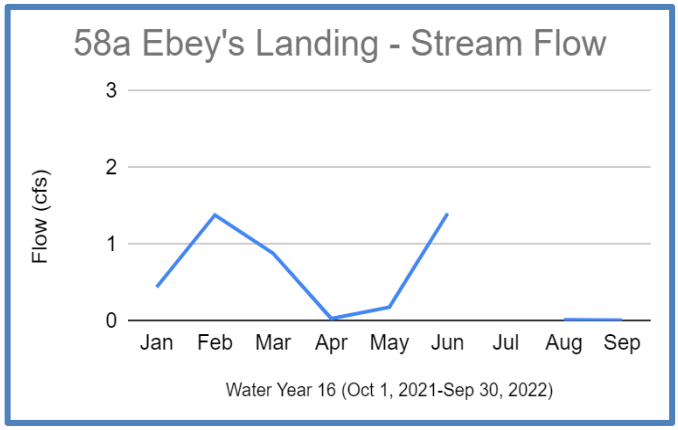
58a – Ebey's Landing

- Water quality was Poor based on data collected in WY16.
- The geomean was 77 MPN/100 mL, but seasonal geomeans exceeded state standards of 100 MPN/100 mL during the months of April through September. The percentage of samples that exceeded the state limit of 320 MPN/100 mL was 37%.
- Failed Part 1 and Part 2 of Water Quality Standard
- This stream ran 92% of the year or 11 out of 12 months and 95% of the samples were able to be taken (18 out of 19). One month was missed due to tidal inundation in the month of December.



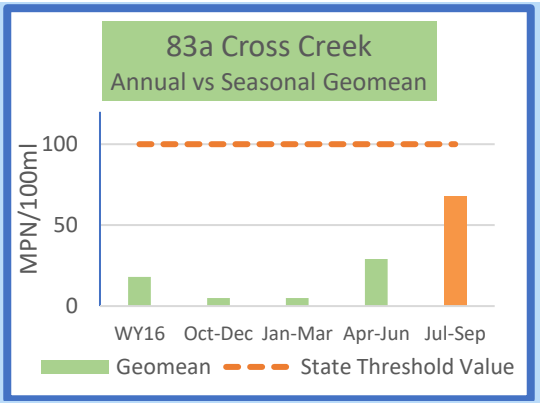
Surface waters are captured in roadside catch basins and field drain tiles then piped, subsurface, across agricultural fields before daylighting in a ravine where it forms a stream channel that outfalls on Ebey's Landing beach. The area immediately upstream of the sampling location is zoned for commercial agriculture and is currently being used for agriculture.

This location was able to be consistently sampled except for December 2021 when there was tidal inundation making the site unsampleable. Higher salinity levels were also measured at this site which could be due to upstream sources or tidal influence. Due to multiple high hits, bracket Source ID was conducted upstream at culverts along and near the conservation easement. Water quality based on levels of *E. coli* levels has worsened since WY15. The seasonal geomeans are based on two years of data and show distinct trends of high hits during the spring and summer months. Historically this site has shown high levels of fecal coliform during these months. Currently, the Adaptive Management Team is working with the Whidbey Island Conservation District (WICD) to help understand best management practices for property owners of agricultural lands.



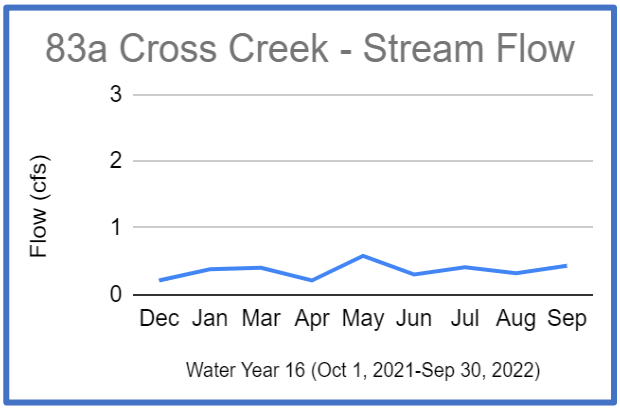
83a Cross Creek (North Bluff)

- Water quality was Good based on data collected in WY16.
- The annual geomean was 18 MPN/100 mL and seasonal geomeans did not exceed state standards. The percentage of samples that exceeded the state limit of 320 MPN/100 mL was 6%.
- Met Part 1 and Part 2 of Water Quality Standard
- This stream flowed all 12 months of the year and 100% of the samples were able to be taken (16 of 16 samples)



This rotational sampling site is a stream on North Bluff Road, known as Cross Creek. The area immediately upstream from the sampling site is zoned as rural residential land. Cross Creek is considered a natural fish bearing stream that drains into the area south of Saratoga Pass.

Historical notes say this was a potential salmon stream with year-round flow. This year showed a high hit of 935 in June 2022 which led to implementation of a Source ID investigation. Seasonal geomeans show a trend towards higher numbers in the summer months July to September. Results were higher but did not exceed the state threshold of 100 MPN/100 mL. There has been recent development in the area upstream and although the site is not on the rotation schedule for WY17, it may be added to Reconnaissance monitoring to document possible changes in water quality. Further sampling may lead to a future Source ID investigation.

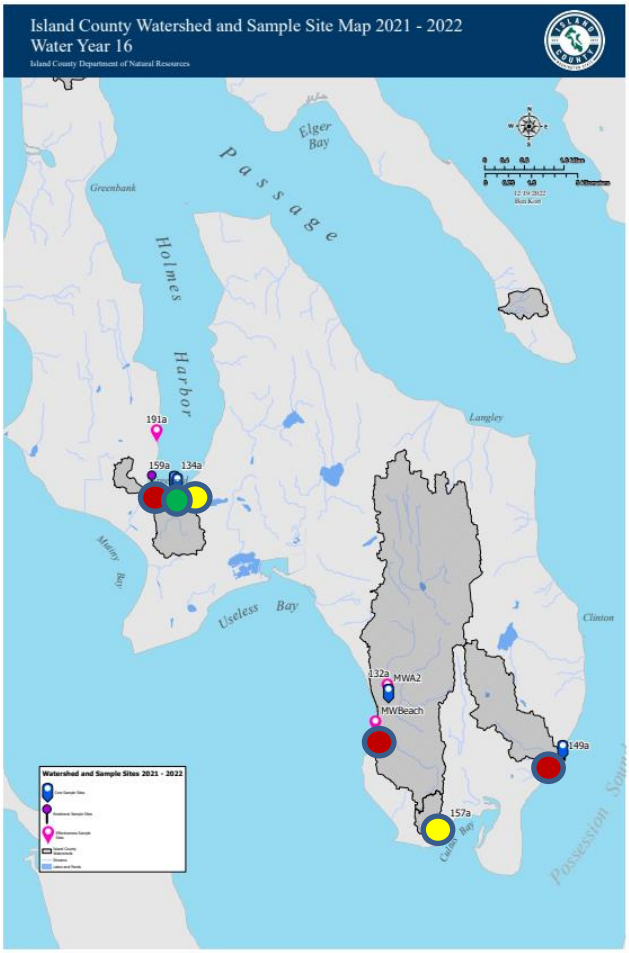


South Whidbey Area Results

Table 6 summarizes the South Whidbey monitoring area results. Subsequent pages provide greater detail for each site within the South Whidbey area including a brief description of the monitoring site.

Table 6. South Whidbey Results *E. Coli* Geomeans

Site	WY15 GEOMEAN	WY16 GEOMEAN	Oct - Dec Geomean	Jan - Mar Geomean	Apr - Jun Geomean	July - Sep Geomean
149a Glendale Creek	35	88	99	13	63	96
157a Scatchet Head	41	99	20	21	70	235
MWA2 Maxwelton Creek	36	86	23	14	47	307
Hhab E Freeland Park	177	121	*	55	183	377
134a Freeland Park	NA	19	5*	10*	55	5*
159a Nichols	NA	180	132*	378*	319	10*

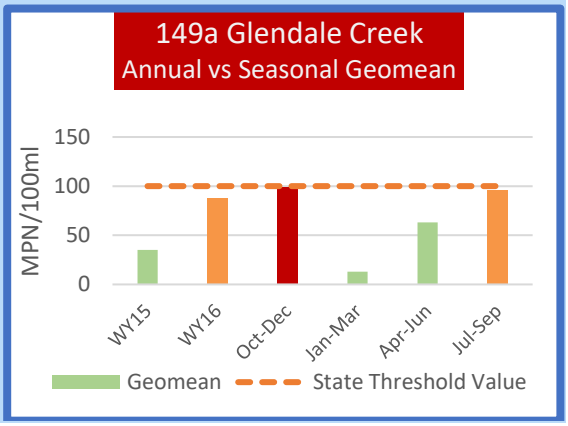


- Met standard: Stream had low bacteria levels and met both parts of the standard.
- Met one part of standard: The stream had either periodic high bacteria levels or had a geomean above 100.
- Failed standard: Stream had high bacteria levels and failed both parts of the standard.

