FINAL PROJECT REPORT

FOR

Application: FP14007 Agreement: G1400435

Drayton Harbor/Semiahmoo Bay Water Quality Enhancement

City Of Blaine

Total Cost of Project: $338,000
Grant or Loan Amount: $249,750

January 1, 2014
December 31, 2017

_____ _____ &/or_____ _____12/19/2017
(AUTHORIZED SIGNATORY) DATE (PROJECT MANAGER) DATE

Drayton Harbor/Semiahmoo Bay Water Quality Enhancement
City of Blaine
G1400435

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Final Ecology Grant Contribution: $249,750

Project Description

Drayton Harbor has historically been a productive commercial, tribal and recreational shellfish harvest area. Anecdotes of commercial shellfish harvest date back to 1906 with the Alaska Packers Association. However, fecal bacteria (FC) pollution has disrupted safe harvest back to the 1950s. In 1988, portions of Drayton Harbor were closed to harvest due to high FC levels and entire harbor was closed to shellfish harvest by 1999.

Ecology's 2008 TMDL study evaluated bacteria reductions required to meet water quality standards. The study determined waste load allocations indicating that Cain Creek, required up to 95% bacteria reduction to meet water quality standards for shellfish harvest and recreation. The TMDL study identified human fecal markers (Hood and Mathieu, 2010) confirming the presence of human waste in Cain Creek, also observed by past studies (HCS, LLC and ESA, 2014). Blaine Public works was awarded a Centennial grant to address fecal contamination in Cain Creek, primary urban drainage in Blaine. This report describes pollution prevention and correction measures taken by Blaine to reduce bacteria loads from Cain Creek and direct discharges to marine receiving waters within city limits by addressing human and animal fecal bacteria sources through long term programmatic planning, corrective action, public education and monitoring.

Drayton Harbor and Semiahmoo Bay from the Cain Creek outlet

Interns collecting water quality samples at Cain Creek site

Project Accomplishments

Purchased robotic video camera and inspected 1.5 miles of sewer line within 100 feet of Cain Creek, identified and repaired one defect discharging untreated sewage. Developed plan to inspect sewer and storm lines

Developed map of Cain Creek drainage and direct discharges to Drayton Harbor delineating and prioritizing sub-basins for video inspection rotations and implementation matrix for corrective action planning based on fecal bacteria monitoring, load estimates and human biomarker presence.

Identified probable sources and pathways of contamination from storm water run-off to human fecal input from a homeless encampment.

Purchased and installed five pet waste stations in the Cain Creek basin and developed a pet waste management plan/program.

Worked with Blaine Parks, Ecology and Nature's Path Foods to purchase lots identified in the Cain Creek (draft) Park plan.

Educated the public through events, public meeting, mailings, website posting (on Blaine's web pages) and through collaboration with Garden of the Salish Sea Curriculum Blaine schools program.

Water Quality Improvements

- Facilitation of future water quality improvements and corrective actions will be achieved through implementation based on planning resulting from project monitoring data in the *Water Improvement Matrix* developed by *Natural Systems Design*.
- A sewer line defect was detected and repaired at CC0.8 in January 2016 that may explain the presence of human markers on 12/3/2016 and subsequent absence (Figure B-8.) Chronic source(s) of human fecal contamination appear prevalent throughout the Cain Creek lower drainage. Purchase and installation of five pet waste stations in the Cain Creek basin and development of a pet waste management plan/program should reduce FC levels.
- Five pet waste stations were purchased and installed in the Cain Creek basin a pet waste management plan/program was developed for future implementation.
- Due to fecal coliform bacteria variability and high FC densities, project data contain considerable variability. Additional ongoing monitoring is recommended to determine whether Cain Creek water quality has improved.

The Next Step for Continued Success

- Systematic Sewer/stormwater video inspection and repair. Develop a 3-5 year rotation schedule for system wide coverage as an ongoing program.
    - Complete an Operations & Maintenance Manual that outlines inspection methodology.
    - GIS mapping of sewer and storm system (in the Cain Creek corridor) for tracking system inspection and repairs. Collect elevations of stormwater system in addition to plan view locations to facilitate future modeling and flow tracing.
    - Continue monitoring priority sub-basins.
- Implement pet waste management plan (Appendix I) and develop a funding mechanism for pet waste station garbage collection and administration.
- Protect/restore wetlands and riparian buffers. Protections are in the City's Critical Area code, however additional protections and development standards should be considered to minimize impervious surfaces and runoff and retrofit water quality treatment to the storm drain system in key sub-basins, such as the Cain Creek headwaters and estuary. Seek funding to implement Cain Creek Park plan.
- Continue public education and to maintain awareness of water quality issues through public education, continue work with community groups, Blaine schools and education programs such as Garden of the Salish Sea Curriculum to engage the public and disseminate information.
    - Continue to work with community groups, Blaine schools and water quality programs such as Garden of the Salish Sea Curriculum to engage the public and disseminate information.
    - Install storm drain markers.
    - Hold annual summer event that highlights clean water and shellfish.
    - Involve citizens and students in educational activities and programs that foster support for clean water and water conservation in the community.
- Ongoing Education and Outreach to maintain public awareness of local water quality issues.
    - Continue to work with community groups, Blaine schools and water quality programs such as Garden of the Salish Sea Curriculum to engage the public and disseminate information.
    - Install storm drain markers.
    - Hold annual summer event that highlights clean water and shellfish.
    - Involve citizens and students in educational activities and programs that foster support for clean water and water conservation in the community.

