# Nooksack River Transboundary Technical Collaboration Group 2020-2021 Annual Report

**FINAL**

July 2021


# Executive Summary

The British Columbia (B.C.) - Washington (WA) Nooksack River Transboundary Technical Collaboration Group (TCG) formed in August 2018 to reduce fecal indicator bacteria (fecal bacteria) concentrations in the Nooksack River watershed. The TCG was established as a three–year project scheduled to end July 31, 2021.

In August 2020, the TCG began its third and final year of formally coordinated project work to reduce fecal bacteria concentrations in the Nooksack River watershed. This 2020-2021 TCG annual report summarizes third year project activities, focusing on the three Nooksack River watershed sub-basins that span the border between B.C. (Canada) and WA (United States of America).

In 2019 B.C. and WA partners set TCG project short-term and long-term border benchmarks for *Escherichia coli* (*E. coli*) concentrations. At four border monitoring locations, the short- and long-term goals were to be met by 2021 and 2024, respectively. B.C. and WA partners sample surface water at the international border to compare results to the established benchmarks.

B.C. data analysis shows that 2020 dry and wet season *E. coli* concentrations met the short-term border benchmark at the Fishtrap Creek border site. The Pepin Brook border site met the short-term benchmark in the dry season but not the wet season. Cave Creek met the border benchmark in the wet season but not the dry season. Bertrand Creek border sites failed to meet the short-term benchmark in both the wet and dry season. B.C. and WA data analysis for 2020-2021 noted an increase in fecal bacteria concentrations in the Bertrand, Pepin, and Fishtrap sub-basins when compared to the prior two years. Analysis of the past three years of data continues to demonstrate the impacts of rainfall, and thus season, on fecal bacteria concentrations.

The Nooksack River is the largest freshwater source to Portage Bay and to the Lummi Nation's Portage Bay Shellfish Growing Area. Portions of the Portage Bay Shellfish Growing Area are classified as Approved and Conditionally Approved for commercial shellfish harvest. The Conditionally Approved portion of the shellfish growing area remains closed to harvest from October-December each year due elevated concentrations of fecal coliform in the marine water during the fall and early winter season. Portage Bay's 2020 Annual Growing Area evaluation assessed a 30-sample dataset through December 2020 for the growing area's marine monitoring stations. The evaluation determined that five Portage Bay Shellfish Growing Area water monitoring stations are threatened with a downgrade in classification.

During the past year, B.C. and WA continued to collect water samples in the Nooksack River watershed to help identify locations of potential fecal bacteria sources. Agencies acted on complaints, offered technical assistance to help landowners control fecal bacteria sources, and conducted regulatory compliance activities. Both jurisdictions engaged commercial and non-commercial agricultural, rural residential, and suburban community members through non-regulatory education and outreach. During the final TCG project year, COVID-19 restrictions altered the way agencies delivered outreach and stewardship activities. B.C. and WA partners shared communication plans and materials and promoted similar spring 2021 outreach materials on both sides of the border.

The TCG Terms of Reference documented a project purpose to "reduce fecal coliform bacteria contamination at transboundary stream locations of the Nooksack Watershed." Based on results compiled through the project's third year we did not achieve the project's short-term border benchmark at all border locations and have not reached Approved classification throughout the Portage Bay Shellfish Growing Area during the three-year project period. The Nooksack River continues to deposit fecal bacteria into Portage Bay where portions of the Lummi Nation's Shellfish Growing Area fail to meet standards to allow year-round shellfish harvesting. We continue to measure high bacteria concentrations throughout this shared watershed.

TCG project partners know finding and fixing sources of nonpoint pollution often take time and require follow up to educate, encourage, support, and confirm sustained source control and regulatory compliance. The three-year workplan did not anticipate that over a year of COVID-19 precautions would restrict staff's ability to perform field work and to engage and support residents in finding and fixing bacteria pollution sources. TCG partners see value in continued collaborative efforts within a shared watershed to support related natural resource protection initiatives and activities. Acknowledging the value of coordination, multi-year commitment, and dedicated resources, this report identifies ongoing commitments and recommendations beyond July 31, 2021 toward improving water quality and protecting public health across boundaries.

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# Introduction

The British Columbia (B.C.) - Washington (WA) Nooksack River Transboundary Technical Collaboration Group (TCG) began its formal partnership in August 2018, guided by a Terms of Reference and three-year workplan. TCG partners work to reduce fecal indicator bacteria (fecal bacteria) concentrations in Nooksack River watershed transboundary sub-basins. More about TCG partnership origins and multi-year project data, sampling methods, and activities can be found in the *Nooksack River Transboundary Technical Collaboration Group 2018-2019 Annual Report* and the *Nooksack River Transboundary Technical Collaboration Group 2019-2020 Annual Report*.

The Nooksack River watershed (shown in Figure 1) encompasses the northwestern slopes of the Cascade Mountain Range through foothills and lowlands to Bellingham Bay in Whatcom County, WA. Much of the Nooksack River delta and the entirety of the Portage Bay Shellfish Growing Area are located within the boundaries of the Lummi Indian Reservation.

The mountainous part of the Nooksack River watershed's upper basin is drained by the North, Middle, and South forks of the Nooksack River. In the watershed's lower elevations near the town of Deming, WA, the forks converge as the mainstem Nooksack River. Downstream of Deming, the lower Nooksack River watershed drains mostly valley lands, including three sub-basins that span the international border between B.C., Canada and WA, United States of America. The TCG project focuses on the three transboundary sub-basins - Bertrand Creek, Pepin Brook, and Fishtrap Creek.

The three transboundary sub-basins contribute a significant proportion of flow to the lower Nooksack River watershed. Land use activities in the sub-basins on both sides of the international border periodically contribute to high fecal bacteria loads in the area's waterways. Seasonal fecal bacteria loading from these sub-basins contribute to high fecal counts in the Nooksack River. The Nooksack River flows to the receiving waters of Portage Bay where some marine monitoring sites fail to meet fecal bacteria criteria to allow year-round shellfish harvest. Portions of the Lummi Nation's Portage Bay Shellfish Growing Area remain closed to harvest October through December each year due to poor water quality.

The TCG completed its third and final year of formal project work during August 2020 to July 2021. This *Nooksack River Transboundary Technical Collaboration Group 2020-2021 Annual Report* (herein referred to as the 2020-2021 Annual Report) summarizes data analysis, project activities and status, observations, recommendations, and conclusions.

# Conditions Evaluation

This section highlights relevant B.C. and WA fecal bacteria data gathered in the three transboundary sub-basins of Bertrand Creek, Pepin Brook, and Fishtrap Creek from April 1, 2020 through March 31, 2021. The three sub-basins are described from upstream to downstream:

- B.C. – north of the international border within sub-basin boundaries,
- Border – monitoring sites located at the Canada-United States border,
- WA – south of the international border to the confluence with Nooksack River.

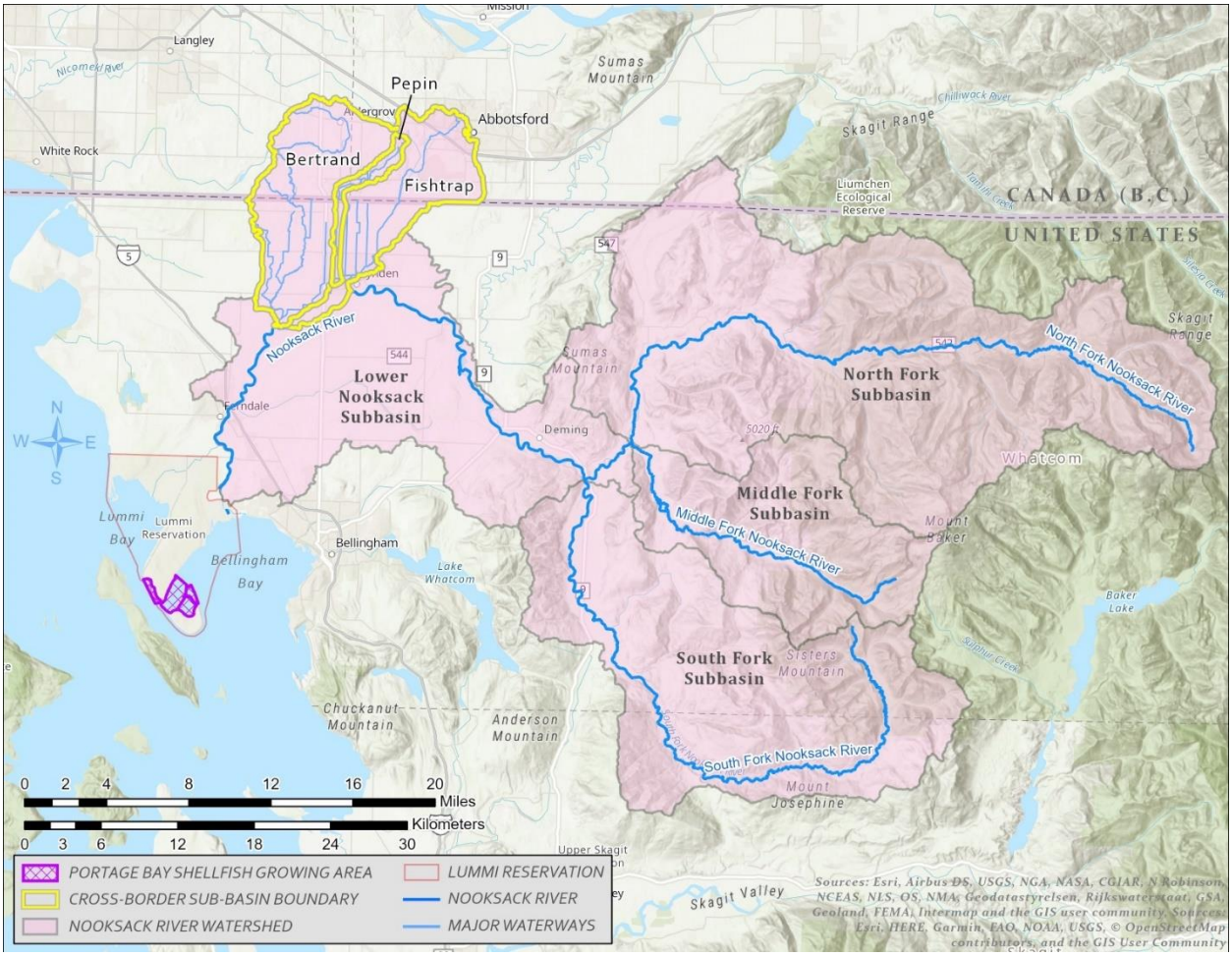



Figure 1. The Nooksack River Watershed including its transboundary sub-basins. Portage Bay Shellfish Growing Area is shown in purple (hatched).

Surface water monitoring in B.C. includes collecting and analyzing samples for both fecal coliform and for *Escherichia coli (E. coli)* as indicators of fecal bacteria concentrations measured in colony forming units (CFU) per 100 milliliter (mL). B.C. collects ambient samples at fixed locations monthly. B.C. complements the monthly ambient data with seasonal five consecutive weekly samples collected in 30 days (5-in-30) at four border sites. The 5-in-30 sampling aligns with requirements for comparison to B.C. water quality guidelines. Additionally, this project uses these 5-in-30 sampling event results to evaluate status relative to the project-specific border benchmarks.

In WA, Whatcom Clean Water Program partner monitoring focuses primarily on fecal coliform bacteria, though some partners also collect and analyze samples for *E. coli.* WA monitoring partners collect ambient samples at multiple locations within the Nooksack River watershed, including si.es at the international border. WA partners complement ambient sampling with storm event and source identification sampling throughout the lower Nooksack River watershed, including in the Bertrand, Pepin, and Fishtrap sub-basins.

The monitoring results summarized in this report can be found online on WA's Surface Water Monitoring for Fecal Coliform Bacteria map or B.C.'s Surface Water Monitoring Sites Interactive Map. Water quality guidelines applicable to this project and project-specific benchmarks are provided in Appendix 1. For a complete dataset or for data related questions, please contact Meg Harris (WA; mharris@whatcomcd.org) or Lyndsey Johnson (B.C.; Lyndsey.Johnson@gov.bc.ca).

The following sections provide an overview of the water quality by transboundary sub-basin and include figures of annual geometric means for fecal bacteria as well as the three-year geometric means. Additional data is provided in Appendix 3, including a summary of the number of sampling events, minimum, maximums, 12-month geometric means, and the percentage of events that exceed the applicable water quality guidelines.

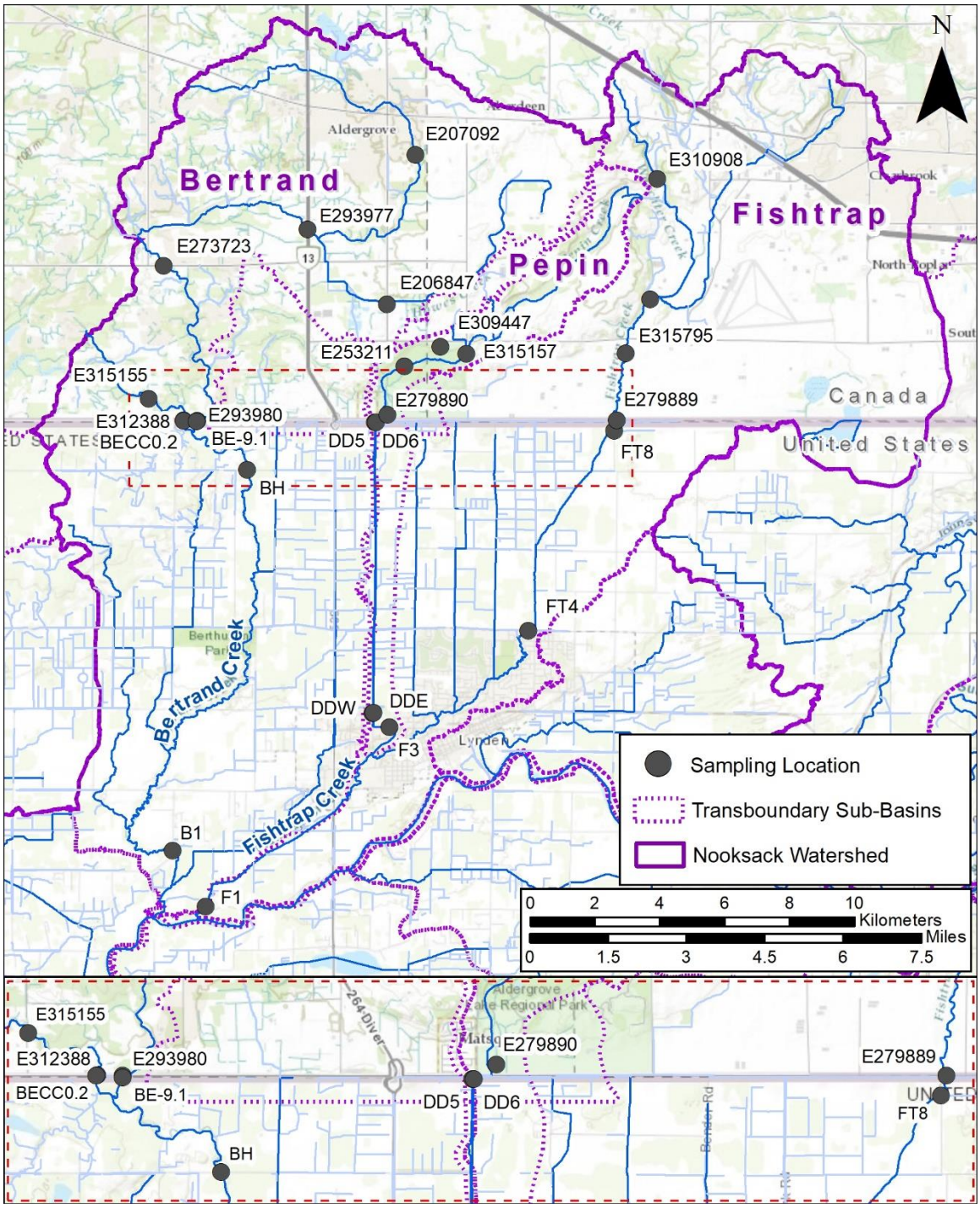


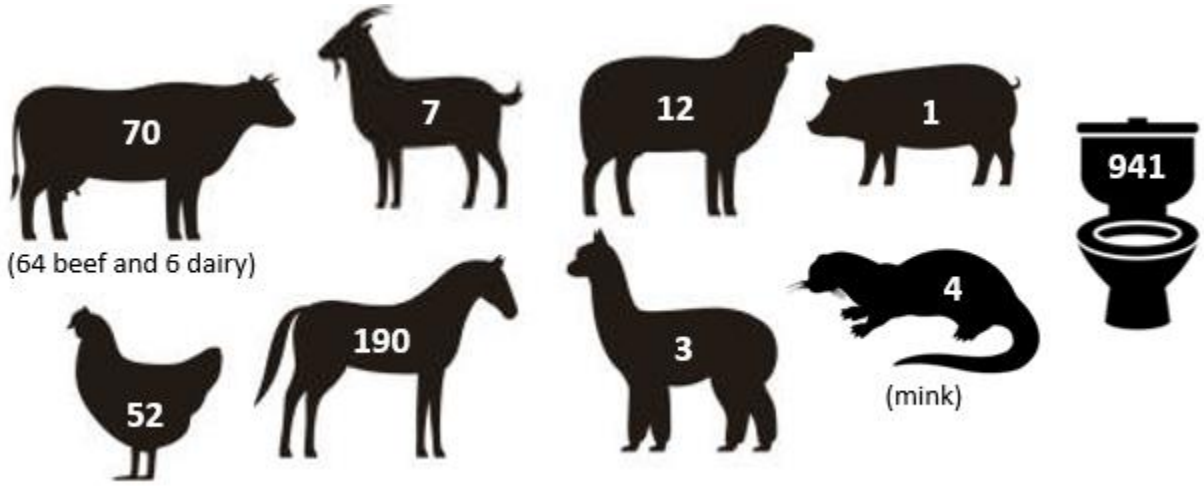

Figure 2. Bertrand, Pepin, and Fishtrap make up the three transboundary sub-basins. Monitoring occurs in all sub-basins on both sides of the international border and at sites directly adjacent to the border (lower inset).

## Bertrand Creek sub-basin

Bertrand Creek is a fish-bearing tributary of the Nooksack River. Bertrand Creek headwaters are in the most northwest end of the Nooksack River watershed in Aldergrove and Langley, B.C., Canada (Figure 2). The Bertrand Creek sub-basin covers approximately 42.8 square kilometers, or 17 square miles, of land and is the largest of the three transboundary Nooksack River sub-basins. Bertrand Creek flows south across the border just south of 0 Avenue. Cave Creek is a four kilometers long tributary to Bertrand Creek. Cave Creek joins Bertrand Creek approximately 250 meters south of the border. Water quality results for Cave Creek are included in the Bertrand Creek sub-basin summary.

### North of the Border

This sub-basin has a mix of urban and agricultural land uses. Of the B.C. portion of the three transboundary Nooksack watershed sub-basins, 3,304 hectares (8,164 acres) of forage or pasture are in the Bertrand Creek sub-basin. The sub-basin contains 23 dog kennels, 66 greenhouses, seven mushroom growers, 23 gravel pits, and 339 livestock properties (Infographic 1). This data is derived from the B.C. Ministry of Agriculture, Food and Fisheries' Agricultural Land Use Inventory (ALUI) System[1] conducted in 2012 and 2016. This data includes properties where livestock is raised at the 'backyard[2]' scale and may only contain one animal. Bertrand Creek sub-basin geographic area contains an estimated 941 properties that are not connected to municipal sewers and likely have septic systems, which is more than either of B.C.'s other two transboundary sub-basins (Infographic 1).




Infographic 1. Number of livestock properties by type and number of septic systems properties for Bertrand sub-basin north of the border.

[1] The ALUI System employs a "windshield" survey method which captures data visible from publicly accessible lands and roads. Where visibility is limited, data may have been interpreted from aerial photography, in combination with local knowledge. The data captures a snapshot in time and may have changed since the dataset was collected. Capturing the type and number of livestock on a property using a "windshield" survey method is very difficult. Livestock often are in buildings or at the back of the property and therefore not seen. Also, livestock move from property to property and while they may be present one day on one property, they could be present on a different property the next day resulting in over counting. For many properties, livestock type and a range of the number of animals present was estimated using a number of methods including barn size and local knowledge. Properties with unknown livestock type and numbers were not included in these totals. Using this data to extrapolate livestock farm management practices or environmental impacts from livestock is invalid.