Figure 7. South Whidbey Water Quality Status

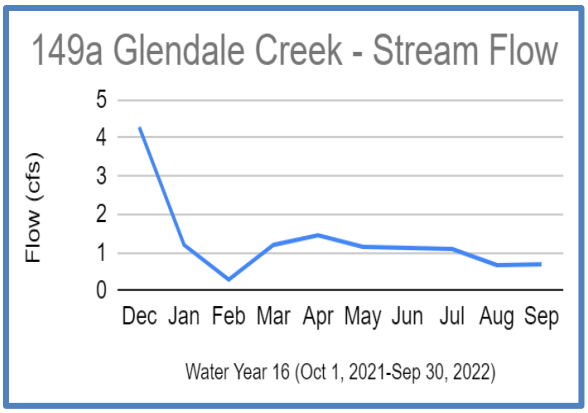
149a – Glendale Creek

- Water quality was Poor based on data collected in WY16.
- The geomean was 88 MPN/100 mL which is not over state limits but seasonal geomeans exceeded state standards during the months of October through December. The percentage of samples that exceeded the state limit of 320 MPN/100 mL was 19%.
- Failed Part 1 and Part 2 of the Water Quality Standard
- This stream flowed all 12 months of the year and 100% of the samples were able to be taken, (21 of 21 samples)



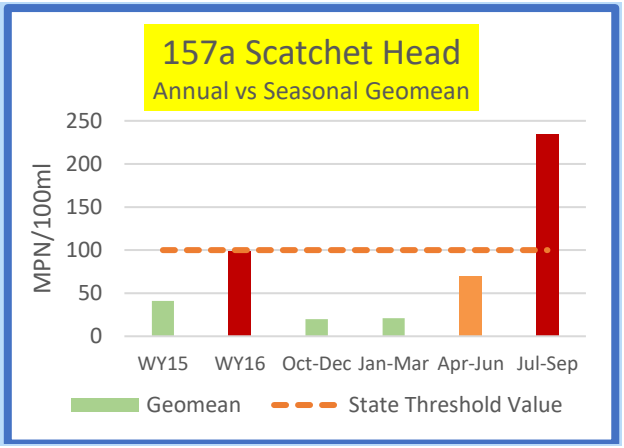
The sample location for Glendale Creek is located above the second driveway crossing up from Humphrey Road. This is a historical salmon bearing stream that is immediately bordered by roads and houses at the pour point. The area immediately upstream of the sampling location is zoned rural designated for rural land use.

The Surface Water Quality Team was able to consistently sample at this site and 90-day geomean exceedances and a series of high hits at this location lead to repeated testing and bracketing above and below the culvert. Reports received of a stream contamination concern was followed up on by both environmental health and planning. In these areas with fewer buffers, the stream is more susceptible to pollution and thus residential and roadway practices likely have a more direct impact on the stream's water quality. Annual geomeans show a trend towards reduced water quality since WY15. The seasonal geomeans are based on two years of data and show a trend towards higher hits during the fall and winter months with levels at the state threshold value.



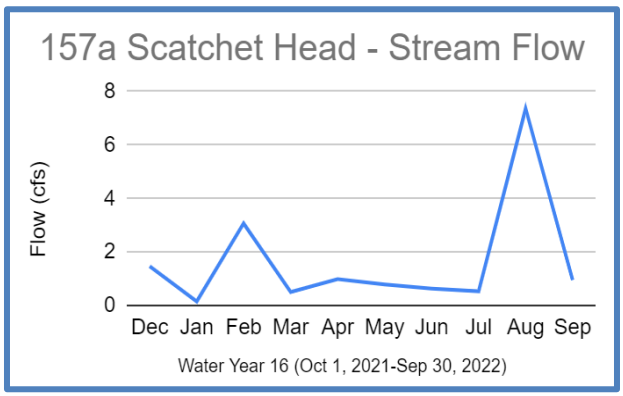
157a – Scatchet Head

- Water quality was Moderate based on data collected in WY16.
- The annual geomean was 99 MPN/100 mL which is just under the state limit but seasonal geomeans considerably exceeded state standards during the months of July through September. The percentage of samples that exceeded the state limit of 320 MPN/100 mL was 5%.
- Failed Part 1 of the Water Quality Standard.
- This stream flowed all 12 months and 100% (18 out of 18) samples were able to be taken.



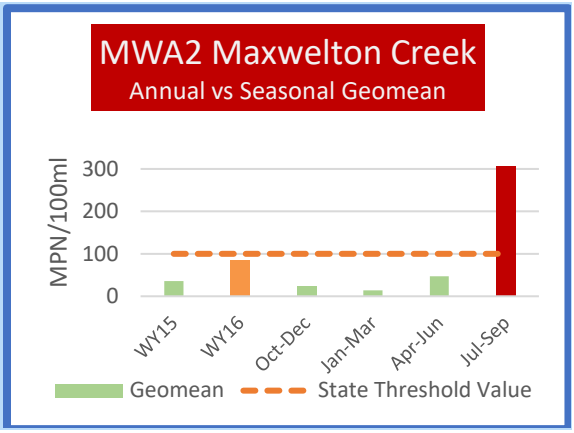
This site location is a stream that runs through the Scatchet Head Community Park. It then enters a culvert under Driftwood Road before draining into Puget Sound. The area immediately upstream of the sampling location is zoned rural and its designated use is rural land.

This site has a history of septic challenges related to pumping of effluent to different parcels. In the past dye tests have been performed in the community to identify possible sources of pollution through the PIC program. The current site of 157a has formerly tested high for fecal coliform and there is a history of bracketing at sites upstream. A high 90-day geomean in June and July at the normal sampling site led to bracketing at site 157b. In September further bracketing was conducted at sites 157b as well as 157c due to follow-up results of over 3000 MPN/mL. The AMAT was notified, and plans were made to collaborate with Environmental Health and the On-Site Septic Team to send letters out to the property owners of parcels connected to the multi-drain field site. Water quality has decreased since WY15 and seasonal geomeans based on two years of data show a distinct trend of higher hits during the summer months.



MWA2 – Maxwelton Creek (French Road)

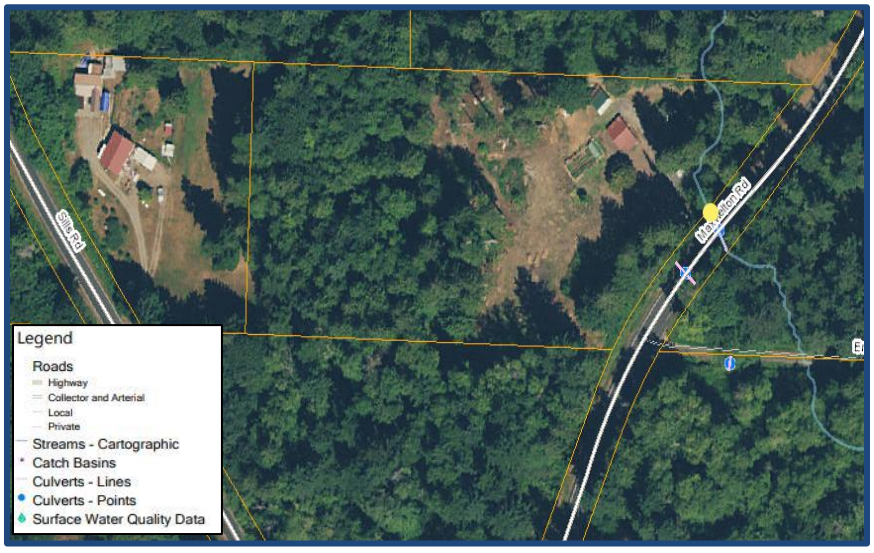
- Water quality was Poor based on data collected in WY16.
- The geomean was 86 MPN/100 mL which is not over state limit but seasonal geomeans exceeded state standards during the months of July through September. The percentage of samples that exceeded the state limit of 320 MPN/100 mL was 33%.
- Failed Part 1 and Part 2 of Water Quality Standard
- This stream flowed all 12 months of the year and 100% of the samples were able to be taken (18 of 18)

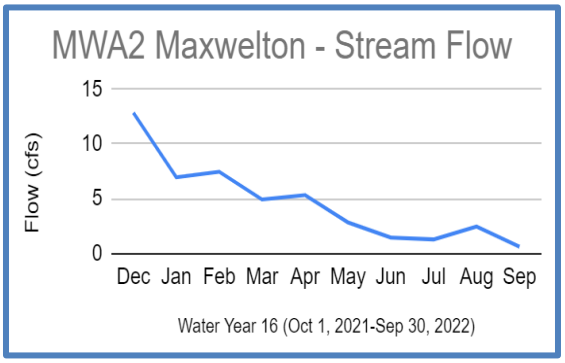


This sampling location is on the north side of French Road on Maxwelton Creek. This site has extensive riparian vegetation cover and year-round flow. The area immediately upstream of the sampling location is zoned rural and designated to be rural lands. Water quality has decreased since WY15. The seasonal geomeans are based on two years of data and show a distinct trend towards higher hits during the summer and fall months.

Surface Water Quality Team have been able to consistently sample at this site. Repeated high hits that exceeded standards at this site instigated bracketing upstream to sites 132a, QCA, and MWBeach. Review of bracketing reports led to the search being narrowed down to six possible parcels that were the most probable source of pollution. Working collaboratively with the AMAT led to discussions with OSS enforcement who were asked to look at the six parcels closest to MWA2 for septic compliance and send out letters to those property owners.

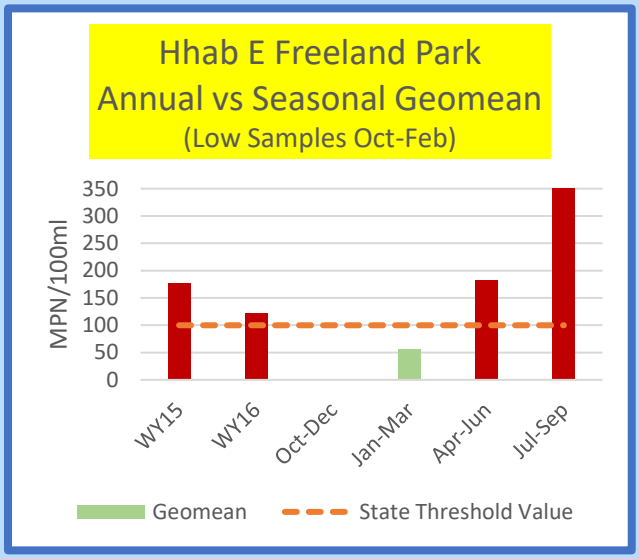
The Maxwelton watershed area is an important location for shellfish projects incorporating PIC and is a prime opportunity for education and outreach to local property owners. The site currently pours out to a commercial shell fishing prohibited zone; hence in the past it has been a targeted area of the PIC program and continues to be of interest to the Department of Health shellfish program. The SWQ team have also reached out to Whidbey Watershed group to collaborate on education and outreach with local schools and community groups to encourage responsible stewardship of the watershed.





