KITSAP COUNTY HEALTH DISTRICT
ENVIRONMENTAL HEALTH DIVISION
WATER QUALITY PROGRAM

DOGFISH CREEK RESTORATION PROJECT

FINAL REPORT

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and

KITSAP COUNTY
SSWM
Surface and Storm Water Management

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NOTE: The appendices listed above are not included in the electronic version of this report. To request copies of the Appendices, please contact the following:

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ACKNOWLEDGMENTS

The author would like to thank the residents of the Dogfish Creek watershed for their cooperation during the survey, and their demonstrated commitment to water quality. The author would also like to thank all of the Health District staff (current and past) that contributed to the success of this project.

This project would not have been possible without grant funding from the Washington State Department of Ecology, and matching funds from Kitsap County's Surface and Stormwater Management (SSWM) Program. SSWM's core purpose is to address non-point pollution, which has been identified as the primary source of pollution in Kitsap County's surface waters. SSWM funds a variety of activities oriented toward non-point pollution control, flood reduction, and fish passage improvement. SSWM provides a stable funding source for Health District pollution identification and correction activities.

The Kitsap Conservation District is a valuable non-regulatory partner and resource that provides free technical and financial assistance to property owners. The Health District and the Conservation District developed a partnership over the years which has proven effective in addressing properties with inadequate animal waste management practices that violate state surface water quality standards for fecal coliform.

DOGFISH CREEK RESTORATION PROJECT
FINAL REPORT

EXECUTIVE SUMMARY

History

Dogfish Creek has documented fecal coliform bacteria (FC) and turbidity contamination. It was listed in 1996 and 1998 on the Washington State Department of Ecology's (Ecology) Section 303(d) List of Impaired Surface Waters. (Washington State Department of Ecology, 1996, 1998). To correct the FC and turbidity contamination problems, the Kitsap County Health District (Health District), Kitsap Conservation District (Conservation District) and the City of Poulsbo conducted a pollution identification and correction project (PIC Project) within the Dogfish Creek watershed. Therefore, the goals of the project were to:

- Protect public health and the environment by identifying and correcting sources of FC contamination from failing OSS and inadequate animal waste management.
- Prevent future FC contamination through public education about OSS operation and maintenance and adequate animal waste management practices.
- In the long term, restore water quality in the watershed to a point which would allow for the removal of Dogfish Creek from the state 1998 Clean Water Act Section 303(d) List of Threatened and Impaired Waterbodies. Various segments of the stream are listed for both fecal coliform bacteria and turbidity contamination.

Project Results

- A project total of **8** OSS failures (**7%**) were found. A descriptive list of the OSS failures is contained in **Appendix E**. The **7%** failure rate found in the Dogfish Creek basin is in the middle of the range of failure rates (3% - 16%) found in other areas of Kitsap County surveyed by the Health District over the last twelve years.
- A project total of **1** suspect OSS (**1%**) was found.
- A project total of **21** non-conforming OSS (**19%**) were found.
- A project total of **35** OSS (**31%**) with no records were found.
- A project total of **47** OSS (**42%**) were rated as no apparent problems.
- Two (**2**) farms were confirmed to have inadequate livestock waste management that lead to fecal coliform bacteria pollution of the stream. Both farms implemented corrective actions.
- **17** farms implemented **46** best management practices to protect or restore water quality
- Four **(4)** public meetings were conducted by the Health District and Kitsap Conservation District during the project period. A total of 57 people attended these meetings. At these meetings, the public learned about the water quality of Dogfish Creek, proper on-site sewage system operation and maintenance and animal waste management practices.
- Project participants received various educational brochures related to maintaining OSS and water quality protection.

Water Quality Improvements

The main channel, west fork, east fork and south fork are all experiencing improving trends in FC concentrations, and getting closer to meeting Washington State's Primary Contact Standard for FC Bacteria.

In the main channel of the stream, FC levels have decreased from a geometric mean of 243 in the 1999 water year, to 62 in the 2003 water year. This is a tremendous improvement, and the bulk of the credit should go to project area residents who either correct an FC source on their property, or implemented new practices to prevent problems from occurring.

Continuing Presence in the Project Area

The Health District will have a continuing presence, through SSWM, in the project area to:

- Track improvements or declines in FC concentration data collected by the Health District's ongoing countywide monitoring program;
- Repair the two remaining failing OSS;
- Reinspect suspect OSS and farms;
- Work with the Conservation District to address additional farms found to be violating state water quality standards for fecal coliform; and
- Respond to sewage complaints in the project area.

DOGFISH CREEK RESTORATION PROJECT
FINAL REPORT

1.0 INTRODUCTION

Dogfish Creek has documented fecal coliform bacteria (FC) and turbidity contamination. It was listed in 1996 and 1998 on the Washington State Department of Ecology's (Ecology) Section 303(d) List of Impaired Surface Waters. (Washington State Department of Ecology, 1996, 1998). To correct the FC and turbidity contamination problems, the Kitsap County Health District (Health District), Kitsap Conservation District (Conservation District) and the City of Poulsbo conducted a pollution identification and correction project (PIC Project) within the Dogfish Creek watershed. All work was conducted pursuant to the Health District's "Manual of Protocol: Fecal Coliform Bacteria Pollution Identification and Correction Projects, 1999 (PIC Protocols), and the Ecology approved Dogfish Creek Basin Monitoring Plan. Funding sources included Ecology Centennial Clean Water Fund Grant #G9900234, Kitsap County Surface and Stormwater Management Program (SSWM) and the City of Poulsbo.

The purpose of the PIC project was to identify and correct sources of FC and turbidity contamination impacting Dogfish Creek. To accomplish this, the following tasks were completed:

- Health District conducted a door-to-door survey of approximately 145 properties in the watershed to locate failing on-site sewage systems and inadequate animal waste (pet and/or livestock) management practices.

- Kitsap Conservation District conducted an agricultural inventory, planning and implementation of best management practices to reduce FC and turbidity impacts to the stream.

- Health District conducted ongoing "trend" monitoring for FC, turbidity and conventional parameters to assess the effectiveness of the project over time. In addition, the Health District conducted intensive "impact" monitoring throughout the watershed to assist in the location of FC sources. Impact monitoring for turbidity was conducted only within the South Fork due to the documented history of problems.