[2] Approximately one bison or cow or horse, three hogs, five goats or deer, 10 sheep, 50 turkeys, 100 chickens (one animal unit equivalent).

B.C. Ministry of Environment and Climate Change Strategy (ENV) monitored several locations monthly in the Bertrand Creek sub-basin north of the border. This section highlights monitoring results from five locations: an upstream site located in a residential area and four others located in predominantly agricultural areas. Consistent with previous years, water quality sampling shows fluctuations in fecal bacteria counts during 2020-2021. Ambient sampling events took place in fairly dry conditions with typically little rain preceding or during the sampling, with the exception of June 2020 when there was 18.8 mm (¾ inch) of rain preceding and during this sampling event. Fecal bacteria concentrations were notably high (two sampling locations were over 2000 CFU/100 mL) during this time, with rainfall potentially contributing to the high fecal bacteria concentrations (Figure 3).

Overall, analysis of ambient monitoring results indicates that fecal bacteria concentrations in Bertrand Creek were higher in 2020-2021 than those seen in 2019-2020. Seasonal land management practices (i.e. manure storage and spreading) and/or other factors such as an isolated event may have contributed to the high concentrations. B.C. continues to identify fecal bacteria sources, respond to complaints, and take appropriate compliance measures. Howe's Creek (E204847), a tributary to Bertrand Creek, continues to have high concentrations as in previous years. In 2020-2021, 60 percent of the monthly samples were greater than B.C.'s recreational water quality guideline (freshwater) for a single sample maximum concentration of 400 CFU/100 mL for *E. coli*.

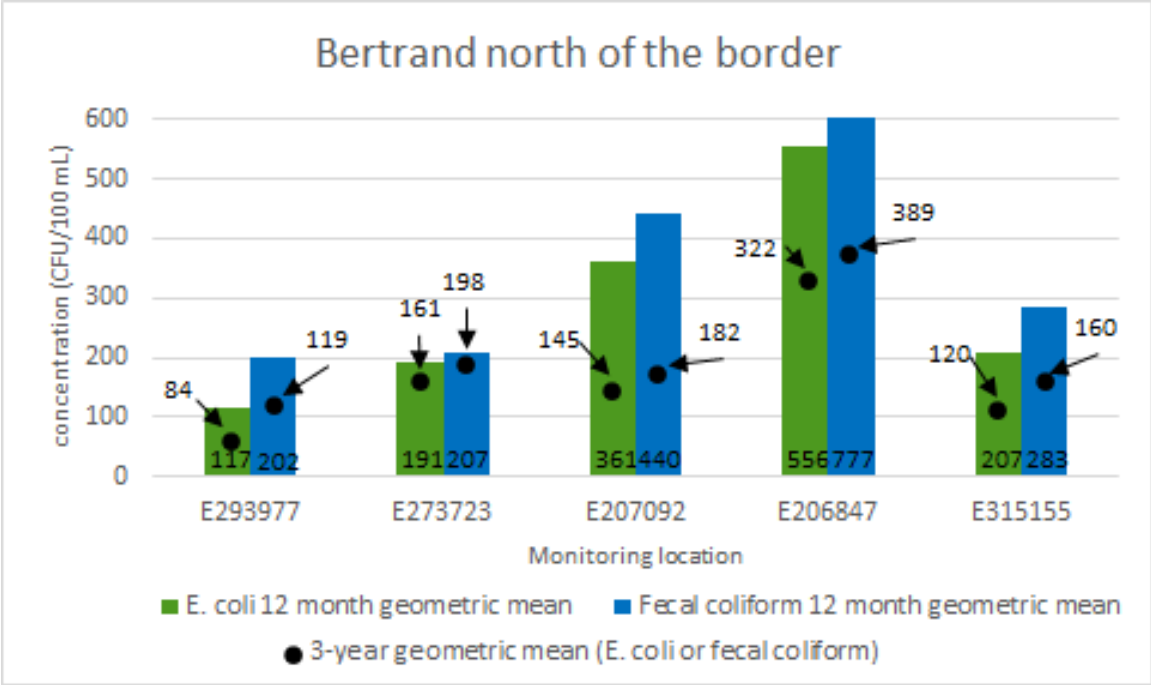



Figure 3. Twelve month (April 2020-March 2021) and 3-year geometric means for *E.coli* and fecal coliform for the B.C. Cave Creek and Bertrand Creek sites.

**Border**

During most of the project's first two years (2018-2020), B.C. and WA partners sampled at the same Cave Creek (E312388, BECCO.2) and Bertrand Creek (E293980, BE-9.1) border locations. The Cave Creek and Bertrand Creek sampling sites must be accessed from the B.C. side of the border. COVID-19 related travel restrictions prevented WA partners from crossing the international border to access the sampling locations starting March 2020. Throughout the third year of the project, B.C. partners continued monthly sampling at the two locations and shared water quality data with WA partners.

Monthly monitoring results show that both Cave Creek and Bertrand Creek border sites continue to have intermittently elevated fecal bacteria (Figure 4). Evaluation of the monthly ambient sampling during the wet season (October to March) data shows that two sampling events exceeded the B.C. single sample maximum criterion for *E. coli* of 400 CFU/100 mL at both the Bertrand and Cave border sampling locations. Evaluation of monthly ambient dry season data (April to September) shows only one sampling event at each site exceeded the B.C. single sample maximum criterion for *E. coli* of 400 CFU/100 mL. Monitoring during 2020-2021 of both *E. coli* and fecal coliform showed increases in fecal bacteria concentrations since the 2019-2020 period at both border sites.

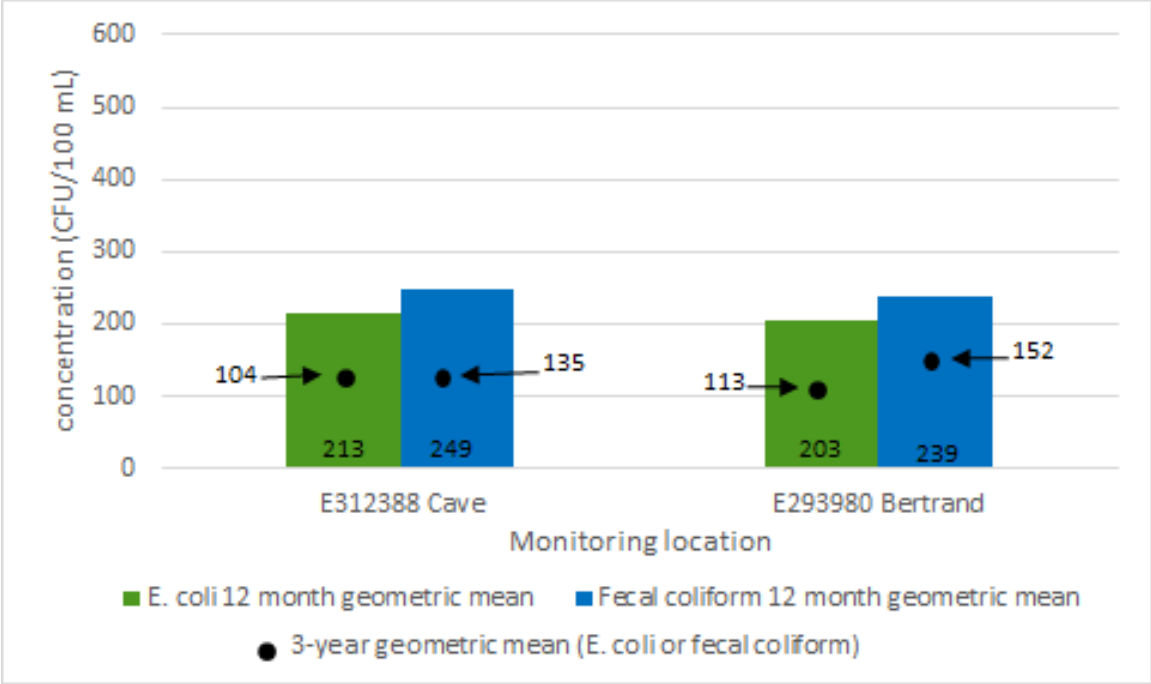
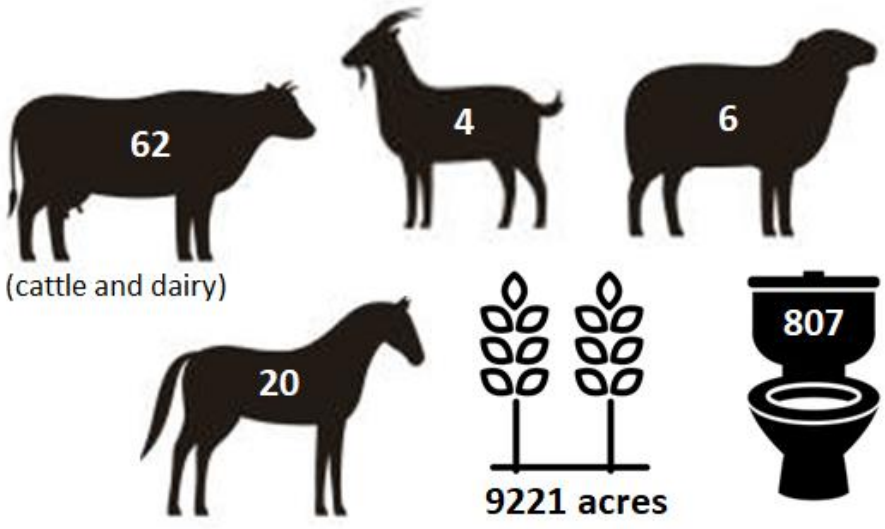



Figure 4. Twelve month (April 2020-March 2021) and 3-year geometric means for *E. coli* and fecal coliform for the B.C. and WA Cave Creek and Bertrand Creek border sites.

### South of the border to B1 (Bertrand enters Nooksack mainstem)

About 70 percent of the Bertrand sub-basin is in agriculture, including grass and corn forage (39 percent and 12 percent, respectively), berry production (26 percent), and potatoes (6 percent). Pastures associated with small livestock owners make up about six percent of the watershed, more than the other two transboundary sub-basins. This information is based on crop surveys of the watershed by the Whatcom Conservation District (WCD) during the spring and summer of 2020 (WCD, 2020a)

Approximately 10 percent of the sub-basin is developed for rural residential and commercial use. The Bertrand sub-basin on the WA side has the most natural space of the three sub-basins, with 15 percent of the area as forest or riparian area. WA partners have identified 94 livestock properties within the sub-basin. Whatcom County Health Department documents 807 septic systems (Infographic 2).




Infographic 2. Number of livestock properties by type, total crop acreage, and number of septic systems for Bertrand sub-basin south of the border. (Note: Two properties included as a livestock property had evidence of livestock, but animal type is unknown.)

In WA, monitoring site BH (Bertrand Creek at H Street) is the most upstream Bertrand Creek sub-basin sample location in WA. Monitoring site B1 (Bertrand Creek at Rathbone Road) is the most downstream monitoring station in the sub-basin before Bertrand joins the Nooksack River. WA also routinely samples Bertrand Creek and its tributaries during a monthly Bertrand monitoring run. Results are not included here as they are not part of the coordinated sampling; however, they are available through WA's online results map.

Site BH exceeds WA's historic threshold for fecal coliform (100 CFU/100mL) for both the 12-month and 3-year geometric means (geomeans). However, the 12-month geomean shows improvement compared to the 3-year geomean (Figure 5). Site B1 meets the historic threshold for fecal coliform for both the 12-month and 3-year geomeans.

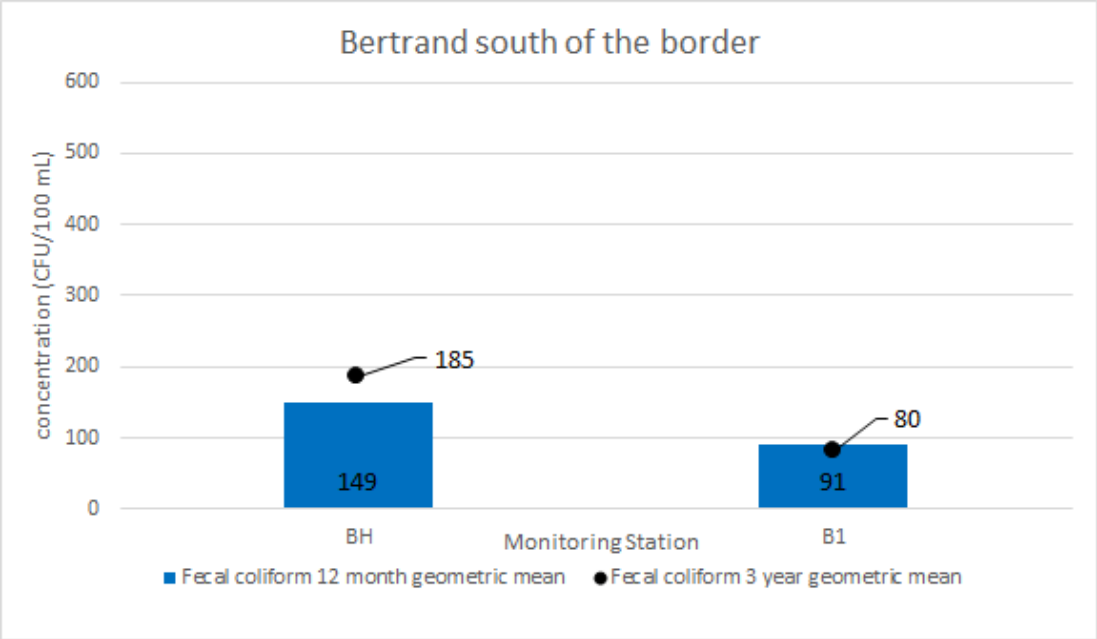


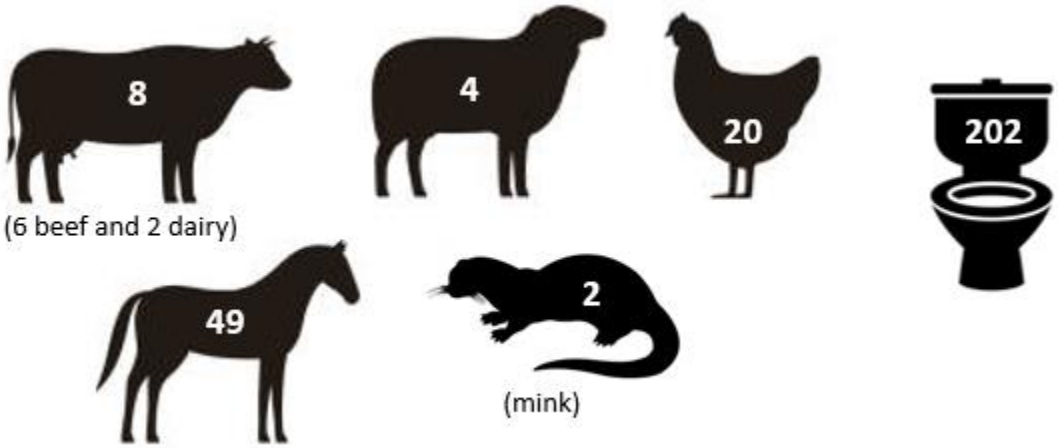

Figure 5. Twelve month (April 2020-March 2021) and 3-year geometric means for fecal coliform for the WA Bertrand Creek sites.

## Pepin Brook sub-basin

Pepin Brook is a fish-bearing stream located east of the Bertrand Creek sub-basin (Figure 2). It covers approximately 15.2 square kilometers, or six square miles, north of the border flowing south through Aldergrove Regional Park and then across the border. At the international border, Pepin Brook travels through a culvert system that separates the waterway in WA into two roadside ditches referred to as Double Ditch. The ditches flow south along the west and east sides of Double Ditch Road until reconnecting just within the City of Lynden. Pepin Brook flows to Fishtrap Creek before Fishtrap Creek enters the Nooksack River.

### North of the Border

The Pepin sub-basin has fewer agricultural land uses compared to Bertrand. The Pepin sub-basin has a mix of industrial, rural, and agricultural land uses. There are 780 hectares (or 1,927 acres) of forage or pasture in this B.C. sub-basin of the Nooksack watershed. There are 15 gravel pits, six greenhouses, one mushroom compost operation, one compost operation and three dog kennels. Eighty-three livestock properties are in this sub-basin and 202 properties that are not connected to municipal sewers and likely have septic systems septic systems (Infographic 3). This data is derived from the B.C. Ministry of Agriculture, Food and Fisheries' Agricultural Land Use Inventory (ALUI) System[1] conducted in 2012 and 2016. This data includes properties where livestock is raised at the 'backyard'[2] scale and may only contain one animal.




Infographic 3. Number of livestock properties by type and number of septic systems properties for Pepin sub-basin north of the border.

A tributary to Pepin Brook flows through the property of a large privately owned composting facility and connects to Pepin Brook within Aldergrove Regional Park. The lower portion of Pepin Brook flows through a series of wetland complexes, meadows, and mixed forests in Aldergrove Regional Park.

Four of the ENV sampling sites are in Aldergrove Regional Park, including the border site on 0 Avenue. The annual geometric means for *E. coli* at two sites north of the border were less than 400 CFU/100 mL; however, fecal coliform geometric means at these two sites are notably high (above 500 CFU/100 mL) (Figure 6). Elevated fecal bacteria concentrations (above 1000 CFU/100 mL) at the three Pepin Brook sites occurred following precipitation events in June 2020. B.C. continues to identify sources and follow up.

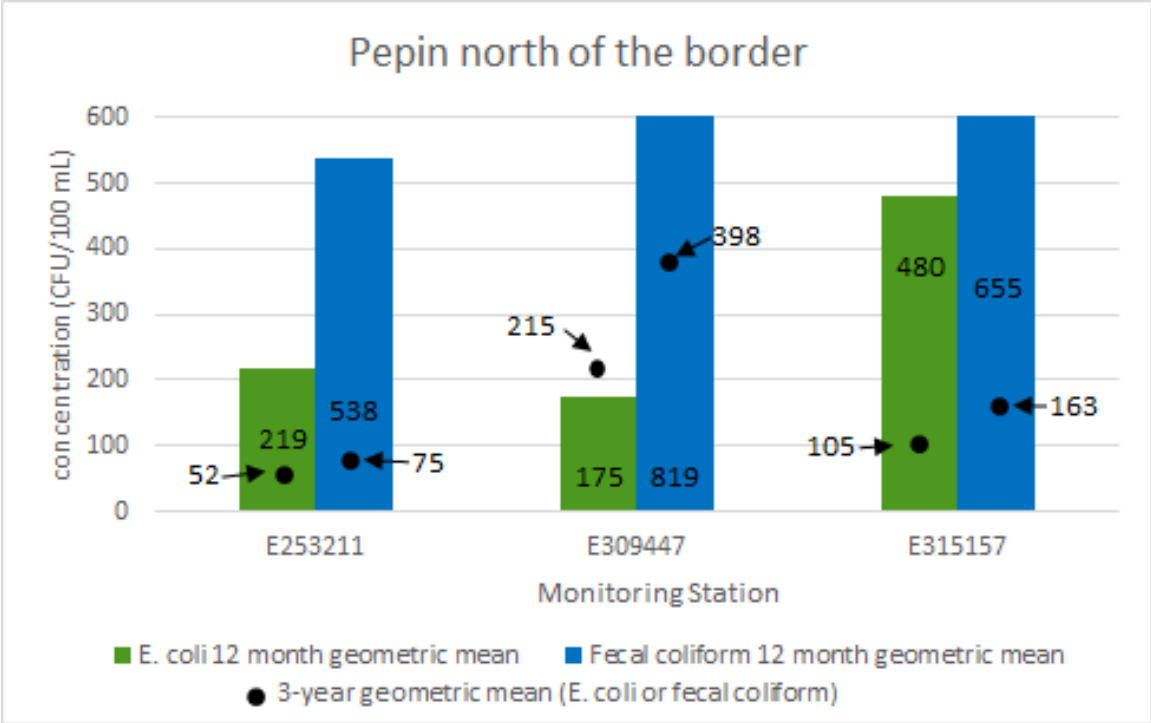



Figure 6. Twelve month (April 2020-March 2021) and 3-year geometric means for *E. coli* and fecal coliform for the B.C. Pepin Brook/Double Ditch sites.

**Border**

ENV monitors Pepin Brook at the international border (E279890). WA partners monitor Pepin Brook on the south side of 0 Avenue, after it splits into two roadside ditches, West and East Double Ditch (sample sites DD5 and DD6, respectively).