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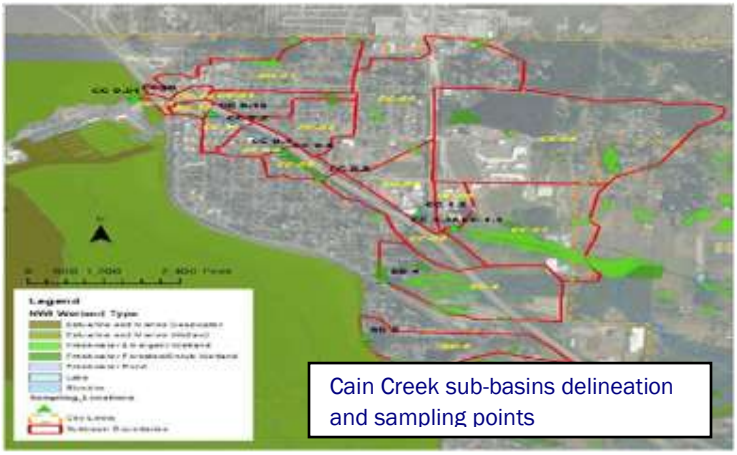

Cain Creek sub-basins delineation and sampling points

III. OVERVIEW DESCRIPTION OF PROJECT

Drayton Harbor has historically been a productive commercial, tribal and recreational shellfish harvest area. Anecdotes of commercial shellfish harvest date back to 1906 with the Alaska Packers Association. However, fecal bacteria (FC) pollution has disrupted safe harvest back to the 1950s. In 1988, portions of Drayton Harbor were closed to harvest due to high FC levels and entire harbor was closed to shellfish harvest by 1999.

Ecology's 2008 TMDL study evaluated bacteria reductions required to meet water quality standards. The study determined waste load allocations indicating that Cain Creek, required up to 95% bacteria reduction to meet water quality standards for shellfish harvest and recreation. The TMDL study identified human fecal markers (Hood and Mathieu, 2010) confirming the presence of human waste in Cain Creek, also observed by past studies (HCS, LLC and ESA, 2014). Blaine Public works was awarded a Centennial grant to address fecal contamination in Cain Creek, primary urban drainage in Blaine. This report describes pollution prevention and correction measures taken by Blaine to reduce bacteria loads from Cain Creek and direct discharges to marine receiving waters within city limits by addressing human and animal fecal bacteria sources through long term programmatic planning, corrective action, public education and monitoring.

This project documented water quality baseline data for the Cain Creek drainage, delineated and ranked sub-basins for management solutions based on fecal coliform bacteria loading estimates. Corrective actions within the scope of the project have been taken to enhance water quality in Cain Creek and Drayton Harbor while laying groundwork for continued and programmatic water quality protection.

IV. OUTCOME:

- **Task - 2 Water Quality Monitoring -** Monitoring was conducted by NSEA and HSC staff from November 2014 through January 2017. Monitoring was conducted to identify fecal (bacteria) loads, pollution sources, document effectiveness of initial corrective actions and support efforts to plan BMPs, programmatic support and restoration of the Cain Creek corridor. Central to the project has been video inspection of sewer and storm piping within 150 feet of Cain Creek that was accomplished by Blaine Public Works Department. Monitoring conducted over more than two years supports camera work and was comprised of three elements: 1) ambient monitoring 2) storm monitoring and 3) "hot spot" monitoring associated with results of system video and sewer repair. Additional ambient water quality parameters were collected and are included in the project database

  Bacteroides host specific chain reaction (HSPCR) analysis was donated to the project by the EPA Region 10 Laboratory Water and Watersheds program and utilized to determine (Appendix E) the presence/absence of human markers for 42 samples during 6 sampling events.