- Health District and City of Poulsbo conducted the "City of Poulsbo Nonpoint Pollution Impacts to South Fork of Dogfish Creek. The purpose of the project was to locate, map, inspect and sample stormwater control structures, and provide the City of Poulsbo with recommendations for improving the quality of stormwater runoff and implementing best management practices. In addition, the City paid the local match for PIC surveys within city limits since SSWM funding is only available in unincorporated portions of the county.

- Educational activities including public meetings, workshops on on-site sewage system operation and maintenance, and workshop on proper livestock waste management (and overall farm best management practices.

The following report will discuss each aspect of the project and present some recommendations for future work that will be needed to protect water quality in Dogfish Creek.

2.0 PROJECT AREA DESCRIPTION

2.1 DOGFISH CREEK WATERSHED

Please see **Figure 1** for a map of the Dogfish Creek Watershed and project area. Dogfish Creek is the largest creek in the Liberty Bay / Miller Bay Watershed located in Kitsap County, Washington. The Dogfish Creek system is composed of the main stem, the west fork, the east fork, the south fork, and many small tributaries.

The Main Stem begins at the confluence of the east and west forks due west of Little Valley Road, crosses Bond Road (State Highway 307), and follows Bond Road to its discharge point in Liberty Bay.

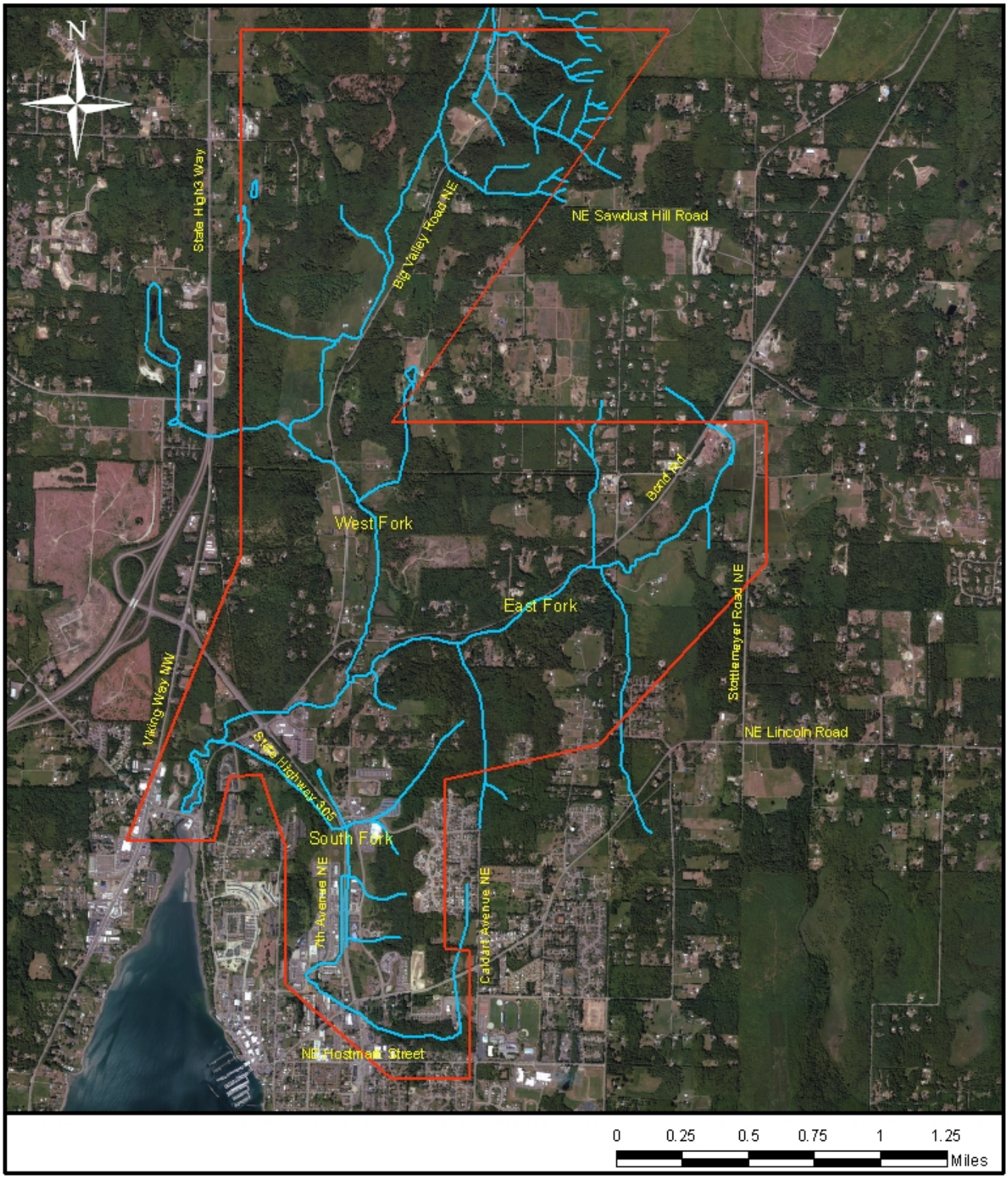
The headwaters of the West Fork are in wetlands approximately 2 miles up Big Valley Road. From there it works its way down Big Valley, crosses Bond Road (State Highway 307) and joins the east fork due west of Little Valley Road. Land use is primarily rural with a number of small farms on relatively large parcels (greater than an acre up to 40 acres). The stream runs primarily through pasturelands and many sections of the stream have been channelized.

The headwaters of the East Fork lie between Bond Road (State Highway 307) and Stottlemeyer Road due south of Gunderson Road. In addition, the headwaters of a tributary to the east fork are located within a tree farm located north of Pugh Road. This tributary enters the East Fork due south of Pugh Road. From there it flows along Bond Road, crosses Bond Road east of where the West Fork crosses, and joins the West Fork due west of Little Valley Road. Land use is primarily rural with a number of small farms located on relatively large parcels (greater than an acre up to 50 acres). A few commercial properties are located in this basin including a topsoil business, electrical supply, nursery, and county road shed.