Sampling during 2020-2021 measured increased *E. coli* and fecal coliform concentrations in Pepin Brook on both sides of the border as compared to the 3-year geomean (Figures 6 and 8). For site E279890, the annual *E. coli* geomean calculated from monthly ambient data was greater than 200 CFU/100 mL and the fecal coliform geomean exceeded 400 CFU/100mL (Figure 7). As in previous years, sampling measured occasional elevated fecal bacteria concentrations during the wet season (October-March), typically following rainfall events. At sites DD5 and DD6 on the WA side, fecal coliform geomeans were lower than those measured the B.C. side, but still exceeded 200 CFU/100mL (Figure 7). The difference in fecal coliform geomeans between sites E279890, DD5, and DD6 is largely due to October 2020 sampling results. October 2020 sampling measured elevated bacteria at E279890 but not at the sampling site just downstream in WA, most likely due to the timing of sampling on that day.

During the wet season 2020-2021, three sampling events exceeded the B.C. single sample maximum criterion for *E. coli* of 400 CFU/100 mL, compared to one exceedance during the dry season (April-September). Two sampling events in October and November 2020 had notably high *E. coli* concentrations (8,000 CFU/100 mL during both events). At DD5 and DD6 on the WA side, fecal coliform counts exceeded 10,000 CFU/100mL in November 2020 and again in February 2021.

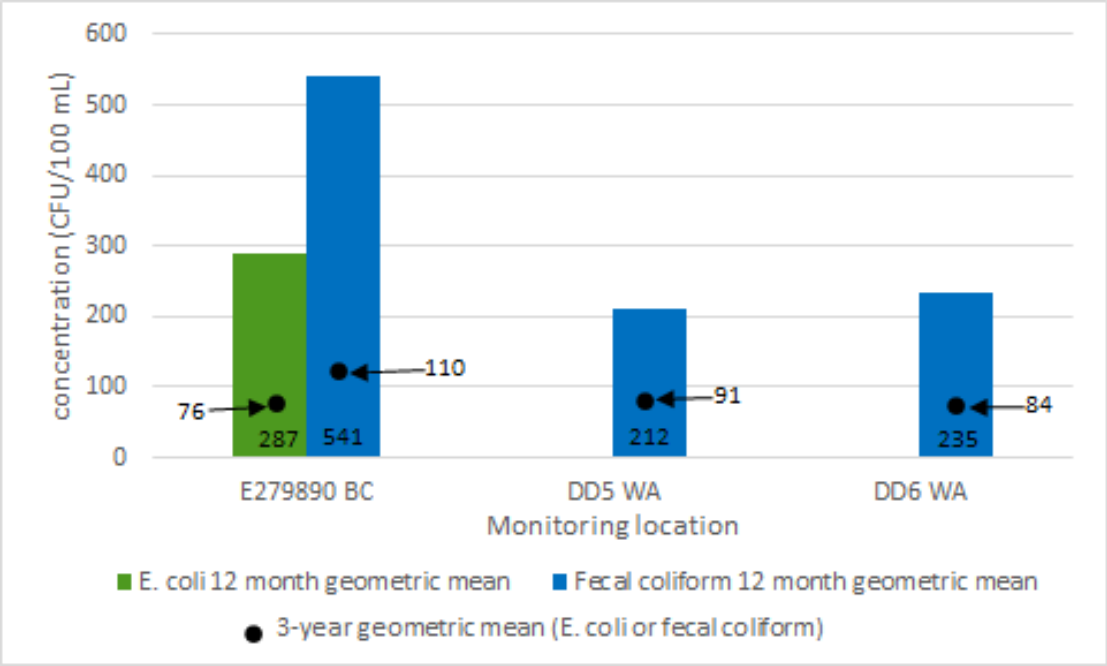
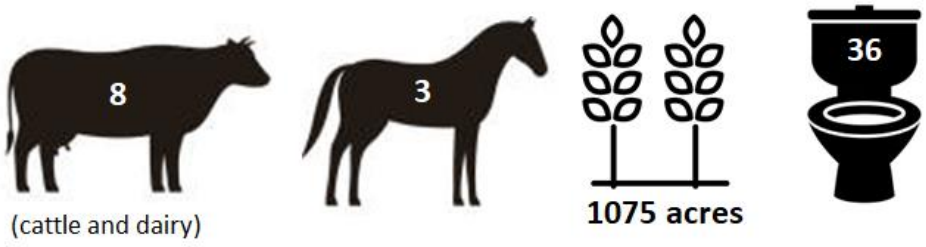



Figure 7. Twelve month (April 2020-March 2021) and 3-year geometric means for *E. coli* and fecal coliform for the B.C. and WA Pepin Brook/Double Ditch sites.

**South of the border to F3 (Pepin enters Fishtrap mainstem)**

WA partners generally include the Pepin Brook sub-basin as part of the Fishtrap sub-basin because Pepin Brook/Double Ditch flows into Fishtrap Creek on the WA side before entering the Nooksack River. However, when we look at the Pepin sub-basin separately from Fishtrap we see that, similar to Bertrand, 70 percent of the sub-basin is in crop agriculture, including grass and corn forage (33 percent and nine percent, respectively), berry production (12 percent), and potatoes (seven percent). Pastures associated with small livestock owners make up less than one percent of this watershed. This information is based on crop surveys of the watershed by the WCD during the spring and summer of 2020 (WCD, 2020b)

Approximately 25 percent of the sub-basin is developed for rural residential and commercial use. On the WA side, the Pepin sub-basin has the least natural space of the three sub-basins, with only two percent of the area as forest or riparian area. WA partners have identified 12 livestock properties within the sub-basin. Whatcom County Health Department documents 36 septic systems (Infographic 4) in this small sliver of a sub-basin, which mostly runs the length of Double Ditch Road.




Infographic 4. Number of livestock properties by type, total crop acreage, and number of septic systems for Pepin sub-basin south of the border. (Note: One property included as a livestock property had evidence of livestock, but animal type is unknown.)

WA partners monitor Pepin Brook at least four times per month: twice monthly as part of Nooksack Routine sampling and twice monthly for the Fishtrap Focus Area sampling. On the south side of Boundary Road, paired sampling sites DD5 and DD6 monitor Pepin Brook flowing across the border on the west and east sides of Double Ditch Road. Pepin Brook continues to flow south as Double Ditch. WA monitors Double Ditch at DDW and DDE as the waterways enter the city limits of Lynden. Further south, Double Ditch/Pepin Brook becomes a single waterway again and WA monitors it at Main Street (F3) in the City of Lynden before the waterway meets Fishtrap Creek.

Similar to results measured at border locations, WA results showed increasing fecal coliform concentrations in Pepin Brook over the last year (Figure 8). The increase was largely driven by periodically elevated fecal coliform results of 1,000 CFU/100mL and greater. On two occasions in 2020-2021, fecal coliform concentrations at DDW and DDE exceeded 15,000 CFU. These bacteria spikes appear to originate north of the border and were also measured at DD5 and DD6. The spikes led to 12-month geomeans that exceed WA's historic threshold for fecal coliform (100 CFU/100mL). In comparison, the 3-year geomeans of 55 to 72 CFU/100mL meet this historic threshold.

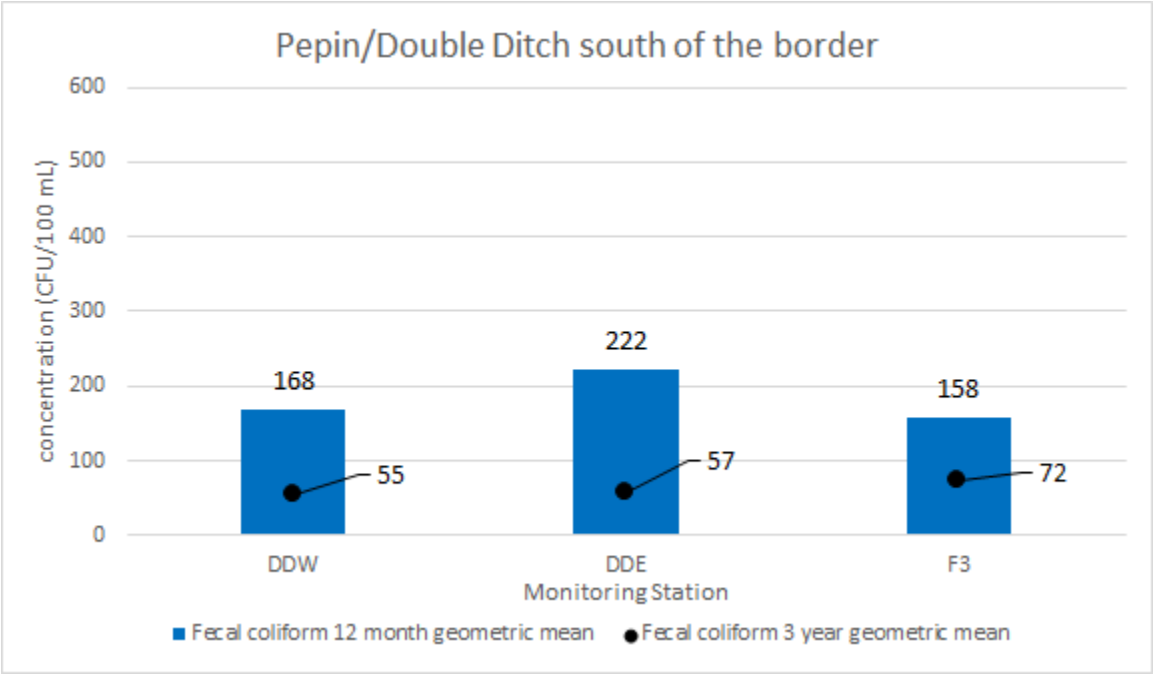


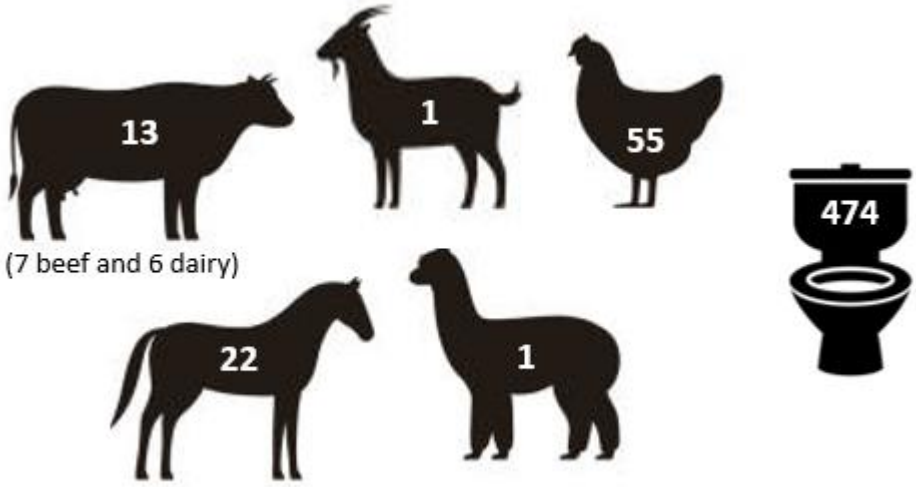

Figure 8. Twelve month (April 2020-March 2021) and 3-year geometric means for fecal coliform for the WA Pepin Brook/Double Ditch sites.

## Fishtrap Creek sub-basin

Fishtrap Creek is a fish-bearing stream draining a sub-basin of approximately 80 square kilometers, or 31 square miles. Fishtrap Creek flows south through West Abbotsford to the border (Figure 1). Waechter Creek is a significant tributary to Fishtrap Creek north of the border. In the B.C. portion, Fishtrap Creek and its tributaries flow through a mix of urban (City of Abbotsford) and agriculture land use. In the WA portion, Fishtrap flows through a mix of agriculture land use and an urban area (City of Lynden). In WA the agricultural land use area includes four notable ditch systems that originate near or north of the international border, flow north to south, and act as tributaries of Fishtrap Creek.

### North of the Border

The Fishtrap sub-basin has fewer agricultural land uses but the highest number of poultry operations in B.C.'s portion of the Nooksack watershed. Of B.C.'s portion of the three Nooksack watershed sub-basins, 1,170 hectares (2,891 acres) of pasture or grazing fields are in this Fishtrap sub-basin. There are 11 gravel pits, 25 greenhouses and one mushroom composter in this sub-basin. The sub-basin contains 92 livestock properties and 474 properties that are not connected to municipal sewers and likely have septic systems (Infographic 5). This data is derived from the B.C. Ministry of Agriculture, Food and Fisheries' Agricultural Land Use Inventory (ALUI) System[1] conducted in 2012 and 2016. This data includes properties where livestock is raised at the 'backyard'[2] scale and may only contain one animal.




Infographic 5. Number of livestock properties by type and number of septic systems properties for Fishtrap sub-basin north of the border.

B.C. samples Fishtrap Creek monthly at two sites north of the border, with one of the sites located on Waechter Creek. The monitoring results show continued high concentrations at Waechter Creek (E310908) with a 12-month geomean for *E. coli* of 408 CFU/100 mL (Figure 9). Sampling during 2020-2021 measured notable increases in fecal bacteria concentrations compared to the previous year of sampling. Fishtrap Creek sampling location E315795 is located just upstream of the border sampling location (E279889) and continues to have low concentrations with none of the monthly sampling results being above B.C.'s single-sample maximum for *E. coli* of 400 CFU/100 mL.

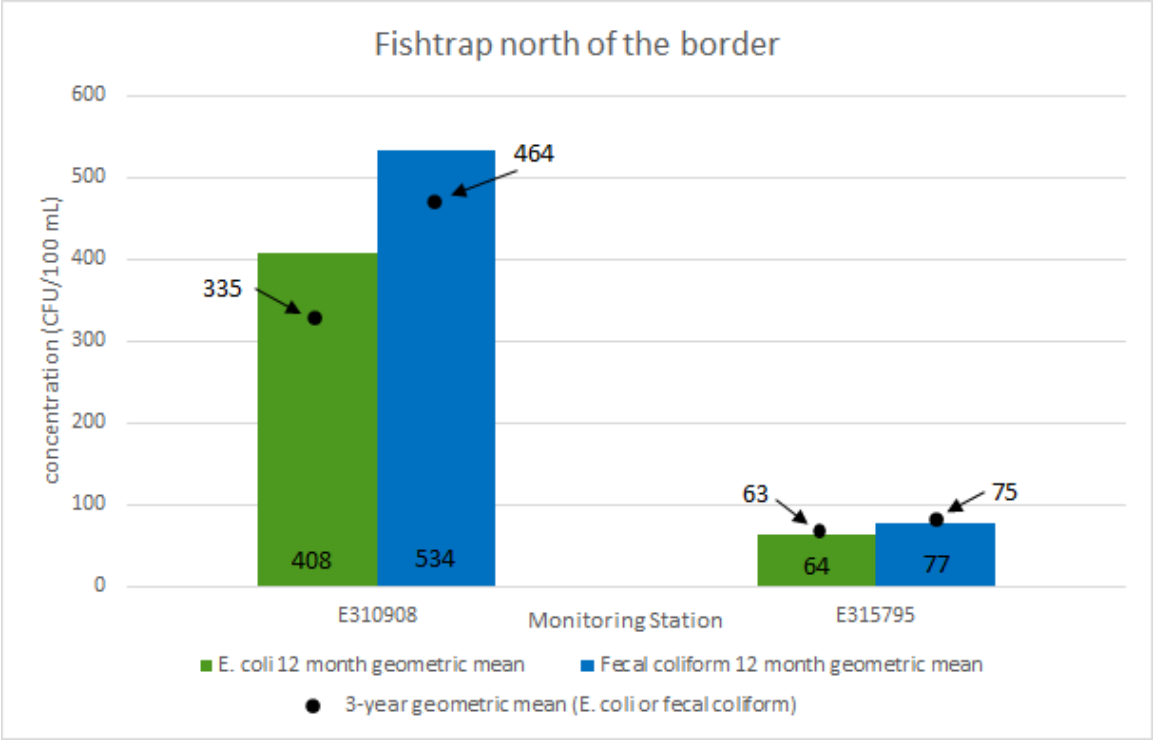



Figure 9. Twelve month (April 2020-March 2021) and 3-year geometric means for *E. coli* and fecal coliform for the B.C. Fishtrap Creek sites, including Waechter Creek.

## Border

ENV monitors Fishtrap Creek at the international boundary (E279889). WA partners monitor Fishtrap Creek approximately 200 meters downstream at Northwood Road (FT8). Monitoring results at these two sites show the lowest fecal bacteria concentrations of the border sites (Figure 10). Annual geomeans meet both the long-term border benchmark for *E. coli* and the historic threshold for fecal coliform of 100 CFU/100mL.

All B.C. sampling events were less than the B.C. single sample maximum criterion for *E. coli* of 400 CFU/100 mL. Only one WA sampling event saw fecal coliform concentrations exceeding 400 CFU/100 mL, with two additional sample dates recording fecal coliform at FT8 greater than or equal to 200 CFU/100 mL.

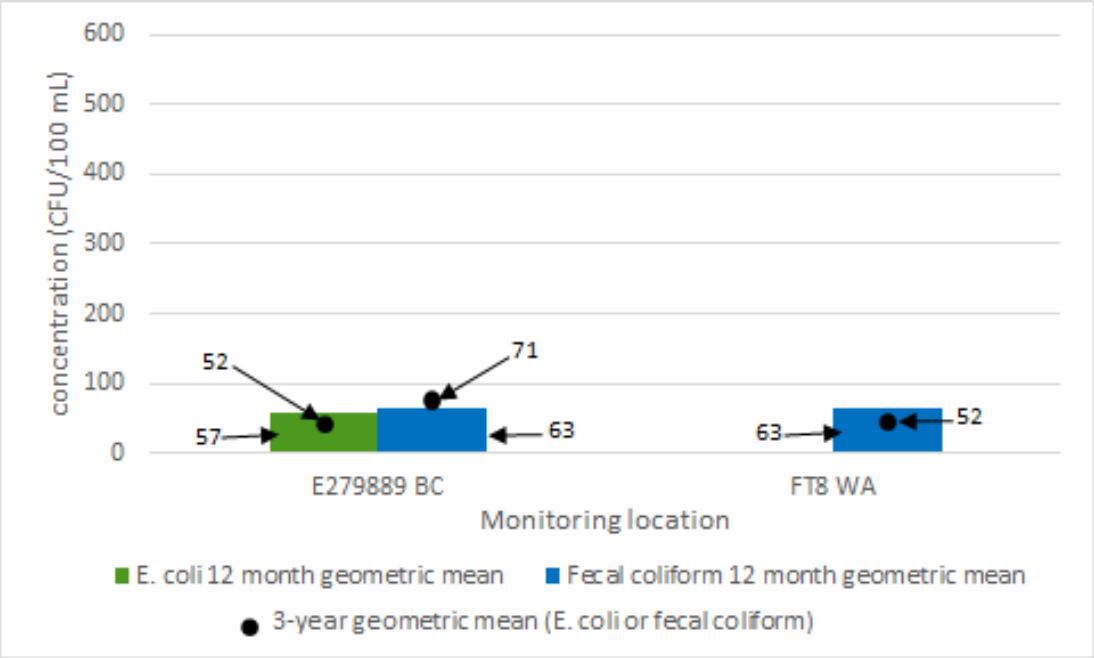
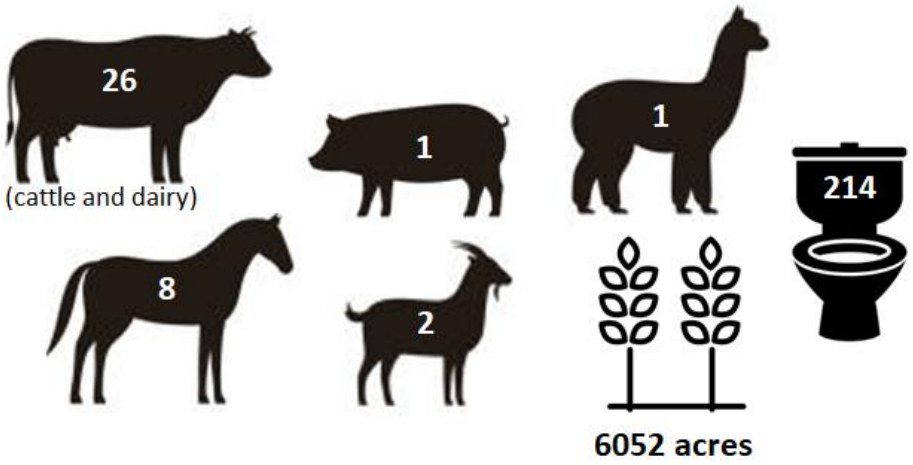



Figure 10. Twelve month (April 2020-March 2021) and 3-year geometric means for *E. coli* and fecal coliform for the B.C. and WA Fishtrap border sites.