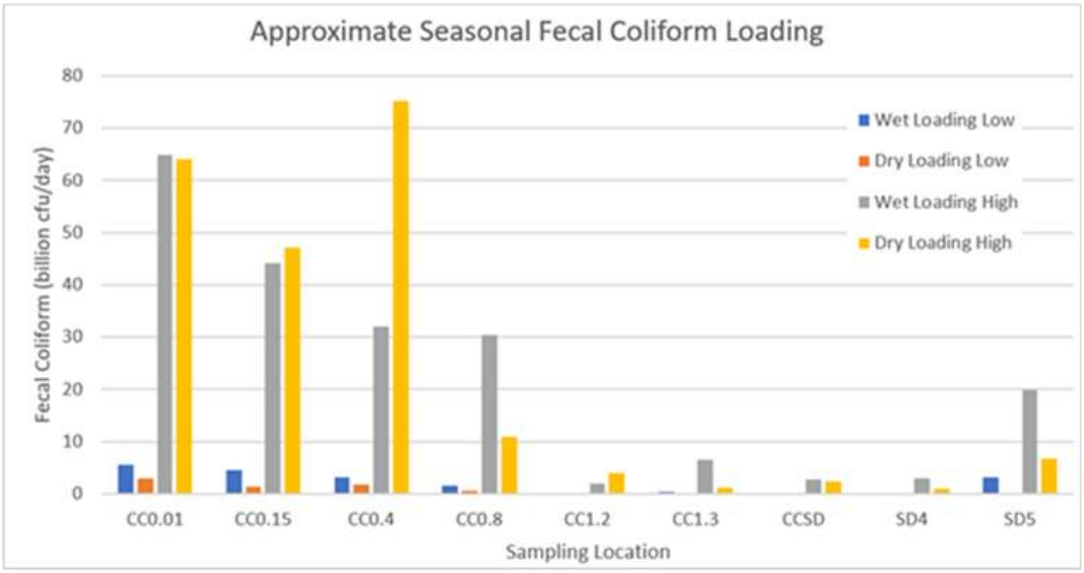

Figure B-11 - Fecal coliform bacteria loading estimates (NSD, 2017).

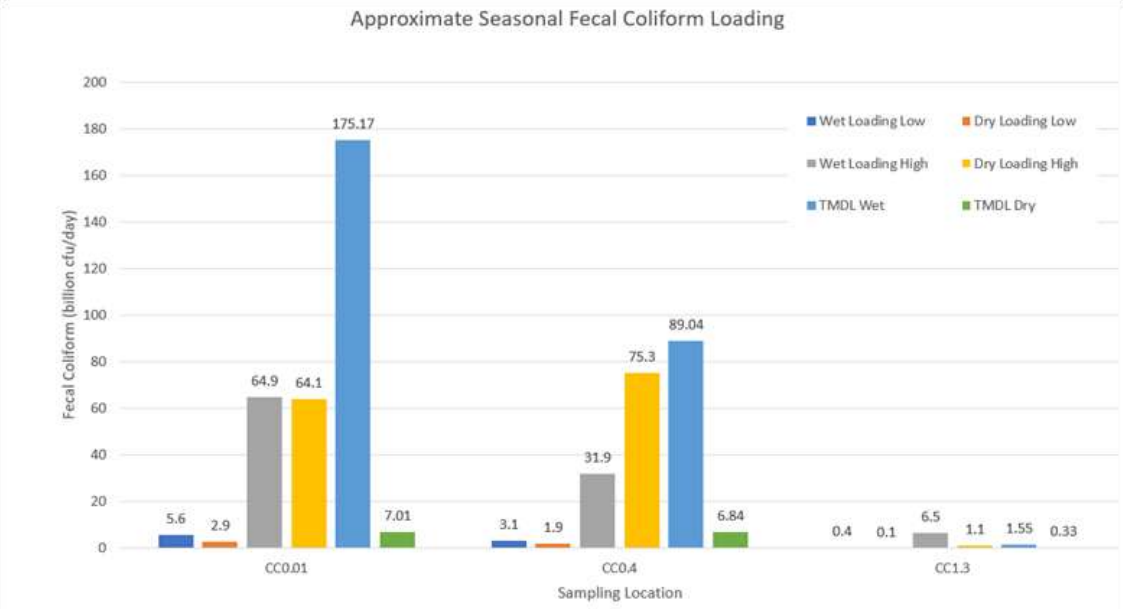

Figure B-12 - Fecal coliform bacteria loading estimates in comparison to draft TMDL values

- **Task 3 - Hot spot monitoring**
  Blaine Public Works Department purchased a pipeline video camera (Cues Steerable Pipe Ranger WM 350-W) and inspected 1.5 miles of sewer and storm line within 150 ft of Cain Creek during the 2015 dry season(Figure B-7). Monitoring was conducted at the site of the sewer line defect repair identified by Blaine Public Work's sewer line camera inspection in 2016. A map of the sewer system inspection near Cain Creek is shown in Figure 8.

