FINAL WATER QUALITY PROJECT REPORT

FOR

WQC-2020-ClCHHS-00011

Pollution Identification and Correction (PIC)
Sequim Bay-Dungeness Watershed Pollution Identification and Correction

Clallam County Environmental Health Services

Grant or Loan Amount: $224,000

Project Start Date: November 1, 2019
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Washington State Department of Health

CLALLAM COUNTY Environmental Health SERVICES


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Project Overview

Characterization of Project Area

Geography and Designations

The Pollution Identification and Correction (PIC) Project takes place within the Sequim-Dungeness Clean Water District (CWD), a shellfish protection district in the eastern portion of Clallam County, on the North Olympic Peninsula of Washington State. Boundaries of the district include Bagley Creek to the west, the County line to the south, the Sequim Bay watershed to the east, and the Strait of Juan de Fuca to the north (Chadd and Bond 2015). Washington State law provides for the creation of shellfish protection districts under Chapter 90.72 RCW where non-point pollution threatens shellfish beds.

The very same geographic area is also classified as a Marine Recovery Area (MRA) under Chapter 70.118A RCW. Such a designation envisions onsite sewage (OSS) management programs to reduce public health hazards and protect water quality.

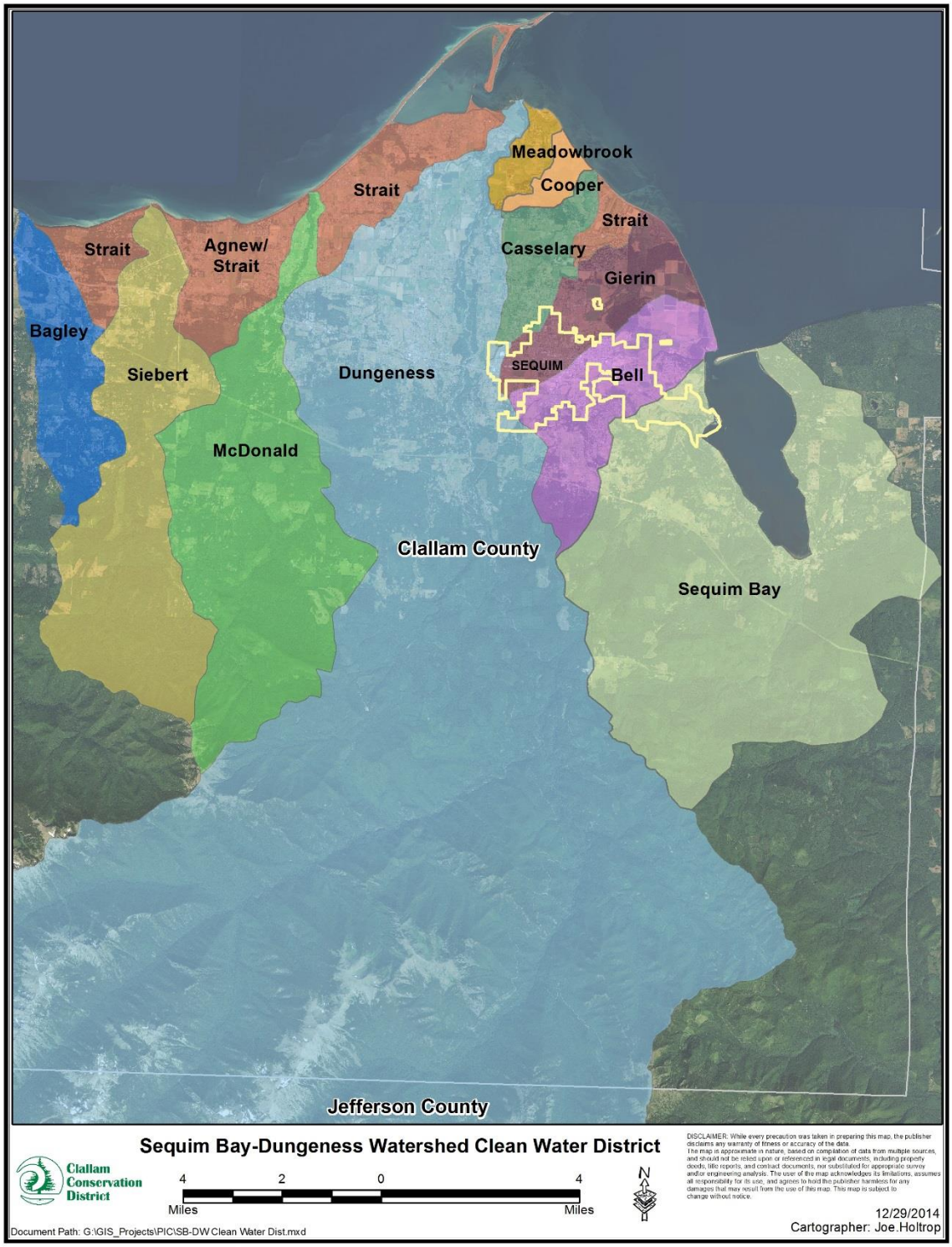
The project area includes the city of Sequim, agricultural lands, rural residential areas, forestlands, and the Carlsborg Urban Growth Area (UGA). This portion of the County generally receives less precipitation than other parts of the Olympic Peninsula due to a rain shadow effect produced by the Olympic Mountains: "[precipitation] varies from 15 inches near Sequim to 80 inches in the headwaters of the Dungeness River" (Soule and Chadd 2013).

The population of Clallam County grew from 56,210 to 64,525 between 1990 and 2000 with the greatest increases occurring in the Dungeness Watershed (Rensel 2003). The 2020 United States census puts the population of Clallam County at 77,155. Along with this growth has come a shift from forest lands and commercial agriculture to residential development and small farms (Rensel 2003).

Streams and Rivers

Many freshwater streams exist within the Sequim-Dungeness Clean Water District with the majority summarized from Chadd and Bond (2015) in the table below. The Dungeness River stands out as the primary fluvial feature within the District originating within the Olympic Mountains and draining 270 square miles (Jamestown S'Klallam Tribe 2007).

Figure 1. Sequim-Dungeness Clean Water District.



Sequim-Dungeness Clean Water District and its various constituent sub-watersheds. Map courtesy of Clallam Conservation District.

Table 1. CWD Streams and Rivers

Name	Receiving Waters	Comments
Chicken Coop Creek	Sequim Bay	3.1 miles long with 3.1 miles of tributaries
No Name Creek	Sequim Bay	Forested, short, steep; little development; little non-point pollution
Dean Creek	Sequim Bay	~4 miles long; drains ~4 miles^2
State Park Creek	Sequim Bay	Forestry, agriculture, residential land uses
Jimmycomelately Creek	Sequim Bay	Drains ~16 miles^2
Johnson Creek	Sequim Bay	Mainstem 5 miles long with 2 miles of tributaries; drains ~6.2 miles^2
Bell Creek	Sequim Bay	3.8 miles long; drains 8.9 miles^2; urban and rural development; historically conveyed irrigation water
Dungeness River	Dungeness Bay	32 miles long; drains 172,517 acres; major source of Dungeness Bay freshwater; upper river within National Park/National Forest
Matriotti Creek	Dungeness River	9.3 miles long; enters left bank of Dungeness at river mile 1.9
Lotzgesell Creek	Matriotti Creek	Matriotti Creek tributary
Hurd Creek	Dungeness River	~1 mile long; enters Dungeness at river mile 2.7
Meadowbrook Creek	Dungeness River or Dungeness Bay	Point of discharge varies
Meadowbrook (Dungeness) Slough	Dungeness River, Dungeness Bay, or Meadowbrook Creek	Point of discharge varies
Golden Sands Slough	Outer Dungeness Bay	Constructed channels in estuarine wetland
Cooper Creek	Outer Dungeness Bay	Straightened lower portion; tide gate; fed by wetland, upper portion undeveloped
Cassalery Creek	Dungeness Bay	4.2 miles long
Gierin Creek	Dungeness Bay	8.3 miles of stream/tributaries; drains 3.1 miles^2; Olympic Mountains groundwater discharge
Unnamed Intermittent Stream	Inner Dungeness Bay	Storm water conveyance, irrigation outflow
McDonald Creek	Strait of Juan de Fuca	13.6 miles long; drains ~23 miles^2; originates around 4,700 feet elevation; deeply-incised coastal upland and marine bluff
Agnew Ditch	Strait of Juan de Fuca	Part of irrigation ditch system; Dungeness River water conveyed by McDonald Creek; Irrigates Agnew area
Siebert Creek	Strait of Juan de Fuca	12.4 miles long; 31.2 miles, including tributaries; drains 19.5 miles^2; originates around 3,800 feet elevation; westernmost stream influenced by Dungeness area irrigation
Bagley Creek	Strait of Juan de Fuca	9.5 miles stream/tributaries; westernmost watershed of Clean Water District

Streams and rivers of the Clean Water District, loosely organized from east to west.

Characterization of Water Quality Problems

Bacterial Pollution

Tribal communities have relied on shellfish resources of Dungeness Bay and surrounding areas for many centuries. Over the past 150 years, the area has also become important for non-tribal recreational and commercial harvest of shellfish (Jamestown S'Klallam Tribe, 2007).

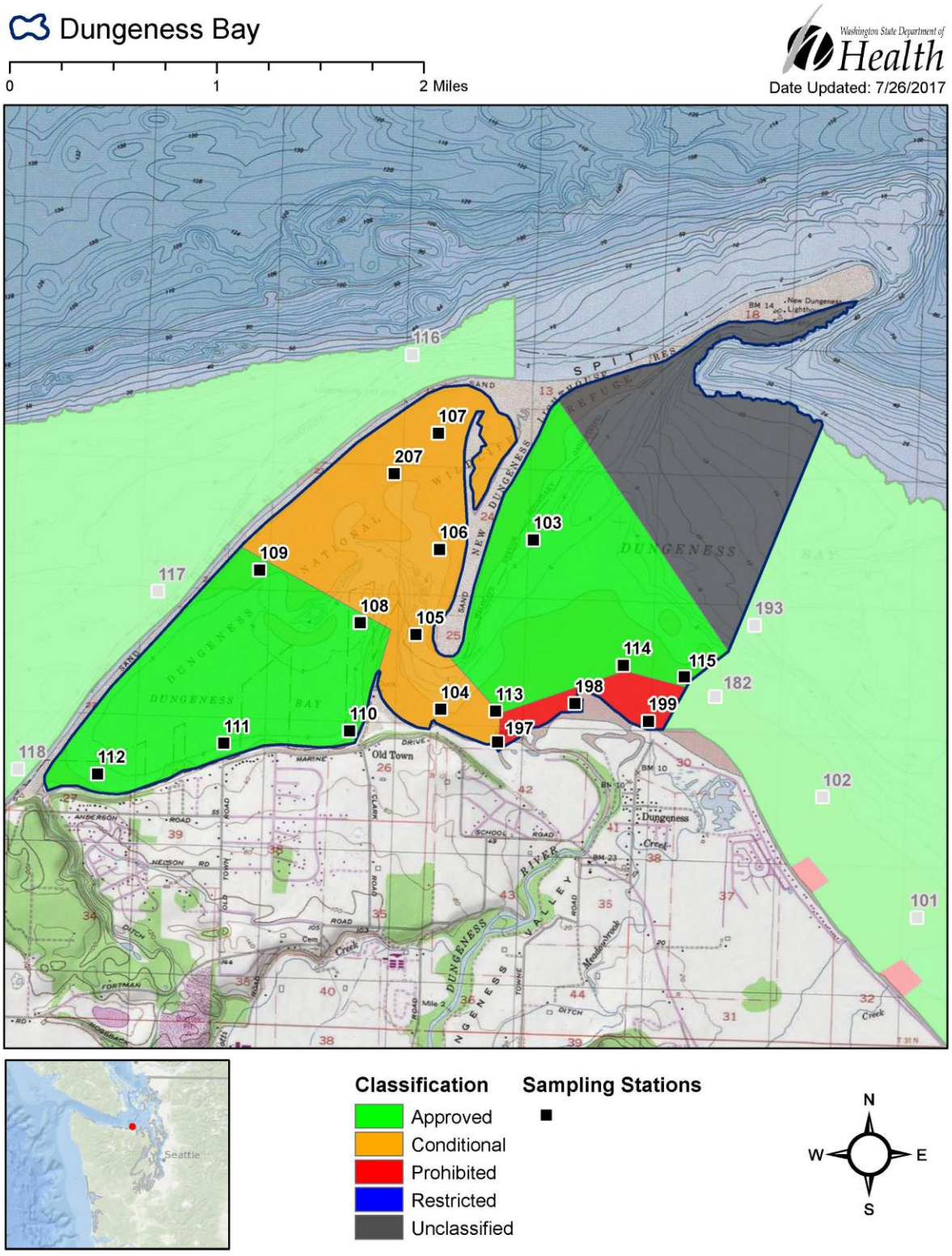
In the late 1990s and early 2000s regular Washington State Department of Health water quality sampling, for the purpose of classifying shellfish growing areas, documented increasing concentrations of fecal coliform bacteria in Dungeness Bay (Rensel 2003). Various studies also highlighted fecal coliforms in upland freshwater bodies (Rensel 2003, Sargeant 2002) and by 1996 Matriotti Creek had already been listed as "impaired" due to fecal coliform bacteria. Fecal coliforms commonly occur in human and animal wastes and their presence may indicate other, accompanying harmful bacteria and pathogens (DeBarry 2004).

Shellfish Downgrades

In 1998 an area immediately adjacent to the mouth of the Dungeness River was formally closed to shellfish harvest. This area was expanded toward inner Dungeness Bay in 2000 and again in 2001. By 2007 much of the area around the mouth of the Dungeness River was classified as "prohibited" for shellfish harvest and the majority of Dungeness Bay was classified "conditionally approved" (Jamestown S'Klallam Tribe 2007).