The headwaters of the South Fork are located off Caldart Road in Poulsbo due north of its intersection with Lincoln Road. From there it flows along Caldart Road, through Wilderness Park (due west of North Kitsap High School), crosses State Highway 305 due south of Lincoln Road intersection, crosses Lincoln Road and 8th Avenue, then flows north through an urban area along State Highway 305, crosses Bond Road and flows into the main stem. The South Fork runs primarily through heavily developed portions of the City of Poulsbo. Eleven stormwater outfalls (ranging in size from 8 inches to 42 inches) currently enter the South Fork within the City of Poulsbo (Kitsap County Health District / City of Poulsbo, 2002).

Over 71% of the existing land uses in the Dogfish Creek basin are either residential (41%), farmland (22%), or commercial/miscellaneous (8%). Approximately 700 residential units have been identified in the watershed. (Puget Sound Cooperative River Basin Team, 1994). A total of 46 agriculture sites have been identified in the watershed (Kitsap Conservation District, 2004)

FIGURE 1
Kitsap County Health District / SSWM
Water Quality Program
Dogfish Creek Restoration Project Area Boundaries



The "Draft WRIA 15 (Kitsap County Streams) Salmonid Habitat Limiting Factors" (Washington State Conservation Commission, 2000) reports that Dogfish Creek supports Chinook, chum, and coho salmon, steelhead, and cutthroat trout. However, conditions in the South Fork are poor due to the condition of the stream channel, lack of spawning substrate and riparian vegetation, and poor water quality.

2.2 POLLUTION IDENTIFICATION AND CORRECTION PROJECT AREA

Figure 1 describes the project area. All surface waters in the project area are classified by the State of Washington as Extraordinary Primary Contact Waters (Ecology, 2003).

There are a total of **145** properties located in the project area. Forty-seven (**47**) of these properties are adjacent to a fresh water shoreline. The other **98** properties are in upland areas and were surveyed proactively in order to prevent future FC contamination problems. Lot sizes range from .25 acre in the city limits to 10 acres in the rural portions of the project area (Puget Sound Cooperative River Basin Team, 1994). Due to the timeframe (1960's) in which development occurred in this area, many of the OSS in the project area are standard gravity type with the drainfield located down gradient of the building structure.

The average annual rainfall is approximately 38 inches. In the past nine years, rainfall has averaged 47 inches with a maximum of 62 inches in the 1998-1999 water year (October 1 – September 30), and a minimum of 29 inches in the 2000-2001 water year. During this nine-year period, the maximum 24-hour rainfall ranged from 1.41 inches in the 1999-2000 water year to 3.00 inches in the 1994-1995 water year. (Kitsap Public Utility District #1, 1431 NW Finn Hill Road, Poulsbo, WA). The majority of this rainfall occurs between the months of October and April, a period of time generally classified as the "wet season".

As presented in the "Soil Survey of Kitsap County Area, Washington" (SCS, 1980), soils in the project area primarily consist of Poulsbo Gravelly Sandy Loam, Norma Fine Sandy Loam, and Sinclair Very Gravelly Sandy Loam. Each of these soils is poor for on-site sewage system performance due to wetness and shallow depth to hardpan.

3.0 HISTORY OF WATER QUALITY PROBLEMS IN THE DOGFISH CREEK WATERSHED

At the beginning of this project in December 1999, Dogfish Creek had the worst fecal coliform pollution problems of any major fresh water body in Kitsap County. Data collected by the Health District since 1994, through the Liberty Bay/Miller Bay Watershed planning effort and the Kitsap County Surface and Storm Water Management Program (SSWM), showed that 100% (8 of 8) of the Dogfish Creek monitoring stations exceeded the state's fecal coliform standard (Chapter 173-201A WAC, Class AA).

Dogfish Creek has repeatedly been identified by the Health District (1988, 1995, and 1996-1999) the state Department of Health (1985, and 1991), and the Kitsap Conservation District (1990) as the major source of fecal coliform loading to the head of Liberty Bay. Commercial shellfish harvesting along the head and the eastern shoreline of Liberty Bay has been classified as Prohibited by the Department of Health since 1985. The remainder of the bay has been

classified as Restricted since 1991, except for Lemolo Bay which was upgraded to Approved in 1994. (Puget Sound Cooperative River Basin Team, 1994).

Dogfish Creek has been on Washington State Department of Ecology's Section 303(d) List of Impaired Surface Waters since 1996 for fecal coliform and turbidity pollution (Ecology, 1996 & 1998).

The results of water quality monitoring and field surveys conducted by the Health District, Kitsap Conservation District, and Department of Health over the last 13 years strongly suggested that the major sources of fecal coliform pollution to Dogfish Creek included livestock management, manure run-off problems, and failing on-site sewage systems sewer cross connections.

Additionally, the Health District had documented severe sedimentation and erosion problems from the rapidly urbanizing South Fork tributary, which lies within the City of Poulsbo. Aside from causing fish passage problems at the mouth, the Health District believes that poor development practices and inadequate storm water controls may be exacerbating the current, and historical, fecal coliform problems in Dogfish Creek and Liberty Bay by providing a turbid and "fecal coliform-friendly" environment. Turbid waters are known to increase the survivability of fecal coliform bacteria.

4.0 GOALS AND OBJECTIVES

The goals of the Dogfish Creek Restoration Project are to:

- Protect public health and the environment by identifying and correcting sources of FC contamination from failing OSS and inadequate animal waste management.
- Prevent future FC contamination through public education about OSS operation and maintenance and adequate animal waste management practices.
- In the long term, restore water quality in the watershed to a point which would allow for the removal of Dogfish Creek from the state 1998 Clean Water Act Section 303(d) List of Threatened and Impaired Waterbodies. Various segments of the stream are listed for both fecal coliform bacteria and turbidity contamination.

To meet the project goals, the following objectives were developed and implemented:

- Track, isolate and identify fecal pollution sources and areas in need of corrective action;
- Enforce correction of failing OSS under Bremerton-Kitsap County Board of Health Ordinance No. 1996-8, "Rules and Regulations Governing On-Site Sewage Systems" (Health District, 1996). Hereinafter referred to as "OSS Regulations".
- Enforce correction of animal waste management practices causing violation of state water quality standards (Ecology, 1992) under Bremerton-Kitsap County Board of Health Ordinance No. 2000-6, "Solid Waste Regulations" (Health District, 2000). Hereinafter referred to as "Solid Waste Regulations". Kitsap's Solid Waste regulations were revised in 2000, facilitating remediation of inadequate animal waste management.