- **Task - 4 Implementation Planning and Program Development**

  Strategies were developed and prioritized in an action plan to assist Blaine in implementing water quality improvements, incorporating sewer-storm line video inspection scheduling. A planning process utilizing a water quality improvement matrix developed by NSD, evaluates and prioritizes a range water quality improvement strategies based on effectiveness, cost, effort and feasibility (Initial Program Goals, January 2016, Final Water Quality Improvement Matrix November 2017, Appendix C). Actions with multiple benefits are prioritized. A map of the Cain Creek basin was developed by NSD that delineates and ranks Cain Creek sub-basins for water quality improvements by relative fecal coliform loading and the presence of human biomarkers (Figure B-11). Camera inspection (3-5 year) rotations can be based on sub-basin ranking. Approaches to Cain Creek restoration consistent with Blaine's long term planning process for the Cain Creek riparian corridor supports implementation of the draft Cain Creek Park plan (Figure B-12) and the Natures Path Mitigation project scope of work (Appendix M).

- Defect was found and repaired. Pet waste stations (5) were purchased and 3 installed along the Cain Creek corridor paved path in the lower Cain Creek drainage with installation scheduled for 2 stations at Lincoln Park, in the upper Cain Creek watershed. A pet waste management plan was completed using Bellingham's program as a model (Appendix I).

- **Task 6- Local Awareness and Education** activities includes a Salish Sea Challenge evaluation (November 2016, Appendix J). Education components included: a community based event, public meetings, presentations to local government and community bodies, publicity through a (utility billing) mailer, local newspapers and schools through partnership with Blaine School District and Garden of the Salish Sea Curriculum.

Lessons Learned:

- Due to staffing schedules and unforeseen constraints on Lighthouse Point Water Reclamation Facility laboratory (LPWRF), the storm sampling strategy was revised in HCS.LLC Memorandum #1 (Appendix F: Task 2: Monitoring and Analysis - Ambient and Storm Event Monitoring Revision).

- Scheduling constraints and stream flow conditions required revisions to methods for collection of discharge. Staff gages were installed by NSEA at selected sampling stations and rating curves developed to allow for rapid estimation of stream flow. Flow measurements at each location were collected to develop a stage-discharge curve. The curve with the staff gauges allowed sampling crews to only record water level during sampling and estimate discharge. In some locations, discharge measurements were inconclusive or were not able to be captured for higher stages. To bolster the stage-discharge curves, NSD developed hydraulic models of several of the more complex sampling locations to develop a synthetic rating curve to augment the measured rating curves. The hydraulic model methodology and results are included in Appendix C.

- Due primarily to low flows in Cain Creek during dry season conditions, completeness of planned data collection at sampling sites ranged from 45% to 100% for FC and 55% to 100% for YSI data in the upper drainage at CC1.2 from 11/14 to 1/17. During year two

of the project, dry season sampling was suspended in order to include additional wet season sampling during flow and FC loading conditions.

Water Quality Benefits

This project supports restoration of the Cain Creek corridor that will enhance awareness by providing access and education promoting sustained community involvement and stewardship. The Drayton Harbor/Semiahmoo Bay Water Quality Enhancement project achieved project goals and objectives:

- Refined understanding of spatial patterns of sources of fecal coliform contamination to Cain Creek and neighboring drainages within Blaine city limits that flow into Drayton Harbor and Semiahmoo Bay.
- Developed a map of the Cain Creek drainage and direct discharges to Drayton Harbor that delineates and prioritizes sub-basins and drainage areas based on fecal bacteria load estimates for planning and implementing corrective actions.
- Provides a baseline of data to allow for effectiveness monitoring post-implementation.
- Provides an action plan and a prioritized list of corrective actions.
- Monitored the effectiveness of initial corrective actions.
- Characterized seasonal trends in bacteria concentrations and loading along the length of Cain Creek and at direct discharges to Drayton Harbor (within Blaine City limits).
- Purchased pipeline video camera and characterized the condition of the existing storm and sewer system, through video inspection of 1.5 miles of sewer line within 100 feet of Cain Creek to identify breaks, cross-connects, or other conditions that would result in untreated sewage discharging directly to the storm drain system.
- Identified probable sources and pathways of contamination from storm water run-off to human fecal input from a homeless encampment.
- Implemented corrective actions within the project scope:
    - Repaired a sewer defect found by sewer line video inspection.
    - Purchased and installed five pet waste stations in the Cain Creek basin and developed a pet waste management plan.
    - Worked with Blaine Parks and Nature's Path Foods to initiate purchase of 2 lots identified in the Cain Creek Park draft plan.
    - Purchased storm drain markers.
- Educated the public through events, public meeting, mailings, website posting (on Blaine's web pages) and through collaboration with Garden of the Salish Sea Curriculum Blaine school program.