Hhab – East Freeland Park

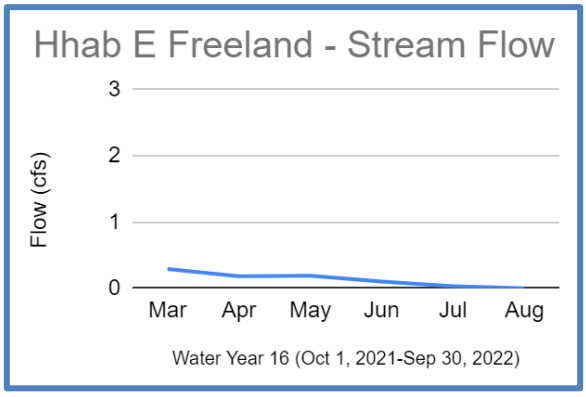
- Water quality was Moderate based on data collected in WY16.
- The annual geomean was 121 MPN/100 mL and seasonal geomeans also exceeded state standards of 100 MPN/100 mL during the months of April through September. The percentage of samples that exceeded the state limit of 320 MPN/100 mL was 6%.
- Failed Part 1 of Water Quality Standard
- This stream flowed 8 out of 12 months of the year and was sampled intermittently 56% of the year with 9 of 16 samples being taken. In July and August the water was stagnated and towards the end of September samples were unable to taken due to tidal inundation. No samples were taken from October 2021 through January 2022 due to tides.



This sampling location is in a tidally influenced stream near the parking lot of Freeland Park. The area immediately upstream from the sampling site is zoned for rural residential and designated to be an urban area.

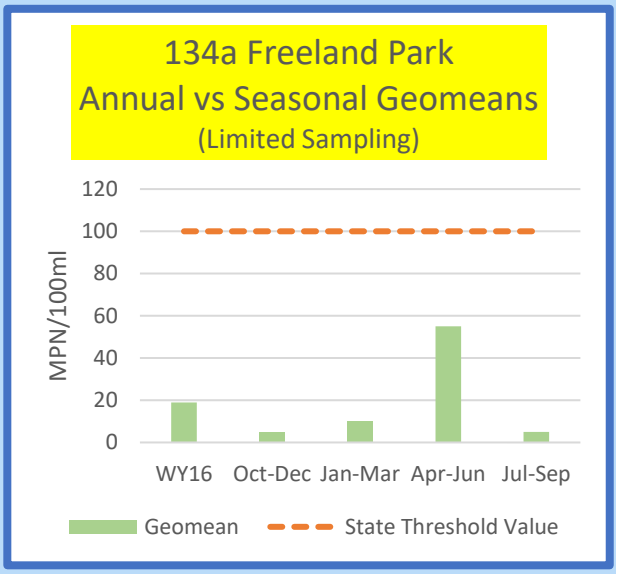
The sampling at this site was inconsistent with tidal influence and low flow and that has led to upstream bracketing at HHBe1. Hhab has had issues with high salinity and tidal exchange, but most samples fell below the conductivity threshold making them viable samples. Water quality has improved since WY15, but seasonal geomeans show a distinct trend towards higher hits during the spring and fall months.

This area is also the focus of the Swim Beach sampling reported to ECY. In the 2021 swim beach report it was reported that "Freeland County Park beach had a permanent swimming advisory from June 1 through September 15, due to sporadic high bacteria levels during the months that beach wrack accumulates on the beach. This beach was sampled 15 times in 2021. On May 8 and June 29, Freeland County Park had bacteria results that exceeded the safe swimming standard. Signs were already posted at the beach warning the public, since these events took place during the permanent advisory."



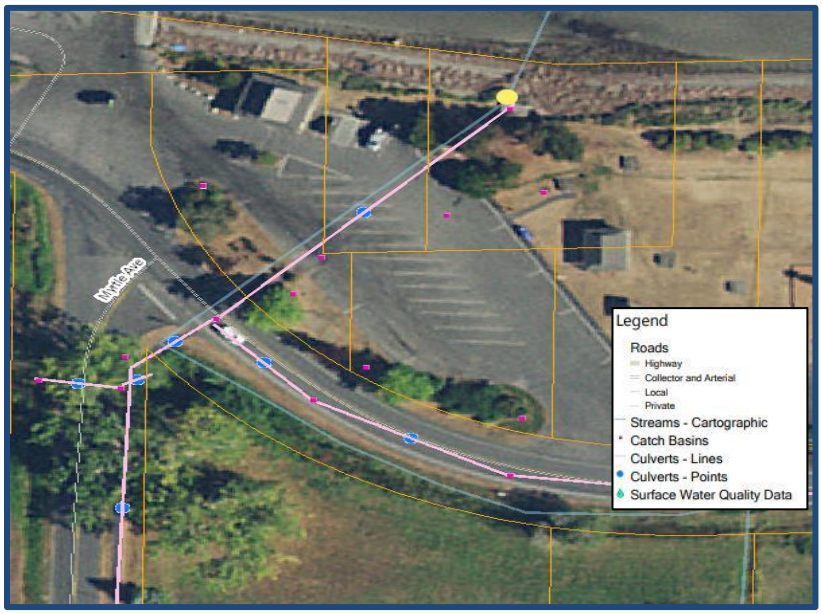
134a Freeland Park

- Water quality was Good based on data collected in WY16, but results could be considered inconclusive due to limited sampling in the fall and winter months.
- Limiting sampling produced an annual geomean of 19 MPN/100 mL which is under the state limit and the seasonal geomeans did not exceed state standards of 100 MPN/100 mL. The percentage of samples that exceeded the state limit 320 MPN/100 mL was 8%.
- Conditionally Met Part 1 and Part 2 of Water Quality Standard but this is based on limited sampling.
- This stream flowed 5 out of 12 months of the year and was sampled intermittently 46% of the year with 6 out of 13 samples being taken. This stream was not sampled from October 2021 to February 2022 due to high tides and ran dry in August. Flow was extremely low in September



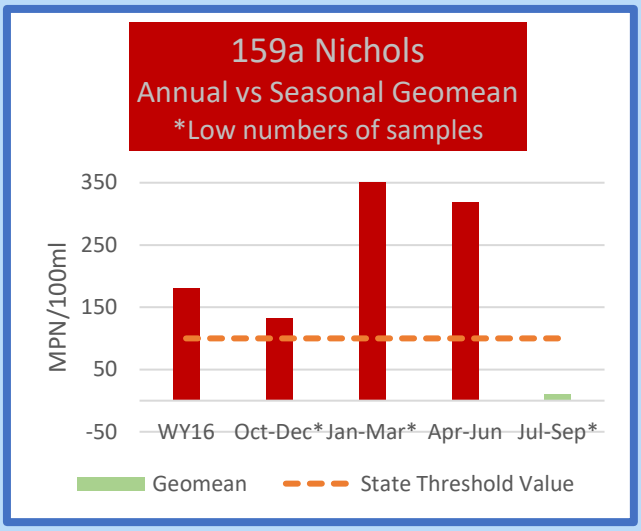
This sampling site is at the stormwater outfall in Freeland Park. The area immediately upstream from the sampling site is zoned for rural residential and designated to be an urban area. The site is located near a beach and swim site called Freeland County Park which is placed under a swimming advisory due to high *Enterococcus* levels from Memorial Day to Labor Day.

Water flowed most during wet season storm events and slowed down significantly in the dry season. Data for this location may not have been representative of ambient water quality due to the inability to collect samples year-round. The stream had issues with tidal influence, salinity and intermittent flow; due to these issues results and results were based on six months of sampling. The seasonal geomeans are based on two years of data and show a distinct trend towards higher hits during the spring months. Low flow and tidal inundation meant that streamflow could not be calculated for the majority of months.



159a – Nichols

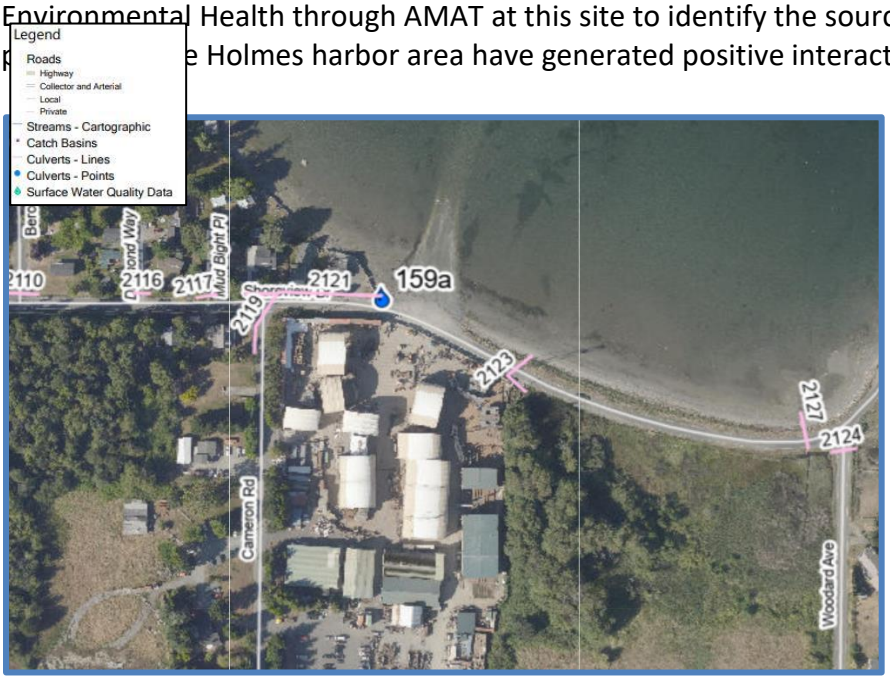
- Water quality was Poor based on data collected in WY16.
- The geomean was 180 MPN/100 mL which is over state limit and seasonal geomeans also exceeded state standards of 100 MPN/100 mL during the months of January through June and October through December. The percentage of samples that exceeded the state limit 320 MPN/100 mL was 13%.
- Failed Part 1 and Part 2 of Water Quality Standard.
- 7 out of 12 months this stream was flowing. Only 50% of the samples were able to be taken, (7 of 14 samples). From July through September 2022 this site ran dry, also no sample was taken October and December of 2021 and January 2022



This monitoring location is at the outfall of a catchment basin on the Holmes Harbor side of Shoreview Road.