Various efforts to clean up freshwater bodies within the Clean Water District—including reductions in runoff from irrigation water—have led to a reversal in water quality trends (at least relating to bacteria in Dungeness Bay) and acres of shellfish beds have been upgraded in recent years. The map, below, summarizes the status of Dungeness Bay in 2023.

Figure 2. Status of Dungeness Bay Shellfish Beds in 2023.



Status of Dungeness Bay shellfish beds in 2023. Courtesy of Washington State Department of Health.

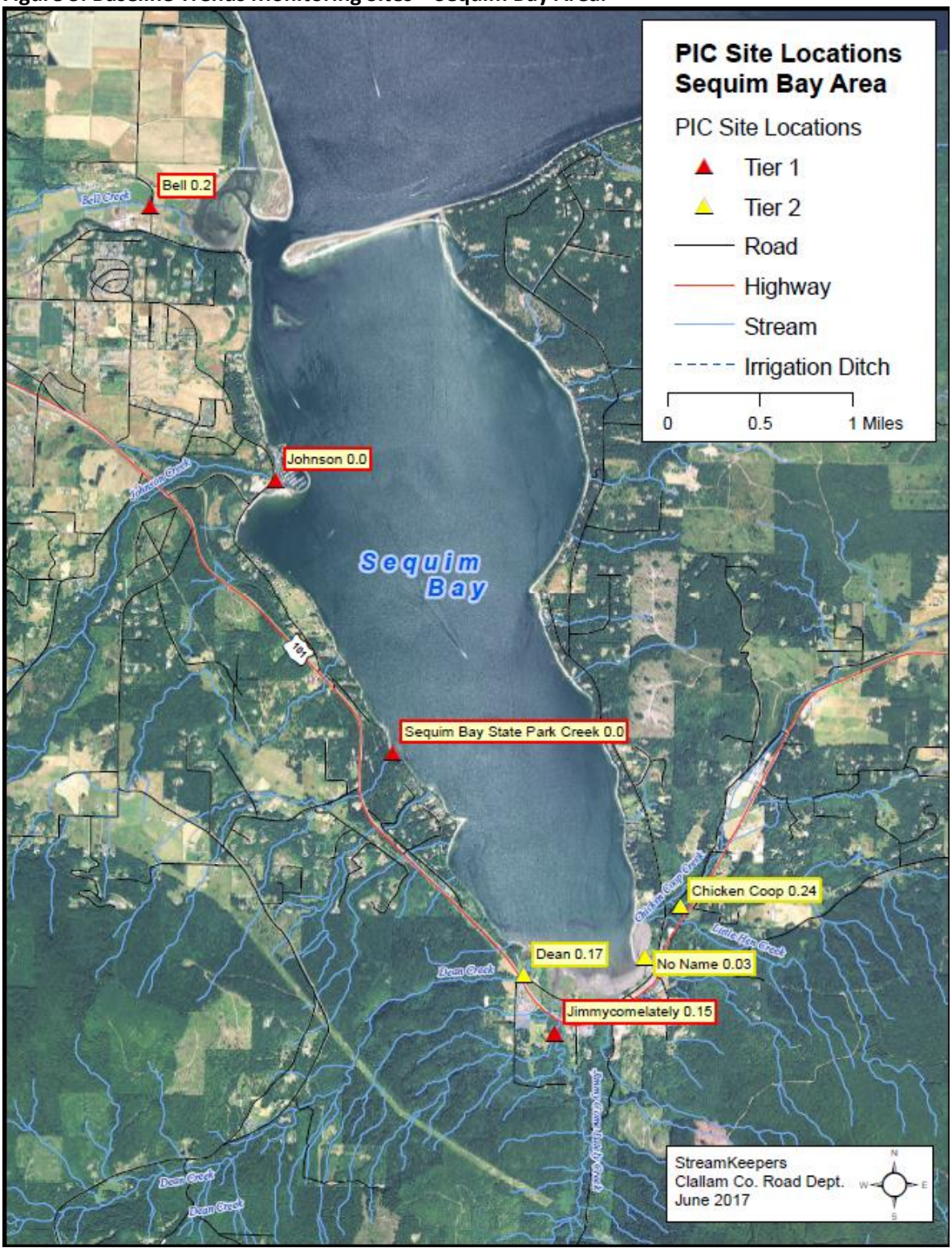
Plan of Action

Clallam County Environmental Health partnered with Clallam Conservation District, Jamestown S'Klallam Tribe, and Streamkeepers of Clallam County to implement the 2015-2017 Pollution Identification and Correction (PIC) Project designed to address ongoing bacterial pollution issues within the Clean Water District and build upon previous successes that lead to shellfish growing area upgrades in Dungeness Bay. Primary components of the PIC Project follow.

Baseline Trends Monitoring

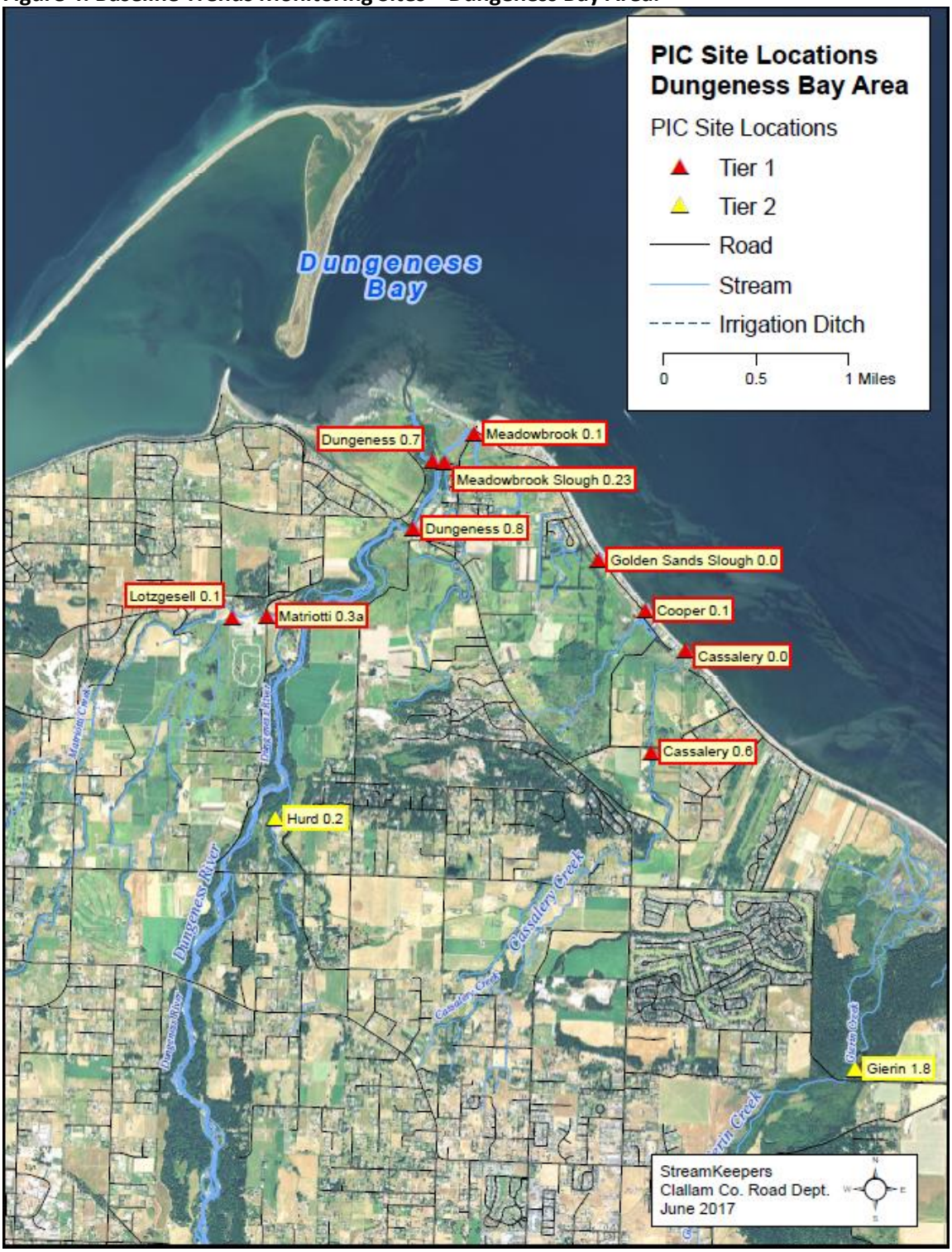
Streamkeepers of Clallam County took the lead on a baseline trends monitoring project to characterize chemical and physical properties of Clean Water District streams by sampling near each stream's point of discharge into receiving waters. Throughout the project period a dedicated team of Streamkeepers volunteers collected data on standard water quality parameters of district streams, along with grab samples for fecal coliform and nutrients analyses. Baseline Trends sites were grouped into two tiers: monitoring occurred monthly at Tier 1 streams while Tier 2 streams received quarterly visits (with few exceptions due to funding and/or scheduling). Information generated by the Baseline Trends Monitoring Program guided decisions on where to focus further investigation and remediation efforts within the district.

Figure 3. Baseline Trends Monitoring Sites—Sequim Bay Area.



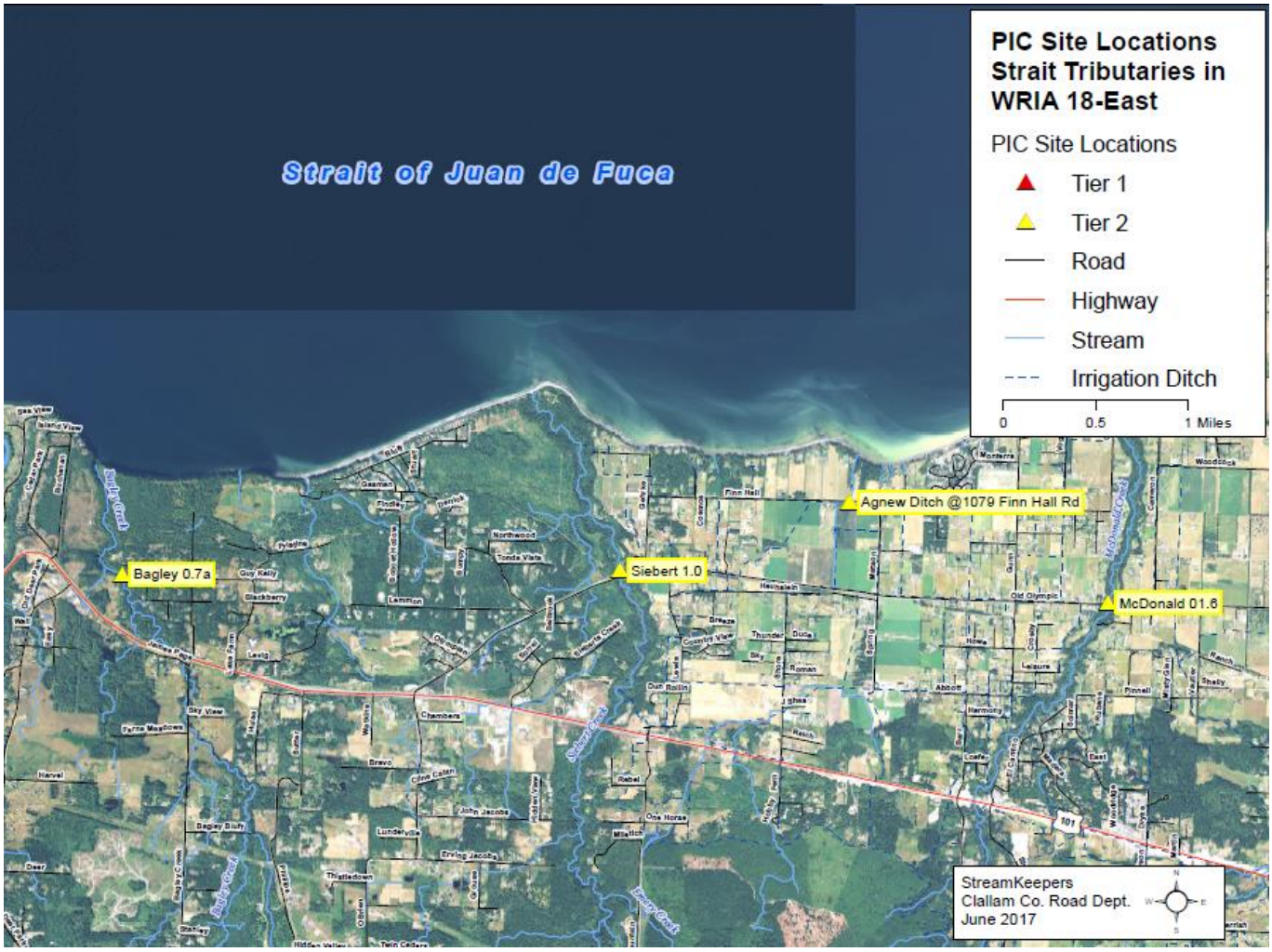
Baseline Trends Monitoring sites in the easternmost portion of Clallam County's Clean Water District. In general, Streamkeepers volunteers sampled Tier 1 sites monthly and sampled Tier 2 sites quarterly.

Figure 4. Baseline Trends Monitoring Sites—Dungeness Bay Area.



Baseline Trends Monitoring sites in the central portion of Clallam County's Clean Water District. In general, Streamkeepers volunteers sampled Tier 1 sites monthly and sampled Tier 2 sites quarterly. Note: alternate sites occasionally used in place of Meadowbrook 0.1 not shown to reduce map clutter.

Figure 5. Baseline Trends Monitoring Sites—Strait Tributaries Area.