Data Quality Comparability and Completeness

- Replicates are compared with project method quality objectives as shown in Table A-5. To facilitate comparable data collected for this project with Ecology collected data, the procedures for data collection used by Ecology were incorporated into the project QAPP. Procedures provide data comparable to those collected during the Drayton Harbor Watershed Fecal Coliform TMDL study.
- Replication ranged from 12% for FC samples to 15% for temperature, conductivity and dissolved oxygen. Fecal coliform replicates met the 20% median RSD criteria but failed the 90% criteria. Replicates for temperature and conductivity met method quality objectives for precision, however dissolved oxygen failed for 41% of replicates. The YSI water quality meter failed the post calibration check for dissolved oxygen at least three times and qualified at least twice.
- Forty-nine percent of FC samples were qualified as estimates by the LPWRF lab for being outside countable plate limits (between 20 and 60 CFUs per plate). The high percentage of estimates reflects the variability in Cain Creek FC densities. The LPWRF laboratory ran 3 dilutions per sample. The 20% RSD criteria for FC duplicates was exceeded for 35% of replicates.

Parameter	N (total samples)	Percent replication	YSI criteria	YSI result	Median RSD criteria	Median RSD	90th percentile RSD criteria	90th percentile RSD	Pass
FC membrane filter (MF)	410	12%	NA	NA	<20%	11%	<50%	83%	Fail
Temperature	303	15%	<0.2 °C	0.015°C	NA	NA	NA	NA	Pass
Conductivity	303	15%	10% RSD	1%	NA	NA	NA	NA	Pass
Dissolved Oxygen	303	15%	<0.2 mg/L	0.31 mg/L	NA	NA	NA	NA	Fail

- Due primarily to low flows in Cain Creek during dry season conditions, completeness of planned data collection at sampling sites ranged from 45% to 100% for FC and 55% to 100% for YSI data in the upper drainage at CC1.2 from 11/14 to 1/17. During year two of the project, dry season sampling was suspended in order to include additional wet season sampling during flow and FC loading conditions. Completeness for data collection is represented in Table A-6. Instrument calibrations are shown in Table A-7.

  Performance Items and Deliverables: The following are the anticipated action items that will play an integral role in implementation of the project.

1) Monthly water quality sampling at approximately 10sites in Cain Creek for bacteria, dissolved oxygen, Conductivity, pH, and flow/current for 2 years.

Monthly ambient sampling was conducted at ten sites along the Cain Creek corridor by Nooksack Salmon Enhancement (NSEA) and Hirsch Consulting Services L.L.C (HCS, LLC) field personnel from November 2014 through January 2017 with two additional sites added during the second project year. Sampling was suspended during July, August and September 2016 due to low creek flows. A total of 25 sampling events were conducted over the study

period. Two direct discharges to Drayton Harbor were added beginning in November 2015. Samples sites are shown in Table A-1, Figure B-5.

Rainfall conditions are shown in Table A-3. Scheduling constraints and stream flow conditions required revisions to methods for collection of discharge. Staff gages were installed by NSEA at selected sampling stations and rating curves developed to allow for rapid estimation of stream flow. Flow measurements at each location were collected to develop a stage-discharge curve. The curve with the staff gauges allowed sampling crews to only record water level during sampling and estimate discharge. In some locations, discharge measurements were inconclusive or were not able to be captured for higher stages. To bolster the stage-discharge curves, NSD developed hydraulic models of several of the more complex sampling locations to develop a synthetic rating curve to augment the measured rating curves. The hydraulic model methodology and results are included in Appendix C.

2) Storm event sampling at approximately 10stormwater outfall locations (as determined as part of the monitoring planning process) for 8 storm events over 2 years.

Due to constraints described above storm sampling was revised and approved by Ecology.

Rainfall for Sampling Dates	
Date:	24 hr rainfall
11/20/2014	0.10
12/18/2014	0.13
1/15/2015	0
2/26/2015	0.13
11/19/2015	0.01
12/3/2015	0.01
1/21/2016	0.39
2/25/2016	0
3/24/2016	0.27
11/10/2016	0
12/8/2016	0
1/19/2017	0.63

3) Entering sampling data in EIM: Notice of completion: **From:** Kleinknecht, Jake (ECY)

Sent: Thursday, February 02, 2017 9:52 AM
To: Annitra Peck <apeck@n-sea.org>
Cc: Levesque, Kim (ECY) <KLEV461@ECY.WA.GOV>
Subject: your EIM data submission for G1400435 is complete!

4) Survey all storm and sewer piping within 100 feet of Cain Creek shorelines for potential breaks and cross connections (creek length approximately 1.3 miles x 2 sides of creek),

Characterized the condition of the existing storm and sewer system, through video inspection of 1.5 miles of sewer line within 100 feet of Cain Creek. Identified and repaired one sewer line defect.