Due to low flow, the surface water quality (SWQ) team was only able to collect samples 7 months out of the year. Samples were not collected in June, July, August, and September. The seasonal geomeans show higher hits throughout the year. Low flow and tidal inundation meant that streamflow could not be calculated for the majority of months.

In prior water years, the SWQ team partnered with the IC Environmental Health Department's Onsite Septic Team to conduct dye testing and address septic failures upstream of this site. We continue to work with Environmental Health through AMAT at this site to identify the sources. Letters sent out through the PIC p[illegible]e Holmes harbor area have generated positive interactions from local property owners.

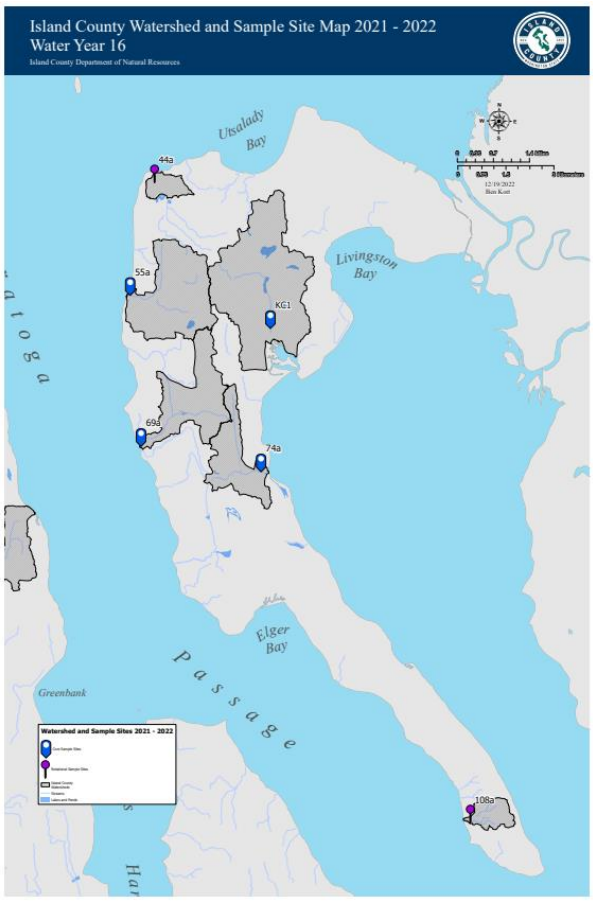


Camano Island Results

Table 7 summarizes the Camano Island monitoring area results. Subsequent pages provide greater detail for each site within the Camano Island monitoring locations and include a brief description of the monitoring site.

Table 7. Camano Island Results

Site	WY15 GEOMEAN	WY16 GEOMEAN	Oct - Dec Geomean	Jan - Mar Geomean	Apr - Jun Geomean	July - Sep Geomean
108a South Camano	NA	**6**	**6**	**5**	**10**	**5***
44a Rocky Pt at Brokaw	NA	**33**	**57**	**20**	**39**	**21**
55a Carp Creek	**17**	**28**	**26**	**11**	**51**	**27**
69a Chapman Creek	**25**	**49**	**42**	**12**	**39**	**79**
74a Cavalero Creek	**26**	**40**	**20**	**11**	**35**	**86**
KC1 Kristoferson Creek at Russell	**14**	**37**	**5**	**10**	**68**	**304**



Met standard: Stream had low bacteria levels and met both parts of the standard.

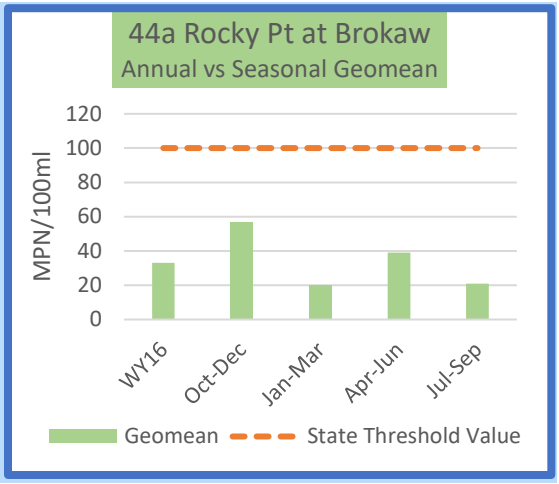
Met one part of standard: The stream had either periodic high bacteria levels or had a geomean above 100.

Failed standard: Stream had high bacteria levels and failed both parts of the standard.

Figure 8. Camano Island Water Quality Status

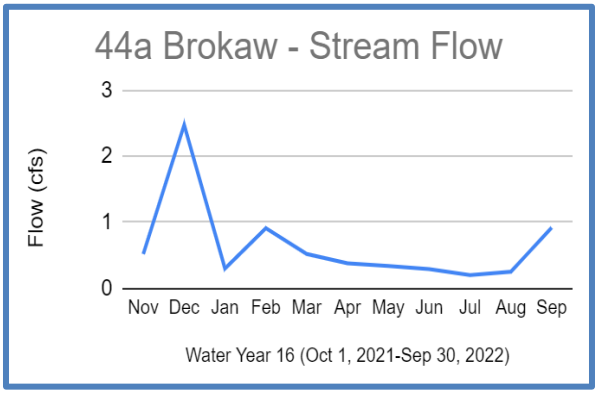
44a –Rocky Point at Brokaw

- Water quality was Good based on data collected in the WY16.
- The annual geomean was 33 MPN/100 mL and seasonal geomeans also did not exceed state standards. The percentage of samples that exceeded the state limit of 320 MPN/100 mL was 8%.
- Met Part 1 and Part 2 of Water Quality Standard
- This stream flowed all 12 months of the year and 100% of the samples were able to be taken meaning that 13 of 13 samples were taken.



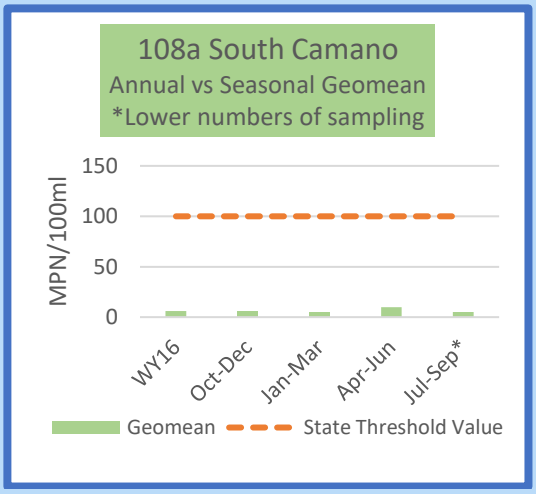
Rocky Point is a rotational sample site for WY 2021-22 and is sampled monthly as part of the routine sampling cycle. Last cycle of sampling was WY 2018-19 for fecal coliform. This site is a perennial stream that has been routed through roadside ditches through the highly developed Rocky Point neighborhood. The outfall of this stream is Maple Grove which is designated a fish bearing stream. This stream consistently flowed all year.

In May the 90-day geomean was above the state threshold value, so the SWQ team bracketed all three sides of the culvert then later bracketed downstream. Results showed that the downstream bracket had higher levels of *E. coli*. The cause of this high hit may be the result of a nearby septic failure. The AMAT was notified and the SWQ team worked with Environmental Health OSS team and property owners as there is an open case near our sample site. After septic repairs are completed and the case is closed, resampling of the site is planned.



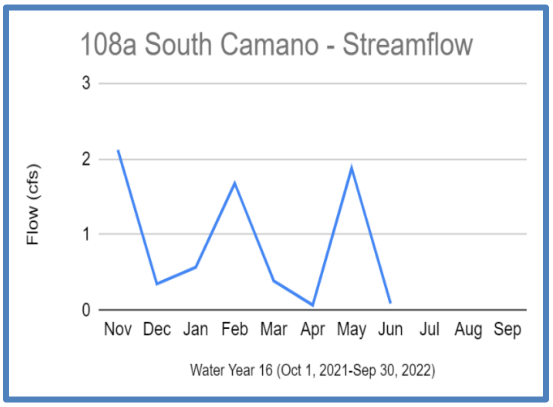
108a –South Camano

- Water quality was Good based on data collected in WY16.
- The annual geomean was 6 MPN/100 mL which is well under state limits and the seasonal geomeans did not exceed state standards. The percentage of samples that exceeded the state limit 320 MPN/100 mL was 0%.
- Met Part 1 and Part 2 of Water Quality Standard.
- This stream flowed 9 out of 12 months of the year and 85% of the samples were able to be taken (11 out of 13 samples). In August this stream was stagnated and became dry in September.