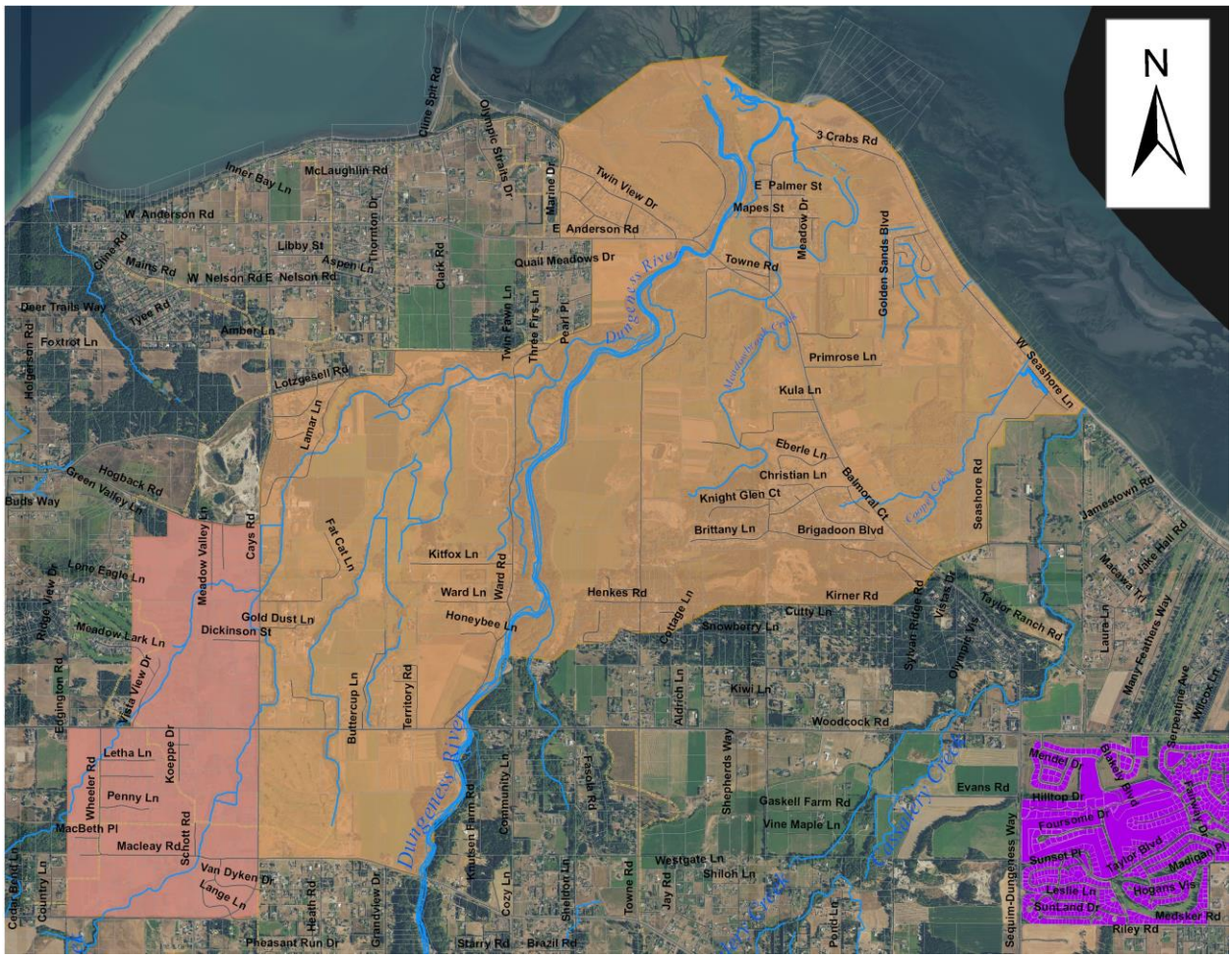


Baseline Trends Monitoring sites in the westernmost portion of Clallam County's Clean Water District. In general, Streamkeepers volunteers sampled Tier 1 sites monthly and sampled Tier 2 sites quarterly.

Coordination

PIC Project Partners coordinated efforts to address bacterial pollution in waters of the Sequim Dungeness Clean Water District. Often this involved meeting with the Clean Water Work Group (CWWG), a subset of the Dungeness River Management Team (DRMT), for guidance. At regular work group meetings partners shared information and made decisions regarding PIC project direction, including determination of Focus Areas and site selection. Focus Areas allow more intensive pollution investigation and correction efforts aimed to uncover and remediate sources of bacterial water pollution.

Figure 6. 2015-2023 PIC Focus Areas.



The Clean Water Work Group chose the current PIC Focus Area (2019-2023), Upper Matriotti Creek, highlighted in coral, and Lower Bell Creek, highlighted in purple, based on several factors, including Baseline Trends Monitoring Data provided by Streamkeepers of Clallam County, and the focus area's proximity to impacted marine waters and shellfish beds. Map data from ESRI and Clallam County. Orange highlighted areas indicate past PIC Focus Areas (2015-2019).

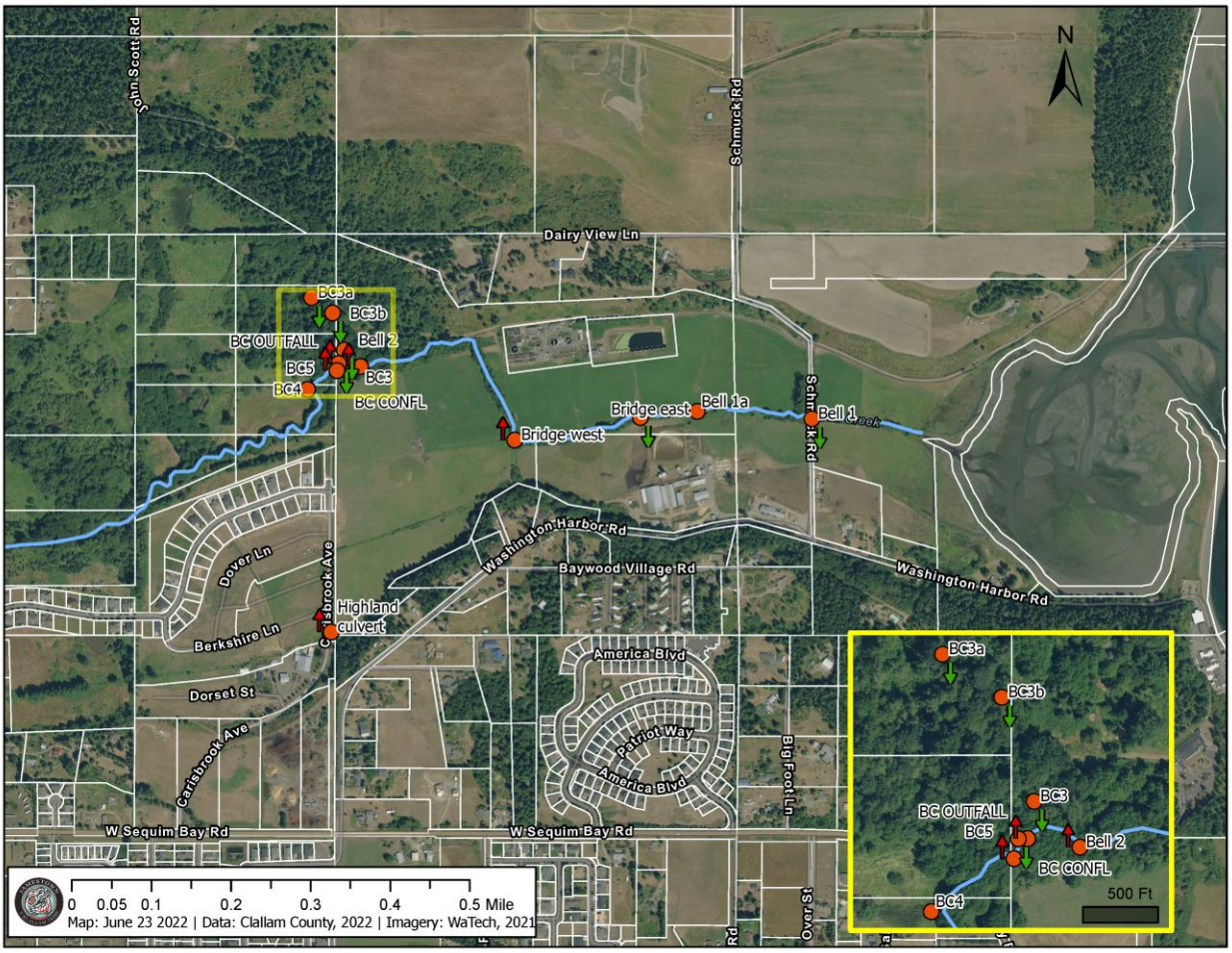
Segmented/Targeted Monitoring

In order to narrow down the search for sources of pollution, targeted water quality sampling sites were set up along water bodies within the PIC Focus Area. Here, Jamestown S'Klallam Tribe and Clallam County Environmental Health collected water grab samples to measure fecal coliforms along with temperature and salinity data. By collecting information at multiple points along the length of a stream project partners should, ideally, be able to tell if a particular stream segment stands out in terms of poor water quality and requires remediation. Such information would enable Environmental Health to look more closely at the surrounding properties to determine if any corrections might benefit the waterway. Bacterial pollution could potentially come from storm water runoff, animal waste (both domesticated and wild), onsite sewage systems, or other unanticipated sources. Segmented water quality sampling sites for the PIC Focus Area follow.

Figure 7. Segmented Sampling Sites on Matriotti Creek.

Segmented sampling sites on Matriotti Creek set up to investigate any potential sources of bacterial pollution entering the waterway. Map data from ESRI and Clallam County.

Figure 8. Bell Creek Segmented Sampling Sites.



Segmented sampling sites on Bell Creek (including Highland Ditch) set up to investigate any potential sources of bacterial pollution entering the waterway. Map data from ESRI and Clallam County.

Further Investigation

Hot Spot Designation

When elevated fecal coliform levels were found in PIC Focus Area waterways through segmented sampling, Environmental Health and Jamestown S'Klallam Tribe made an effort to return for multiple supporting observations in order to classify a particular segmented site as a "hot spot." The classification of a site as a hot spot triggered further investigation to include assessment of surrounding properties and use of other available investigative tools.

Parcel Assessment

Environmental Health used County records of properties within the PIC Focus Area to begin the analysis of land uses and consideration of any possible bacterial pollution sources. As-built drawings of onsite sewage systems, OSS inspection records (or lack thereof), structures, aerial photography, and property uses all informed an initial examination of the spectrum of influences on PIC Focus Area water quality.

Parcel Assessment forms were pre-filled with the information above in the office, and hard copies were printed for specific properties identified as potentially having a high environmental impact, and designated as requiring further investigation via property survey.

Property Surveys

Property surveys allowed for further on the ground research into property use, following initial research conducted during office-based parcel assessments. EH staff visited parcels of participating property owners to evaluate water uses, storm water management, sewage treatment methods, animal waste, and any other pertinent factors that could potentially impact surface waters. EH staff requested written permission from property owners within the PIC Focus Area and walked each selected parcel (ideally with the property owner present) using a PIC Survey Form to gather information on the above topics.

Pollution Correction

Technical Assistance

Project partners provided technical assistance to landowners wherever possible to improve outcomes for water quality within the PIC Focus Area. Clallam County Environmental Health Registered Sanitarians and Certified Wastewater Inspectors were able to provide guidance to landowners regarding sewage treatment practices and pet waste management. Clallam Conservation District provides a host of services where animal-keeping practices or farming are involved. The Conservation District provides technical assistance to landowners regarding the implementation of best management practices (BMP) to protect waterways and the environment.

Financial Assistance

The primary mechanism to assist homeowners in need of septic repairs or upgrades involved low interest Clean Water Loans available through Craft 3. As a fallback, Clallam Conservation District also provided a cost-share program intended to ease the burden of septic costs. Homeowners with failing or non-conforming sewage systems at their primary residence and meeting specific financial criteria could apply for assistance from Craft3 in the form of loans with favorable terms. To bridge the gap for those not qualifying for loans or with excessive financial barriers, homeowners had the option to apply for grant funding from Clallam Conservation District to pay for a portion of septic designs and installations.

Compliance Timelines/Enforcement

Where water quality issues were documented and potentially responsible landowners took an antagonistic stance toward cleanup efforts, Clallam County Environmental Health resorted to compliance timelines and enforcement protocols developed in conjunction with the County Prosecuting Attorney's Office. EH used these tools to compel septic inspections by licensed inspectors as required by Washington State law. Full inspections greatly helped to sort the properly functioning, conforming sewage systems from those contributing to water pollution. Where verified failing septic systems are documented, EH initiates compliance timelines to compel repairs.

Outreach and Education

Success of the PIC Program in the 2019-2023 Focus Area greatly hinged upon the drive of residents within the project area to protect and value water resources. As such, project partners sought to engage

the public early on and strove to keep landowners informed of PIC developments throughout the project period. To this end, project partners held various public meetings, sent direct mailings to the project area, produced press releases, and maintained a website to aggregate PIC literature.

Outcomes/Results

Water Quality Results

Trends Monitoring

PIC Trends Monitoring results guided Clean Water Work Group selection of PIC focus areas, continued the accumulation of baseline data begun through previous projects, and provided an overall picture of the chemical and physical properties of district streams near their points of discharge into receiving waters.

In general, data collection occurred monthly for Tier 1 streams and quarterly for Tier 2 streams. Tier 1 streams include Bell Creek, Cassalery Creek, Cooper Creek, Dungeness River, Golden Sands Slough, Jimmycomelately Creek, Johnson Creek, Lotzgesell Creek, Matriotti Creek, Meadowbrook (Dungeness) Slough, Meadowbrook Creek, and Sequim Bay State Park Creek. Tier 2 streams include Agnew Ditch (Creek), Bagley Creek, Chicken Coop Creek, Dean Creek, Gierin Creek, Hurd Creek, McDonald Creek, No Name Creek, and Siebert Creek.

Measurements gathered through PIC Trends Monitoring include: ammonia as nitrogen, barometric pressure, dissolved oxygen, dissolved oxygen percent saturation, fecal coliforms, discharge (where stream gages facilitate calculation), nitrate as N, nitrite as N, pH, phosphate as P, salinity, silicate as Si, specific conductivity (at 25 deg. C), stream or river stage, water temperature, total persulfate nitrogen, total persulfate phosphorous, and turbidity.