I am not sure storm line inspections were completed, must check with Ravyn/Leroy

5) Survey storm and sewer piping along direct discharges to Drayton Harbor within Blaine city limits as identified in TMDL site map as 1-Dray-SD4.

I am not sure this was completed, must check with Ravyn/Leroy

6)Hot spot bacteria monitoring along areas of potential pipe breaks or cross connections. Pre and post repair monitoring was completed during ambient and MST sampling events.

7) Complete implementation action plan; January 2015

ESA developed the Drayton Harbor/Semiahmoo Bay Water Quality Enhancement Project Preliminary Watershed Characterization and Planning Matrix that was included in the interim project report. The final Water Quality Improvement Matrix was completed in September 2017.

8) Complete Cain Creek corridor restoration action plan; June 2015.

Cain Creek corridor restoration was included as a component of the initial and final implementation plans. Worked with Blaine Parks and Nature's Path Foods to initiate purchase of 2 lots identified in the Cain Creek Park draft plan.

9) Complete citywide Operations and Maintenance Program:

Program was initiated with the purchase and outfitting of inspection van. Inspections were tracked and recorded for planning. The priority water quality improvement map was developed based on FC (loading) data to guide future inspection priorities and retrofits.

10) Implement necessary repairs to sewer and storm piping systems which have shown to be potential sources of contamination within the scope of this project.

Repaired a sewer defect found by sewer line video inspection just downstream from CC0.8 in January 2016.

11) Install 5 Pet Waste Stations

12)Install 5 interpretive signs in Cain Creek Park

Purchased and installed five pet waste stations with interpretive signage in the Cain Creek basin and developed a pet waste management plan.

Complete Cain Creek watershed pledge program with 100 pledges

The Blaine Clean Water Challenge effort gained more than 150 commitments from Blaine residents through publicity and events implemented by the project team, Blaine Public Works Department and in-kind partner Garden of the Salish Sea Curriculum, Blaine Schools education partner.

V. Evaluation: This project was successful in meeting project goals, however there is much work to be done to improve Cain Creek water quality. The most significant outcomes concern increasing capacity for the city of Blaine to inspect and repair sewer and storm system defects. The Water Quality Improvement Matrix, developed by NSD) was based on project monitoring data and hydrologic modeling was developed as a tool. Follow-up will be needed to implement systematic programming and realize meaningful water quality improvement. Initiation and implementation of the pet waste management plan in will contribute to bacteria reduction. A funding mechanism will be necessary to implement an effective program. Facilitation of the purchase of two Cain Creek lots by Nature's Path Foods, as a mitigation measure, will initiate creek corridor restoration and elevate public awareness and appreciation of the value of this urban stream corridor.

Cain Creek bacteria loads are compared with the Drayton Harbor TMDL study as shown in Figure B-13. Microbial source tracking using *Bacteroides* host specific chain reaction (HSPCR) analysis was donated by the EPA Region 10 Laboratory Water and Watersheds program to determine (Appendix E) the presence/absence of human markers for 42 samples during 6 sampling events. MST samples were collected during a wet season from December 2016 through January 2017. Human biomarkers were found throughout the lower drainage. On April 29, 2016, Crusher, a sewage sniffing dog, employed by Whatcom County identified human from sites throughout the lower Cain Creek drainage. Results shown in table A-12 indicate a lower frequency of human markers than found in the 2010 study however human fecal sources were present throughout the lower portion of the Cain Creek drainage. A homeless encampment was found just above CC0.15, however that does not explain the occurrence of human markers at CC0.4 and CC0.8. The sewer line defect was repaired at CC0.8 in January 2016 which may explain the presence of human marker at CC0.8 on 12/3/2016 and subsequent absence (Figure B-8. Chronic source(s) of human fecal contamination appear prevalent throughout the Cain Creek lower drainage.

Bacteria loading analysis by NSD concluded:

- Bacteria concentrations increase with distance downstream along Cain Creek as drainage from each sub-basin enters the creek.
- Bacterial concentrations are higher in locations that are more strongly influenced by residential and commercial land uses.
- Spatial patterns are similar in dry vs. wet season. Concentrations are generally higher in the dry season, likely scaling to higher water temperatures.
- High dry season concentrations when runoff is low indicates that there are bacteria pools within the creek system that are not directly tied to runoff.
- While dry season concentrations are high the overall annual loading appears to be greater in wet months due to very low base flows in the summer.

- Cain Creek bacteria loads are compared with the Drayton Harbor TMDL study as shown in Figure B-13. Load estimates appear lower than reported for Cain Creek in Ecology's TMDL study however FC loading is a chronic issue, especially in the lower drainage. Fecal bacteria loading increased markedly between CC0.8 and CC0.4. A beaver pond between these sites may be partially responsible for elevated FC densities.