### South of the border to F1 (Fishtrap enters Nooksack mainstem)

Similar to the other sub-basins on the WA side, 70 percent of the sub-basin is in crop agriculture, including grass and corn forage (21 percent and 15 percent, respectively), and berry production (24 percent). Pastures associated with small livestock owners make up about one percent of this watershed. This information is based on crop surveys of the watershed by the WCD during the spring and summer of 2020 (WCD, 2020b)

Approximately 21 percent of the sub-basin hosts rural residential and commercial use. In WA, the Fishtrap sub-basin is like Pepin in that about five percent of the area is natural space (e.g. forest or riparian area). WA partners have identified 39 livestock properties within the sub-basin. Whatcom County Health Department documents 214 septic systems (Infographic 6).




Infographic 6. Number of livestock properties by type, total crop acreage, and number of septic systems for Fishtrap sub-basin south of the border. (Note: One property included as a livestock property had evidence of livestock, but animal type is unknown.)

WA partners monitor Fishtrap Creek at least four times per month: twice monthly as part of the Nooksack Routine sampling and twice monthly for the Fishtrap Focus Area sampling. In WA, two routine sample sites - Fishtrap at Badger Road (FT4) and Fishtrap at River Road (F1) - offer snapshots of water quality along Fishtrap Creek. Four tributary ditches (one that originates in B.C. and three that begin in WA near the international border) run north-south through the agricultural areas of the sub-basin and act as tributaries to Fishtrap Creek. WA samples these ditches twice monthly, in addition to sites along Fishtrap Creek within the City of Lynden.

Fishtrap Creek at Badger Road (FT4) generally shows good water quality, with a 3-year geomean that meets WA's historic threshold for fecal coliform (100 CFU/100mL; Figure 11). Fishtrap Creek at River Road has seen increasing bacteria over the past years (Figure 15). The 12-month geomeans at both sites have increased over the past year in comparison with the 3-year period of this project, most notably at F1. Elevated bacteria in Pepin Brook over the past year has contributed to the increasing bacteria trend at F1 as compared to upstream at FT4 (Pepin Brook enters Fishtrap Creek downstream of FT4 and upstream of F1). Other contributing sources between these sites include the agricultural ditches along Bender, Benson, and Depot Roads, as well as stormwater sources as Fishtrap Creek runs through the City of Lynden.

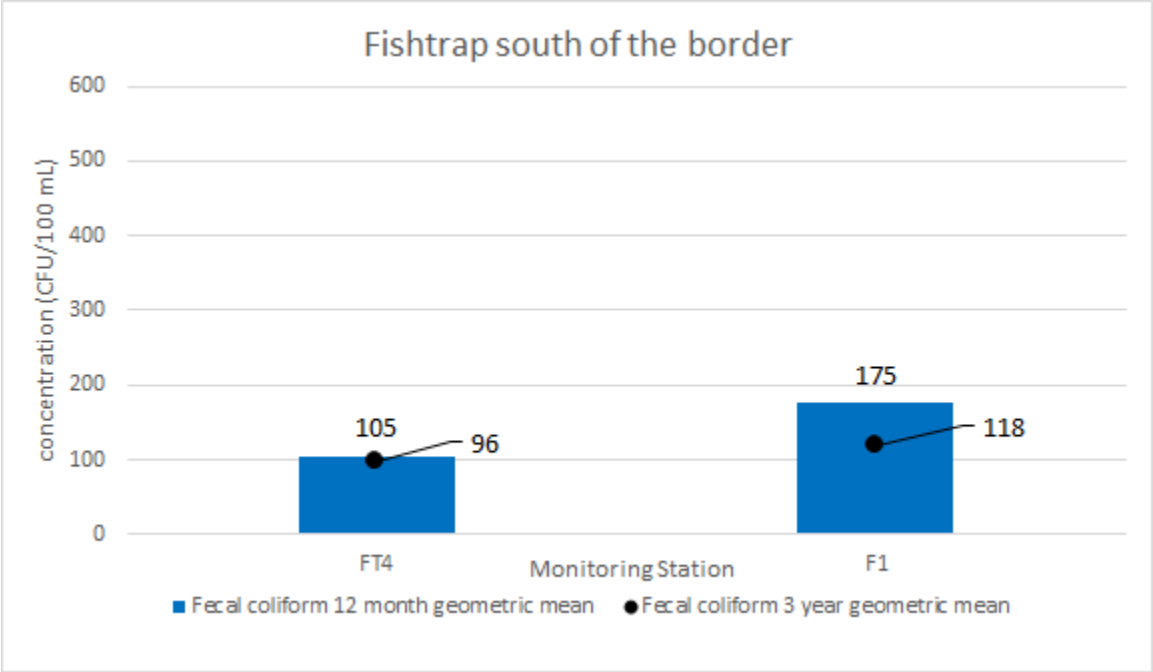



Figure 11. Twelve month (April 2020-March 2021) and 3-year geometric means for fecal coliform for the WA Fishtrap Creek sites.

## Border Benchmark Evaluation

In June 2019, B.C. and WA TCG partners adopted short-term (to be met by 2021) and long-term (to be met by 2024) border benchmarks using *E. coli* as the fecal bacteria indicator. The short- and long-term border benchmarks apply at the four border locations at Cave (E312388), Bertrand (E293980), Pepin (E279890), and Fishtrap (E279889).

The project's border benchmarks differ from B.C.'s water quality guidelines and from WA's historic fecal coliform threshold measure (see Appendix 1). *E. coli* data collected during one dry season and one wet season are used to assess whether water quality meets the short- and long-term project border benchmarks.

Border benchmarks are as follows:

- *E. coli* of 200 CFU/100 mL – Short-term border benchmark to be achieved at border stations over two-years:
    - Benchmark is based on the geometric mean calculation of five weekly samples collected over 30 days (known as 5-in-30) and apply to both wet and dry seasons.
- *E. coli* of 100 CFU/100 mL – Long-term border benchmark to be achieved at border stations within five years:
    - Benchmark is based on the geometric mean calculation of 5-in-30 samples and apply to both wet and dry seasons.

Figure 12 illustrates status relative to the short- and long-term border benchmarks based on data collected during two 5-in-30 sampling events completed at each of four border sites during 2020. B.C. completed one 5-in-30 sampling event during May-June 2020 (dry season) and one 5-in-30 sampling event during November-December 2020 (wet season).

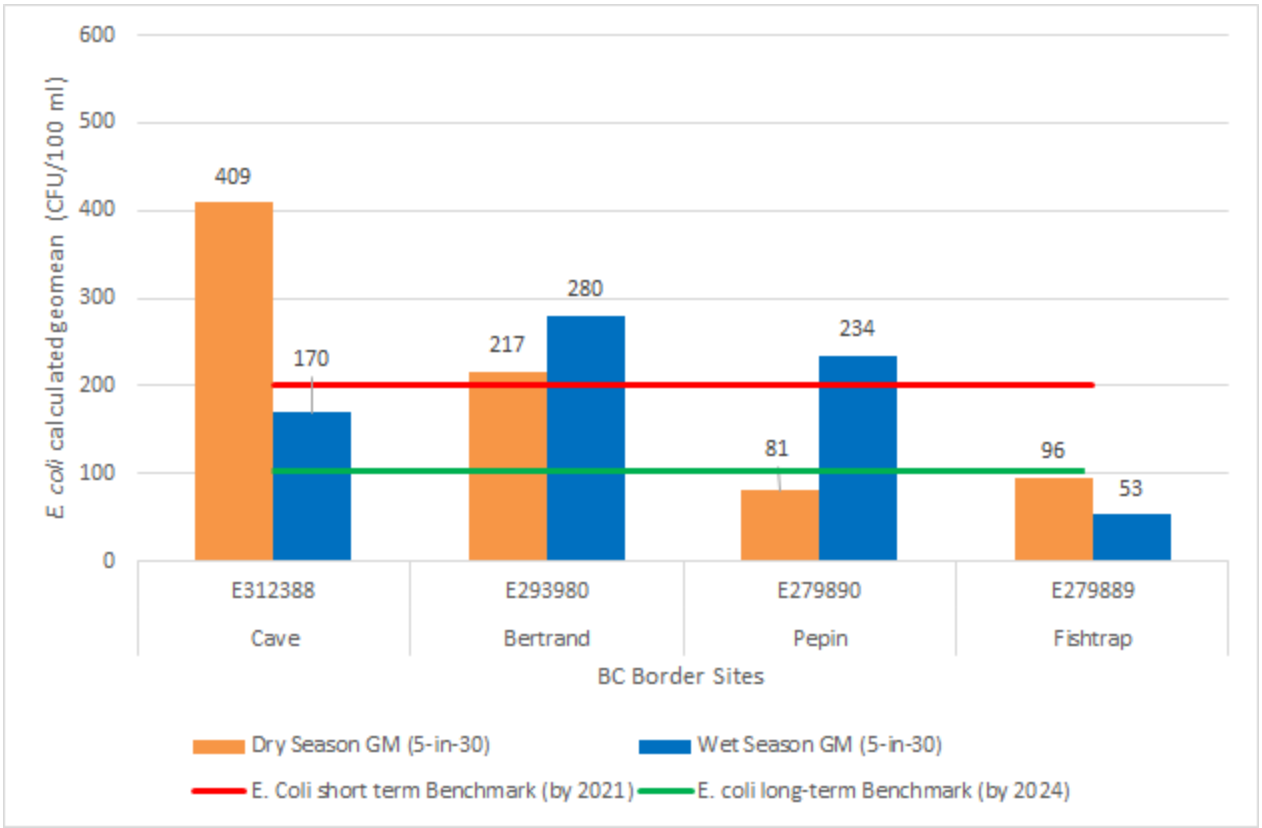



Figure 12. Border benchmark evaluation (geometric mean (GM) calculations) at the four border locations in dry season (May-June) 2020 and wet season (November-December) 2020; evaluation based on 5-in-30 datasets.

Data analysis for 5-in-30 dry and wet season 2020 sampling shows that:

- **Bertrand Creek sub-basin**: Sub-basin benchmark evaluation sites include both the Bertrand (E293980) and the Cave (E312388) sites.
    - Dry season 2020:
        - Bertrand (E293980) failed to achieve the short-term benchmark, with an *E. coli* geometric mean of 217 CFU/100 mL.
        - Cave (E312388) failed to achieve the short-term benchmark, with an *E. coli* geometric mean of 409 CFU/100 mL.
        - Both Bertrand and Cave had high fecal bacteria concentrations during at least two of the sampling events. B.C. is working to identify the source(s) and to follow up.
    - Wet season 2020:
        - Bertrand failed to achieve the short-term benchmark, with an *E. coli* geometric mean of 280 CFU/100 mL.
        - Cave achieved the short-term border benchmark.
- **Pepin Brook sub-basin**:
    - Dry and wet seasons 2020:
        - Pepin achieved the short-term benchmark during the dry season 5-in-30 sampling events but failed to achieve the short-term benchmark during the wet season, with an *E. coli* geometric mean of 234 CFU/100 mL.
- **Fishtrap Creek sub-basin**:
    - Dry and wet seasons 2020:
        - Fishtrap achieved the short-term border benchmark during both seasonal 5-in-30 sampling events.

As noted above, this report covers monitoring from April 2020 to March 2021. Additional 5-in-30 sampling was conducted during May-June 2021. Results from this sampling period are summarized in Appendix 4.

## Lower Nooksack River

The "Lower Nooksack River" refers to the generally low elevation portion of the mainstem Nooksack River downstream of the town of Everson, WA (Figure 1, Figure 13). The North, Middle, and South Forks (or "Upper Nooksack Watershed") are higher elevation river forks draining national forest land and low density rural residential and agricultural areas. Water quality from the upper reaches of the Nooksack River watershed is generally excellent. WA partners monitor water quality in the Nooksack River Forks twice monthly during the late summer and fall season when historic sampling data predicts elevated fecal bacteria concentrations could most likely occur.

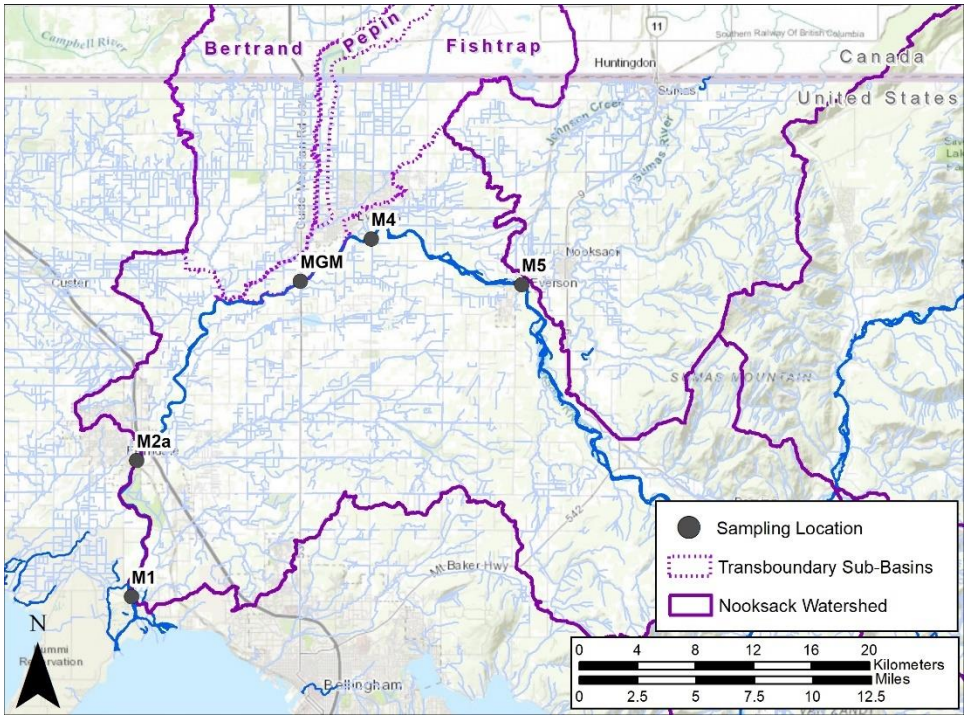



Figure 13. Map of Nooksack River and Nooksack sampling stations

### Nooksack mainstem at Everson downstream to M1

WA partners routinely sample ambient water quality at five key sites on the mainstem Nooksack River. From Everson, WA to downstream, the mainstem Nooksack River monitoring site locations are M5, M4, MGM, M2a (previously M2), and M1 (Figure 13). For both the 12-month and 3-year datasets, fecal coliform geomeans for these sites are lower than the Nooksack River Watershed Bacteria Total Maximum Daily Load (TMDL) target geometric mean of 39 CFU/100mL (Figure 14).

### Contribution of Fishtrap and Bertrand to Nooksack mainstem

By water volume, Fishtrap and Bertrand creeks are the largest of the lowland tributaries of the Nooksack River (TMDL Evaluation, 2000). Accordingly, data continues to support that seasonal fecal bacteria loading from Bertrand Creek and from Fishtrap Creek (including Pepin Brook) sub-basins can have significant seasonal effects on the downstream water quality of the Nooksack River and the receiving waters of Portage Bay (Figure 15).

Water quality data show the annual geomean for Bertrand Creek (B1) exceeding 100 CFU fecal coliform for a time period during 2020, decreasing in early 2021 (Figure 15). The geomean for Fishtrap Creek (F1) continued to rise during 2021 to

151 CFU/100 mL at the end of March 2021. Annual geomeans for both B1 and F1 continue to exceed their respective TMDL target geomeans (Bertrand target geomean = 49 CFU/100mL; Fishtrap target geomean = 39 CFU/100mL).

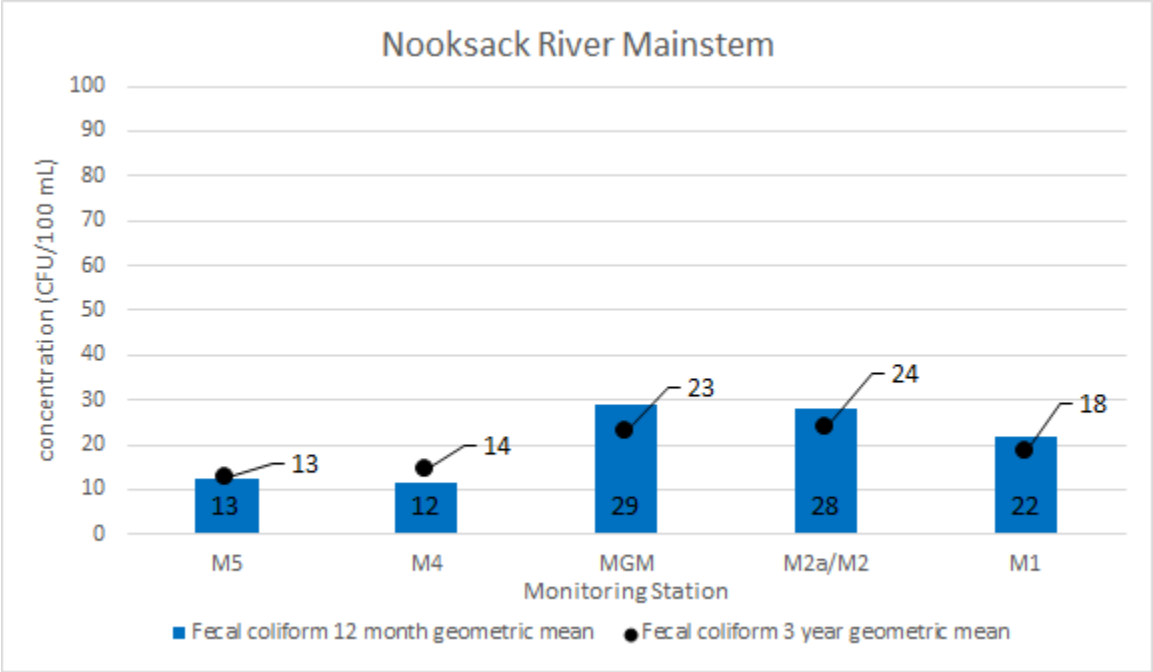



Figure 14. Twelve month (April 2020-March 2021) and 3-year geometric means for the Nooksack River mainstem sites.

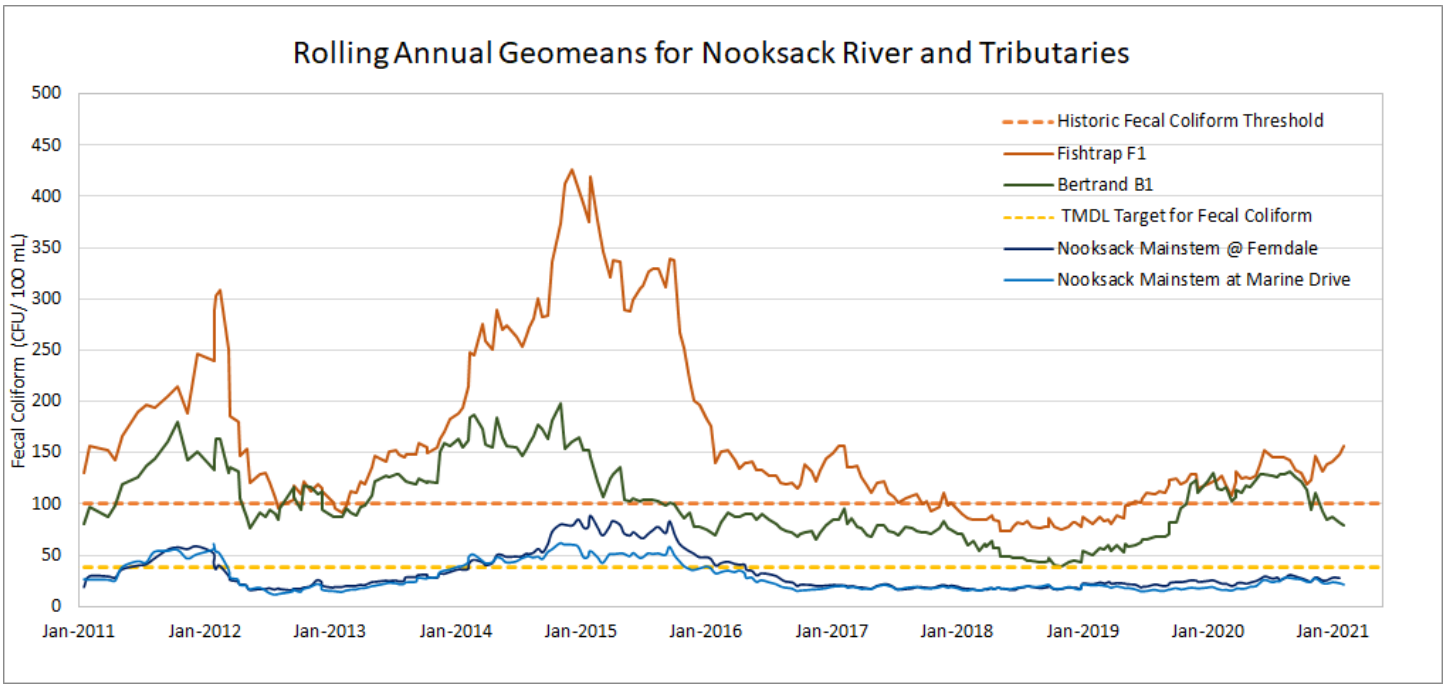



Figure 15. Rolling 12-month geometric means Nooksack River mainstem and tributaries (B1 and F1); evaluation based on monthly ambient fecal coliform datasets. Historic fecal coliform threshold = 100 CFU/100ml; Total Maximum Daily Load target = 39 CFU/100mL.