- Educate homeowners and occupants about OSS operation and maintenance and adequate animal waste management. Help residents recognize and avoid OSS stresses/problems to get the longest possible lifespan of the system.
- Achieve a high percentage of participation by holding public meetings, taking as much time as necessary with each resident/property owner, and providing free technical assistance.
- Thoroughly assess all properties in the project area, including investigating surface water flows from properties where owners/residents deny access or do not participate.

5.0 PROJECT DESIGN AND METHODS

The project design consisted of the following components:

5.1 POLLUTION IDENTIFICATION AND CORRECTION SURVEY

All work performed was conducted according to the methods contained in the "Manual of Protocol: Fecal Coliform Bacteria Pollution Identification and Correction Projects" (Health District, 1999).

The PIC survey consisted of an OSS record search, homeowner/resident interview, field survey, and if necessary, water samples and dye test. The purpose of the survey was to identify all potential sources of FC contamination, including failing OSS and inadequate animal waste management.

Based upon the results of each survey, each OSS was categorized as Failing; Suspect; Non-Conforming; or No Apparent Problems (see **Appendix A** for rating category criteria.) Properties found to be vacant or rated Suspect were contacted annually and surveyed when changes were noted. Failing OSS were corrected pursuant to the Bremerton-Kitsap County Board of Health's Ordinance No. 1996-8, "Rules and Regulations Governing On-Site Sewage Systems".

Health District inspectors also identified inadequate animal waste management practices and investigated those properties for potential FC contamination of surface waters. Surface water pollution caused by animal manure is enforced under local solid waste regulations.

5.2 KITSAP CONSERVATION DISTRICT AGRICULTURAL INVENTORY, PLANNING AND BMP INSTALLATION

Pursuant to Memorandum of Agreements with the Health District (one specific to this project and the other covering our general working relationship), the Conservation District was tasked to conduct an agricultural inventory within the Dogfish Creek Watershed, perform farm planning (including waste management planning), technical assistance / public education, and implementation of best management practices (bmp's) to protect water quality. Please see **Appendix B** for copies of these documents. Farm and/or waste management plans and bmp installation were completed in accordance with Natural Resources Conservation Service requirements.

5.2.1 FARM BEST MANAGEMENT PRACTICE IMPLEMENTATION GRANT PROGRAM

The Health District, Conservation District and Ecology also partnered on the Farm Best Management Practice Implementation Grant Program that was funded by the grant and the landowner. The program was set up to pay for 75% of the costs associated with design and installation of best management practices that directly benefited water quality in the watershed.

The program had three primary requirements for participation: One, the property owner had to work with the Conservation District on the development of a U.S. Natural Resources Conservation Service (NRCS) approved farm plan. Two, the landowner had to sign a "Landowner Agreement" that included a detailed site description, work to be completed, maintenance requirements, project schedule, easement restrictions, and (if needed) property access limitations after project installation. Three, the project had to directly benefit or protect water quality and the stream riparian zone. For example, fencing, stream crossings, plantings within the riparian zone were eligible projects.

5.3 WATER QUALITY MONITORING

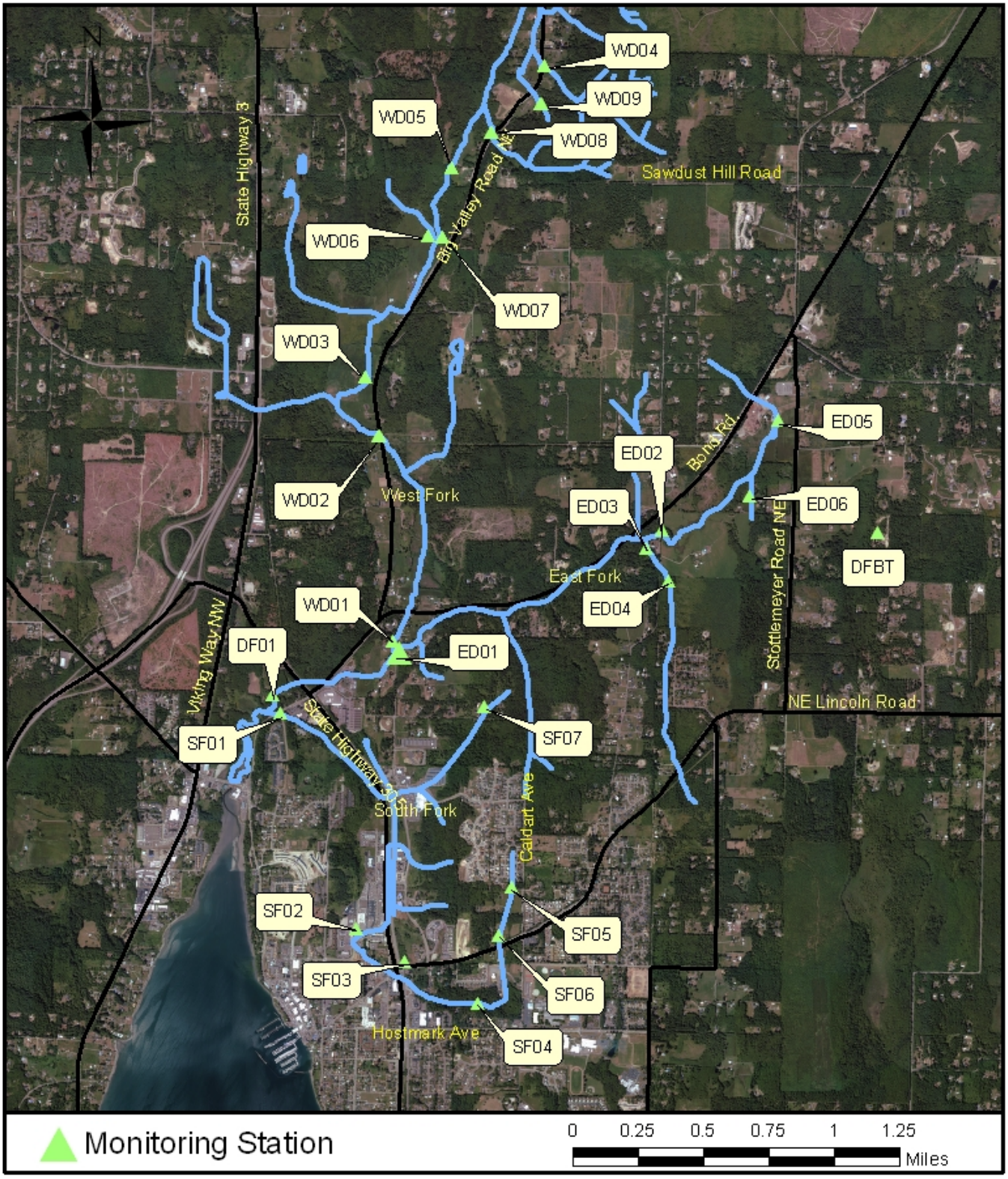
Please see **Figure 2** for stream monitoring station locations, and **Appendix C** for station list. All water quality monitoring was conducted pursuant to the Dogfish Creek Basin Monitoring Plan (KCHD, 2001). This document will hereafter be referred to as the QAPP. Four (4) trend stations were monitored for fecal coliform bacteria, turbidity, and other conventional water quality parameters (including temperature, dissolved oxygen, pH, total dissolved solids and conductivity). One (1) trend station was established in the Gamble Creek watershed to serve as background or "natural conditions" for assessment of Dogfish Creek turbidity data.