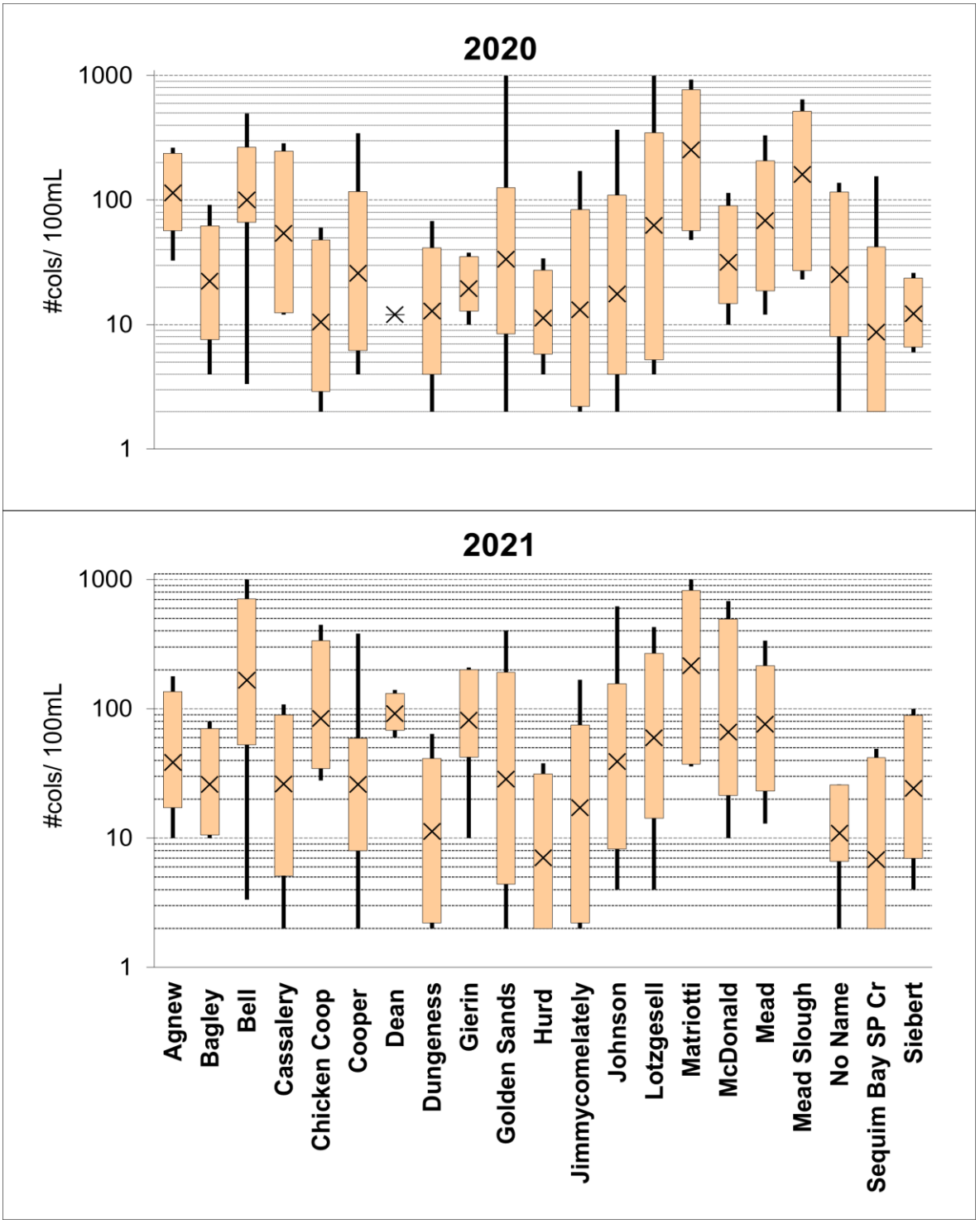
In order to quantify fecal coliform concentrations, field teams collected grab samples in sterile plastic bottles that were transported on ice for same-day analysis. Clallam County Environmental Health Water Laboratory performed fecal coliform analyses following the membrane filter method, for which the laboratory is accredited. Standard water quality parameters were collected using a YSI ProDSS multi-meter. Nutrient samples were shipped, chilled, by overnight courier, for analysis at University of Washington School of Oceanography Chemistry Laboratory.

All data were verified and entered into the Clallam County Water Resources Database. All standard water quality parameter data, including fecal coliforms, were forwarded to Washington State Department of Ecology's Environmental Information Management System (EIM). Nutrient data were not submitted to EIM as Ecology does not recognize the laboratory methods used as accredited for regulatory purposes.

PIC Trends annual reports (Streamkeepers 2020-2021, Streamkeepers 2022) review, in depth, all physical and chemical data collected through the Trends Monitoring Program along with discussion on data quality analysis. Here, we focus on a select water quality parameter- fecal coliforms —collected over the entire project period as they relate to the investigation of bacterial pollution sources. Summary graphics of fecal coliform follow.

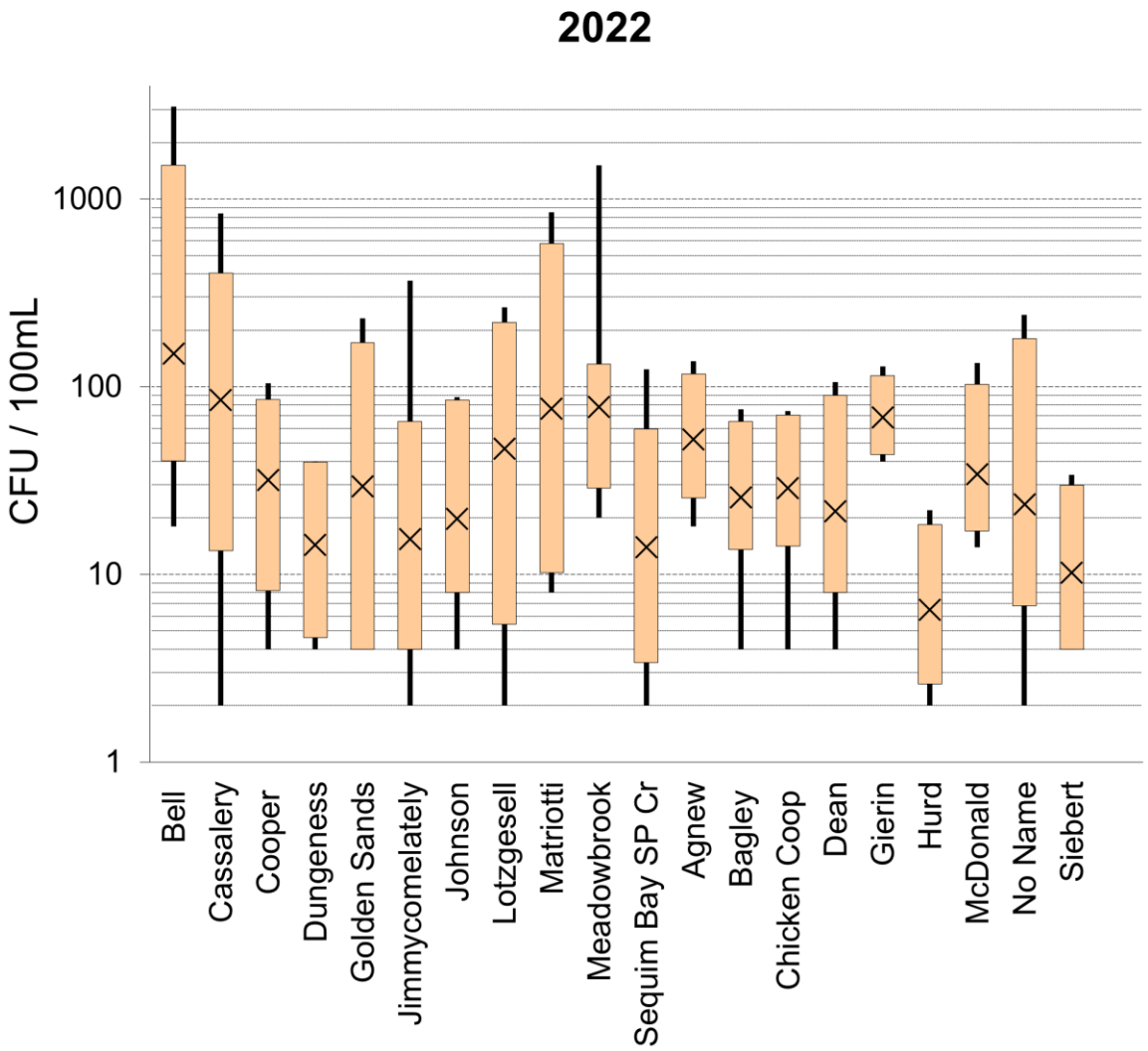
Analyte non-detects were substituted with the minimum detection limit (MDL) to facilitate the below analyses. As an example, the MDL of the membrane filter method used to quantify fecal coliform concentrations is usually one (the smallest number of colonies an observer can detect using a microscope and assuming a sample dilution factor of one). If no fecal coliform colonies are counted the result is reported as the number “one” with a “less than” qualifier and the number “one” is used in any analyses. All fecal coliform data are reported as “colony-forming units per 100 milliliters,” abbreviated to CFU/100 ml.

Figure 9. Tier 1 and Tier 2 Streams Trends Fecal Coliform Summary, 2020-2021.



Summary of Tier 1 and Tier 2 stream fecal coliform data collected monthly from January 2020 – December 2021. Box and whisker plots denote 10th percentile, geometric mean, 90th percentile and minimum/maximum values. Note log scale.

Figure 10. Tier 1 and Tier 2 Streams Trends Fecal Coliform Summary, 2022.



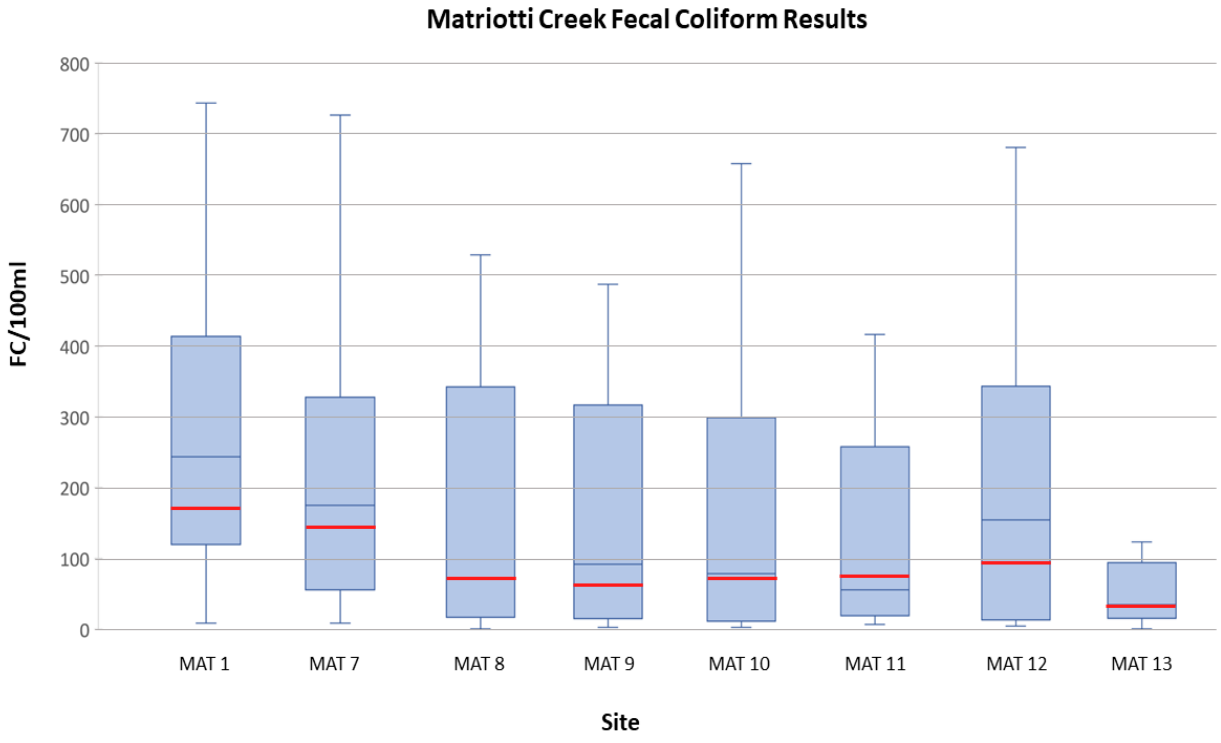
Summary of Tier 1 and Tier 2 stream fecal coliform data collected monthly from January 2022 – December 2022. Box and whisker plots denote 10th percentile, geometric mean, 90th percentile and minimum/maximum values. Note log scale.

Segmented/Targeted Monitoring

The Clean Water Work Group chose a focus area for heightened non-point source pollution investigation and remediation that included Upper Matriotti Creek, and Bell Creek. Each waterway was divided into segments where fecal coliforms, temperature, and salinity were measured periodically throughout the project.