## Portage Bay Shellfish Growing Area

### Harvest Status and Season Critical Conditions

Washington State Department of Health (DOH) annually reviews marine water quality data and potential pollution sources for commercial shellfish growing areas, including the Portage Bay Shellfish Growing Area. Fecal bacteria in marine waters are measured as fecal coliform bacteria most probable number per 100/mL (MPN/100 mL) based on National Shellfish Sanitation Program (NSSP) guidelines (FDA, 2019). Relevant criteria are summarized in Appendix 1.

Portions of the Portage Bay Shellfish Growing Area (Figure 16) are classified as:

- Approved: Year-round harvest is allowed for human consumption; an Approved classification authorizes commercial shellfish harvest for direct marketing.
- Conditionally Approved: Closed to commercial harvest October 1 to December 31 each year; also closed to ceremonial and subsistence harvest October 1 to December 31; Open to harvest January 1 to September 30 each year.
- Prohibited: Harvest is prohibited. Station 48 meets the shellfish harvest marine water fecal coliform criteria; however, the NSSP Model Ordinance requires a Prohibited classification due to the station's proximity to a potential pollution source (wastewater treatment plant (WWTP) outfall).

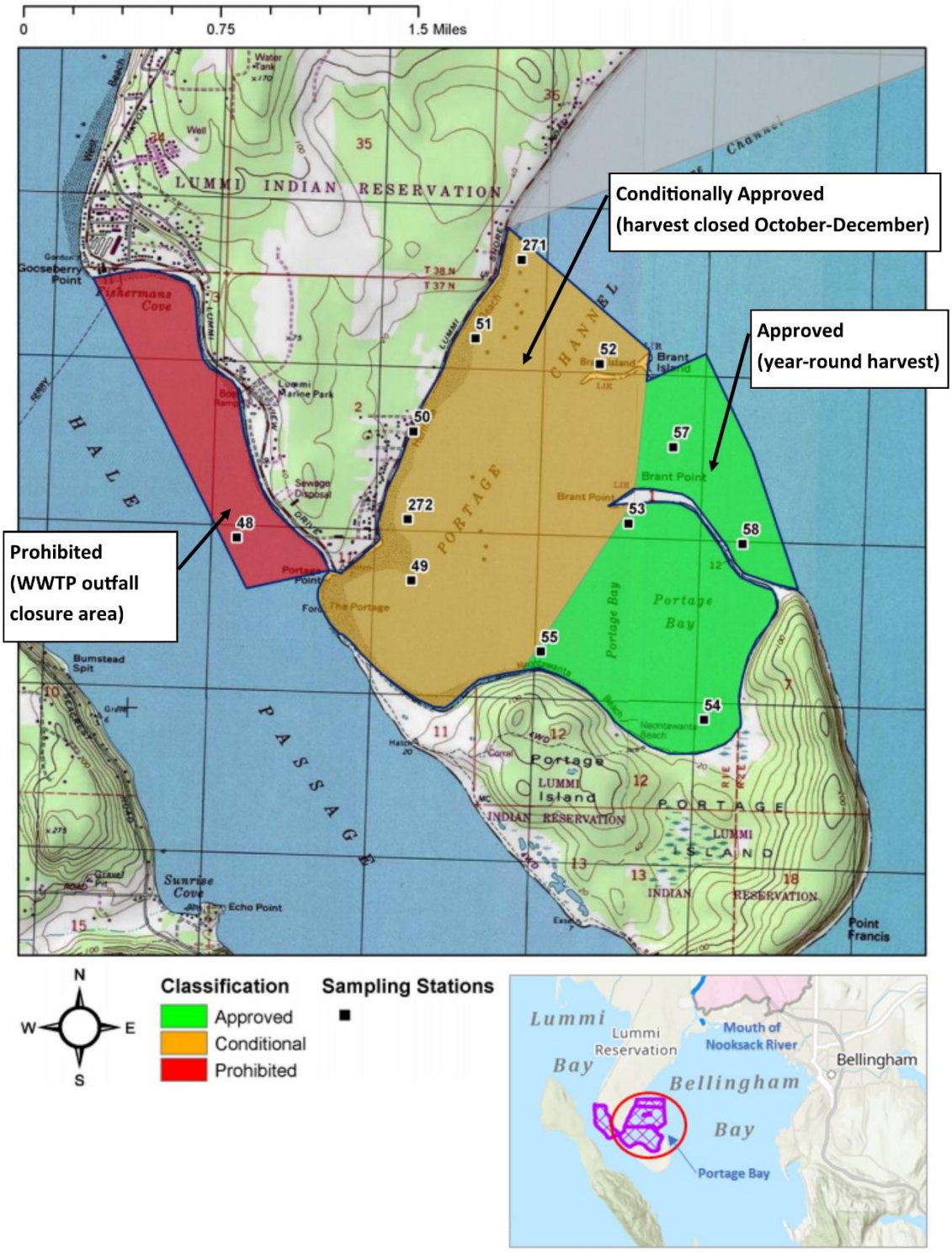



Figure 16. Map of Portage Bay Shellfish Growing Area classifications and marine water quality monitoring stations. The 2020 Portage Bay Annual Shellfish Growing Area Review identified stations 50, 52, 55, 57, and 58 as threatened with a downgrade in classification.

Portage Bay's 2020 Annual Growing Area evaluation assessed a 30-sample dataset through December 2020 for marine monitoring stations. The evaluation determined that five Portage Bay Shellfish Growing Area water monitoring stations

are threatened with a downgrade in classification. A monitoring station is determined to be threatened with a classification downgrade when analysis of the 30-sample dataset for the location results in an estimated 90th percentile between 30 and 43 MPN/100mL (see https://www.doh.wa.gov/Portals/1/Documents/4400/portage.pdf). Of the five threatened monitoring stations, three stations are located within the "Approved" portion of the growing area and two stations are located within the "Conditional" portion of the growing area (see Figure 16 map). In the Approved portion, stations 55, 57, 58 are threatened. In the "Conditional" portion, stations 50 and 52 are threatened when analysis includes data obtained during the Open period (January – September).

## 2020-2021 Shellfish Growing Area Monitoring

Regulatory fecal coliform sampling takes place in the Portage Bay Shellfish Growing Area according to the National Shellfish Sanitation Program systematic random sampling method.

This report uses the following ranges to generally characterize marine water sampling results:

- Low is less than 20 MPN/100 mL,
- Moderate is 21 to 43 MPN/100 mL,
- High is more than 43 MPN/100 mL.

During spring, summer, and fall 2020, sampling at marine water stations in the Conditionally Approved and Approved portions of the growing area resulted in some moderate and high levels of fecal coliform bacteria (Table 1). April 2021 is outside this summary's reporting period, but sample results are included here for additional insight into current patterns.

Table 1. Fecal coliform marine sampling results (MPN/100mL) from April 2020 to April 2021. Stations are organized based on their classification (Conditionally Approved or Approved).

| | **Fecal coliform result (MPN/100mL)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Conditionally Approved Area** | | | | | | **Approved Area** | | | | |
| **Sample Date** | Stat 49 | Stat 50 | Stat 51 | Stat 52 | Stat 271 | Stat 272 | Stat 53 | Stat 54 | Stat 55 | Stat 57 | Stat 58 |
| 4/2/2020 | 1.7 | 4.5 | 2 | 4.5 | 4 | 2 | 2 | 1.7 | 1.7 | 7.8 | 2 |
| 5/12/2020 | 14 | 22 | 33 | 23 | 79 | 13 | 1.7 | 1.7 | 23 | 11 | 17 |
| 6/10/2020 | 7.8 | 49 | 23 | 17 | 17 | 11 | 2 | 1.7 | 2 | 17 | 13 |
| 7/15/2020 | 1.7 | 1.8 | 13 | 1.7 | 4.5 | 1.7 | 1.7 | 1.7 | 2 | 1.7 | 2 |
| 8/5/2020 | 2 | 23 | 6.8 | 6.8 | 2 | 13 | 1.7 | 1.7 | 1.7 | 1.7 | 2 |
| 9/24/2020 | 2 | 33 | 6.8 | 2 | 27 | 4 | 1.7 | 1.7 | 2 | 1.7 | 2 |
| 10/8/2020 | 1.7 | 2 | 2 | 79 | 1.7 | 1.7 | 1.7 | 1.7 | 2 | 2 | 1.8 |
| 11/18/2020 | 33 | 79 | 79 | 49 | 49 | 49 | 33 | 23 | 49 | 49 | 13 |
| 12/8/2020 | 2 | 4.5 | 4.5 | 1.7 | 12 | 1.7 | 2 | 1.7 | 1.7 | 1.7 | 2 |
| 1/26/2021 | 2 | 11 | 4.5 | 4.5 | 7.8 | 7.8 | 2 | 2 | 1.7 | 1.7 | 1.7 |
| 2/9/2021 | 2 | 1.7 | 2 | 4.5 | 1.7 | 1.7 | 2 | 4.5 | 2 | 2 | 1.7 |
| 3/23/2021 | 1.7 | 1.7 | 1.7 | 2 | 1.7 | 1.7 | 1.7 | 1.7 | 2 | 1.7 | 4.5 |
| 4/6/2021 | 1.7 | 1.7 | 1.7 | 2 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 |

On the day prior to pre-scheduled marine water sampling in Portage Bay, WA partners sample at freshwater Nooksack River watershed monitoring stations. Higher fecal bacteria densities measured in Nooksack River watershed freshwater sites on the day before each spring, summer, and fall 2020 instance of moderate or high marine sampling results support

that the Nooksack River has a strong influence on Portage Bay water quality. Salinities are measured at the time of marine sampling and further support the pattern of freshwater influence on the marine growing area.

Only one of the nine moderate or high counts measured during spring and summer months of 2020 was in the Approved portion of the Portage Bay Shellfish Growing Area. The rest of the spring and summer higher fecal bacteria counts were measured at stations in the Conditionally Approved portion of the growing area. The Conditionally Approved portion of the growing area is closed to harvest each year during the months of October through December.

November 2020 sampling resulted in widespread high fecal bacteria counts throughout the shellfish growing area. Marine sampling on this day followed over one inch of rain (25 mm) in the 48 hours prior to sampling, with rain continuing throughout the day of sampling. The marine sampling results continued to demonstrate the challenges of protecting water quality in the growing area during rainy periods and in the Conditionally Approved portion most influenced by the Nooksack River.

In contrast to conditions during wet weather sampling events, ambient monitoring during a dry period of December 2020 produced low fecal coliform results in both freshwater and in marine water. These observations help support that high fecal bacteria levels are not present in the watershed nor in the marine waters during all conditions.

## Seasonal Comparisons

This section compares water quality observations seasonally during the project period for eleven of the growing area's marine water sampling stations. The observations do not include sampling station 48. Station 48 is in Hale Passage outside of Portage Bay and is not included in the Approved or Conditionally Approved portions of the shellfish growing area (see Figure 16). Station 48 meets the shellfish harvest marine water fecal coliform criteria; however, the NSSP Model Ordinance requires a Prohibited classification due to the station's proximity to a potential pollution source (WWTP outfall). Compared to water quality in Portage Bay, Hale Passage water quality is less influenced by the Nooksack River.

The following seasonal trends were observed:

- Spring (April to June): Some deterioration. All spring 2019 sampling produced low results. During 2020, sampling occurred once monthly at each of the eleven sampling sites. While most spring sampling results were low, May and June 2020 sampling resulted in five moderate fecal coliform counts. May 2020 sampling produced one high result at Station 271. June 2020 sampling followed 0.45 inches (11.5 mm) of rain the day prior.
- Summer (July to September): Some improvement. During 2020, sampling occurred once monthly at each of the eleven sampling sites. Summer 2020 sampling produced only three results in the moderate range. During August 2020, Station 50 had a result in the moderate range. September 2020 sampling produced moderate results at stations 50 and 271. July and August sampling followed periods of dry weather; September 2020 sampling followed 0.75 inches (20 mm) of rain in a 48-hour period.
- Fall (October to December): Continued challenges. During November 2020 sampling, only Station 58 had a low bacteria result. Three stations had moderate results while seven stations had high results from 49 to 79 MPN. October 2020 resulted in only one high count of 79 MPN at Station 52. The fall season and the month of November remain the most challenging times to maintain low marine bacteria levels. November and December 2020 sampling followed heavy rainfall, with 1.5 inches (38 mm) of rain falling in a 48-hour period in November and over 2 inches (51 mm) of rain falling in a 48-hour period in December.
- Winter (January to March): Less consistent winter sampling due to challenging weather conditions makes direct year-to-year data comparison difficult. During winter 2019, marine sampling took place in February and twice in March with all low results. During winter 2020, sampling took place only during January, with eight stations resulting in moderate fecal coliform counts and three stations with high results between 79 and 130 MPN. Rain

prior to the January 2020 sampling date exceeded 1.85 inches (47 mm) in 48-hours. During winter 2021, marine sampling took place monthly in January, February, and March. The winter 2021 data document low fecal coliform concentrations, ranging from 1.7 to 11 MPN. Sampling during winter 2021 followed days of moderate rainfall of 0.5-0.8 inches (12-20 mm) in 48-hours.

Washington State Department of Health marine data records can be accessed at ftp://ftp.doh.wa.gov/MarineWater/PreliminaryWaterData/or results can be viewed on the commercial shellfish Map Viewer https://fortress.wa.gov/doh/oswpviewer/index.html.

# Contributing Factors and Observations

## Ensuring Data Quality

B.C. and WA have worked together during the past three years to collect high quality monitoring data and to assess the data comparability from multiple sampling programs.

During the 2020-2021 reporting period, B.C. and WA partners focused on 1) coordinating sampling dates to ensure data comparability, and 2) maintaining an ongoing monthly sampling program despite COVID-19 limitations. Coordinated sampling on both sides of the border occurred on 8 of the 11 monthly ambient sampling events. B.C. missed April 2020 monthly sampling due to COVID-19 field sampling limitations. B.C. also collected samples for WA partners at four sample sites on the north side of the border throughout 2020-2021, during which time COVID-19 travel restrictions prevented WA partners from crossing the international border to access and sample these sites. Two of these sites were regular ambient monitoring locations sampled by B.C. (Bertrand Creek (E293980, BE-9.1) and Cave Creek (E312388, BECCO.2). B.C. sampled two additional sites along the border on WA's behalf (JD-F-1; E314290 and JD-B; E319491). B.C. and WA coordinated sampling dates for wet and dry season 5-in-30 sampling events so that sampling on both sides of the border occurred on the same day.

Additional coordination between B.C. and WA to support data quality on this project included attendance at WA's quarterly Data Team subcommittee meetings. At these meetings, partners shared information on specific studies in the watershed, hotspot areas, sampling methods, newly available analysis technologies, data assessment, and priorities.

## Influence of Season and Weather

Previous TCG annual reports discussed the important influence of season and weather on fecal bacteria concentrations measured at sites within the Nooksack transboundary sub-basins. Analysis of three years of border location data again demonstrates the impacts of rainfall (and thus season) on fecal bacteria concentrations.

WA evaluated ambient fecal coliform monitoring data for April 2018 to January 2021 at five border stations based on rainfall (prior 24-hour rainfall; Figure 17) and season (Figure 18). Both geometric means and 90$^{th}$ percentiles show similar patterns; geometric means are presented in the figures below.

Figure 17 shows that monitoring events following a 24-hour period with greater than 0.5 inches (13 mm) of rain captured much higher fecal bacteria concentrations in all sub-basins than days with less rain. Days with 0.2 to 0.5 inches (5 to 13 mm) had a higher fecal coliform geomean than days with less than 0.2 inches (5 mm). Ambient monitoring disproportionately missed the rainiest days over the past three-year project timeline: five to six samples (or approximately 15 percent) have been taken on days with less than 0.5 inches of rain. Of these, only two days (five percent of the monitoring dates) had 24-hour rain over one inch. Twenty-six to 34 samples were taken on days with less than 0.2 inches (5 mm) of rain (representing 75 to 80 percent of the monitoring dates). Source ID and storm driven monitoring by both B.C and WA captured water quality during days with higher rain amounts, but those results are not included in long-term trend analysis of the ambient monitoring program.

Figure 18 shows monitoring results at five border stations by season, with fall and/or winter having higher geometric means than spring and summer at all stations. Cave Creek (BECC0_2; E293980) has the highest geomean for the winter; Bertrand Creek (BE-9_1; E312388) has the highest geomean in the fall. At Pepin/Double Ditch (DD5, DD6) and Fishtrap (FT8) sites, both fall and winter geomeans exceed those of spring and summer. This seasonal pattern is driven by rainfall patterns described above. Fall (October to December) and winter (January to March) are significantly wetter months with rain events of 0.3 inches (8 mm) or greater in a 24-hour period occurring relatively frequently. Interestingly,

geomeans for the summer (July to September) are higher than the spring (April to June) on Cave Creek, Bertrand Creek, and Pepin, likely due to the higher concentrations sometimes seen during very-low flow conditions.

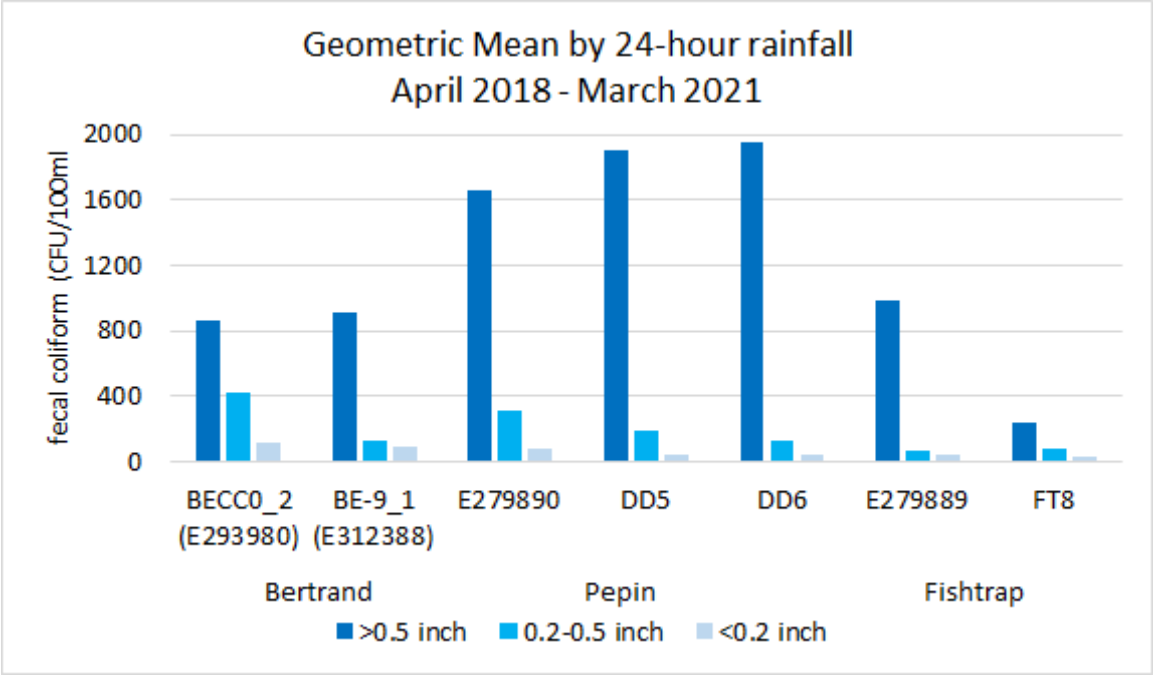



Figure 17. Geometric mean of fecal coliform (April 2018-March 2021) at the border sites by 24-hour rainfall amounts. 24-hour rain amounts were categorized as less than 0.5 inches (less than 13 mm), 0.2 to 0.5 inches (5 to 13 mm), and greater than 0.2 inches (greater than 5 mm).