In addition to trend monitoring, the Health District also conducted "impact monitoring" of 18 additional stations along Dogfish Creek. The purpose of "impact monitoring" was to further segment the stream so that polluted segments could be identified and PIC efforts targeted to those locations. Impact monitoring for turbidity was conducted on the South Fork given its documented history of turbidity contamination. This monitoring was paid for by the City of Poulsbo as described in the "City of Poulsbo Nonpoint Pollution Impacts to South Fork of Dogfish Creek: Final Report. (Kitsap County Health District, 2002).

5.4 CITY OF POULSBO NONPOINT POLLUTION IMPACTS TO SOUTH FORK OF DOGFISH CREEK

Please see **Appendix D** for a copy of the "City of Poulsbo Nonpoint Pollution Impacts to South Fork of Dogfish Creek, Final Report." The local match requirement for conducting door-to-door sanitary surveys within Poulsbo City limits was paid for by the City of Poulsbo. Surveys were conducted according to the PIC Protocols referenced above. In addition, the City contracted with the Health District to locate, map, inspect and sample stormwater control structures, and provide the City of Poulsbo with recommendations for improving the quality of stormwater runoff and implementing best management practices. All work was conducted pursuant to standardized procedures outlined in the report.

FIGURE 2
Kitsap County Health District / SSWM
Water Quality Program
Dogfish Creek Restoration Project Monitoring Station Locations



5.5 EDUCATIONAL ACTIVITIES

The homeowner/resident survey included a strong educational component to proactively educate property owners about how to properly operate and maintain their OSS and to identify any non-conforming conditions that could cause premature OSS failure. Educational brochures were made available to all participants.

In addition, two educational workshops were conducted during the project period to inform residents about on-site sewage system operation and maintenance, and proper livestock waste management practices (Kitsap Conservation District).

6.0 RESULTS AND DISCUSSION

6.1 POLLUTION IDENTIFICATION AND CORRECTION SURVEY

The pollution identification and correction OSS survey was conducted from January 2000 through September 2003. During this period, a total of 112 properties were surveyed (101 residences and 11 businesses), including 47 fresh water shoreline and 98 upland properties. In addition, OSS records were located and evaluated, residents were interviewed, water samples were collected, OSS were dye-tested (when necessary), and OSS and other potential sources were rated according to the protocols set forth in the "Manual of Protocol: Fecal Coliform Bacteria Pollution Identification and Correction Projects" (Health District, 1999).

6.1.1 OSS Survey Results

T**able 1, Figure 3** and **Figure 4** summarize the project OSS survey results. OSS were rated according to "Criteria for Rating OSS Inspection Results" in Appendix A**.** As presented in Table 1 and Figure 3:

- A project total of **8** OSS failures (**7%**) were found. A descriptive list of the OSS failures is contained in **Appendix E**. The **7%** failure rate found in the Dogfish Creek basin is in the middle of the range of failure rates (3% - 16%) found in other areas of Kitsap County surveyed by the Health District over the last twelve years.
- A project total of **1** suspect OSS (**1%**) was found.
- A project total of **21** non-conforming OSS (**19%**) were found.
- A project total of **35** OSS (**31%**) with no records were found.
- A project total of **47** OSS (**42%**) were rated as no apparent problems.

As presented in Figure 4, 112 (**77%)** of the homes in the project area were surveyed, 5 (**3%**) were vacant, 11 (**8%**) did not participate, and 17 (**12%**) denied access for inspection. "Did not participate" means that the property owner and/or occupant never responded to Health District attempts to contact them. The rate of "denied access" is very high compared to other recently completed projects (1 – 2%). The reasons for this are not clear, except that these property owners displayed general distrust of governmental agencies.

TABLE 1
DOGFISH CREEK WATERSHED RESTORATION PROJECT
SUMMARY OF POLLUTION IDENTIFICATION AND CORRECTION RESULTS
JANUARY 2000 TO SEPTEMBER 2003

	OSS RATING CATEGORY											
	TOTAL[1] PROPERTIES	PARTICIPATING[1] PROPERTIES	FAILING		SUSPECT		NON-CONFORMING		NO RECORDS		NO PROBLEM	
			#	%	#	%	#	%	#	%	#	%
CREEKSIDE	47	45	5	63%	1	100%	9	43%	9	26%	21	45%
UPLAND	98	67	3	37%	0	0%	12	57%	26	74%	26	55%
PROJECT TOTALS	**145**	**112**	**8**	**7%**	**1**	**1%**	**21**	**19%**	**35**	**31%**	**47**	**42%**