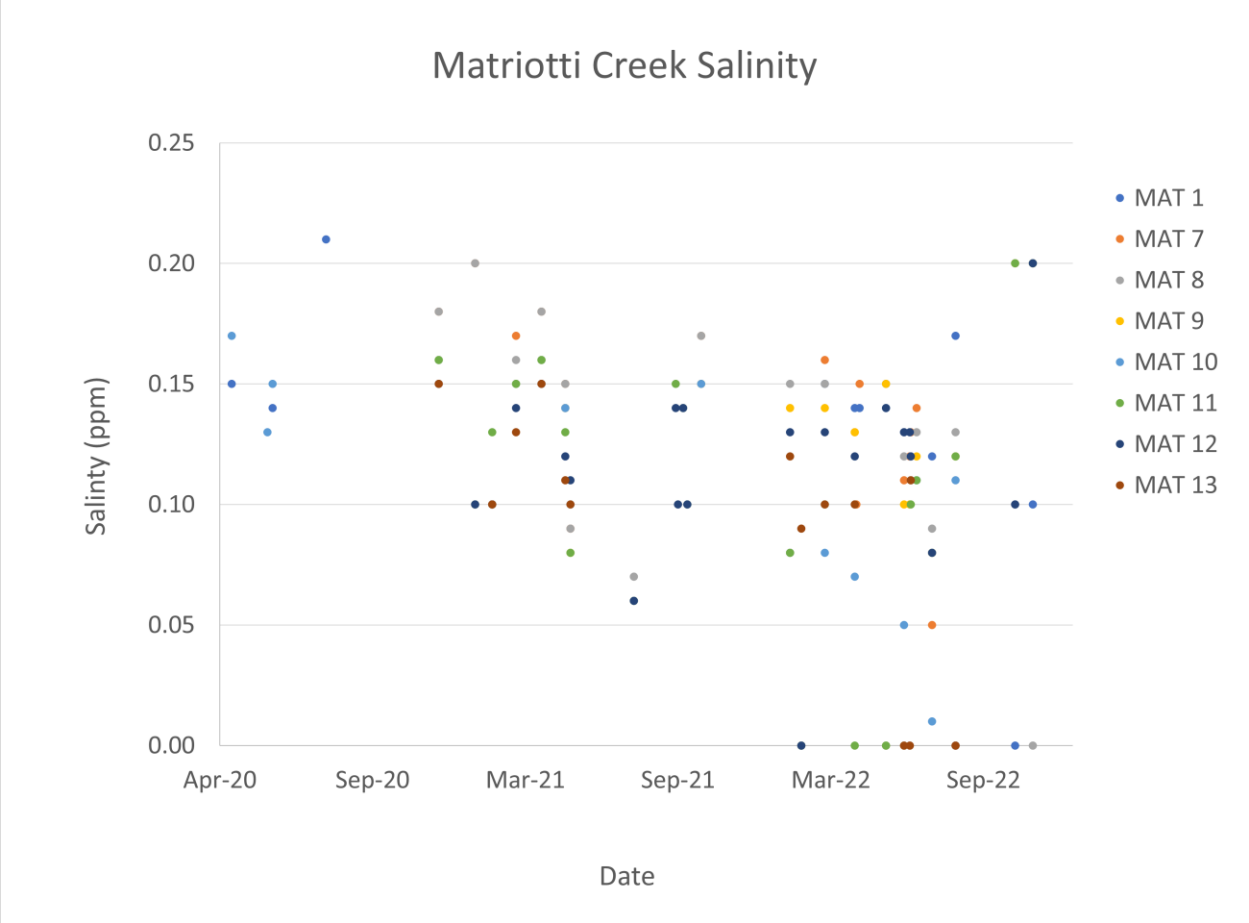
Summaries of segmented sampling fecal coliform, salinity, and temperature data follow along with calculations for the purpose of classifying hot spots. Clallam County Environmental Health Water Laboratory analyzed grab samples for fecal coliforms using the membrane filter method. In order to facilitate the analyses below, the minimum detection limit was used in place of any non-detects. Further, primary results were averaged with any laboratory duplicates and reported as a composite result. Salinity and temperature measurements were recorded in-situ using a YSI multi-meter. Segmented sampling data were uploaded to United States Environmental Protection Agency's (EPA) Water Quality Exchange (WQX) data warehouse.

Figure 11. Matriotti Creek Segmented Sampling Fecal Coliform Levels.



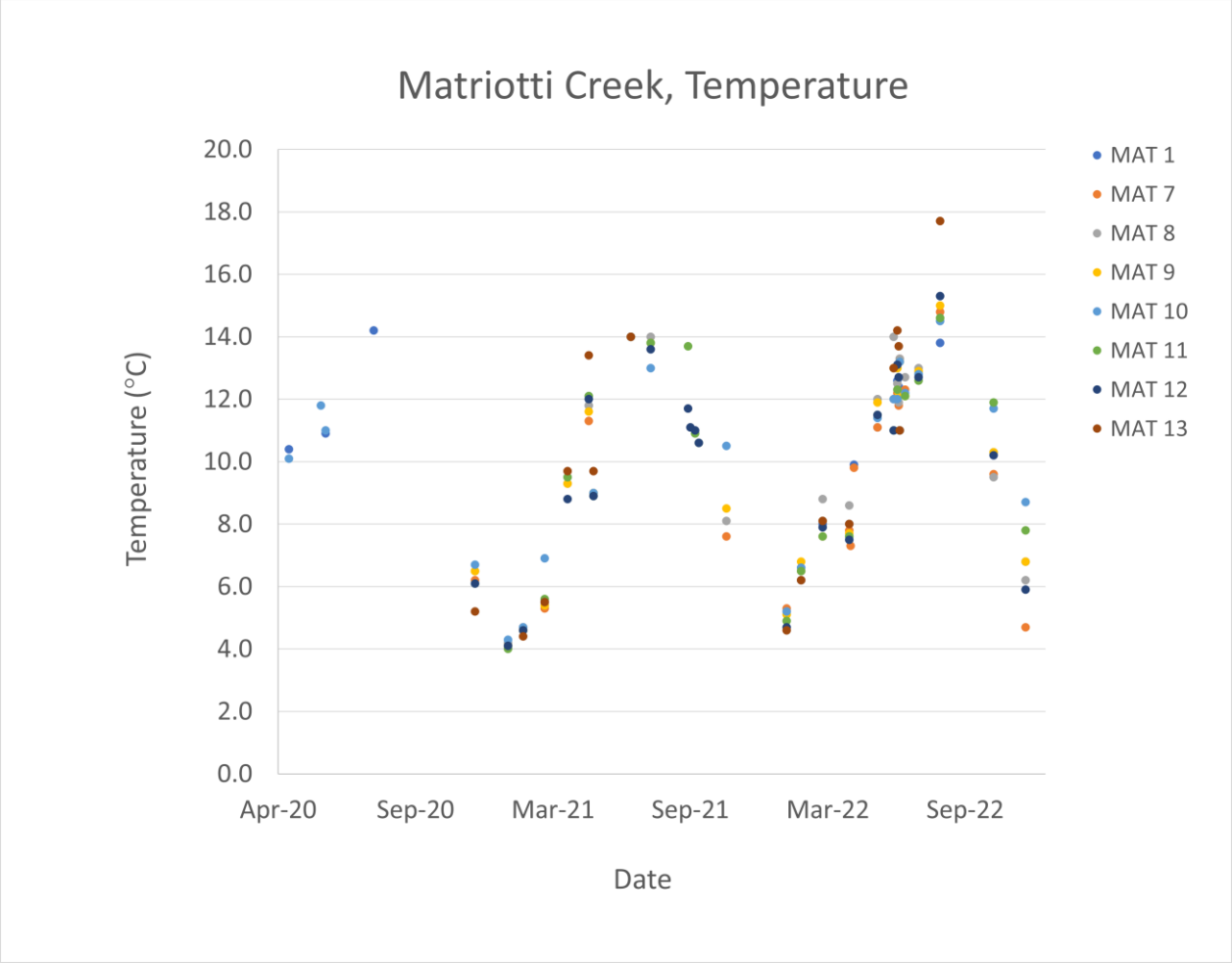
Matriotti Creek fecal coliform counts measured in colony-forming units per 100 ml sample at 8 segmented sampling sites, March 2020-December 2022. Box and whisker plots denote minimum value (lower whisker), geometric mean (red line), and maximum value (upper whisker). MAT 1 *n* = 18, MAT 7 *n* = 30, MAT 8 *n* = 30, MAT 9 *n* = 29, MAT 10 *n* = 32, MAT 11 *n* = 30, MAT 12 *n* = 32, MAT 13 *n* = 24.

Figure 12. Summary of Matriotti Creek Segmented Sampling Salinity Data.



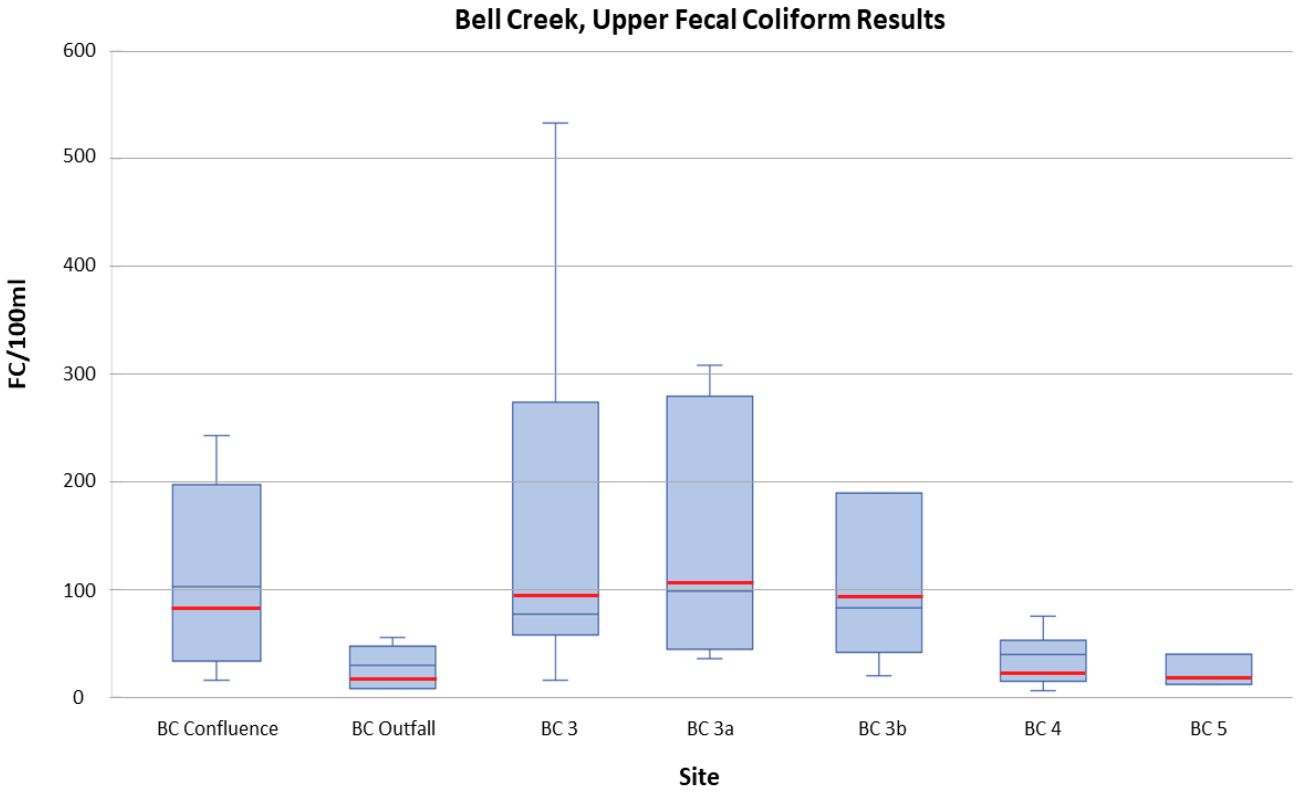
Summary of all Matriotti Creek salinity data collected from April 2020 through December 2022. (MAT 1 *n* = 14, MAT 7 *n* = 23, MAT 8 *n* = 22, MAT 9 *n* = 22, MAT 10 *n* = 24, MAT 11 *n* = 23, MAT 12 *n* = 24, MAT 13 *n* = 14).

Figure 13. Summary of Matriotti Creek Segmented Sampling Temperature Data.



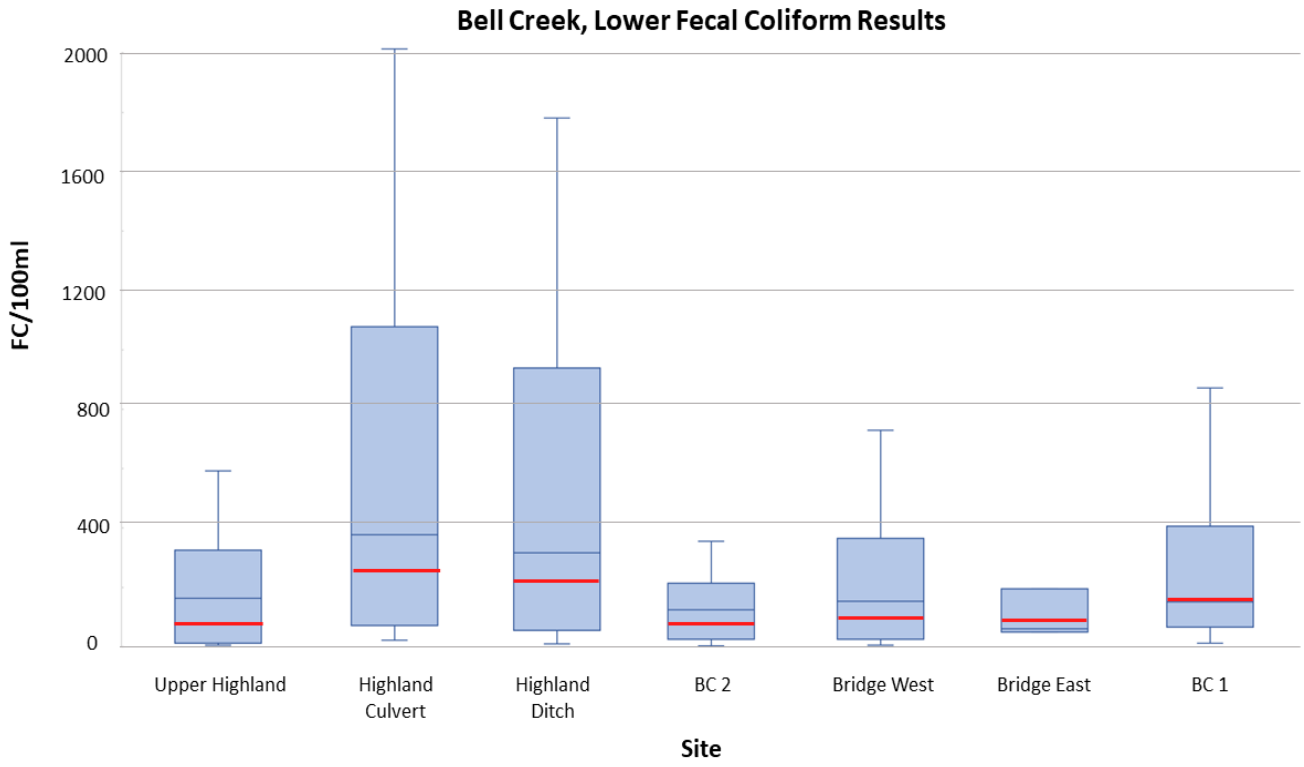
Summary of all Matriotti Creek temperature data collected from April 2020 through December 2022. (MAT 1 *n* = 14, MAT 7 *n* = 25, MAT 8 *n* = 24, MAT 9 *n* = 24, MAT 10 *n* = 26, MAT 11 *n* = 25, MAT 12 *n* = 26, MAT 13 *n* = 16).