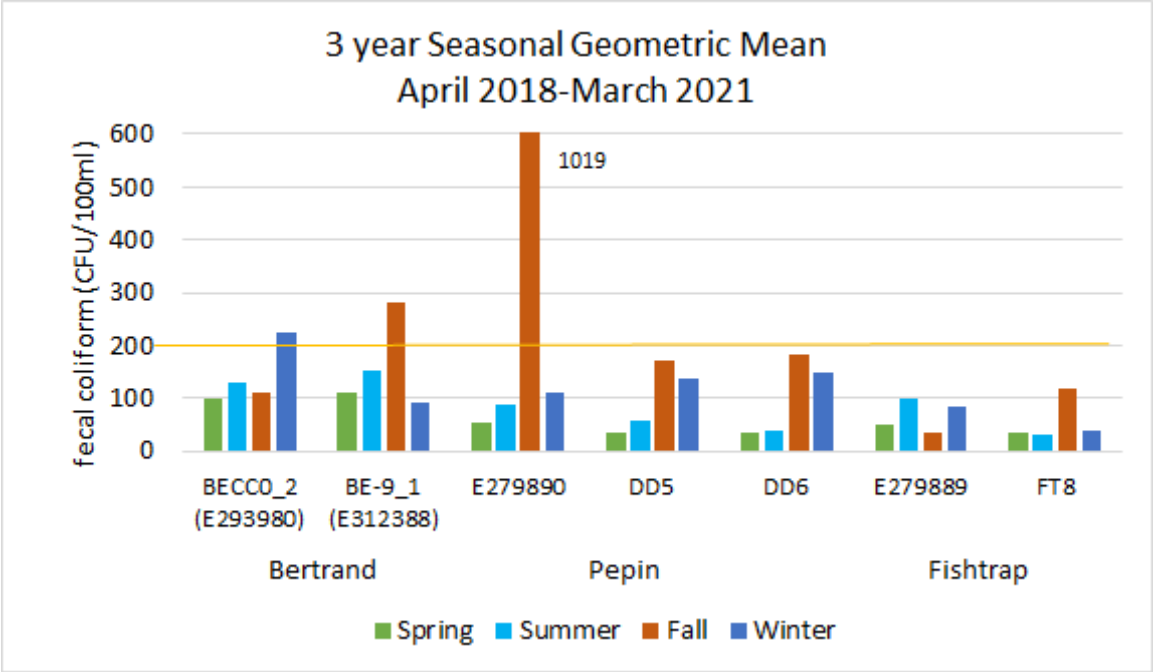



Figure 18. Geometric mean of fecal coliform (April 2018-March 2021) at the border sites by season. Nine to 11 samples were collected per season at each site over the 3-year project duration.

## Hydrology

A TCG workplan task was to gain an understanding of loading from the Canadian portions of Bertrand and Fishtrap sub-basins to downstream WA tributaries and to the mainstem Nooksack River. During 2020, B.C. contracted Hatfield Consultants to estimate the *E. coli* and fecal coliform bacteria concentrations on the Nooksack River at Ferndale near Bellingham Bay based on available B.C. flow and water quality data.

Hatfield Consultants estimated that B.C.'s portion of the Nooksack River watershed represents about 3.8 percent of the total watershed area. The study estimated the combined flow from B.C. tributaries represent only 1.4 percent of the mean flow of the Nooksack River at Ferndale. B.C.'s overall disproportionately small amount of flow relates to dry season and wet season flow influences in WA. During the summer months, both portions of the watershed have little rainfall. Nooksack River flows during the summer in WA are largely driven by ice and snowmelt from the Cascade Mountain Range. Snowmelt drives base flows seasonally in the WA portion of the watershed with little contribution from the B.C. portion of the watershed. In winter, both areas receive comparable rainfall however, B.C. still contributes disproportionately less flow, though the difference is much less than during summer. This could be due to more infiltration, less snowmelt, or more withdrawals in B.C. (Hatfield 2021).

Despite the small contribution to flow and small watershed area, B.C. fecal bacteria loadings are expected to periodically exceed the WA shellfish harvesting guideline for median concentrations of *E. coli* and fecal bacteria concentrations over 30-days (Hatfield, 2021). This has been noted during the three years of coordinated monitoring on both sides of the border. See the sub-basin water quality summaries beginning on Page 8 for further details. The Hatfield hydrologic review further supported the need to coordinate water quality and flow monitoring.

B.C. is working to improve its understanding of the hydrological and hydrogeological processes within the Bertrand Creek sub-basin. B.C.'s Ministry of Forests, Lands, Natural Resource Operations and Rural Development is collecting water use information as well as conducting assessments of water use and availability within the Bertrand Creek sub-basin. The end goal is to move towards sustainable water use and water management within this sub-basin. Other work on the B.C. side of the border includes monitoring Fishtrap Creek during the summer low flow season.

## Outreach and Compliance Promotion

COVID-19 related restrictions continued both sides of the border throughout the TCG project's third year. Social distancing restrictions limited in-person contacts and prevented or significantly altered the way some outreach and stewardship events and activities were carried out. B.C. and WA partners continued to adapt outreach activities and promoted compliance throughout the watershed during this project's final year. Joint activities included:

- In December 2020 B.C. joined a WA pollution identification and correction (PIC) program outreach team meeting.
- In February 2021 a joint TCG outreach subcommittee met and discussed B.C.'s draft risk assessment and management plan.
- B.C. and WA partners shared communication plans and materials and promoted similar spring outreach materials on both sides of the border.

### British Columbia

North of the border, B.C. targeted outreach to address activities that had the greatest risk of contributing to fecal bacteria in the watershed. The focus of this work included agricultural and industrial operations, municipal (county

equivalent) sewage and stormwater management, septic systems, and domestic pets. Due to the lack of jurisdiction and/or resources, possible fecal bacteria sources like homeless camps and wildlife were not addressed. In addition, contributions from four large developments (e.g. mobile home parks) were dismissed as all are connected to city sewers. The following summarizes B.C.'s final project year outreach efforts.

Social media, article, and website: B.C. tweeted 13 tweets using WA's spring tips during February to May 2021. The second-year annual report was posted on ENV's website. ENV supplied an article to 69 agricultural associations and to the Country Life publication about the project and posting of the second-year annual report.

Agricultural outreach:

- The B.C. Dairy Association has required dairies to complete an Environmental Farm Plan (EFP) as part of the association's ProAction program. Two hundred dairies in the Lower Mainland are scheduling EFP planners to complete their dairy's EFP by September 2021.
- A dairy inspector from the B.C. Ministry of Agriculture, Food, and Fisheries (AFF) distributed an ENV outreach letter on manure management to four dairies near high fecal bacteria areas in the Bertrand watershed February to April 2021.
- ENV contacted several poultry boards in early 2021 about the project and requested a meeting to discuss how to best communicate to members. AFF confirms it promotes Beneficial Management Practices (BMPs) and engages with small flock owners on healthy flock management and will continue this work.
- ENV contacted the newly formed Langley Farmers Initiative to promote manure management through a newsletter article for small agricultural operations in the watershed. ENV submitted a newsletter article for the spring 2021 publication.
- ENV distributed an outreach letter promoting manure management to the six members of the BC Shorthorn Association early 2021.
- AFF and the Langley Environmental Partners Society (LEPS) plan to promote manure management with horse and small-lot farms in 2021.
- Farms along Bertrand and Cave Creek were invited to join a group EFP in fall 2020. This work follows up on recommendations from the 2018-19 Group EFP for Bertrand Creek and supported by the BC Agricultural Research and Development Corporation (ARDCorp). Due to COVID-19, engaging farm owners/operators in person was not possible. A news article encouraging participation was published in November 2020 and in January 2021. This group EFP is funded through Watersheds BC and is supported by three students from the University of Fraser Valley. These students will help distribute Septic Sense packages to farmers. If successful, ARDCorp will offer group EFPs to farms adjacent to Pepin and Fishtrap Creeks.
- ENV distributed an outreach article on manure management to BC Horse Council, BC Dairy Association, BC Cattlemen's Association in the spring of 2021.
- AFF's ongoing Beneficial Management Practices Program continues to provide funding to farms with current EFPs to support farms with increasing water percolation and retention, ensuring clean and safe water runoff, and enhancing and conserving biodiversity. This year's funding program became available April 2021.

Industrial sector outreach: In September 2020, ENV mailed 17 gravel pit companies with 34 operations in the watershed a promotional letter describing proper storage of manure, biosolids, or amending soil. Authorization cover letters for gravel pits in B.C. now include a reminder for proper storage, treatment, and application of manure and biosolids

Residential sector outreach: In September 2020, the Township of Langley's (TOL) Water Wise program retained LEPS for a Septic Sense Webinar in the watershed to promote septic system maintenance. At the webinar, ENV presented the TCG project and briefly outlined monitoring results and bacteria source tracking findings. The Western Canada Onsite

Wastewater Management Association (WCOWMA) and affiliates promoted septic awareness during the week of September 14 to 18, 2020. The purpose of this initiative is to promote proper operation and maintenance of septic systems. This association also offered two free "BC Septic Sense" webinars on September 15 and 17, 2020. ENV purchased 150 Septic Sense promotional packages from the WCOWMA in the fall of 2020. Through the EFP program, ARDCorp will distribute these packages to agricultural operations adjacent to Bertrand and Cave Creeks. The remaining packages will be distributed to agricultural operations adjacent to Pepin and Fishtrap Creeks during the EFP program in 2021 and beyond. ENV requested that WCOWMA offer realtors septic system education webinars to the list of realtor offices within the watershed in the spring of 2021.

Municipal (county equivalent) outreach: During February 2021 ENV mailed out 26 outreach letters to dog kennels in the watershed and provided municipal resources to promote proper waste management. ENV distributed educational handouts in May 2021 to City of Abbotsford, TOL, and AFF to display at their offices and/or distribute at future community events. ENV shared water quality monitoring data with City of Abbotsford and TOL to assist with the current updates of integrated stormwater management plans. ENV also provided guidance to both municipalities on what type of authorization is required for certain activities that could contribute to fecal bacteria in the watershed. A goal is to ensure municipal staff can easily identify and communicate to applicants the appropriate authorization/regulatory requirements.

## Washington

In Washington (WA), Whatcom County Public Works and Whatcom Conservation District continued to lead WA's non-regulatory outreach to promote community-wide participation in water quality improvement activities. WA partners developed and implemented coordinated seasonal strategies for wet season (fall 2020 to winter 2021) and for spring 2021. Strategies included seasonally specific messages and resources to help residents reduce fecal bacteria pollution from pets, farms, septic systems, boats, recreational vehicles, and urban wildlife. The strategies incorporate water quality monitoring, landowner contacts, and outreach activities. Much of WA's outreach and compliance promotion since April 2020 adapted to online, virtual experiences emphasizing availability of online resources for tips and access to assistance programs.

Water quality data communication: WA agencies continued to post preliminary data to online, publicly available interactive maps. Quickly communicating preliminary sampling results to community members continues to support goals for transparency and timely feedback about land use and potential impacts to water quality. Public Works maintained online water quality summaries documenting monthly sampling results and water quality status. WA staff continued to communicate with B.C. partners to coordinate sampling dates, review and analyze data, and communicate fecal bacteria spikes observed at the international border stations. WSDA Dairy Nutrient Management Program staff maintained an online water quality story map to share water quality results, current events, and resources related to improving water quality.

Printed materials: Public Works developed and distributed an annual printed PIC Newsletter to 3,537 landowners in program focus areas. During summer 2020, WA posted signage at Nooksack River access points reminding recreationalists about the importance of responsibly managing human and pet waste. Whatcom County Planning and Development Services sent an annual "Natural Resource News" mailing to owners of Agriculture, Rural Forestry, and Rural zoned properties. The newsletter highlighted farm planning and resources available through Whatcom Conservation District, encouraged septic system evaluations and proper dog waste disposal, and advertised financial incentives to help with water quality protection activities.

Social media, website, e-newsletters: Public Works distributed PIC program electronic newsletters and posted 30 social media messages from April 2020 through September 2020 supporting work to prevent pollution from dog waste, boating, recreation, onsite sewage systems (OSS), farms, and urban wildlife. Increased online and social media focus produced a 20 percent increase in followers to Public Works social media accounts, enabling delivery of PIC program messaging to a wider audience. WA used social marketing techniques to expand its campaign to reduce fecal bacteria pollution from dog waste.

- Dog waste focus: Based on review and feedback from a 2019 campaign to encourage proper pet waste disposal, Public Works and Whatcom Conservation District (WCD) expanded a community pet waste campaign. Instead of in-person events, WA adapted to an online dog waste pledge and neighborhood ambassador program.
    - Scoop the poop pledge – Public Works received 168 scoop pledges, distributed 114 leash clips as incentives for taking the pledge, and distributed 29 neighborhood ambassador kits. Ambassador kits include yard signs, tips for talking with neighbors about dog waste, poop bags and dispensers, and stickers.
    - Photo contest – The scoop pledge included a dog photo contest to feature dogs whose owners chose to take the pledge. The pledge program and photo contest were shared and boosted on social media. "Scooping Star" contest dog photos were collected for future campaign use.
    - Find Fido – Public Works, local municipalities, and WCD planned a scavenger hunt for May 2021 to encourage participation in the scoop the poop pledge and to share "Scoop it, Bag it, and Trash it" messages. Scooping Star photos were featured in the scavenger hunt activity planned for popular county parks and trails.

Non-dairy agriculture outreach: WA's fall 2020 strategy emphasized encouraging non-dairy agriculture landowners to start to prepare during the summer for the pending wet season. WA partners communicated with specific non-dairy agriculture properties of concern. The contacted properties were those with previously identified water quality concerns that had not been resolved or that recur seasonally. The letters encouraged residents to act prior to onset of the wet season to help avoid future muddy, manure-contaminated runoff from pastures and manure storage areas during the wet season. Communication offered technical and financial assistance programs. As the wet season progressed, agencies contacted additional properties based on data identifying water quality hot spots and/or visual observations of high pollution risk.

As an adaptation to traditional on-farm tours, WCD launched a virtual pasture tour series in early spring 2021. The virtual events from March through July 2021 offer tours and interviews with local farmers implementing BMPs. The series highlights tips specifically relevant for the month/season. (See https://www.whatcomcd.org/speaker-series) Episode One had 162 views.

From April 2020 to March 2021 WCD provided technical assistance to 92 landowners. Thirty-three farm plans were completed, covering 907 acres. Recommended BMPs included filter strips, fencing, waste storage structures, heavy use area protection, roof water management, pasture and hayland management, riparian forest buffers, underground outlets, and nutrient management.

Dairy agriculture outreach: As part of WA's fall outreach, Washington State Department of Agriculture Dairy Nutrient Management Program sent "fall check-in" mailings to 78 Whatcom County dairy producers. The mailing included reminders about reseeding to retain soils and reduce sediment runoff, soil testing, record keeping, and managing winter lagoon storage. WSDA also made 23 referrals to the WCD for technical assistance: Collection Systems (11), Nutrient Management Plan updates (7), Lagoon Storage (4), Land Application (1).

Financial incentives: Public Works and Whatcom Conservation continued to distribute rebates to help with the cost of implementing eligible small farm practices such as heavy use area protection and temporary fence installation. Public

Works and County Health distributed rebates for qualifying septic system evaluation and other operation and maintenance projects.

# Ongoing Commitments and Recommendations

## Ongoing Commitments

The 2018 TCG Terms of Reference and three-year workplan contemplated that Nooksack watershed water quality improvement efforts may extend longer than three years. The workplan called for determining next steps at the end of the three-year timeline based on evaluation of progress on reducing fecal coliform bacteria pollution.

The official TCG dissolution date is July 31, 2021. British Columbia (B.C.) and Washington (WA) identified tasks as ongoing commitments to be carried out in the shared Nooksack watershed after project end from August 2021 to July 2024. Ongoing commitments represent tasks that partners intend to continue, generally contingent on sustained legislative support and funding caveats described for each task when relevant.

### Joint commitment

- Annual meeting: B.C. and WA will meet annually to discuss status of fecal bacteria related water quality in Nooksack transboundary sub-basins. Meetings will take place following dry season 5-in-30 border sampling. Three projected meetings will occur in June 2022, June 2023, and June 2024.

### B.C. commitments

- Receive and follow up on border water quality data: Using a risk-based approach, ENV will continue to follow up to identify sources of fecal bacteria contamination when complaints are received via the Report All Poachers and Polluters (RAPP) line.
- Communication with WA water quality partners: A B.C. liaison will coordinate water quality data communication annually, sampling, and compliance in collaboration with WA. This B.C. liaison function was filled by ENV staff as part of the TCG.
- Fecal bacteria monitoring at international border: B.C. will partner with the Langley Environmental Partners Society to conduct twice yearly, dry and wet season 5-in-30 monitoring for fecal coliform and *E. coli* at four international border sites (E312388, E293980, E279890, E279889). Sampling events are projected to occur during November 2021, May 2022, November 2022, May 2023, November 2023, and May 2024.
- Farm planning: The B.C. Ministry of Agriculture, Food and Fisheries (AFF) will continue to offer the Environmental Farm Plan (EFP) and Beneficial Management Practices (BMP) programs, and support the agricultural community with stewardship projects and outreach initiatives throughout B.C.
- Outreach and stewardship activities: The following agencies and non-governmental organizations will continue to perform non-regulatory outreach and stewardship activities: BC Agricultural Research & Development Corporation, Langley Environmental Partners Society, Township of Langley, City of Abbotsford, Bertrand Creek Enhancement Society.

### Washington commitments

WA partner commitments summarized in this section are tasks that each agency or department carries out now and plans to continue through July 2024 as part of ongoing workplans. While even programmatic work is subject to agency budget appropriation processes, some WA fecal bacteria pollution reduction work is grant-funded with contract end dates expiring before July 2024. Grant funding is through U.S. Environmental Protection Agency Puget Sound Geographic Funds (or National Estuary Program funds, commonly called NEP funds). NEP grant funded tasks are included here as commitments through a date coinciding with contract expiration. The task notes if further funding will be pursued.

- Pollution identification and correction (PIC) program: Multi-agency staff in WA will continue to carry out a PIC program to address fecal bacteria pollution originating in WA's portion of the lower Nooksack watershed. PIC program tasks will include fecal bacteria monitoring, partner coordination, field surveys, outreach and education with technical assistance to residents, and regulatory enforcement
    - Fecal bacteria monitoring at international border:
        - WSDA Dairy Nutrient Management Program staff will:
            - Collect ambient water samples at five border sites (BECC0.2, BE9.1, JBB, JD-F1.1, and FT9) once per month. Samples will be analyzed for fecal coliform and for *E. coli*. (*Note: this commitment is subject to access and permission related to border crossing and discussion with B.C.*).
            - Coordinate with B.C. and Whatcom County Public Works for spring and fall 5-in-30 sampling runs.
            - Collect source identification samples as needed.
        - Whatcom County Public Works staff will:
            - Collect ambient water samples at four border sites (FT8, DD5, DD6, and BH) at least once per month as a part of the Nooksack routine run. Samples will be analyzed for fecal coliform and *E. coli*.
            - Collect ambient water samples at three border sites (FT8, DD5, DD6) an additional twice per month as a part of Fishtrap focus area run and one border site (BH) once per month as a part of Bertrand focus area run. Samples will be analyzed for fecal coliform and *E. coli*. (These sites will be sampled at minimum three times per month, see bullet above.)
            - Coordinate sampling with B.C. and WSDA for spring and fall 5-in-30 sampling runs.
        - As part of monitoring and source identification work in transboundary sub-basins, WA partners will use B.C.'s Report All Poachers and Polluters (RAPP) reporting system to notify B.C. when WA fecal bacteria monitoring results at the border indicate pollution originating in B.C.
    - Seasonal strategies: WA partners will continue to develop specific strategies to address seasonal conditions leading to potential or actual fecal bacteria pollution risk. The strategies will include a communication plan, tailored messages, and contact with prioritized landowners. The strategies will address the broad range of fecal bacteria sources and communicate desired community actions along with resources to help residents understand the problem, access educational, financial, and technical assistance opportunities, and act in ways that prevent pollution. WA staff will share the seasonal strategies with B.C.'s non-regulatory agencies listed above (e.g. ARDCorp, LEPS, etc.).
    - Communication with B.C.: WA multi-agency staff will communicate with the designated B.C. liaison to coordinate sampling dates, data management, and compliance information. WA staff will refer water quality pollution concerns to B.C.'s Report All Poachers and Polluters (RAPP) system for follow up.
    - On-site sewage (OSS) program: Whatcom County Health Department Environmental Health Division has regulatory oversight for all OSS in Whatcom County and will continue administering the local OSS operation and maintenance program. Tasks include OSS owner education, notification of required system evaluations, follow up when OSS maintenance is required, and ensuring OSS failures are fixed.
    - Dairy agriculture regulatory oversight: WSDA Dairy Nutrient Management Program staff will continue to administer Washington's Dairy Nutrient Management Act, including a program of inspections, technical assistance, and compliance work.
    - Non-dairy agricultural regulatory oversight: Regulatory oversight for non-dairy agriculture related to land use and water quality protection is a shared role of Whatcom County Planning and Development Services and Washington State Department of Ecology.