FIGURE 3
DOGFISH CREEK RESTORATION PROJECT
OSS SURVEY BREAKDOWN BY FINAL RATING

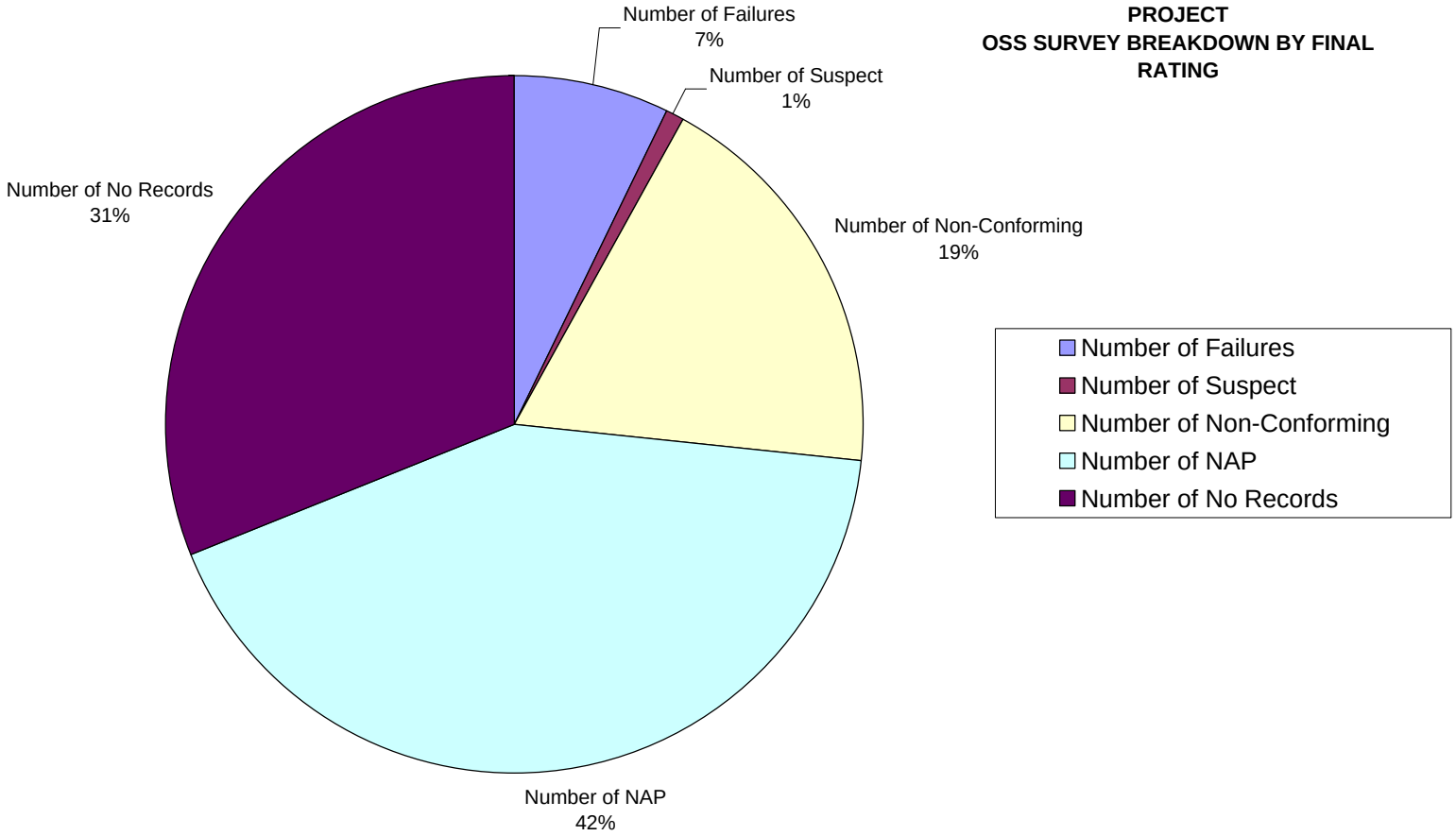
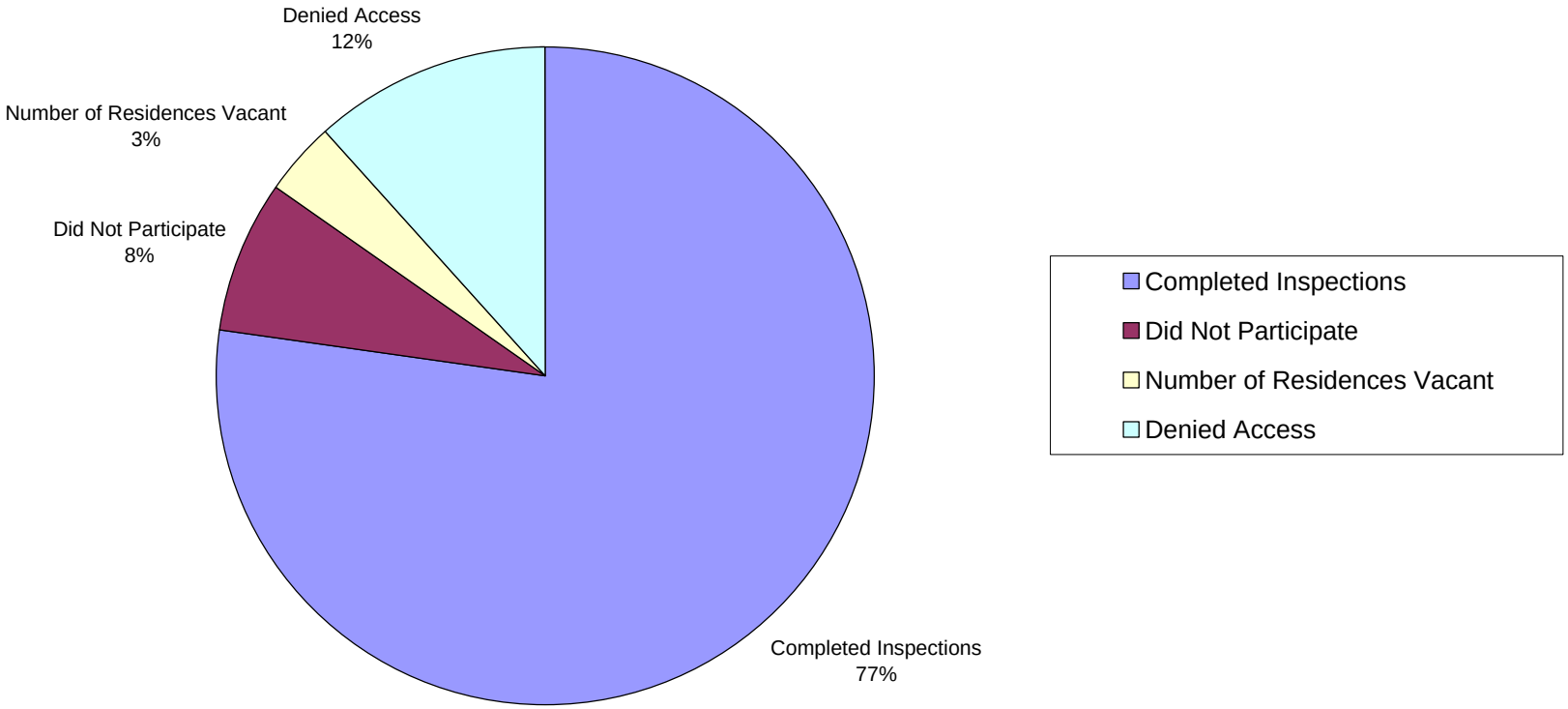