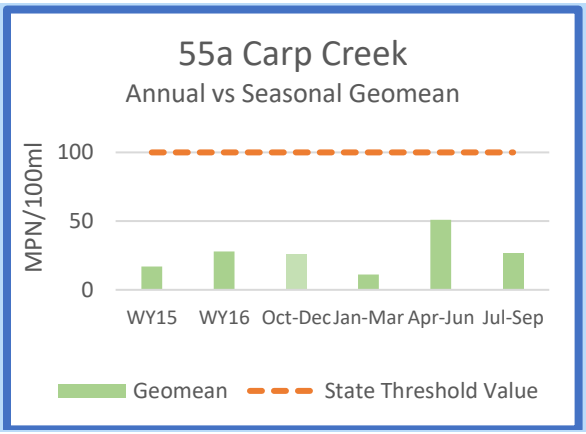
This sampling site was determined to be at the terminus of a small, forested wetland. The sampling site is located less than 500 feet from the wetland feature and represents natural watershed conditions. This seasonal stream is one that drains into the Saratoga Pass, and the area is zoned predominately rural. The stream stagnated in August and became dry in September.

The SWQ team will be doing follow-up sampling in the wet season to add to the available database and complete effectiveness monitoring for this culvert that was recently installed. The site shows low levels of *E. coli*, but annual and seasonal geomeans are limited and only based on one year of data from WY16 with significant data gaps during the summer months. Further sampling will be required to form a more complete picture of geometric mean values.



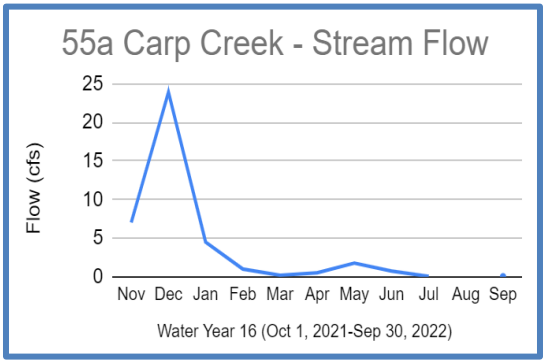
55a – Carp Creek

- Water quality was Good based on data collected in WY16.
- The geomean was 28 MPN/100 mL which is under state limits and seasonal geomeans did not exceed state standards. The percentage of samples that exceeded the state limit of 320 MPN/100 mL was 0%.
- Met Water Quality Standard
- 100% of the samples were taken (14 out of 14 samples) and the stream flowed 12 out of 12 months



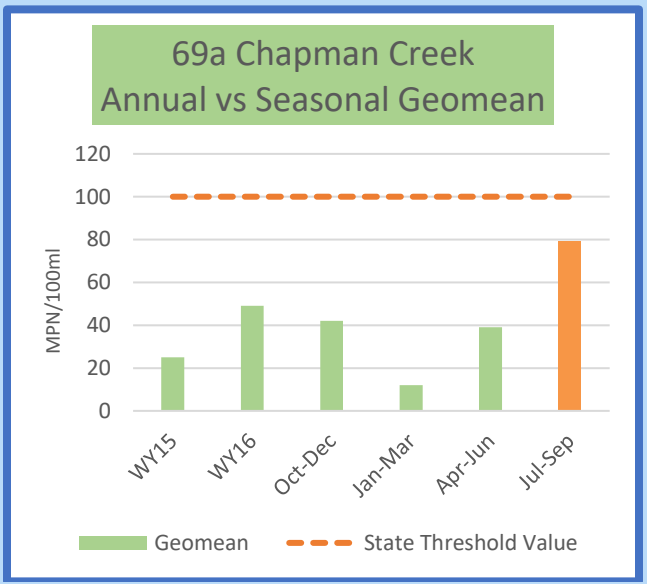
The sampling site for Carp Creek is located at the junction of two streams that flow into ditches near Sunset and Olympic Road. One stream is feed from mostly wetlands and the other is feed from Carp Lake and other wetlands. Carp lake drains through mostly privately owned forested lands to most developed waterfront properties.

This stream flowed consistently throughout the year with lower flows seen in summer and fall months. Higher flows were seen in November and December due to storm events correlated with higher *E. coli* levels. Surface Water Quality Team did not need to bracket this stream this year due to high hits or high geomeans, however, historically this site has had higher hits of fecal coliform all throughout the year. Water quality has decreased slightly since WY15. The seasonal geomeans are based on two years of data.



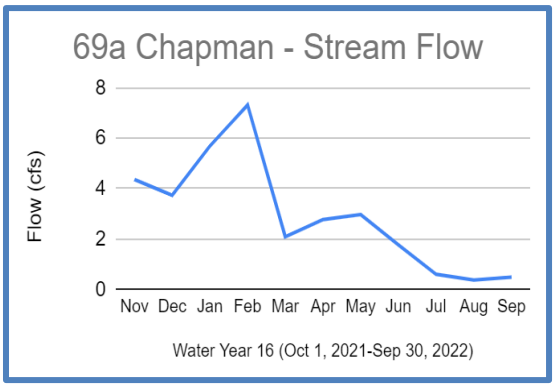
69a – Chapman Creek

- Water quality was Good based on data collected in WY16.
- The annual geomean was 49 MPN/100 mL which is under the state limit of 100 MPN/100 mL and the seasonal geomeans also did not exceed state standards. The percentage of samples that exceeded the state limit was 0%.
- Met Part 1 and Part 2 of Water Quality Standard.
- This stream flowed 12 out of 12 months of the year and 100% of the samples were able to be taken meaning that 15 out of 15 samples were taken.



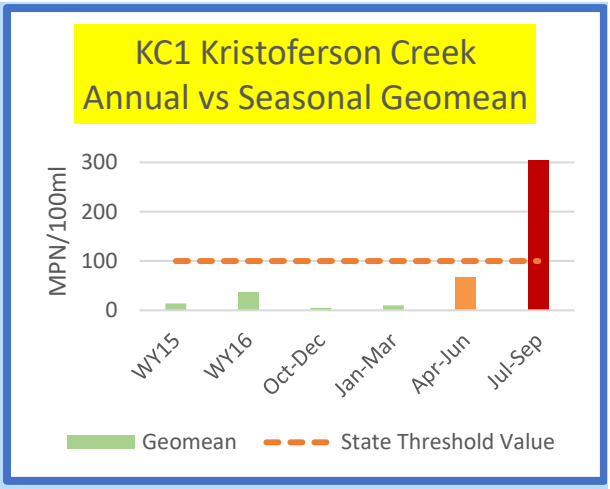
This sampling site is located on the upstream (east) side of Sandy Beach Road, just before the stream flows into Saratoga Passage. The designated land use upstream from the sampling site is zoned for rural residential.

A high hit recorded in August led to bracketing upstream; however, no additional high hits were reported and by September *E. coli* numbers had gone down to below state thresholds. The SWQ team worked with Environmental Health at this site to identify the source of high hits through AMAT. Water Quality geomeans have increased since WY15, however, two years of seasonal geomeans do not exceed the state threshold.



KC1 –Kristoferson Creek (Russell)

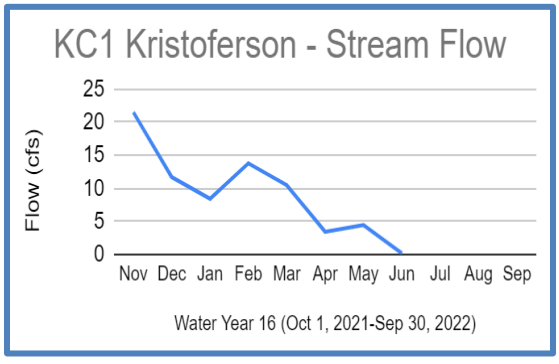
- Water quality was Moderate based on data collected in WY16.
- The annual geomean was 37 MPN/100 mL under the state limits but seasonal geomeans exceeded state standards of 100 MPN/100ml during the months of July through September. The percentage of samples that exceeded the state limit 320 MPN/100 mL was 0%.
- Failed Part 1 of Water Quality Standard.
- This stream flowed 10 out of 12 months and 86% of the samples were able to be taken (12 out of 14 samples). The two samples that were unable to be taken were due to water stagnation during the months of August and September.



This site is on the north side of Russell Road at Kristoferson Creek main stem culvert. It has a long history of restoration and is considered a priority fish-bearing stream. The designated land use upstream from the sampling site is mixed use, zoned rural, and designated for agriculture and light manufacturing.

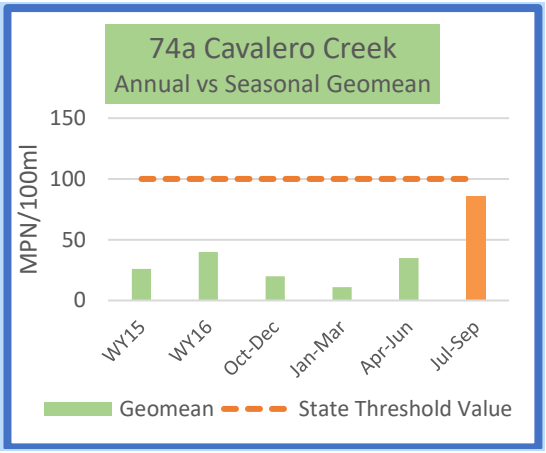
Due to the lack of flow caused by low precipitation and ponding of the water, the SWQ team was unable to collect in August and September. Stream stagnation led to bracketing of reconnaissance sites above and below the restoration area as well as nearby culverts. Ponding also led to planning review of active land use permits, as well as having the critical areas planner, the land use planner, fish and wildlife and department of ecology out for a site visit.

Water quality has decreased since WY15. The seasonal geomeans are based on two years of data and show a distinct trend towards higher hits during the summer months.