- While FC wet season loads were higher during the wet season, relatively high loading during the dry season indicates the presence of chronic pollution sources in addition to storm water run-off.
- The watershed also includes Interstate 5, and drainage from the highway may have a strong influence on overall water quality in the lower 0.5 stream miles of Cain Creek.
- Fecal source identification and control are needed west of I-5 from CC0.8 downstream to the outfall in residential and commercial areas of downtown Blaine.

VI. Follow- up:

A planning matrix developed by NSD and based on project monitoring data identified actions to improve water quality and the health of Cain Creek. Cain Creek and its riparian corridor have the potential of serving as a valuable community asset providing multiple beneficial uses. Approaches to addressing contaminant loading in Cain Creek and Drayton Harbor include systematic programming and a set of holistic solutions in response to continued and broadly distributed water quality issues.

Recommendations are drawn from the Water Quality Planning Matrix (Appendix C) and Figure B-13 that prioritizes sub-basins for water quality improvement based on FC load estimates and human markers B-11. (NSD, 2017). Loading calculations suggest that bacteria concentrations are elevated throughout the watershed with a notable increase where the more urbanized portions of the basin start to dominate runoff patterns. Because FC loading is broadly distributed, it will be important to pursue distributed solutions. The following sections detail actions that can be taken throughout the City and site specific opportunities.

1.1 Water quality improvements that can be applied throughout Blaine

1. Systematic Sewer and stormwater video inspection and repair
   1.1. Develop a 3-5 year rotation schedule for system wide coverage as an ongoing program.
   1.2. Complete an Operations & Maintenance Manual that outlines inspection methodology.
   1.3. GIS mapping of sewer and storm system (in the Cain Creek corridor) for tracking system inspection and repairs. Collect elevations of stormwater system in addition to plan view locations to facilitate future modeling and flow tracing.

2. Implementation of pet waste management plan (Appendix I).

2.1. Develop a funding mechanism for pet waste station garbage collection.

3. Protection/restoration of wetlands and riparian buffers. Protections are in the City's Critical Area code, but additional protections can be considered in key portions of the watershed, such as the Cain Creek headwaters and the estuary.

4. Review and consider development standards for minimization of impervious surfaces and runoff and retrofitting water quality treatment into the City's stormdrain system.

5. Ongoing Education and Outreach to maintain public awareness of local water quality issues.

   5.1. Continue to work with community groups, Blaine schools and water quality programs such as Garden of the Salish Sea Curriculum to engage the public and disseminate information.

   5.2. Install storm drain markers.

   5.3. Hold annual summer event that highlights clean water and shellfish.

   5.4. Involve citizens and students in educational activities and programs that foster support for clean water and water conservation in the community.

1.2 Subbasin Specific Opportunities

Using the monitoring results, the investigated subbasins were ranked into three tiers relating to the intensity of fecal coliform loading. These groups are then used to organize site-specific opportunities, detailed below. Please note that there are opportunities in all subbasins; the tiers are useful to target ongoing monitoring and retrofit actions.