FIGURE 4
DOGFISH CREEK RESTORATION PROJECT
ANALYSIS OF PARTICIPATION



6.1.2 Analysis of Failures

Three of eight (38%) of the failing OSS were located adjacent to surface waters (<100 feet) and five of eight (62%) were located 100 feet or more from surface waters. One failing OSS discharged directly to a roadside ditch which flowed into a stormwater pond. Another failing OSS probably discharged into a ditch and then ran into the West Fork of the stream. However, this was never documented. The other failing OSS had no direct impact on surface waters.

The following factors have been related to OSS failure in previous surveys. Of these, age of the OSS and homeowner maintenance of the OSS have been the most prevalent causes of failure:

- Age of the OSS;
- Close proximity of the OSS to surface water bodies;
- Poor soil types and shallow depth to water table/impervious layer;
- Inadequate or lack of maintenance of the OSS;
- Number of previous repairs (failure history); and
- Grey water discharge.

Analysis of failing OSS found in the Dogfish Creek project area shows that:

- Eight of eight (100%) of the failing OSS were 16 years old or older;
- Three of eight (38%) of the failing OSS were located less than 100 feet from surface waters;
- One of eight (13%) of the failing OSS failed due to shallow depth to water table and leaky tanks.
- Two of eight (25%) of the failing OSS had failed, and been repaired, at least once in the past;
- Three of eight (38%) of the failing OSS were grey water discharges; and
- One of eight (13%) of the failing OSS were linked to system abuse through poor installation or damage to the drainfield area.

As shown above, age of the system and grey water discharges were the most common cause(s) of failure.

6.1.3 Types of OSS Repairs and Maintenance Requirements

Six of eight (75%) failing OSS have been repaired: one (17%) was repaired with an alternative OSS, one (17%) was repaired with a standard gravity system, two (33%) were repaired by re-connecting grey water to the septic tank, one (17%) was repaired by connection to sanitary sewer, and one was repaired through sealing tank connections and installation of water tight risers.

New state and local regulations require that all OSS be properly maintained and operated. The requirements of Bremerton-Kitsap County Board of Health Ordinance 1995-14, "Regulations for Operation and Maintenance of On-Site Sewage Treatment Systems" are in place. All alternative

septic systems are required to have ongoing operation and maintenance and all standard gravity septic systems require a septic tank inspection every three years.

6.2 POLLUTION IDENTIFICATION AND CORRECTION - ANIMAL WASTE SURVEY RESULTS

Please see **Appendix F** for a copy of the Kitsap Conservation District's (KCD) "Final Report, Dogfish Creek Restoration Project". KCD submitted their initial agricultural inventory and prioritization to the Health District in 1999. Properties were prioritized based upon the likelihood of impacting water quality (i.e., FC and turbidity). Therefore, factors such as number of animals, access of animals to surface waters, slope of the land, pasture condition, etc., were used in the evaluation. At that time, there were a total of 48 properties in the inventory. Nineteen (19) properties were rated as high priority, 23 sites were rated as medium priority, and 15 properties were rated as low priority.

Over the project period, the inventory was modified based upon information gathered by KCD, and by Health District staff during field inspections (observations of animal waste and pasture management management practices). The final inventory includes 3 high priority, 34 medium priority, and 9 low priority properties.

According to the KCD report, the reduction of high priority sites from 19 to 3 over the project period resulted from "improved livestock and pasture management, implementation of best management practices, and livestock removal". In their final report, KCD documents 46 best management practices implemented on 17 properties within the Dogfish Creek watershed. Notable highlights include 8776 feet of fencing and four (4) waste storage structures.

The Health District conducted nine water quality investigations related to farms during the project period. Two (22%) farms were confirmed as FC contributors, and found to be in violation of local solid waste regulations. One property owner cooperated with KCD and implemented best management practices to correct the water quality problem. The other property owner cooperated with the KCD on the development of a farm plan and a funding package that would have paid for 100% of all the improvements. However, they decided to remove the livestock from the farm instead. Sampling of two (22%) farms revealed that they were not contributing FC or turbidity. One (11%) farm was confirmed to be contributing FC, but property access was denied so no source could be located to prove a solid waste violation. Four (45%) farms are still being investigated for water quality impacts.

One farm participated in the "Best Management Practice Implementation Grant Program". It was a successful project involving fencing to exclude livestock from Dogfish Creek, drainage ditch and pond.

6.3 WATER QUALITY MONITORING RESULTS

As presented in the project QAPP, trend, impact and best management practice effectiveness monitoring were conducted for this project. Pursuant to the grant agreement, all raw data collected for this project has been provided in **Appendix G**, and an electronic version will be delivered on compact disk. Please find below descriptions of each type of monitoring and results:

6.3.1 FC Trend Monitoring

Trend monitoring was conducted of Dogfish Creek at four stations representative of the main channel, the west fork, the east fork, and the south fork. Please see Figure 2 and Appendix C for station locations. Please see Appendix G for raw data.

Table 2
Fresh Water Stream Fecal Coliform (FC) Results
Dogfish Creek (DF01), Water Years 1996-2003

Water year	Number of Samples	Range (FC/100ml)	GMV[1] (FC/100ml)	# Samples >100 FC/100ml	% Samples >100 FC/100ml	Meets WQ Standard[2]
96	6	13 - ≥1600	406	4	67%	No
97	9	43 - 1200	221	6	67%	No
98	13	30 - ≥1600	322	11	85%	No
99	12	30 - ≥1600	243	11	92%	No
00	8	23 - 500	100	5	63%	No
01	13	8 - 900	107	7	54%	No
02	12	11 - 240	72	5	42%	No
03	12	13 - ≥1600	62	6	50%	No

Shaded entries indicate an exceedance of the applicable water quality standard (Chapt.173 – 201A-030 WAC)
[1] Geometric mean value
[2] FC levels shall not exceed a GMV of 50 FC/100ml and not have more than 10% of all samples exceed 100 FC/100 ml.