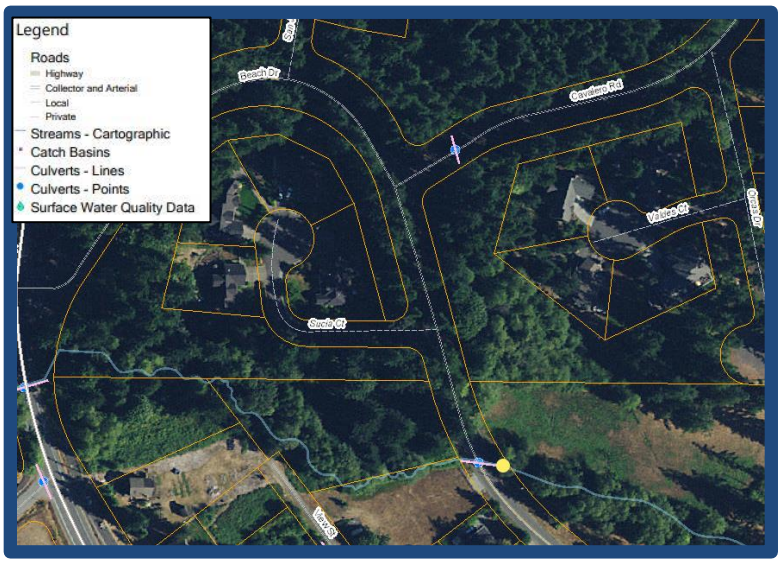
74a – Cavalero Creek

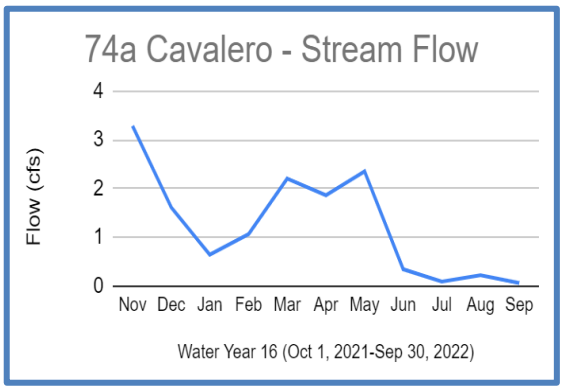
- Water quality was Good based on data collected in the WY16
- The geomean was 40 MPN/100 mL, not over state limits and the seasonal geomeans also did not exceed state standards of 100 MPN/100 mL. The percentage of samples that exceeded the state limit of 320 MPN/100 mL was 0%.
- Met Part 1 and Part 2 of Water Quality Standard.
- 100% of the samples were able to be taken (17 out of 17 samples) and stream flowed all twelve months of the year



This perennial stream begins as a series of ponds then drops into a forested ravine between dense developments with two road crossings before discharging into Port Susan. The area immediately upstream from the sampling site is zoned for rural residential and designated to be an urban area. Water quality has decreased since WY15. The seasonal geomeans are based on two years of data and did not exceed the state threshold.

Site 74a is a fish bearing stream and is one of the newer box culverts installed in the summer of 2021. This stream flowed consistently throughout the year but variations in stream depth during the summer and fall months caused us to move farther upstream to sample. Reports of nearby septic issues led to the formation of a Source ID investigation in collaboration with the OSS team. The sample site showed higher geomeans during the fourth quarter of the water year (July through September) The nearby parcels are also connected to a larger ongoing grant for a tide gate and salmon restoration project.





DISCUSSION

Date Collection and EIM Submission

The primary objectives of Island County's Surface Water Quality Monitoring Program (SWQMP) are to collect reliable surface water quality data, identify areas where water quality standards are being exceeded and identify the sources of those exceedances, and to collaborate with other departments and outside agencies to address the source of exceedances with the Adaptive Management Action Team (AMAT).

Collaboration includes working with the Department of Ecology (ECY) and submitting our data to Environmental Information Management (EIM) database. This involves extensive review and research to eliminate gaps in the data, include weather and tidal conditions, as well as conduct data correction and alignment with EIM standards of submittal. To address these deficiencies in data the Surface Water Quality Team worked with EIM staff, who provided guidance and support with the template. The EIM data uploads also include monthly updates to the newly revamped SQL database. The EIM upload was created in coordination with the Island County IT department to format requests for downloading reports from the SQL database. Draft Standard Operating Procedures (SOPs) for data submission were developed for more effective EIM data transfer. Due to Covid-19 and lack of oversight by ECY staff, there were some gaps in submitted data, but these have been corrected and are in the process of being reviewed by the state. Once completed this will ensure that Island County Surface Water Quality will have a comprehensive data set, and all data will be stored on the EIM website. ECY is developing protocols for the transfer to the national water quality EPA database, WQX. "The Water Quality Exchange (WQX) is the mechanism for data partners to submit water monitoring data to EPA. The Water Quality Portal (WQP) is the mechanism for anyone, including the public, to retrieve water monitoring data from EPA (EPA 2023).

In addition to data collection for core and rotational monitoring, the SWQMP staff performs reconnaissance, source identification, and effectiveness water quality monitoring, and coordinates public outreach activities. The following activities were carried out during WY16.

Reconnaissance Monitoring

Reconnaissance monitoring was intended to explore water quality outside of the regular core watershed sample sites and identify areas with water quality impairments that may need further investigation and check for watersheds that may have been developed. Reconnaissance monitoring occurred at sampling locations selected based on the presence of priority resources and estimation of current pollution risk, identified in the Adamus & Eilers (2006) report. Water quality staff used results to determine whether a site merited the addition to core, rotational, or source identification sample sites. Activities for WY16 included:

- Monitoring conducted in the Penn Cove, South Holmes Harbor, and the Maxwelton Valley region of Whidbey Island, where residential and commercial shellfish harvest and operations were under threat of being closed due to marine water quality impairment identified by the Washington State Department of Health (WADOH). Private and commercial shellfisheries have been identified as a priority resource for Island County.
- Monitoring revealed impairments that were corrected in conjunction with the Island County Onsite Septic (OSS) Program.
- Monitoring will continue in the future in conjunction with the Pollution Identification and Correction (PIC) program, which has applied for new grant funding for 2023 through 2025. The goals of the PIC program are to use water quality data to identify fecal coliform pollution, identify corrective action to be taken with other departments through education, outreach, and other corrective actions deemed

necessary (based on partnering department's procedures) in Maple Grove, South Holmes Harbor, and the Maxwelton Watershed.
- Investigated complaints of onsite septic failures on both Camano and Whidbey Islands in support of Island County's OSS Program, and conducted dye testing as appropriate, and working with AMAT.
- Reconnaissance monitoring in the Race Lagoon area in anticipation of salmon recovery efforts and restoration projects.
- Monitoring of currently unrestricted shellfish areas in the English Boom area of Camano Island.

Source ID

Source identification (Source ID) water quality monitoring was initiated when monitoring trends indicated areas with repeated exceedances of water quality standards that rose above the Statistical Threshold Value (STV) for *E. coli*. Source ID narrowed down possible sources of pollution through:

- Monitoring intensification, which involves increasing the number and locations of monitoring points upstream and downstream from the original sample point until geographic pinpointing of the pollution source(s) is/are achieved; or increasing the frequency and/or timing of monitoring at the original sample point to pinpoint the activity in that location that may be influencing sample results; or Microbial Source tracking using alternative methods such as: chemicals of emerging concern (CECs), optical brightener detection (fluorometer or passive treatment test), caffeine or drugs as a septic tracer, dye testing, etc.
- Identifying impaired waterbodies and working with Island County's onsite septic program and planning departments to pinpoint activity that could be influencing sample results.