        - Whatcom County Planning and Development Services staff will continue to administer Whatcom County's Critical Areas Ordinance (CAO). CAO administration includes ensuring compliance with critical areas protection and providing agricultural landowners flexibility to standard buffers through the CAO's Conservation Program on Agricultural Lands option. NEP grant funding to carry out this work lasts through December 2022. Whatcom County will seek additional funding to continue this task through July 2024.
        - Washington State Department of Ecology Water Quality Program regulatory staff will continue to administer Washington's Water Pollution Control Act, including source identification, technical assistance to residents, and compliance work. NEP grant funding to carry out this work lasts through December 2022. Ecology will seek additional funding to continue this task through at least July 2024.
    - Data coordination and management: Whatcom Conservation District's Data Coordinator will continue to manage the Whatcom Clean Water Program (WCWP) water quality database and online map of preliminary water quality data. The Data Coordinator will also continue to support WCWP partner data needs and transboundary data collection, analysis, and communication. NEP grant funding to carry out this work lasts through December 2022. Whatcom County and Whatcom Conservation District will work together to seek additional funding to continue these services through July 2024.
    - Non-regulatory technical assistance to farm operators: Whatcom Conservation District outreach and farm planning staff will continue to provide voluntary site assessments and technical and financial resources to address identified water quality and other natural resource concerns. Engagement and assistance opportunities offered will include workshops, farm tours, technical assistance for site specific farm planning, BMP implementation, rebates, cost-share, and other financial incentives. NEP grant funding to carry out this work lasts through December 2022. Whatcom County and Whatcom Conservation District will work together to seek additional funding to continue these services through July 2024.
    - Community Outreach and Engagement: Whatcom County Public Works and Whatcom Conservation District will continue to lead local PIC program outreach and education tasks. Outreach will continue to build awareness and offer solutions and incentives for addressing a variety of fecal bacteria pollution sources in the Nooksack watershed. NEP grant funding to carry out this work lasts through December 2022. Whatcom County and Whatcom Conservation District will work together to seek additional funding to continue these services through July 2024.
- Marine water regulatory sampling: The Washington State Department of Health shellfish program, in association with the Lummi Nation, will continue to monitor marine water in the Portage Bay Shellfish Growing Area. Marine water sampling will take place monthly (subject to weather-related safety limitations) and water samples will be analyzed for fecal coliform. Shellfish program staff will evaluate the growing area each year and summarize results in an annual report.

## Recommendations

Throughout the course of this project, project partners identified several areas of future work outlined below.

### Joint recommendations

- Partner and Stakeholder Coordination and Information Sharing: Addressing fecal bacteria contamination in the transboundary Nooksack watershed is complex and multifaceted. Addressing this concern requires coordination across overlapping jurisdictions and multiple agencies. We recommend an ongoing integrated approach to bring watershed stakeholders together. This could be achieved by creating a B.C. WA Nooksack River Transboundary Community of Practice involving partners and stakeholders across agencies and local stakeholders. Partnership for Water Sustainability or the Canada Water Agency are potential leads for coordinating B.C.s participation in this project platform. WA supports a sustained and continued partnership with B.C. to address Nooksack transboundary water quality and water quantity issues.

### B.C. recommendations

- Agricultural sector outreach: We recommend that AFF and LEPS continue to provide outreach activities related to nutrient management in the watershed.
- Riparian habitat enhancement: We recommend that farmers adjacent to Bertrand, Pepin and Fishtrap creeks apply to applicable funding opportunities to enhance riparian areas along these tributaries to protect habitat for aquatic and terrestrial species.
- Human wastewater: Results from the bacterial source tracking study consistently identified the presence of human sewage throughout the watershed. This indicates that human wastewater is entering water sources from either municipal wastewater systems, individual septic systems, or through direct discharge. The study indicated that the issues are widespread throughout the region which points to the need for a comprehensive strategy across municipal and regional boundaries to address these sources of contamination. Consultation with septic system professionals occurred in January 2020. During this meeting several suggestions and insights were given into how septic system management could be improved. In general, more homeowner education is required around installation and maintenance of septic systems. LEPS has delivered homeowner education in the past and is well positioned to continue this work contingent on funding. Additional accountability measures could be implemented via annual property taxes, realtor training, among others.
- Data and information needs: Availability of adequate information to create an accurate and comprehensive understanding of priority areas and issues is paramount (Table 2). Several data needs were uncovered during the source assessment. If data is available, accurate assessments and appropriate actions will be possible.

Table 2: Recommended Data Improvements for B.C.

| Data Need | Comments |
|---|---|
| **Detailed Stream Network** | A detailed and connected stream monitoring network which depicts the most accurate water quality knowledge of local streams and ditches. A detailed and connected stream network can be used to integrate with information from US agencies, to represent a contiguous watershed across borders. The purpose of this network would be to improve information on where to target outreach, inspections, and source control actions, and provide information about which agency has jurisdiction for those actions. Partners such as Natural Resources Canada, B.C. Ministry of Forests, Lands, Natural Resources Operations and Rural Development, and local municipalities will all benefit from this improved water course information. |

| | |
|---|---|
| **Water Quality and Quantity Sampling Sites** | Water quality sampling sites could be added in urban areas to understand potential sources from storm water and municipal sewage systems. Tracers of human waste such as caffeine, aspartame or acesulfame could be explored as an indicator of human contamination in waterways, to design focused source control measures. In addition, a coordinated effort to collect water quality and quantity data would assist in confirming B.C.'s fecal coliform loading during wet and dry seasons. |
| **Current Property Uses** | Engaging with property owners who have farms and/or septic systems through the appropriate agricultural association, marketing board or representative agency would help target compliance promotion and outreach programs. |

## WA recommendations

- Three-year review: As B.C. and WA transboundary Nooksack watershed water quality work approaches July 2024, partners should evaluate progress on fecal bacteria pollution abatement to determine next steps.
- Data and information needs: Table 3 summarizes WA data gaps and recommendations to address the gaps.

Table 3: Recommended Data Improvements for WA

| Data Need | Comments |
|---|---|
| **Water Quality Sampling – *E.coli*** | In WA, Whatcom Clean Water Program partners continue to use fecal coliform (FC) data to track fecal bacteria sources, to analyze trends, and to measure impact on downstream shellfish harvest use. Until December 31, 2020, WA state used FC and associated numeric criteria to determine compliance with protecting freshwater contact recreation use. The use of FC organism levels to determine compliance expired December 31, 2020 when the state transitioned to *E. coli* as the indicator to determine compliance with protecting water contact recreation use in freshwater. The transition to *E. coli* as WA's bacterial indicator to determine compliance with freshwater recreational contact suggests that regular testing for *E.coli* in addition to fecal coliform would be informative. Additionally, it would assist WA in future communication with B.C. partners given that B.C. guidelines and the project border benchmark are both set for *E.coli.* |
| **Marine Circulation in Portage Bay** | An understanding of circulation and flushing in Portage Bay would be valuable to our knowledge of the system and how the Nooksack River and its tributaries impact marine water quality in the Portage Bay Shellfish Growing Area. A project is being developed among the United State Environmental Protection Agency, Pacific Northwest National Laboratory (PNNL), and local partners to apply the Salish Sea Model to Portage Bay and downscale model predictions. |
| **eDNA Tools** | Continued development and application of eDNA tools is a promising additional approach for identifying pollution sources in the watershed. This is especially true at sites where long-term work (for example, ambient and source identification sampling for fecal coliform, windshield surveys, property contacts, outreach, technical assistance) has not successfully addressed elevated fecal bacteria counts. The eDNA tools include additional work in both PCR and whole genome sequencing. Identifying funding to support use of the expensive source identification methods is the biggest challenge for locals. |

## Summary and Conclusions

Project partners recognize the TCG's work as an excellent example of cross-border collaboration. Since 2018, B.C. and WA staff have formed good relationships and shared information and tools to coordinate fecal bacteria pollution reduction efforts in the Nooksack River watershed. Unfortunately, as of spring 2021, we have not yet achieved the improved water quality goals we had set for the three-year project period. The Nooksack River continues to deliver loads of bacteria to Portage Bay where portions of Lummi Nation's Shellfish Growing Area fail to meet standards to allow year-round shellfish harvest. We continue to measure high bacteria concentrations in tributaries on both sides of the international border which flow to the mainstem Nooksack River.

The TCG was created to carry out tasks identified in a three-year workplan. Appendix 2 lists TCG project workplan activities, status, and next steps. First-year monitoring tasks focused on coordinating water quality monitoring and setting the border benchmark. Monitoring coordination during year two confirmed that laboratory analysis was consistent and produced the same results on both sides of the border. During the first two years of project outreach and stewardship, B.C. Ministry of Environment and Climate Change Strategy began to engage the agricultural sector and impacted communities.

In contrast, WA had begun fecal bacteria pollution reduction work years earlier and had more established programs and focused outreach within the watershed. After working in the watershed for two years, B.C. learned from WA's targeted approach, coordinated agency outreach, and stewardship programs. B.C. adapted WA outreach messaging to use in B.C. during the project's third year. As a result, prioritized agricultural operations within the watershed on both sides of the border received similar coordinated outreach messaging during spring 2021.

When reviewing the water quality results over the past three years, partners noted the following key takeaways:

- Each unique sub-basin needs targeted source identification and correction approaches based on land use and fecal bacteria sources.
- Elevated fecal bacteria in the watershed is largely driven by rain events during the wet season.
- Outreach is most effective when tailored to specific audiences and delivered in person.
- Three years is a relatively short duration to analyze trends and to see water quality improvements resulting from corrective actions.

Regarding compliance activities in the watershed, WA continued to review non-dairy agriculture properties for violations of Whatcom County's Critical Areas Ordinance or WA's Water Pollution Control Act. Relevant agencies followed up to correct observed violations. WA State Department of Agriculture Dairy Nutrient Management Program staff consistently inspected dairy operations and conducted compliance follow up to correct deficiencies and violations. Whatcom County Health Department continued to require evaluations of septic systems in the Nooksack watershed.

B.C. started inspecting agricultural and industrial operations in late 2017 in preparation for the formal start of the TCG project. During the TCG project's three years, B.C. directed resources to inspect operations near consistently high fecal bacteria monitoring sites and followed up on complaints received in B.C.'s portion of this shared watershed.

TCG project partners know finding and fixing sources of nonpoint pollution often take time and require follow up to educate, encourage, support, and confirm sustained source control and regulatory compliance. Changing land management and enhancing infrastructure on individual properties in the watershed can take multiple years of support to build relationships and community norms that result in long-term water quality improvements. Addressing fecal bacteria sources such as septic systems and livestock manure is an ongoing process, as infrastructure malfunctions and owner-operators make improper management decisions.

Technical staff have demonstrated the importance of monitoring, inspecting sites and responding to data observations to prevent continued water quality deterioration.

The workplan did not anticipate that over a year of COVID-19 precautions would restrict staff's ability to perform field work and to engage and support residents in finding and fixing bacteria pollution sources. COVID-19 travel and social distancing restrictions in 2020 and 2021 hampered project outreach and technical assistance that in the past had most successfully engaged community members when delivered through direct, in-person connections.

To conclude, TCG partners see value in continuing to work collaboratively within a shared watershed, not only to coordinate work but to support related natural resource protection initiatives and activities. Improving water quality and protecting public health across boundaries requires coordination, multiple years of commitment, and dedicated resources.

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# Appendices

## Appendix 1: Project water quality evaluation guidance

| Evaluation Standards | Bacterial indicator* | Criteria | Data used for evaluation |
|---|---|---|---|
| **B.C. Recreational Water Quality Guideline** (freshwater) | *Escherichia coli (E. coli)*<br><br>most probable number (MPN) or *E. coli*/100 mL | ≤ 200 *E. coli* / 100 mL; geometric mean concentration (minimum of 5 samples)<br>**or**<br>≤ 400 *E. coli* / 100 mL; single sample maximum concentration | 5-in-30 sampling results to determine geometric mean value; or single sample result |
| **Project benchmark at Canada-U.S. border** (freshwater) | *E. coli*<br><br>colony forming units (CFU) per 100 milliliters (mL) | ≤ 200 CFU/100 mL geometric mean – Short-term border benchmark to be achieved at border stations over two-years (by 2021)<br><br>≤ 100 CFU/100 mL geometric mean – Long-term border benchmark to be achieved at border stations within five years (by 2024) | 5-in-30 seasonal sampling results<br><br>Evaluation based on geometric mean calculation of five weekly samples collected over 30 days (known as 5-in-30); should apply to both wet and dry seasons used to calculate geometric mean |
| **Historic threshold measure** (freshwater)<br><br>*WA historically used fecal coliform (FC) and associated numeric criteria to determine compliance with protecting water contact recreation use. The use of FC organism levels to determine compliance expired December 31, 2020.* | Fecal coliform<br><br>CFU or MPN / 100 mL | ≤ 100 CFU or MPN /100 mL geometric mean value<br>**and**<br>≤ 10 percent of all samples (or any single sample when less than ten sample points exist) obtained within an averaging period exceeding 200 CFU or MPN / 100 mL | WA continues to collect ambient FC data and compare results to historic numeric regulatory thresholds. WA calculates quarterly and annual geometric means and 90$^{th}$ percentiles to compare to historic datasets and to communicate status. WA uses FC data to track fecal bacteria sources and to measure impact on downstream shellfish harvest use. |
| WA - **National Shellfish Sanitation Program guidelines** to evaluate fecal bacteria levels in shellfish harvesting areas (marine waters) | Fecal coliform<br><br>organisms/100 mL (fc/100 mL) | For year-round harvest (Approved classification):<br>≤ 14 fc/ 100 mL geometric mean<br>**and** ≤ 43 fc/ 100 mL estimated 90th percentile | Monthly ambient data used to calculate geometric mean and estimated 90$^{th}$ percentile; evaluation uses a 30-sample dataset |

*Units are retained from their relevant criteria. However, for comparison purposes, CFU/100ml, MPN/100mL and organisms/100 ml (fc/100 mL) are all considered equivalent units.

## Appendix 2: Workplan Activities Summary

Red text denotes new activities for Year 3 (2020-2021) of the TCG workplan. Black text denotes ongoing activities from previous year(s). B.C. plans to complete B.C.-led workplan items by the scheduled July 2021 project end. Through the Whatcom Clean Water Program structure, WA will continue WA-led communication, compliance and stewardship, and monitoring workplan items beyond July 2021.

List of acronyms in workplan summary table:

| **Canada** | **United States** |
|---|---|
| • AFF - B.C. Ministry of Agriculture, Food and Fisheries<br>• ARDCorp – B.C. Agricultural Research and Development Corporation<br>• EFP – Environmental Farm Plan<br>• ENV - B.C. Ministry of Environment and Climate Change Strategy<br>• LEPS - Langley Environmental Partner Society | • DOH – Washington State Department of Health<br>• ECY – Washington State Department of Ecology<br>• PDS – Whatcom County Planning and Development Services<br>• PIC – Pollution Identification and Correction<br>• WCD – Whatcom Conservation District<br>• WCHD – Whatcom County Health Department<br>• WCPW – Whatcom County Public Works<br>• WCWP - Whatcom Clean Water Program<br>• WSDA – Washington State Department of Agriculture |

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| | BC/WA joint initiative |
| | British Columbia (B.C.) lead |
| | Washington (WA) lead |

| **COMMUNICATION** | | |
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| ***TASK**: Periodic meetings or conference calls as necessary between B.C. management and Washington/local managers of the Pollution Identification and Correction program* | | |
| **Who** | **Activities** | **Status** |
| Joint | ▪ Official TCG meetings: February and June 2021<br>▪ ENV and DOH co-chairs plan agendas, conduct meetings, track action items, and follow up. | ▪ Item completed.<br>▪ Continue to meet annually until 2024. |
| ENV | ▪ Every two to three months B.C. team coordinate work plan meetings. | ▪ Item completed. |
| WCWP | ▪ Twice monthly field staff meetings; once monthly PIC program manager meeting. | ▪ Item completed and will continue. |

| ***TASK***: *Increase non-regulatory engagement with the agricultural/rural residential community by participating in relevant events and forums. Take advantage of transboundary opportunities for outreach and promotional engagement at events in the Nooksack River watershed and Whatcom County* | | |
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| Joint | ▪ No joint B.C./WA TCG participation in transboundary outreach event with agricultural or rural residential community due to COVID-19 restrictions.<br>▪ Formed outreach subcommittee to facilitate non-regulatory compliance promotion information exchange, shared online access to event schedules and farm planning and septic system education promotional materials. Outreach sub-committee met February 2021 to share work to date and plans. | ▪ Item completed. |
| AFF | ▪ Contributes to and oversees the Environmental Farm Plan (EFP) and Beneficial Management Practices (BMP) programs and supports EFP workshops. | ▪ Continue to support EFP/BMP events and forums. |
| ENV | ▪ Due to the COVID-19 pandemic, all events were cancelled.<br>▪ LEPS delivered an online Septic Sense webinar in September 2020.<br>▪ Despite the Langley Community Rivers Day Festival being cancelled, LEPS organized a self-led Stream Clean Up Event on September 27, 2020 in Bertrand Creek. Participants were encouraged to take photos of the trash collected to win prizes. | ▪ Item complete. |
| WCWP | ▪ During 2020 and early 2021 adapted learning opportunities to online and remote formats:<br>  ▪ Completed surveys: PIC program client and pet waste surveys<br>  ▪ Online or remote adaptations: Farm Expo, Run with the Chums, Cattlemen's Winter School, We Scoop photo contest, created YouTube channel for youth and stormwater education videos<br>▪ Adapted rebated eligibility from in-person to online participation (septic operation & maintenance rebate; small farm rebate).<br>▪ Administered septic system maintenance rebate and small farm rebate and cost-share programs. | ▪ Item completed and will continue.<br>▪ Maintain availability of septic system maintenance and farm planning services and financial help through rebates, grants, or cost-share programs.<br>▪ Improve and maintain access to and content of online and multi-lingual engagement and educational opportunities to address needs related to COVID-19 social distancing, low/fixed income, limited or non-English speaking residents. |