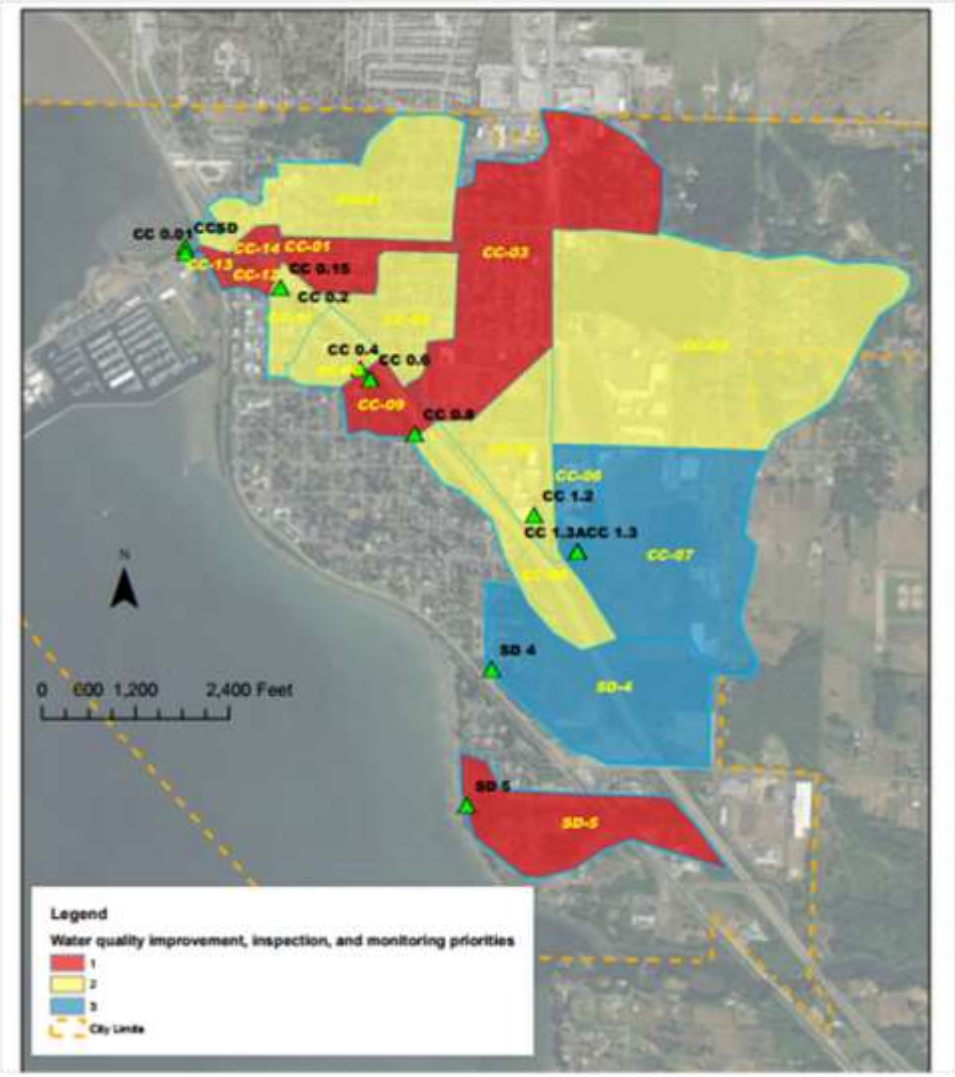

Figure B-11 - Blaine sub-basin water quality improvement, priorities based on FC load estimates and human markers. (NSD, 2017).

1.2.1 Priority 1 (Red) Sub-basins – Lower Cain Creek

1. Sewer and stormwater video inspection and repair program year 1 of 3-5 year rotation.
2. Outfall repair and maintenance - SD20 is overhanging and eroding from stream bank along paved path.
3. Potential for stormwater inputs in nothern and eastern portions of the sub-basin.
4. Identify opportunities to retrofit water quality treatment into stormwater drainage network.
5. Develop Bobblett Street apron as a demonstration site for early action water quality retrofit, pet waste station and educational signage at CC0.8. Site located in highly visible location in Salishan neighborhood and near schools. Project funding is included in Nature's Path Mitigation project scope of work (Appendix M). Address creek access.
6. Complete fish survey to determine whether salmon currently present.
7. Improve fish passage, creek daylighting.

8. Continued FC monitoring at the Cain Creek outfall (CC0.01), CC0.15 and CC 0.4

1.2.2 Priority 1 (Red) Sub-basins – SD5

Small sub-basin at Montfort Park drains duck pond and discharges close to Drayton Harbor Oyster Company lease.

1. Follow up monitoring to trace significant loading.
2. Identify opportunities to retrofit water quality treatment into stormwater drainage network.
3. Post no duck feeding sign.
4. Install pet waste station.

1.2.3 Priority 2 (Yellow) Sub-basins

1. Sewer and stormwater video inspection and repair program on 3-5 year rotation with highest priority in sub-basin DH - 01 that discharges at the Cain Creek storm drain (CCSD) where human biomarkers were detected on three occasions during this study and 5/6 occasions in 2010.
2. Develop strategy and work with the police department to address homeless encampment, a probable source of human fecal contamination.
3. Identify opportunities to retrofit water quality treatment into stormwater drainage network.
4. Sub-basin CC-.10, implement Cain Creek Park plan and riparian corridor restoration. Parcels have been purchased as part of Nature's Path Mitigation Project that includes: native species planting, drainage clean-up, and noxious weed inventory/ eradication.
5. Protection and retrofit of treatment at Cain Creek park site.
6. Retrofit treatment at catch basins near CC0.8 sampling location.
7. Seek funding to restore Creek corridor and develop Cain Creek Park.
8. Continued FC monitoring at CCSD.

1.2.4 Tier 3 (Blue) Sub-basins: CC-06, CC-07, SD-4

The upper Cain Creek watershed has the highest remaining percent of wetland cover associated with the airport and the fields south of Pipeline Road. Wetland and riparian buffers are an effective mechanism of filtering contaminants from stormwater, when of sufficient size and in good condition. Reduction of FC levels in the upper Cain Creek drainage can reduce FC loading to the lower drainage and deliver colder water.

Upcoming development proposals should be developed in a way that protects and enhances existing wetlands and riparian zones to avoid exacerbating issues in the future. Review of stormwater standards is recommended to promote innovative solutions to drainage that work with natural drainage patterns at the Cain Creek headwaters.

1. Blaine Public works yard project near intersection of Pipeline Road and Yew Ave.
2. Cline Property development.
3. Shade in fields at headwaters above CC1.3 and airport property.