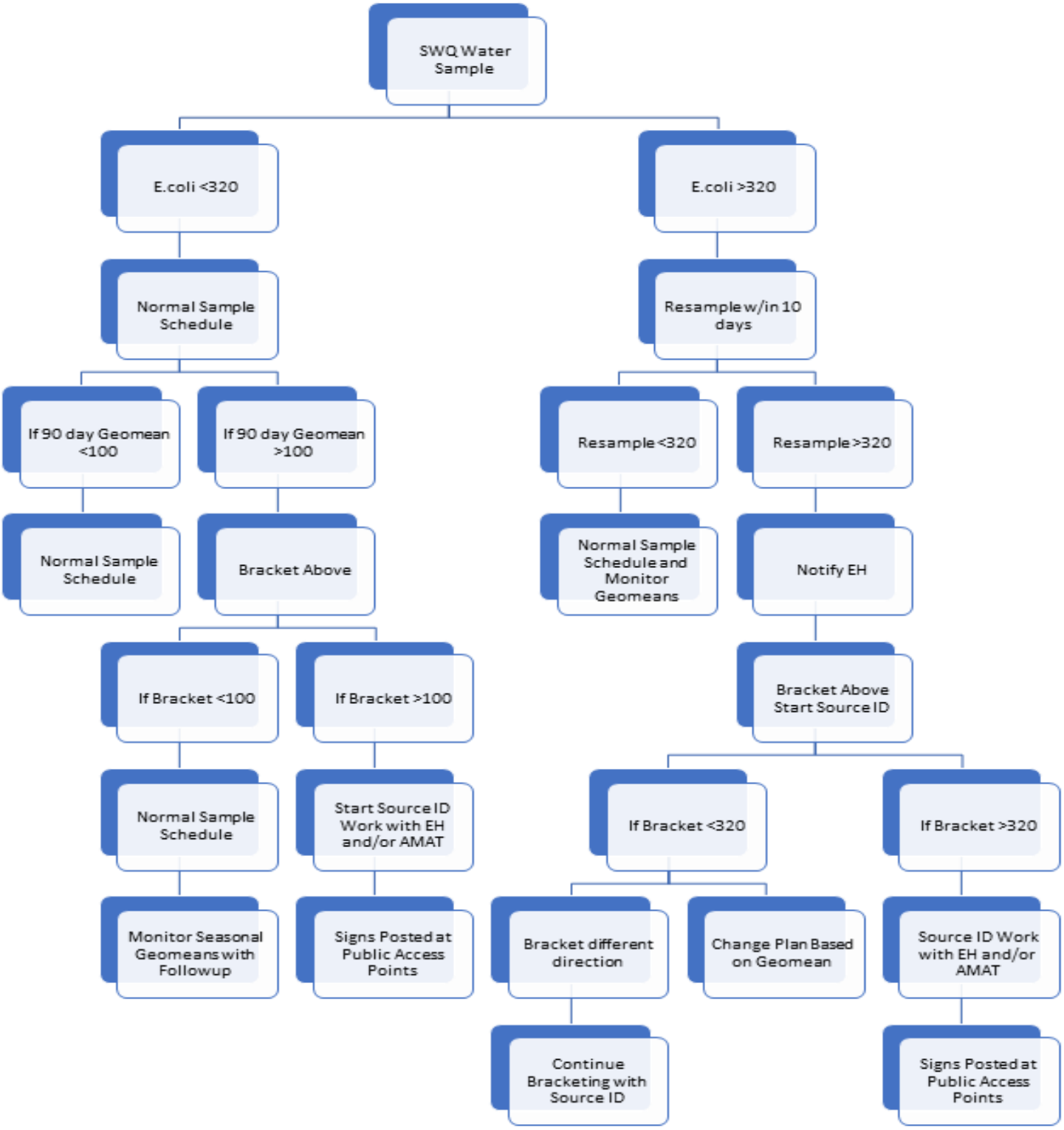


Figure 9. Island County Source ID Bracketing Decision Tree

Adaptive Management

The Adaptive Management Action Team (AMAT) was re-started in August of 2022 after a break due to the Covid-19 Pandemic and staff turnover. When observance of continued exceedances of water quality standards was recorded, a Source ID bracketing process was initiated, and reporting and sharing of information related to a specific site was implemented with a plan for determining next steps and corrections by an interdepartmental coordination and communication process.

The Island County AMAT includes Island County Surface Water Quality (SWQ) staff, Island County Environmental Health Onsite Septic (OSS) team, Whidbey Island Conservation District staff, and Island County Planning & Community Development Department staff. The AMAT collaborates to use water quality impairment data to inform and direct prioritization of areas of overlapping concerns and potential Island County code violations. Education and outreach are a vital piece of the AMAT, providing community members with resources which help them address Federal, State, and Local Critical Areas Ordinance (CAO) violations.

The SWQ team has collaborated with the OSS team in using dye testing to investigate complaints of onsite septic failures on both Camano and Whidbey Islands. Bracketing as part of Source ID investigations resulted in notification letters sent out by the OSS team for septic compliance. Resources were shared amongst team members to come up with a plan to provide additional resources and education to community members.

As part of the Noxious Weed Program, the SWQ team reported invasive species and the top ten most common Class A Noxious Weeds (*Island County Noxious Weeds* 2022) findings along streams near sample sites to the Noxious Weed coordinator. Yellow Archangel is considered by our Island County Weed Board as one of the "Terrible 10 Noxious Weeds" in the category of our four most "Aggressive Invaders," and was reported along several streams. The Noxious Weed coordinator provided educational information and noxious weed mitigation to the homeowners with yards along the creek.

Effectiveness Monitoring and Pollution Identification and Correction (PIC) Support

Holmes Harbor: A success story. In early February a homeowner in Holmes Harbor called to ask questions regarding a shellfish closure for commercial shell fishing on his parcel and neighboring beaches. As a result of this inquiry our department reached out to the Washington State Department of Health (WADOH) to find out the status of this beach area and to learn who the homeowner could contact about the process for reopening closed beaches. In talking to the state, SWQ staff learned that the parcel had been closed since 2017 due to high fecal coliform levels seen at the WADOH sample location. Management through the SWQ team informed the homeowner that the only way to reopen parcels was to conduct testing to prove the levels of coliform bacteria had gone down. The State DOH asked if Environmental Health (EH) management would help with the water quality testing at this location. Plans were made to support this testing for the remaining length of the PIC grant scheduled to end in September 2022.

During late February, the OSS team was advised of this concern related to PIC, and they scheduled a site visit and conducted a dye test that showed fast results from toilet to beach outlet. The process was then started to evaluate the system with a case being opened in March and recommendations for connection to the local sewer system. This process of water testing and Sewer system connection ended in September with the case being closed and the house connected to the Holmes harbor sewer system.

In the processes of sampling, the SWQ team also discovered a blockage in the outfall of the drainage system in this community. Public Works was notified, and the blockages were recently removed so that flow was

restored in the storm drain. In this next water year, SWQ team will move forward with follow up sampling in parallel with WADOH testing to compare how results in coliform bacteria related to this sample site have changed. As part of the Adaptive Management Action Team and the PIC program, the SWQ team will continue observations and monitor as part of the Effectiveness Monitoring program.

Shellfish

The Growth Management Act of Washington, RCW 36.70A outlines the goals of the Monitoring Plan to ensure that critical areas are protected from impacts and to protect Island County ground water resources and surface water resources. Swim beaches and shellfish harvesting areas are important to Island County's recreation opportunities and economy.

WADOH is interested in water quality in Island County because they are conducting a three-year review of the following Growing Areas on Whidbey Island: Southwest Whidbey, Possession Sound, Holmes Harbor, and Penn Cove. According to WADOH this review will document any changes in pollution sources, new freshwater quality data, and recent onsite sewage system evaluations that may impact safe shellfish harvest.

Onsite Septic Systems

Island County SWQ team works carefully with the OSS team and regularly meet to share information on surface water quality locations that are receiving higher counts of *E. coli* in surface water to compare if they are near septic systems in need of maintenance. Both teams work cooperatively and share information in both directions, receiving lists of code violation cases in septic failures as well as communicating higher hits in sampling information. This relationship is critical and helps the OSS team make decisions on prioritizing septic repair permits in areas that are impacting habitat. The prioritization of repair permits has not only helped affect changes in water quality but also becomes important for when the State Department of Health requests our data in relationship to shellfish growing areas.

Salmon Recovery

Island County provides critical shoreline rearing and resting areas that juvenile salmon headed to the ocean first use when coming from the Skagit, Snohomish, and Stillaguamish Rivers. Using the habitat are three species listed as threatened per the Endangered Species Act (Chinook, bull trout, and Hood Canal summer chum), as well as other salmon species and the prey they eat in the Island County watershed. Water Resource Inventory Area (WRIA) 6, which encompasses all of Island County, contains 213 miles of shoreline and 30.3 miles of fish bearing streams.

The following information is taken from the Multi Species Salmon Recovery Plan Update of 2019 (Pucci 2019):

"It is well known that during the lifetime of salmon, the highest mortality often occurs when they are juveniles. Of major concern is that stage when they are transitioning from their home rivers and estuaries to feed and grow in the ocean (Quinn 2005). The watersheds of WRIA 6 in Island County are comprised of streams that are too small to support much salmon spawning. This means that the marine nearshore habitats, pocket estuaries, and the small streams themselves provide vital transition habitat for out-migrating juveniles from the large rivers draining to the Whidbey Basin (Zackey et al., 2015).

"Because changes in the nearshore marine environment are implicated in the status of imperiled fish populations, the WRIA 6 salmon recovery strategies are focused on protecting the diverse marine nearshore and estuarine habitats near three major rivers - the Skagit, Stillaguamish and Snohomish. The central location

of WRIA 6 in the Salish Sea, at the junction of Puget Sound, the Strait of Juan de Fuca and Georgia Strait, places it on the migration corridors used by most Puget Sound juvenile and adult salmon and trout populations.

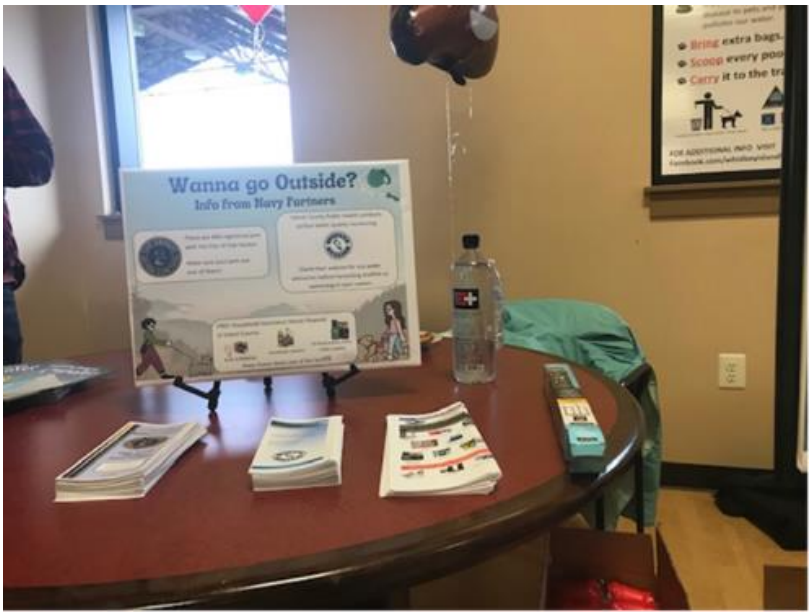
"As these fish move to and from their respective natal streams and rivers, nearshore and coastal estuaries in WRIA 6 provide critical feeding areas and/or shelter from wave energy and predators. Many spawning beaches and eelgrass beds are used by forage fish – surf smelt, sand lance and herring – which salmonids feed on or rely on as a buffer prey for predators. Eelgrass beds provide refuge to juvenile salmonids from both predators and high-energy marine environments. Sheltered beaches, bays, and lagoons also provide resting areas for adult salmonids. In addition to marine habitats, freshwater and tidally influenced streams in WRIA 6 provide valuable stream habitat for juvenile fish to rest in during their early marine out-migrations. Anadromous fish need these areas to adapt to salt water after rearing in freshwater in these coastal streams (Beamer et al. 2013; Zackey et al., 2015)."