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| ***TASK**: Expand Regional Operations Branch (ROB) Nooksack team. Invite non-ENV agencies to planning and work meetings* | | |
| ENV | ▪ Extended invitations to various local, federal and First Nation governments, provincial agencies, and stakeholders; provided updates after every TCG meeting and when reports are posted<br>▪ Continued to meet with representatives, shared monitoring results, and proposed promotional work. | ▪ Item complete. |
| ***TASK**: Continue managing and improving a shared database for multi-agency water quality data, including online results mapping* | | |
| WCWP | ▪ Maintained multi-agency data submittal processes, ArcGIS layers, and collector apps to support online data mapping.<br>▪ Worked with laboratories to facilitate prompt online access to preliminary data to post to online map. | ▪ Item completed and will continue.<br>▪ Continue supporting Data Coordinator position and multi-agency data team meetings to address challenges and improve water quality outcomes. |
| ***TASK:** Identify and use an approved shared platform for producing B.C. and WA joint documents* | | |
| Joint | ▪ Used Box™ for online collaboration and file sharing. | ▪ Item complete. |
| ***TASK:** Compile a list of online resources and related projects to showcase the project's resource development and collaboration* | | |
| Joint | ▪ Appendix 3 of *Nooksack River Transboundary Technical Collaboration Group 2019-2020 Annual Report* is the compiled list of online resources and related projects. | ▪ Item complete. |
| **COMPLIANCE AND STEWARDSHIP** | | |
| ***TASK**: Continue source identification and correction work (compliance inspections and compliance actions)* | | |
| **Who** | **Activities** | **Status** |
| Joint | ▪ WSDA continued to lead WA communication to ENV about high fecal bacteria results and/or visual observations of potential water quality concerns at border location sampling sites; ENV communicated plans and follow up results and inspected sites to determine sources of contamination.<br>▪ Communication resulted in source identification and/or monitoring. | ▪ Item complete.<br>▪ WA staff will contact B.C.'s Report All Poachers and Polluters (RAPP) complaint process when WA fecal bacteria monitoring results at the border are a concern. ENV will continue to follow up on identified sources of contamination through compliance inspections and if necessary, updating authorizations but has limited resources. |

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| ENV | ▪ ENV identified high fecal bacteria concentration areas and worked to determine source. If outside of ENV's jurisdiction, requested appropriate agencies follow up. Some follow up is delayed due to COVID-19 response.<br>▪ ENV followed up on complaints received and those that could not be resolved resulted in inspections.<br>▪ ENV followed up on non-compliant sites (five have escalating compliance responses).<br>▪ ENV inspected 4 gravel operations, 4 mushroom growing facilities, 1 biosolid land application. | ▪ Continue to follow up on past non-compliance inspections and new complaints. |
| ***TASK:*** *Promotional compliance project(s)* | | |
| AFF, ENV and LEPS | ▪ AFF created the On-Farm Composting Guide.<br>▪ LEPS plans to promote the updated Land Management Guide in 2021 through virtual promotional workshops.<br>▪ ENV created a risk assessment and management plan that was shared with TCG's non-regulatory outreach subcommittee.<br>▪ ENV promoted compliance (see the Outreach and Promotion section of this report). | ▪ AFF and LEPS will continue to conduct outreach and promote compliance/beneficial management practices in 2021 and 2022. |
| ***TASK****: Education and Outreach Program on New ENV Regulations* | | |
| ENV | ▪ Promoted the new Code of Practice for Agricultural Management manure management requirements as described above. | ▪ Continue to promote and provide guidance. |
| AFF | ▪ Updated the Environmental Farm Plan (EFP) documents to incorporate the new Code of Practice for Agricultural Management requirements. | ▪ Item complete. |
| ***TASK****: Environmental Farm Plan outreach and cost-sharing initiative in the Nooksack tributaries* | | |
| AFF<br>ARDCorp | ▪ Updated agencies and stakeholders in January 2019 on the Environmental Farm Plan (EFP) program in watershed.<br>▪ Delivered EFP training and workshops in watershed.<br>▪ Promoted a group EFP for operations adjacent to Bertrand. | ▪ Item complete. |
| ***TASK:*** *Effectiveness assessment of Environmental Farm Plan Program [Beneficial Management Practices]* | | |
| AFF<br>ARDCorp | ▪ AFF continues to offer the Environmental Farm Plan (EFP) and Beneficial Management Practices (BMP) programs with third party delivery through ARDCorp. The BMP program is reviewed and updated annually to reflect current priorities. The EFP/BMP programs are a cost-share arrangement with Agriculture and Agri-Food Canada through the Canadian Agricultural Partnership (CAP) Program. | ▪ Continue to oversee and support the EFP/BMP programs. |

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| ***TASK**: Target implementation of AGRI's Manure Spreading Advisory/Application Risk Management tool in Nooksack tributaries; develop nutrient management planning calculator and communicate to users* | | |
| AFF | ▪ The ARM tool has been fully developed and implemented for high-precipitation areas of B.C., which includes BC's Nooksack watershed. As of October 1, 2019, all producers in high-precipitation areas must complete a risk assessment prior to manure application during the month of October, February, and March. AFF has marketed the tool as one unit, both the Manure Spreading Advisory and Application Risk Management portions.<br>▪ A new version of the Nutrient Management Calculator was released earlier in 2020 along with some associated tools. This version includes improved usability and functionality for dairy producers, cattle producers, and mixed crop and animal production.<br>▪ A nutrient management planner training program was developed and will be offered to EFP Planning Advisors and other qualified professionals in July of 2021. | ▪ Continue to implement and promote these tools and provide training when appropriate. |
| ***TASK:** Creation of a communication list for farm operations within the Fishtrap and Bertrand Creek watershed* | | |
| ENV | ▪ ENV does not have access to this information due to B.C. privacy laws. AFF has some of this information, but can legally access it only during emergency management situations. AFF and/or ENV will engage with agricultural associations, as the most effective conduit to farm operations, when necessary. | ▪ Item complete. |
| ***TASK**: Riparian Health Framework project to explore monitoring protocols for riparian health* | | |
| AFF | ▪ Completed a pilot project on Bertrand Creek in September 2020. For three years, AFF contracted the BC Cattlemen's Association to translate the Riparian Health Inventory (RHI) to the B.C. context. This phase of the project is complete.<br>▪ B.C. plans to use the RHI methodology in high priority regions and as a tool within the Farmland Advantage Program, a Payment for Ecosystems Services (PES) program. The Farmland Advantage website is live. Investment Agriculture Foundation (IAF), a provincial organization, will run Farmland Advantage with funding from ENV and the federal Department of Environment and Climate Change Canada. Select sites on Bertrand Creek will be targeted for inclusion in the program for 2021. These sites will receive nominal payments for actively restoring and maintaining riparian areas. | ▪ Farmland Advantage will roll out the PES program that will include select Bertrand Creek sites. |

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| ***TASK**: Continue farm planning and cost-share funding initiatives* | | |
| WCWP | ▪ WCWP partners identified agricultural properties with water quality concerns for PIC program contact; WCD offered non-regulatory technical assistance.<br>▪ WCD and WCPW promoted farm planning services and offered incentives through soil tests, tarps to cover manure piles, manure spreader equipment rental program, and financial help (grants, rebates, and cost-share) for qualifying practices.<br>▪ WCD worked with farmers to produce farm plans and put in place water quality protection practices; technical assistance included working with dairy and crop producers related to manure and facility management. | ▪ Item completed and will continue.<br>▪ Continue funding to deliver and expand farm planning and financial incentive programs to engage the agriculture community in clean water solutions. |
| ***TASK**: Continue educating and reaching out to landowners about clean water goals; offer technical assistance and financial incentives to reduce pollution risk and encourage cooperative compliance* | | |
| WCWP | ▪ Field staff and outreach workgroup developed focused seasonal messages for fall/winter 2020-2021 and spring 2021.<br>▪ Outreach strategy included "get ready for fall" letters sent to properties identified with past season polluting conditions. Letters encouraged accessing available resources.<br>▪ Outreach venues included printed materials, social marketing campaigns, social media posts, pet waste kits, signage, radio ads, phone text alerts, online learning opportunities through Zoom webinars and Facebook Live, and links to online resources such as water quality results map and story map. | ▪ Item complete and will continue.<br>▪ Continue improving seasonal outreach and assistance strategies that include focused messages for partners to deliver based on each agency's program role and responsibility.<br>▪ Continue multi-prong approaches to delivering coordinated messages. |
| ***TASK**: Collaborate to maintain and improve online water quality results and data communication* | | |
| WCWP | ▪ Continued multi-agency data collection to support online mapping and hotspot follow up.<br>▪ Consistently made preliminary results available to the public via the online results map.<br>▪ Provided relevant and timely content to the public via WSDA StoryMap.<br>▪ Consistently created and posted monthly water quality summaries to the WCPW website. | ▪ Item complete and will continue.<br>▪ Continue improving online data mapping of preliminary results, including the addition of freshwater *E. coli* results and marine water fecal coliform sampling results.<br>▪ Include alerts for WSDA StoryMap in WCPW, WCD, and PDS newsletters. |

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| ***TASK**: Maintain regulatory backstop programs, including relevant outreach/technical and financial assistance components* | | |
| WCWP | <u>Dairy</u><br>WSDA Dairy Nutrient Management Program (DNMP)<br>▪ Conducted routine and follow up inspections, including investigations to collect water samples and review nutrient application and soil test records.<br>▪ From July 2020 through April 2021, DNMP staff either completed or were in process of completing 19 formal or informal compliance actions for 13 dairy operations in Whatcom County.<br>  ▪ Enforcement actions included 6 warning letters, 10 Notices of Correction, and 3 Notices of Penalty.<br>▪ Offered dairy operators technical assistance and/or referrals to WCD to address identified problems.<br>▪ Referred non-dairy agriculture properties with water quality concerns to relevant PIC program partner(s).<br><br><u>Non-dairy agriculture</u><br><br>ECY Water Quality Program<br>▪ To non-dairy farm operators, offered technical assistance and/or referral to WCD in response to water quality complaints or to PIC program referrals.<br>▪ Continued regulatory follow up with properties identified as high-risk for fecal bacteria pollution to surface water<br>▪ Issued 2 warning letter (informal compliance).<br><br>Whatcom County PDS<br>▪ Related to Critical Areas Ordinance (CAO) compliance:<br>▪ Offered landowners technical assistance and referral to WCD to help them comply with local Critical Areas Ordinance (CAO).<br>▪ Requested landowners complete farm plans as allowed through CAO Conservation Program on Agricultural Lands guidance or remove agricultural use from regulated critical area buffer.<br>▪ Conducted annual compliance review of farm plans implementation.<br>▪ Issued 2 Notices of Violation. | ▪ Item complete and will continue.<br><br>▪ Continue routine and follow up inspections of dairy facilities and dairy record-keeping documents.<br>▪ Follow up on complaints and/or high fecal bacteria counts related to dairy operations.<br><br>▪ Continue work to improve efficiency and effectiveness of regulatory backstop programs for non-dairy agriculture land use sources of fecal bacteria pollution.<br>▪ Continue regulatory agency work with non-regulatory agencies offering technical assistance, rebate, and cost-share opportunities to encourage implementation and maintenance of water quality protection practices. |
| ***TASK**: Assess effectiveness of management practices* | | |

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| WCWP | ▪ WCD continued conducting a multi-year, controlled edge-of-field monitoring study to assess effects of practices on reducing discharge of sediment, bacteria, and/or nutrients (Discovery Farms Washington: Edge of Field Monitoring). | ▪ WCD research will continue. |
| ***TASK**: Continued administration of OSS compliance efforts; operations & maintenance program (regular system evaluations) including repair/replacement of failing systems; oversight of OSS design and installation; financial incentives* | | |
| WCWP | ▪ Due to COVID-19 response demands, WCHD staff reduced its resources devoted to Whatcom County's On-Site Sewage System (OSS) operation & maintenance (O&M) program.<br>▪ WCHD responded to complaints and to PIC program referrals to address possible human waste sources of fecal bacteria pollution.<br>▪ If human waste source identified, WCHD followed up using agency enforcement protocols.<br>▪ WCPW and WCHD cooperatively administered a rebate program for OSS O&M actions. | ▪ Continue OSS compliance efforts, including landowner contacts and follow-ups.<br>▪ Continue to adapt homeowner training and rebate eligibility in response to COVID-19 social distancing needs. |
| **MONITORING** | | |
| ***TASK**: Continue source identification sampling to identify fecal coliform sources* | | |
| **Who** | **Activities** | **Next Steps** |
| Joint | ▪ WA continued to collect storm event samples at seven border sites.<br>▪ B.C. conducted additional targeted sampling based on unusual site conditions and/or information received about specific sites in the watershed.<br>▪ B.C./WA communicated following high results at the border. | ▪ Item complete. |
| ***TASK**: Continue long- and short-term ambient sampling in freshwater and in shellfish growing areas* | | |
| Joint | ▪ B.C. and WA performed monthly ambient sampling throughout the annual data reporting period (April 2020-March 2021).<br>▪ Coordinated WA freshwater sampling in the Nooksack River watershed with monthly DOH and Lummi Natural Resources marine sampling in Portage Bay.<br>▪ B.C. sampled monthly at 19 stations on Bertrand and Fishtrap Creeks and Pepin Brook, including four sites on the Canada-US border.<br>▪ B.C. and WA coordinated on same-day sampling on 9 events during the annual data reporting period.<br>▪ B.C. completed sampling events both in the wet and dry season to track progress on the border benchmark and evaluated seasonal trends in data. | ▪ Continue coordination of sampling dates as feasible and share water quality results.<br>▪ B.C. will continue dry and wet season 5-in-30 sampling for assessing if water quality is meeting the border benchmark at the four relevant border sites. ENV will fund LEPS to conduct sampling after July 2021 (sampling twice a year in May and November). |

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| | ▪ B.C. and WA data subcommittee coordinated monitoring, data sharing and collective analysis.<br>▪ B.C. and WA continued to share sampling plans and standard operating procedures. | |
| ***TASK**: Research and evaluate usefulness of source tracking methodologies (e.g. microbial source tracking, metagenomics, ZAPS)* | | |
| WCWP | ▪ WA partners continue to use Coliscan Easygel method to test water samples for *E. coli.* WA uses results as an outreach tool to inform follow up. | ▪ Task completed and will continue. |
| ***TASK:** Coordinate and prioritize sampling events to occur on same day north and south of border at least once monthly* | | |
| Joint | ▪ B.C. and WA staff sampled monthly on same dates; pre-scheduled coordination sent well in advance of sampling. | ▪ Item complete. |
| ***TASK:** Conduct multi-agency same site duplicate or replicate samples to evaluate comparability of data* | | |
| Joint | ▪ Was not completed due to continued COVID-19 related international travel restrictions. | ▪ Not completed due to COVID-19 related travel restrictions. . |
| ***TASK:** Evaluate border sampling coordination between jurisdictions:*<br>*a. Prioritize sampling sites*<br>*b. Statistically compare datasets from geographically close B.C. and WA sites to determine if site data can be used interchangeably*<br>*c. Determine if sampling sites can be removed or more sites added*<br>*d. Include required 5-in-30 day sampling during key seasons* | | |
| Joint | a. Monthly sampling data was used to calculate site statistics and prioritize sites for follow up work.<br>b. Datasets from adjacent sites have been evaluated; this work is ongoing. Some discrepancies exist due to differences in sampling dates, but generally the sampling programs produce comparable datasets for each site.<br>c. B.C. and WA reviewed sampling sites<br>d. B.C. and WA conducted 5-in-30 day sampling twice per year: wet season (Nov/Dec 2020) and dry season (May 2021). | ▪ Item complete.<br>▪ Evaluation of status against border benchmark will continue through 2024 |

| ***TASK:*** *Gather hydrogeological information to understand loading from Canadian portions of Bertrand and Fishtrap watersheds to downstream WA tributaries and to the mainstem Nooksack River* | | |
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| Joint | • *E. coli* and fecal bacteria concentrations at Bellingham Bay were estimated, based on available B.C. flow and water quality data. Even though B.C.'s headwaters represent small area of the watershed, B.C. loadings are expected to periodically exceed the WA shellfish harvesting guideline for median concentrations of *E. coli* and fecal coliform concentrations over 30-days. | ▪ Item complete.<br>▪ A need for coordination of water quality and flow monitoring has been pointed out to understand further hydrological and hydrogeological processes within Bertrand sub-basin. |

## Appendix 3: Monthly Monitoring Data Summary: April 2020 through March 2021

| | | | *E. coli* | | | | | | | Fecal coliforms | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site Name | Sample ID | n | min | max | 12M GM | 90th % | % exceed 200 | % exceed 400 | % exceed 1000 | min | max | 12M GM | 90th % | % exceed 200 | % exceed 400 | % exceed 1000 |
| Bertrand Creek D/S Aldergrove Lagoon | E207092 | 11 | 150 | 2600 | 361 | 2403 | 73% | 27% | 9% | 220 | 3100 | 441 | 2853 | 100% | 45% | 9% |
| BC12. Bertrand Creek at 264 St | E293977 | 11 | 20 | 930 | 117 | 856 | 27% | 18% | 0% | 31 | 930 | 202 | 870 | 45% | 27% | 0% |
| Howe's Creek U/S 272 St. | E206847 | 10 | 31 | 7100 | 556 | 6620 | 80% | 60% | 30% | 60 | 7300 | 777 | 7300 | 80% | 70% | 30% |
| Bertrand at 16 Ave. | E273723 | 10 | 26 | 1000 | 186 | 970 | 40% | 20% | 0% | 28 | 1200 | 212 | 1170 | 40% | 30% | 10% |
| Cave Creek 248th (C-01) | E315155 | 10 | 33 | 1000 | 207 | 1000 | 50% | 20% | 0% | 33 | 10000 | 283 | 10000 | 50% | 30% | 10% |
| Cave Creek at 0 Ave. | E312388 / BECC0.2 | 10 | 36 | 2700 | 214 | 2700 | 50% | 30% | 10% | 43 | 2700 | 249 | 2700 | 70% | 40% | 10% |
| Bertrand Creek at 0 Ave. | E293980 / BE-9.1 | 11 | 33 | 1000 | 203 | 934 | 45% | 27% | 0% | 33 | 1000 | 239 | 934 | 55% | 27% | 0% |
| Bertrand Creek at H St | BH | 5 | | | | | | | | 56 | 450 | 149 | 446 | 40% | 40% | 0% |
| Bertrand Creek at Rathbone Rd. | B1 | 25 | | | | | | | | 16 | 3900 | 91 | 202 | 12% | 4% | 4% |
| Pepin Tributary | E309447 | 10 | 1 | 10000 | 175 | 9300 | 40% | 40% | 20% | 64 | 46000 | 819 | 46000 | 60% | 60% | 30% |
| Pepin in Aldergrove Park | E253211 | 10 | 16 | 17000 | 219 | 15640 | 40% | 30% | 20% | 17 | 192000 | 537 | 174600 | 50% | 30% | 30% |
| Pepin Creek Lefeuvre S Huntington | E315157 | 10 | 28 | 18000 | 480 | 16700 | 60% | 50% | 40% | 36 | 22000 | 655 | 21100 | 60% | 50% | 40% |
| Pepin at International Boundary | E279890 | 10 | 23 | 8000 | 288 | 8000 | 40% | 40% | 30% | 23 | 136000 | 542 | 123500 | 50% | 40% | 40% |
| Double Ditch West at Boundary Rd. | DD5 | 11 | | | | | | | | 20 | 12800 | 212 | 6000 | 45% | 45% | 27% |
| Double Ditch East at Boundary Rd. | DD6 | 11 | | | | | | | | 10 | 39000 | 235 | 14000 | 45% | 45% | 27% |
| Double Ditch West at Pine St | DDW | 12 | | | | | | | | 2 | 21000 | 168 | 3060 | 42% | 42% | 25% |
| Double Ditch East at Pine St | DDE | 12 | | | | | | | | 18 | 43000 | 222 | 2205 | 42% | 25% | 17% |
| Double Ditch at E. Main St. | F3 | 24 | | | | | | | | 5 | 6000 | 158 | 5580 | 38% | 21% | 17% |
| Waetcher Creek near Simpson Rd | E310908 | 9 | 80 | 5000 | 407 | 5000 | 56% | 44% | 22% | 110 | 7000 | 534 | 7000 | 56% | 56% | 33% |
| Fishtrap at Ross Rd S of Huntington | E315795 | 10 | 10 | 200 | 64 | 186 | 0% | 0% | 0% | 10 | 280 | 77 | 272 | 10% | 0% | 0% |
| Fishtrap at International Boundary | E279889 | 9 | 16 | 200 | 57 | 200 | 0% | 0% | 0% | 16 | 200 | 62 | 200 | 0% | 0% | 0% |
| Fishtrap Creek at Northwood Rd. | FT8 | 11 | | | | | | | | 15 | 528 | 63 | 360 | 18% | 9% | 0% |
| Fishtrap Creek at Badger Road | FT4 | 24 | | | | | | | | 7 | 520 | 105 | 386 | 46% | 13% | 0% |
| Fishtrap Creek at River Road | F1 | 25 | | | | | | | | 25 | 3800 | 175 | 840 | 44% | 20% | 8% |

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|---|
| Bertrand sub-basin |
| Pepin sub-basin |
| Fishtrap sub-basin |

## Appendix 4: 5-in-30 monitoring results from Spring 2021 (May-June)