Figure 14. Bell Creek Upper Segmented Sampling Fecal Coliform Levels.



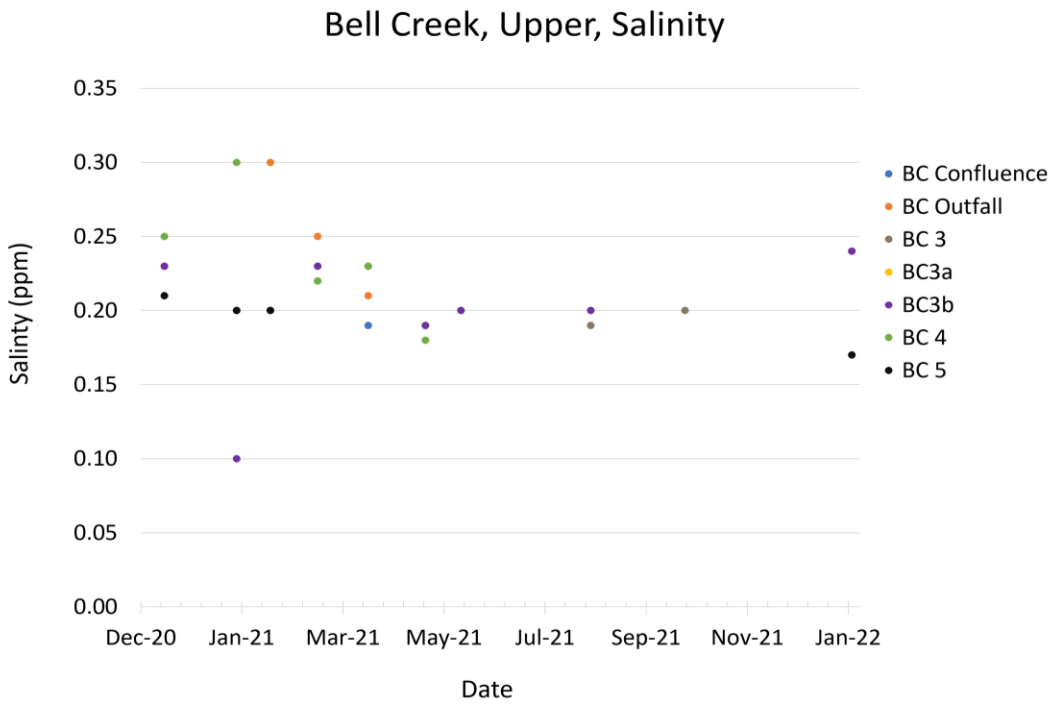
Upper Bell Creek fecal coliform counts measured in colony-forming units per 100 ml sample at 7 segmented sampling sites, February 2020 - February 2022. Box and whisker plots denote minimum value (lower whisker), geometric mean (red line), and maximum value (upper whisker). BC Confluence *n* = 13, BC Outfall *n* = 9, BC 3 *n* = 16, BC 3a *n* = 12, BC 3b *n* = 15, BC 4 *n* = 9, BC 5 *n* = 6.

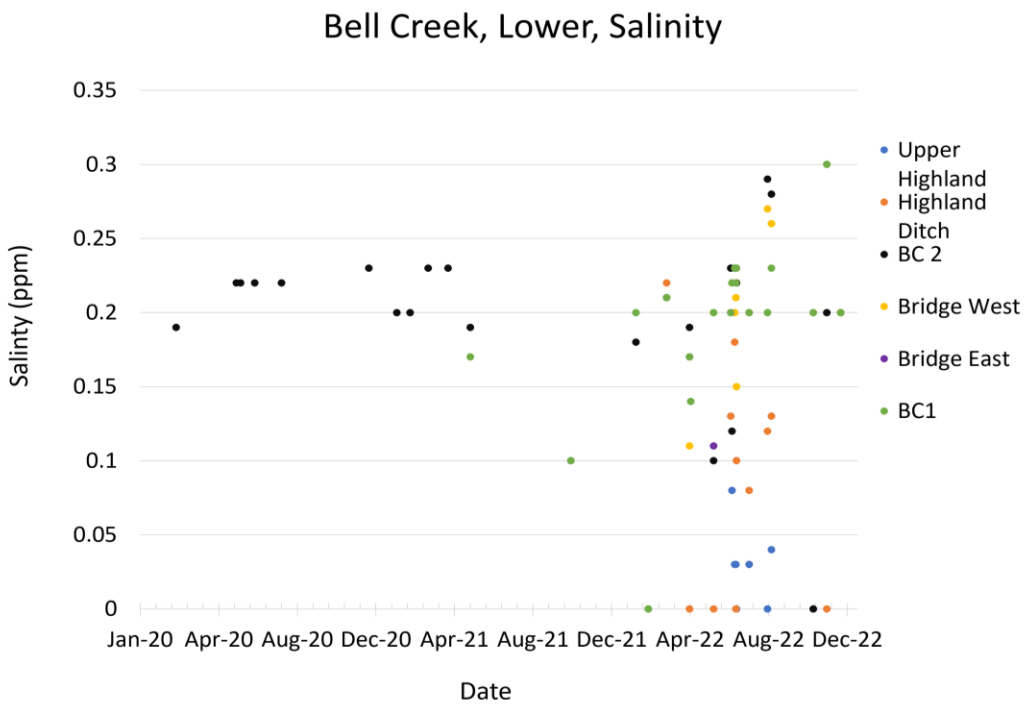
Figure 15. Bell Creek Lower Segmented Sampling Fecal Coliform Levels.



Lower Bell Creek fecal coliform counts measured in colony-forming units per 100 ml sample at 7 segmented sampling sites, February 2020 - December 2022. Box and whisker plots denote minimum value (lower whisker), geometric mean (red line), and maximum value (upper whisker). Upper Highland *n* = 11, Highland Ditch *n* = 18, BC 2 *n* = 30, Bridge West *n* = 15, Bridge East *n* = 3, BC 1 *n* = 25.

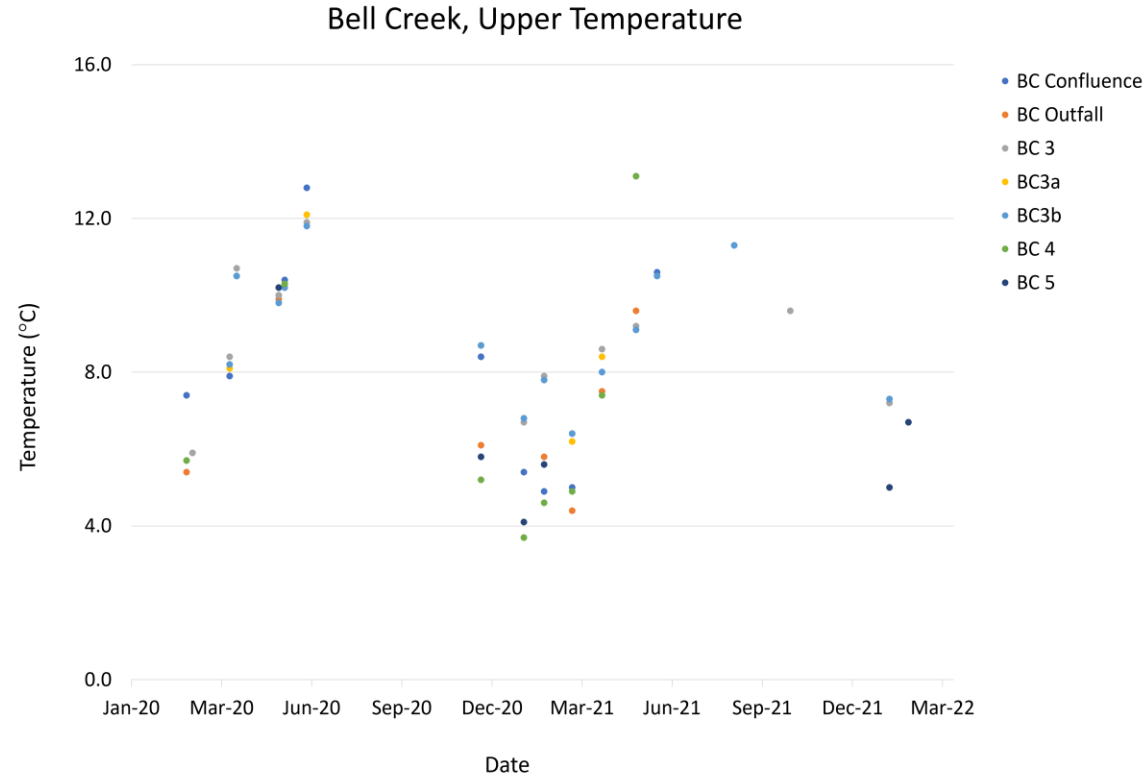
Figure 16. Summary of Bell Creek Segmented Sampling Salinity Data.

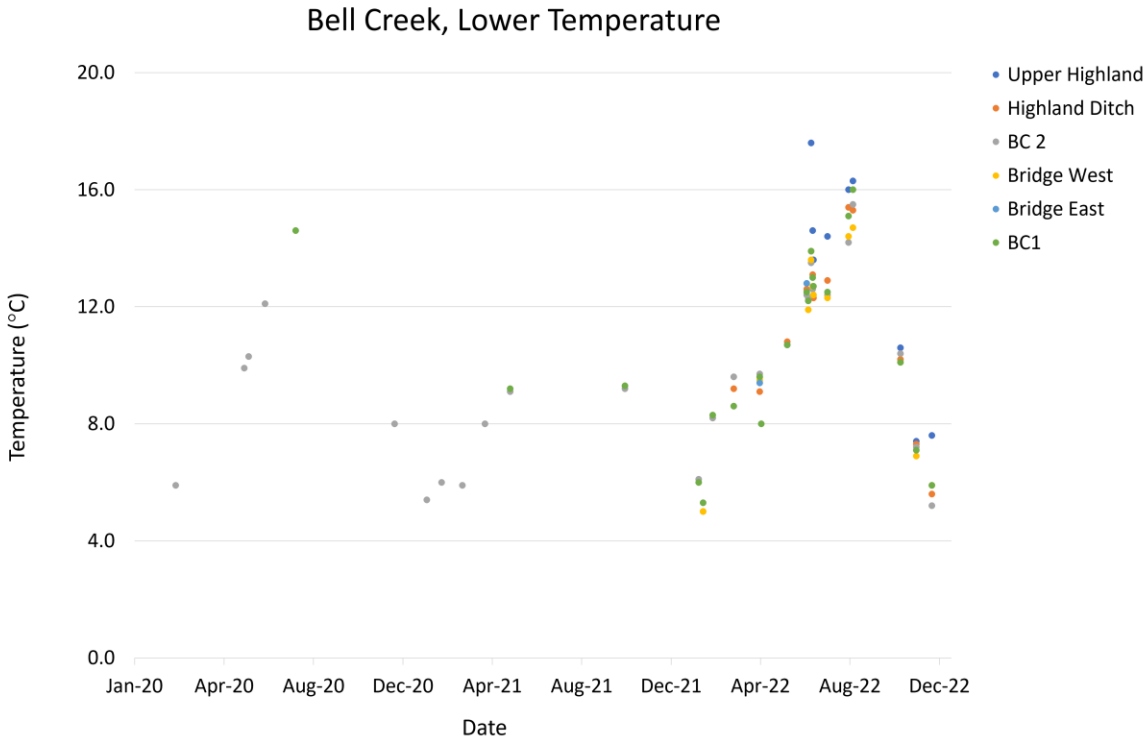




Summary of Upper and Lower Bell Creek salinity data collected from January 2020 through December 2022. BC Confluence *n* = 13, BC Outfall *n* = 8, BC 3 *n* = 16, BC 3a *n* = 11, BC 3b *n* = 14, BC 4 *n* = 9, BC 5 *n* = 5, Upper Highland *n* = 10, Highland Ditch *n* = 13, BC 2 *n* = 28, Bridge West *n* = 12, Bridge East *n* = 3, BC 1 *n* = 19.

Figure 17. Summary of Bell Creek Segmented Sampling Temperature Data





Summary of Upper and Lower Bell Creek temperature data collected from January 2020 through December 2022. BC Confluence *n* = 13, BC Outfall *n* = 8, BC 3 *n* = 16, BC 3a *n* = 11, BC 3b *n* = 14, BC 4 *n* = 9, BC 5 *n* = 6, Upper Highland *n* = 10, Highland Ditch *n* = 14, BC 2 *n* = 27, Bridge West *n* = 13, Bridge East *n* = 3, BC 1 *n* = 21.