Outreach and Education

The Surface Water Quality Monitoring Program (SWQMP) prioritizes education and outreach as a vital part of our program to protect and improve water quality in Island County, and watershed prioritization based on water quality impairments was used to direct outreach and education events in WY16. The SWQ team hosted an event at Lone Lake where the team met with local property owners and answered questions about the lake and future efforts to address Harmful Algal Blooms (HABS). The SWQ Team also hosted tables at the Island County Fair and Camano 101 day alongside our PIC team to highlight water quality and pollution prevention methods to educate the community about the work Island County participates in. The team invited residents to stop and ask questions if they see us working in their neighborhoods.

In addition to showcasing our work at Events, SWQ also participated in outreach and education for local communities. SWQ team has attended Children's Day in the past in the South Whidbey area to educate the younger population about surface water runoff in an engaging manner. This year also saw a new outreach initiative implemented for local school districts, and several teachers invited the SWQ team to their classrooms for a job showcase that incorporated watershed and wetlands models and hands-on activities. Future classroom visits and field trips to sample sites will bring a working knowledge of the Surface Water Quality Program work to local students.

Island County DNR is also collaborating with outside partners to share outreach and education materials. Navy partners planned an outreach event at the recent Navy Housing Fall Festival and utilized Island County materials to educate the public and promote a Pet Waste Campaign. They successfully promoted an education outreach campaign and had many interested participants including 38 people who signed a pledge to bring extra bags and pick up and dispose of their pet waste. Participants that didn't have pets were educated on stormwater in general. Another collaboration during Water Year 16 involved Whidbey Watershed Stewards who were contacted and offered the opportunity to utilize the staff of the SWQ team. DNR staff offered to give time and support to promote the Watershed Steward's educational and field trip offerings to add resources to the education and outreach program.



Navy Housing Fall Festival – Pet Waste Campaign

CONCLUSION

Clean water and watershed health are important in any county and should be taken into consideration for not only public health but also when looking at Puget Sound salmon recovery, local shoreline master plans, as well as critical areas ordinances. WRIA 6 Water Resource Inventory Area is composed of Whidbey, Camano and other smaller islands like Smith, Minor, Deception, Strawberry, Ben Ure, and Baby Islands. WRIA 6 is unusual in that it lies solely withing the boundaries of one county and contains no large river system. This unique habitat has led to a lack of understanding on the importance of seasonal streams and critical areas that are not visually full of water all of the year. This has resulted in confusion and misinterpretation on documented existence of streams and especially their pour points or outlets, as well as how fish and other species utilize these systems. Because of the nature of our seasonal streams and associated watersheds, there must be a constant update of information and a reliance on both current and historical monitoring of all aspects of water quality, including stream flow.

Year to year Island County will continue to see fluctuations in surface water quality, precipitation amounts, and resulting flow conditions. It is important to look at the long-range scope of water quality improvements and understand that increasing pressures through climate change and population density will create new challenges that will require collaboration between Island County departments and outside agencies. In watersheds that either improve, remain the same, or decrease in water quality, the Island County Surface Water Quality Team plans to utilize the adaptive management strategy outlined in this report into Water Year 17 and beyond to maintain continuous improvement of water quality in all our streams.

The water quality goals of the Island County Surface Water Quality Monitoring Plan continue to be focused on preventative and remedial actions to ensure that public health and critical areas are protected from impacts, and to protect Island County ground water and surface water resources. By preserving and improving conditions at local swim beaches, salmon habitat, and shellfish harvesting areas, this will contribute not only to the wealth of Island County's recreational opportunities, but will also support vital economic development as well.

GLOSSARY

Acronyms

AMAT Adaptive Management Action Team

BMP's Best Management Practices

CAO Critical Areas Ordinance

CEC's Contaminants of Emerging Concern

CFU Coliform Forming Units

DNR Department of Natural Resources

E.coli Escherichia coli

ECY Washington State Department of Ecology

EIM Environmental Informational Management System

EPA Environmental Protection Agency

GM Geometric Mean

GMV Geometric Mean Value

IC Island County

MPN Most Probable Number

OSS Onsite Septic

PIC Pollution Identification and Correction

SOP Standard Operating Procedure

Source ID Source Identification

STV Standard Threshold Value

SQL Database Structured query language relational database

SWQ Surface Water Quality

SWQMP Surface Water Quality Monitoring Plan

TMDL Total Maximum Daily Load

USGS U.S Geological Survey

WAC Washington Administrative Code

WADOH Washington State Department of Health

WQI Water Quality Index

WQP The Water Quality Portal (WQP)

WQX Water Quality Exchange (WQX)

WY Water Year

Definitions

Ambient Background or away from point sources of contamination. Surrounding environmental condition.

Anadromous Migrating up rivers from the sea to breed in fresh water.

Aquifers An aquifer is a body of porous rock or sediment saturated with groundwater. Groundwater enters an aquifer as precipitation seeps through the soil. It can move through the aquifer and resurface through springs and wells.

Best Management Practices Policies, practices, procedures, or structures implemented to mitigate the adverse environmental effects on surface water quality resulting from development. BMPs are categorized as structural or non-structural.

Contaminants of Emerging Concern Contaminants of Emerging Concern (CECs) are chemicals and toxics that have been found in waterbodies that may cause ecological or human health impacts and are not currently regulated

Coliform bacteria A group of bacteria predominantly inhabiting the intestines of humans or other warm-blooded animals, but also occasionally found elsewhere. Used as an indicator of human fecal contamination.

Conditionally approved shellfish Area When it meets Approved criteria some of the time, but does not during predictable periods. During these periods the area is closed.

Conductivity a measure of the ability of water to pass an electrical current. This parameter indicates the amount of dissolved substances (salts) present in the water.

Conservation Easement an easement restricting a landowner to land uses that are compatible with long-term conservation and environmental values.

Discharge The volume of water in a stream passing a given point at a given moment in time and is determined by measuring the stream channel cross-sectional area and the water's mean velocity at the site selected

Dissolved oxygen The concentration of dissolved oxygen (mg/L) in a water sample.

Dye Testing Using dye to Identify if a septic system is working properly.

E. coli a bacterium in the family Enterobacteriaceae named Escherichia coli and is a common inhabitant of the intestinal tract of warm-blooded animals, and its presence in water samples is an indication of fecal pollution and the possible presence of enteric pathogens.

Enterococci A subgroup of the fecal streptococci that includes S. faecalis, S. faecium, S. gallinarum, and S. avium. The enterococci are differentiated from other streptococci by their ability to grow in 6.5% sodium chloride, at pH 9.6, and at 10 degrees C and 45 degrees C.

Fecal Coliform That portion of the coliform group of bacteria which is present in intestinal tracts and feces of warm-blooded animals as detected by the product of acid or gas from lactose in a suitable culture medium within 24 hours at 44.5 plus or minus 0.2 degrees Celsius. Fecal coliform bacteria are "indicator" organisms that suggest the possible presence of disease-causing organisms. Concentrations are measured in colony forming units per 100 milliliters of water (cfu/100 mL).

Geometric Mean A mathematical expression of the central tendency (an average) of multiple sample values.

Harmful Algae Blooms occur when colonies of algae grow out of control and produce toxic or harmful effects on people, fish, shellfish, marine mammals and birds.

Non-point source pollution Pollution that enters any waters of the state from any dispersed land-based or water-based activities, including but not limited to atmospheric deposition, surface-water runoff from agricultural lands, urban areas, or forest lands, subsurface or underground sources, or discharges from boats or marine vessels not otherwise regulated under the NPDES program. Generally, any unconfined and diffuse source of contamination. Legally, any source of water pollution that does not meet the legal definition of "point source" in section 502(14) of the Clean Water Act.

Noxious Weeds Noxious weeds are invasive, non-native plants that threaten agricultural crops, local ecosystems, or fish & wildlife habitats.

Perennial Stream Flowing throughout the year.

pH A measure of the acidity or alkalinity of water. A low pH value (0 to 7) indicates that an acidic condition is present, while a high pH (7 to 14) indicates a basic or alkaline condition. A pH of 7 is considered to be neutral. Since the pH scale is logarithmic, a water sample with a pH of 8 is ten times more basic than one with a pH of 7.

Pocket estuaries protected estuaries and lagoons within which there is too little wave action to form beaches.

Pollution Contamination or other alteration of the physical, chemical, or biological properties of any waters of the state. This includes change in temperature, taste, color, turbidity, or odor of the waters. It also includes discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state. This definition assumes that these changes will, or are likely to, create a nuisance or render such waters harmful, detrimental, or injurious to (1) public health, safety, or welfare, or (2) domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or (3) livestock, wild animals, birds, fish, or other aquatic life.

Pour Points are the points on the surface at which water flows out of an area. They are the lowest point along the boundary of a watershed.

Restricted Shellfish Areas Water quality does not meet standards for an Approved classification, but the sanitary survey indicates a limited degree of pollution from non-human sources. Shellfish harvested from Restricted growing areas cannot be marketed directly. They must be relayed (transplanted) to Approved growing areas for a specified amount of time, allowing shellfish to naturally cleanse themselves of contaminants before they are harvested for market.

Salinity The relative concentration of dissolved salts, usually sodium chloride, in a given water.

Septic system Septic System is an on-site system designed to treat and dispose of sewage.

Shellfish beds Shallow and deep-water habitats with substrates consisting of mollusk shells. [EPA Habitat Categories/Habitat Protection at http://www.epa.gov/owow_keep/estuaries/pivot/habitat/habtype.htm]

Statistical Threshold Value STV is a measure of variability of your water quality distribution, derived as a model-based calculation approximating the 90th percentile using the lognormal distribution.

Surface Water All water naturally open to the atmosphere, such as rivers, lakes, reservoirs, ponds, streams, estuaries, and springs.

Turbidity A measure of water clarity. High levels of turbidity can have a negative impact on aquatic life.

Wetlands An area that is saturated by surface or ground water with vegetation adapted for life under those soil conditions, as swamps, bogs, fens, marshes, and estuaries.

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