"Hot Spot" Investigation

Where heightened bacteria levels were found (generally over 50 fecal coliform CFU/100 ml) field teams made an effort to return for multiple sampling visits. At least three sequential measurements were needed to calculate the geometric mean of fecal coliforms and characterize a site as a "hot spot" for closer scrutiny. Ideally, sampling visits for the purpose of hot spot designation should occur in succession, over several days, within an overall time period of no more than two weeks after the initial sampling date, given staff availability. If multiple hot spots were found, the following prioritization scheme was implemented: low priority—50 CFU/100 ml to 99 CFU/100 ml, medium priority—100 CFU/100 ml to 399 ml, high priority—greater than 400 CFU/100 ml.

Equation 1. Geometric Mean Calculation for the Purpose of Hot Spot Designation.

$$\sqrt[n]{sample_1 \times sample_2 \times \ldots \times sample_n}$$

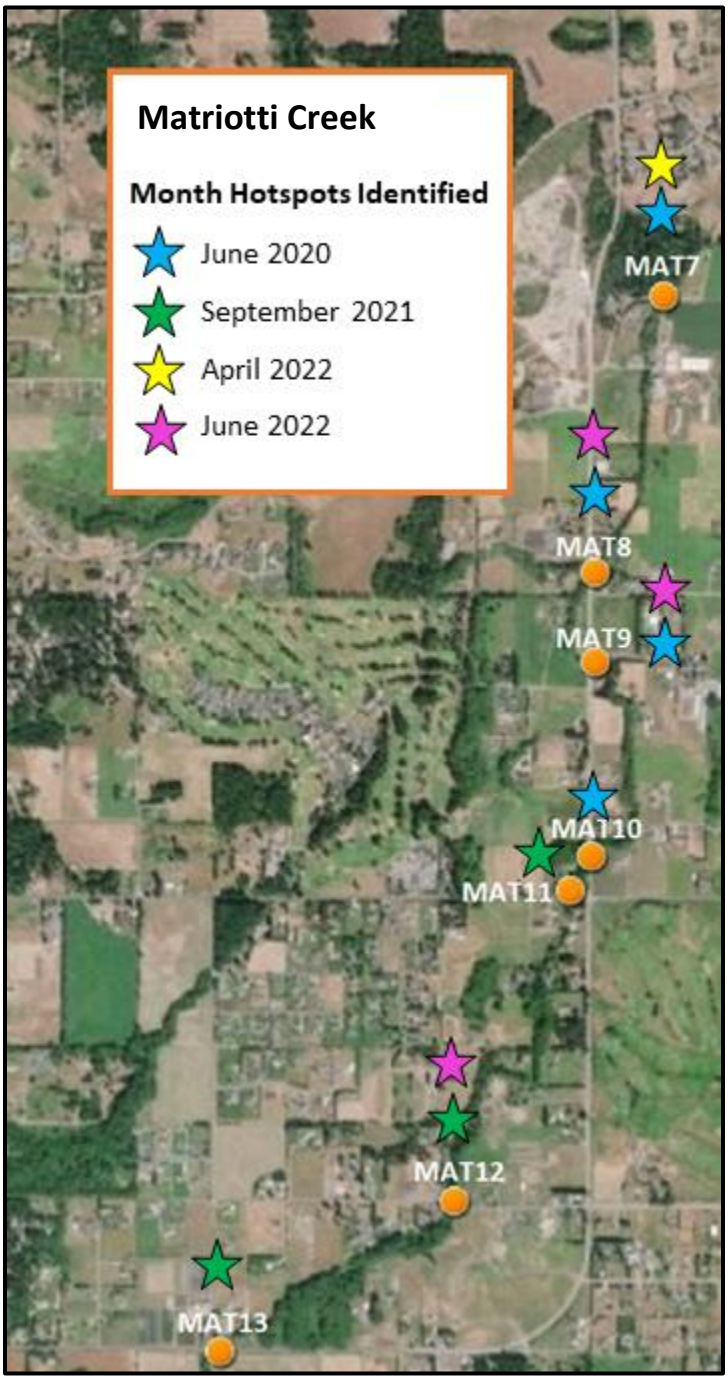
For the purpose of classifying a segmented sampling site as a hot spot at least three sequential fecal coliform concentration measurements are needed. The geometric mean takes the n^{th} root of the product of *n* samples.

Table 2. Matriotti Creek Segmented Sampling Values Used for "Hot Spot" Designation.

	MAT 1	MAT 7	MAT 8	MAT 9	MAT 10	MAT 11	MAT 12	MAT 13
6/16/2020					758			
6/24/2020		204	304	286	232			
7/1/2020		296	324	378	580	386		
7/7/2020		264	368	292		220		
9/20/2021						76	164	56
9/23/2021							928	18
9/29/2021						50	656	
10/4/2021						20	220	16
4/19/2022		144						
4/21/2022		220						
4/25/2022		840						
6/16/2022	452						336	
6/21/2022	242		400	424			504	
6/23/2022	288		356	424			236	
6/27/2022	320		230	320				

Subset of segmented sampling data used for geometric mean calculations in order to classify hot spots.

Figure 18. Matriotti Creek Segmented Sampling site map showing "Hot Spots"



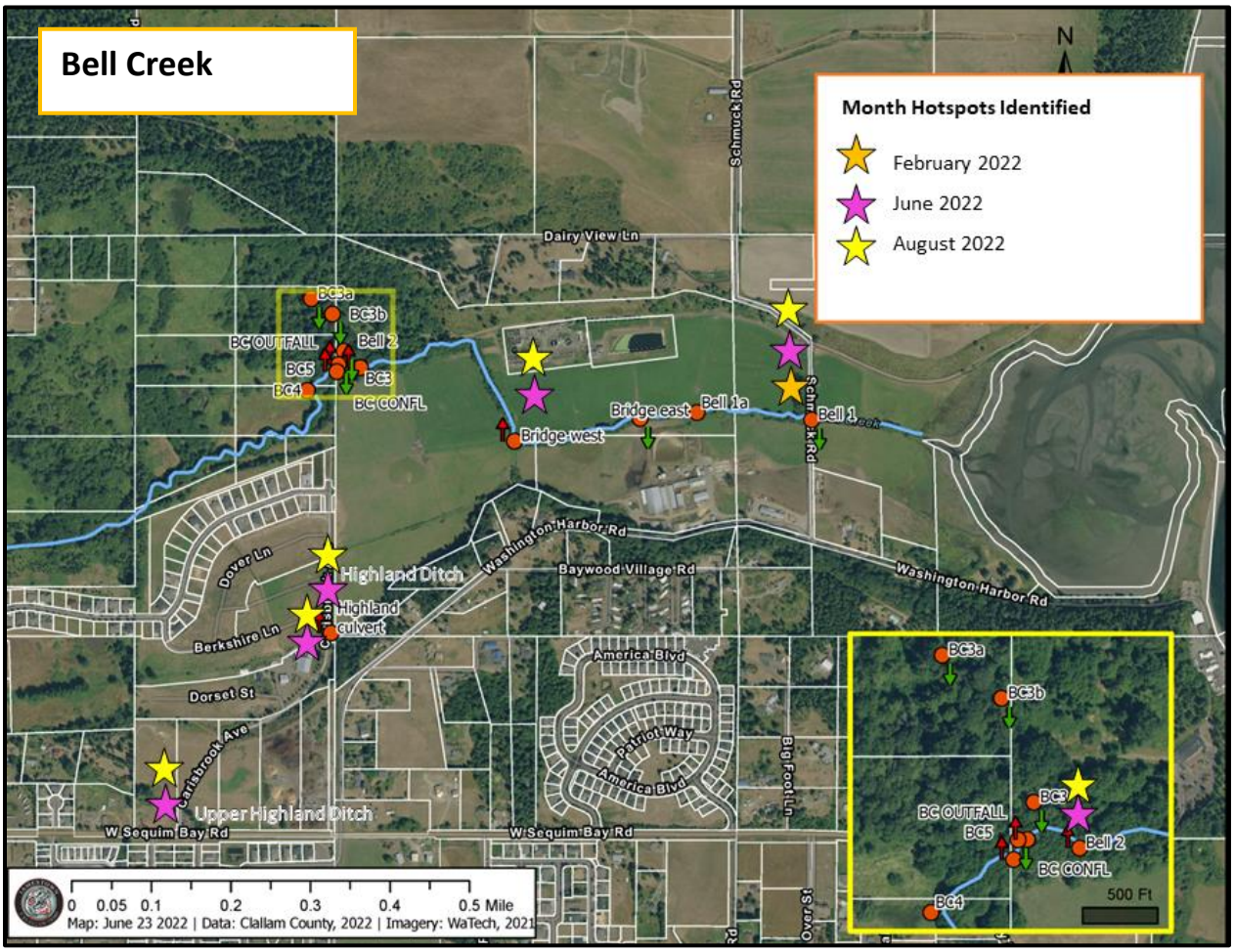
Segmented sampling sites on Matriotti Creek identified as hotspots during project period. Map data from ESRI and Clallam County. MAT 1 Hotspot data presented above; *not shown on this map*. Note: MAT 13 sampled as potential Hotspot in September 2021, denoted by a green star, however fecal coliform results were below hotspot range designation.

Table 3. Bell Creek Segmented Sampling Values Used for "Hot Spot" Designation.

	BC 1	BC 2	Upper Highland	Highland Culvert	Highland Ditch	Bridge West
2/2/2022	52					
2/15/2022	144					
2/22/2022	88					
6/16/2022	120	84			332	
6/21/2022	254	172			1008	
6/23/2022	148	212	584	640	628	280
6/27/2022	400	710	180	150	290	500
6/29/2022	740	760	10	60	1700	720
6/30/2022	460	650	1130	2010	2650	400
8/16/2022	520	160	320	1600	1760	106
8/22/2022	160	210	240	600	900	250
8/30/2022	860	200	160	1200	700	150

Subset of segmented sampling data used for geometric mean calculations in order to classify hot spots.

Figure 19. Bell Creek Segmented Sampling site map showing "Hot Spots"



Segmented sampling sites on Bell Creek (including Highland Ditch) identified as hotspots during project period. Map data from ESRI and Clallam County.

Table 4. Calculated "Hot Spot" values for Matriotti and Bell Creeks.

	BC 1	BC 2	Upper Highland	Highland Culvert	Highland Ditch	Bridge West		
February 2022	95							
June 2022	354	431	476	715	1101	475		
August 2022	513	190	240	1133	1120	169		
	MAT 1	**MAT 7**	**MAT 8**	**MAT 9**	**MAT 10**	**MAT 11**	**MAT 12**	**MAT 13**
June 2020		255	332	319	437	403		
September 2021						49	492	30
April 2022		401						
June 2022	326		329	389			359	

Using the equation above, 7 sampling locations along Matriotti, and 6 sampling locations along Bell Creek/Highland Ditch were identified as hotspots.

Land Use/Parcel Analysis

Offsite Parcel Assessments

155 Parcel Assessments were completed between March 2020 and June 2023. These parcels were reviewed using available information such as aerial photos, tax records, land use classifications, building permits, and onsite sewage system records. This review assisted in the prioritization of efforts for further investigation as to influences upon waterways within the project area. In general, proximity to surface waters, type of land use, and factors such as septic systems without as-built drawings or regular inspections on file led to closer scrutiny.

Site Investigations/Parcel Surveys

Clallam County Environmental Health performed 51 individual property visits, resulting in 19 parcel surveys, in particularly high-risk portions of the 2020-2023 PIC Focus Area, flagged by previous parcel analysis as well as segmented sampling results. This involved on-the-ground visits where EH staff, using a PIC Survey Form developed by project partners as part of the PIC Plan, evaluated aspects of each property that could potentially impact waters of the project area. Specifically, evaluators considered: 1)

storm water/run-off from impervious surfaces, 2) any pet/animal waste present, 3) sewage disposal methods, and 4) any other factors that could lead to water pollution.

Corrections Made

BMPs Implemented

Animal-keeping operations were observed immediately adjacent to waterways within the current PIC Focus Area. This included properties with everything from a single livestock animal up to full-time working agricultural and dairy farms. Clallam Conservation District recommended and provided technical assistance for best management practices throughout the PIC Area. This included advising on projects such as proper manure storage, stormwater runoff and mud management in pastures, and implementing conservation practices such as controlling for noxious weeds and enrolling farm owners in CREP (Conservation Reserve Enhancement Program). Five properties were referred to CCD through the PIC program. Three were for properties which had livestock with access to Matriotti Creek, and two were for manure/cow compost pile runoff into Bell Creek and Matriotti Creek. CCD provided assistance with fencing of livestock away from creeks and coordinating with farmers to relocate manure and compost piles away from areas of runoff/nearby waterbodies.

Inspections

Regular Operation and Maintenance (O&M) inspections serve as an important tool to uncover failing onsite sewage systems and prevent failures. Clallam County Environmental Health developed an enforcement protocol, with guidance from the County Prosecuting Attorney's Office, in order to compel residents to comply with performing regular inspections. At the start of Covid in March 2020, this process was put on pause, to minimize undue additional burdens on individuals during the pandemic. In early 2023, the enforcement protocol resumed, addressing a property of concern along Matriotti Creek.

Evaluation/Discussion

Interpretation of Water Quality Results

Trends Discussion

Over the course of this study, fecal coliform metrics were higher in recent years (2019-2022) when compared to 2015-2019 data, for Bell Creek, Lotzgesell Creek, Matriotti Creek, McDonald Creek, Meadowbrook Creek, and Meadowbrook Slough.

In 2020 and 2021, geometric mean fecal coliform levels in Bell and Matriotti Creeks were higher than 100 CFU/100mL. In 2022, this held true for Bell Creek, however Matriotti Creek saw a decrease in geometric mean, however, was still not meeting acceptable water quality standards (above 43 CFU/mL). As in previous years, these two creeks had higher levels of fecal coliform than most other creeks being monitored. Though these creeks have been a focus for pollution identification and correction, and progress is being made, these results demonstrate that continued effort is needed in these watersheds.

PIC Project Partners elected to include lower Bell Creek as part of the 2019-2023 PIC Focus Area in an effort to seek and eliminate any potential sources of bacterial pollution and avoid taking steps backward from gains in shellfish growing area upgrades that occurred in 2018. Initial work began in the 2019-2022 Focus Area in December 2019. PIC Baseline Trends Monitoring data from Bell Creek were used as a line of evidence to justify the shellfish growing area upgrade (along with many other reasons including good marine water quality).

Very generally, these relative comparisons support the Clean Water Work Group's decision to give specific attention to a PIC Focus Area including Matriotti Creek and Bell Creek. Ultimately, selection of the 2020-2023 PIC Focus area took into account: 1) available data, 2) scope/logistic feasibility, 3) direct connection to desired benefits (proximity to marine waters impacted by shellfish bed downgrades).

PIC Baseline Trends Monitoring aims to gain a picture of Clean Water District streams at their points of discharge into receiving waters. Ideally, the project aims to describe the physical and chemical properties of upland contributors impacting receiving waters. Baseline Trends Monitoring Program Annual Reports (Streamkeepers 2022, Streamkeepers 2023) review all chemical and physical Trends data in depth and provide further analysis of year-over-year changes in Clean Water District waterways.

Segmented Discussion

Matriotti Creek

Overall, MAT 1 and MAT 7 had the highest geometric means for the 2020-2022 time period, falling between the 100-200 CFU/100ml range, with highest hits above 700 CFU/100ml. This result was expected for MAT 1, as it's directly downstream of a large game farm. MAT 7 had a less obvious cause for several months, and we added three sampling stations between MAT 7 and MAT 8 to attempt to isolate the section of creek with a pollution source. During this additional sampling, cows were spotted in a pasture bordering the creek just upstream of MAT 7, and cow poop was seen along the edge of

Matriotti Creek. Further follow up samples were taken to confirm the pollution location, and this information was relayed to the property owner, who after working with CCD moved the cows to a different pasture not bordering Matriotti Creek.

MAT 8 through MAT 12 fell within 75 – 100 CFU/100ml. Attempts to isolate pollution sources were unsuccessful along this section of the creek. Various potential pollution sources, such as piling of grass clippings along a stream bank, beaver dams, and residential construction were all investigated. Several properties with septic systems in need of inspections were identified, but almost all were out of date by only 1-2 years. No unknown or failing systems were identified, and no noticeable septic systems issue were observed during sampling or property surveys (sewage smell, bright green grass/plant foliage, pooling water). MAT 12 is downstream of a property that has a current full-time resident and a non-functioning wastewater system. It is expected that this property is contributing to high hits at MAT 12, but due to lack of homeowner permission downstream, follow-up sampling at a small enough scale was not possible. This property is currently being addressed using the septic inspection compliance protocol.

Upon further examination of the data, seasonality is thought to be tied in with fecal coliform spikes. Sequim, WA has a notable distinction between its rainy season (November to March) and dry season (April-October). In addition, though less prevalent than several decades prior, there is still a significant agricultural industry in the area, as well as many hobby farms. In April, irrigation season begins and continues through September. We suppose that the dry season, in combination with overlapping timeframes of irrigation and fertilization practices, is a potential contributing factor to spikes we see in fecal coliform results from April to October. It would be difficult to separate spikes seen due to large scale irrigation from any distinct point source pollution, if a sampling date and time happened to overlap with two pollution sources. An anecdotal connection between FC spikes and spring waterfowl presence was noted, as were spikes after the first heavy rain in the fall.

Salinity and temperature patterns fell within a relatively close monthly range for all Matriotti sites (0.0-0.22ppm, and 4.0 to 15.8 degrees Celsius, respectively). There is a seasonal fluctuation in values, but nothing of significance was noted.

Bell Creek

Bell Creek saw two distinct sampling periods respective to sites sampled between 2020-2022. From 2020 to early 2022, sampling focus was on Bell Creek “Upper,” an area largely forested and accessible to wildlife, as well as the location of a cow compost pile from the neighboring dairy farm. Early investigation showed high FC hits in this area, and it was suspected the cow compost pile was contributing to FC levels via water runoff. The cow pile was moved immediately by the farm owner. The area was not sampled over a long enough period of time to confirm this was contributing to high FC levels, but since that time, FC levels have fluctuated consistently with the time of year. Additionally, directly upstream of this section of Bell Creek is a man-made wetland. On this property are several small channels of water, that flow through two large pools. This area was investigated with additional sampling in February of 2023, and though was not found to have significantly high levels of fecal coliform, did have signs of the recent presence of an elk herd.

The second sampling period during 2022 focused on Bell Creek "Lower." This area consisted of lower Bell Creek, and the upstream Highland Irrigation Ditch which feeds into the creek. Highland Ditch and Highland Culvert showed highest geometric means, at 208 CFU/100mL and 254 CFU/100mL respectively. The site upstream of these sites, Upper Highland Ditch, had a geometric mean of 74 CFU/100mL, and the sites downstream of these sites, Bridge West, Bridge East, and BC 1, had geometric means of 98 CFU/100mL, 81 CFU/100mL, and 145 CFU/100mL, respectively. The site which looks at fecal coliform levels on Bell Creek before Highland Ditch meets Bell Creek, BC 2, had a geometric mean of 75 CFU/100mL. In looking at the geometric means above, it is possible the property between Upper Highland Ditch and West Bridge is potentially contributing fecal coliform to the Highland Ditch water, however it is diluted once it meets Bell Creek waters. This meeting point also marks the far corner of a dairy farm, and the increase we see between West Bridge and BC 1 could be due to low levels of manure runoff from pastures bordering the creek. Potential manure runoff was addressed promptly by the dairy owner once aware, and the pasture area sloping towards the creek has been fenced off, to prevent cows from grazing there, on the chance it was contributing fecal coliform to the environment. The property between Upper Highland Ditch and Bridge West was undergoing subdivision construction during 2022, and during that time "excess vegetation," primarily in the form of reed canary grass and Cottonwoods, was removed from the ditch waterway. It is not expected these activities would be an additional input of fecal coliform to the system, but sediment disruption is known to result in increased fecal coliform results.

While these geometric means do not meet state water quality standards, they are potentially not as concerning as the high fecal coliform spikes captured during sampling in June 2022 and August 2022. The June 2022 event included 7 sites, each sampled 4-6 times, over a 15-day period. Sampling results reflected a wide variation in fecal coliform at each site between days. For example, BC 2 increased from 84 to 760 CFU/100mL over 14 days, and dropped to 650 on day 15. Highland Ditch varied between low, moderate, and very high spikes, with fecal coliform levels of 332, 1008, 628, 290, 1700, and 2650 CFU/100mL consecutively over the 15-day period. The other four sites sampled during this time period, BC 2, Highland Culvert, Upper Highland, and Bridge West showed similar fluctuations, however the range was not as broad. Highland Culvert and Bridge West showed high spikes, 2010 and 1130 CFU/100mL respectively, on the 15th day. A similar pattern for these six sites was seen in August 2022, with the highest value reported as 1760 CFU/100mL at Highland Ditch.

Fecal coliform can vary significantly temporally, even with samples taken within an hour of one another, and this could be a contributing factor in the variation seen during the two sampling events described above. Additionally, variation could be due to timing of increased or decreased flow in the waterways (input of irrigation waters from system source) relative to the timing of sample collection, as well as timing of fecal coliform input. Despite the variation seen, it is likely there was a source of fecal coliform input to the waterway during these time periods. Despite thorough observation of areas bordering the ditch and creek waters, and sampling back-to-back on 6/27/22, 6/29/22, and 6/30/22, we were unable to locate a clear cause of increased fecal coliform results, however we do expect it is related to human activities, as opposed to wildlife or livestock.

During 2022, EH also received 2 complaints through the ERTS system, from residents further upstream in the Highland Irrigation Ditch system, of neighbors suspected of dumping raw sewage from a motorhome into the ditch water. Follow up sampling was taken during this time, but no high hits of fecal coliform were seen. This could be because dumping didn't occur, or sampling timing missed the influx of raw sewage as it travelled through the waterway. While these complaints could not be tied to the high spikes we have seen in the irrigation ditch system, we are now aware this is a potential issue, and due to the large number of seasonal motorhomes on properties upstream, will incorporate this into future education and outreach work in the area.

Salinity patterns for both Upper and Lower Bell Creek sites varied relatively widely in their monthly range (0.0-0.31ppm), but overall results were within expected limits for freshwater samples. Temperature values showed a similar seasonal pattern as seen at Matriotti sites, ranging from 3.8 to 13.0 degrees Celsius, also within expected limits.

Hot Spot Calculations

Segmented sampling sites MAT 1, MAT 7, MAT 8, MAT 9, MAT 10, MAT 11, and MAT 12 were officially designated as hotspots along Matriotti Creek, while sites BC 1, BC 2, Upper Highland, Highland Culvert, Highland Ditch, and Bridge West were designated as hotspots along Bell Creek/Highland Ditch.

While project partners attempted to follow the PIC Plan as closely as possible, staffing limitations prevented follow-up visits to the waterways in question, on occasion. As such, hotspot designation may appear somewhat arbitrary: sites BC 3, BC 3a, and BC3b for example, in May and June of 2021, showed concerning fecal coliform concentrations (536-1008 CFU/100 ml) though no sequential follow-up measurements are available for the purposes of characterizing a hot spot. During the summer and fall of 2021, the PIC Program was without a program lead, and this resulted in reduced staff ability to take follow-up samples, however one hotspot along Matriotti was identified in September 2021 (MAT 12). Dedicated staff were hired in December 2021, and this allowed for increased sampling and hot spot designation.

When multiple hotspots were designated during a sampling event, they were ranked highest to lowest, and assigned a relative priority level. Follow up investigation then occurred for the 1-3 highest ranked sites, and properties bordering the hotspot were looked at following the parcel analysis criteria. Anything of concern was noted, and either incorporated into the on-the-ground property survey plan, referred to either CCD or the EH On-Site program, or marked as needed for additional sampling and observation during the next monthly sampling event.

Hotspot designations were important to focus our efforts in follow-up with a subset of properties in the area, and in providing clues to properties that may benefit from referrals. It also helps to elucidate, though anecdotally, that seasonality is present in our fecal coliform results, and this suggests there are additional factors, possibly irrigation or fertilization practices, that are influencing our results but are not being accounted for in any quantitative way. It is possible taking flow measurements on sampling days,

as well as accounting for weather events such as snow and rainfall, will help to piece apart what is resulting in increased seasonal fecal coliform levels in our creeks.

Inspection Enforcement

Due to both the Covid pause on inspection compliance enforcement, and limited staffing, no quantitative measurement was able to be made to determine increased inspections specifically due to work done under this grant. In lieu of our standard enforcement protocol, EH relied on postcard mailers to homeowners in past and present PIC Focus Areas that were out of compliance, to notify homeowners they were in need of a septic inspection. This work was largely conducted under another grant, but is directly in support of the PIC program in the Dungeness and Sequim Bay watersheds.

In an attempt to encourage "compliance without enforcement" from homeowners who were behind on their septic inspections, a new version of our standard Homeowners septic referral letter was created. This version provided homeowners with local water quality education and financial resources through a rebate program, with the goal of homeowners agreeing to comply with the inspection requirement on their own. Due to limited implementation (6 properties), this did not result in any new inspections for these six properties. However, we hope to build on this program in future PIC Focus Areas, and use this limited Pilot study as a first step in developing a more well-rounded program.

Corrections Discussion

Within the 2020-2023 PIC Focus Area technical assistance to farmers and implementation of best management practices in agricultural operations contributed to reducing and preventing future sources of pollution. PIC program directed pollution correction efforts related to livestock and farms helped reduce high fecal coliform hits at several properties.

Small lot sizes compounded with financial resources of property owners placed significant barriers in the way of many needed pollution correction efforts within the greater PIC project area. Where non-conforming sewage disposal methods are employed by property owners, physical limitations can place significant constraints on the type of conforming onsite sewage system available as a solution. Further, financial means of property owners can place possible pollution correction solutions out of reach without significant assistance.

Craft 3 Clean Water Loans and cost share assistance provided by Clallam Conservation District made various pollution correction measures in the form of upgrades to conforming onsite sewage systems possible. With the design and installation of conforming OSS, non-permitted sewage holding tanks were removed, non-permitted transport of septage was eliminated, direct greywater discharges into the environment were stopped, and do-it-yourself solutions to sewage conveyance and storage were reduced.

In many cases, pollution correction is not possible without some form of financial and/or technical assistance. The ability to refer property owners to outside organizations for assistance makes a marked positive impact on water quality within the Dungeness and Sequim Bay watersheds.

Follow-Up/Next Steps

Moving forward, compliance efforts will need to continue in the 2020-2023 PIC Focus Area to bring about needed pollution corrections. Specific actions still needed include:

1) Clallam County Environmental Health will continue septic inspection compliance timelines begun in Upper Matriotti (1 in process, 4 to receive first letter's in early August 2023)
2) Clallam County Environmental Health will follow up with administrative penalties for one property owner in the Matriotti Creek neighborhood neglected septic inspection compliance timelines;
3) Clallam County Environmental Health will pursue future PIC work upstream of current sample sites along both Matriotti Creek and Bell Creek, in an attempt to identify pollution sources that could have contributed to high fecal coliform counts at MAT 10-13, as well as conduct follow-up sampling of past hotspot sites;
4) Regular Baseline Trends Monitoring will continue on Clean Water District Streams to guide Clean Water Work Group decisions on where to focus future pollution correction efforts.

A new, 2023-2025 PIC Focus Area, selected by the Clean Water Work Group, including large portions of "Upper Upper" Matriotti and Upper Bell Creek/Highland Ditch, is beginning an investigative phase under a new round of funding from Washington State Department of Ecology. Here, segmented water quality sampling will be used to highlight sections of Matriotti and Bell Creeks in need of remediation due to bacterial pollution. A cursory review of the new focus area indicates greater prevalence of agricultural and animal-keeping practices, as well as commercial businesses surrounded by non-porous concrete and large open areas with high wildlife traffic within the watershed.

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