Figure 5
Fecal Coliform Bacteria Trend Analysis
Main Channel Dogfish Creek (Station DF01), 1996-2003

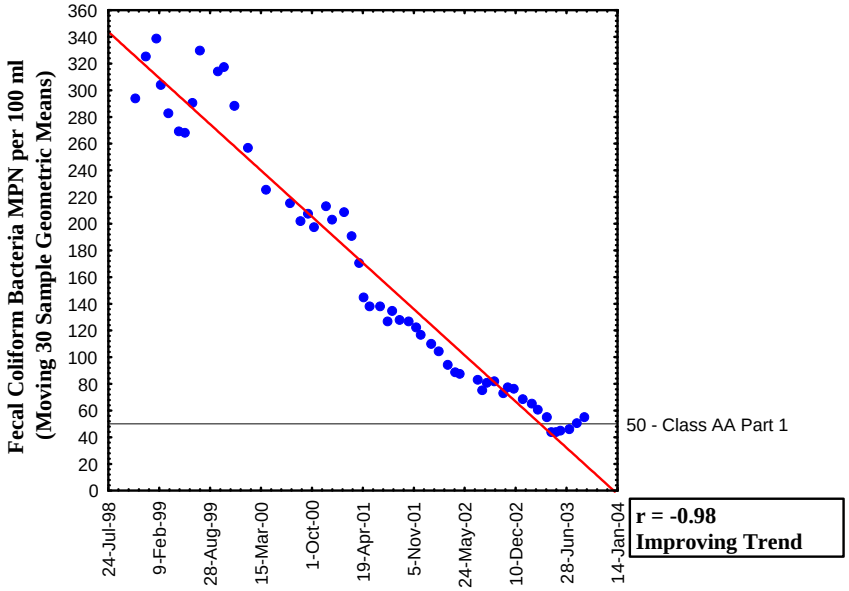


Table 3
Fresh Water Stream Fecal Coliform (FC) Results
Dogfish Creek (SF01), Water Years 1996-2003

Water year	Number of Samples	Range (FC/100ml)	GMV[1] (FC/100ml)	# Samples >100 FC/100ml	% Samples >100 FC/100ml	Meets WQ Standard[2]
96	5	30 - >1600	92	2	40%	NO
97	9	17 - >1600	148	5	56%	NO
98	12	30 - >1600	269	9	75%	NO
99	11	8 – 900	92	4	36%	NO
00	7	8 – 140	44	2	29%	NO
01	12	2 – 500	56	6	50%	NO
02	12	23 - >1600	93	7	58%	NO
03	12	2 - 1600	49	3	25%	NO

Shaded entries indicate an exceedance of the applicable water quality standard (Chapt.173 – 201A-030 WAC)
[1] Geometric mean value
[2] FC levels shall not exceed a GMV of 50 FC/100ml and not have more than 10% of all samples exceed 100 FC/100 ml.

Figure 6
Fecal Coliform Bacteria Trend Analysis
South Fork Dogfish Creek (Station SF01), 1996-2003

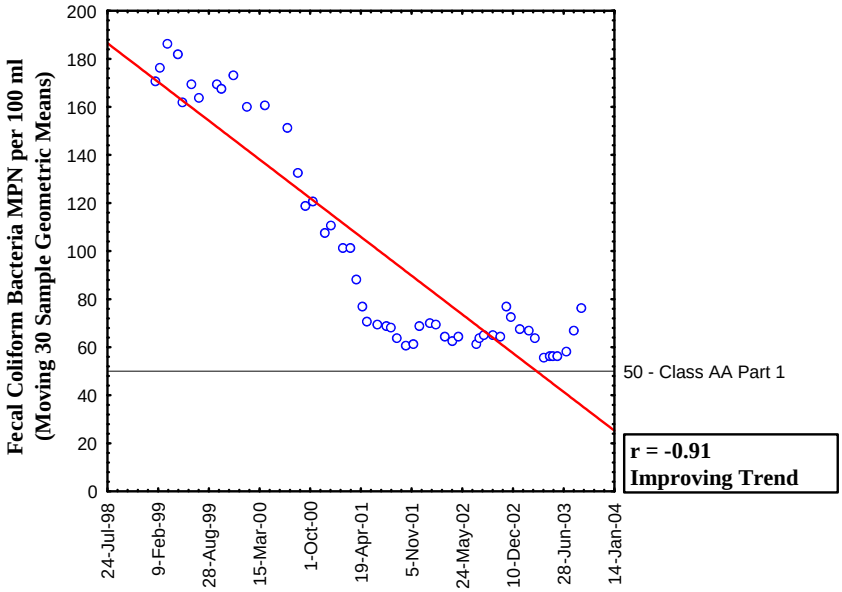


Table 4
Fresh Water Stream Fecal Coliform (FC) Results
Dogfish Creek (WD01), Water Years 1996-2003

Water year	Number of Samples	Range (FC/100ml)	GMV[1] (FC/100ml)	# Samples >100 FC/100ml	% Samples >100 FC/100ml	Meets WQ Standard[2]
96	5	30 - ≥1600	198	3	60%	NO
97	9	13 - 1600	75	3	33%	NO
98	12	9 - ≥1600	68	4	33%	NO
99	11	11 - 1600	76	4	36%	NO
00	8	14 - 240	57	2	25%	NO
01	12	4 - 500	56	5	42%	NO
02	12	13 - 80	34	0	0%	YES
03	12	8 - ≥1600	82	4	33%	NO

Shaded entries indicate an exceedance of the applicable water quality standard (Chapt.173 – 201A-030 WAC)
[1] Geometric mean value
[2] FC levels shall not exceed a GMV of 50 FC/100ml and not have more than 10% of all samples exceed 100 FC/100 ml.

Figure 7
Fecal Coliform Bacteria Trend Analysis
West Fork Dogfish Creek (Station WD01), 1996-2003

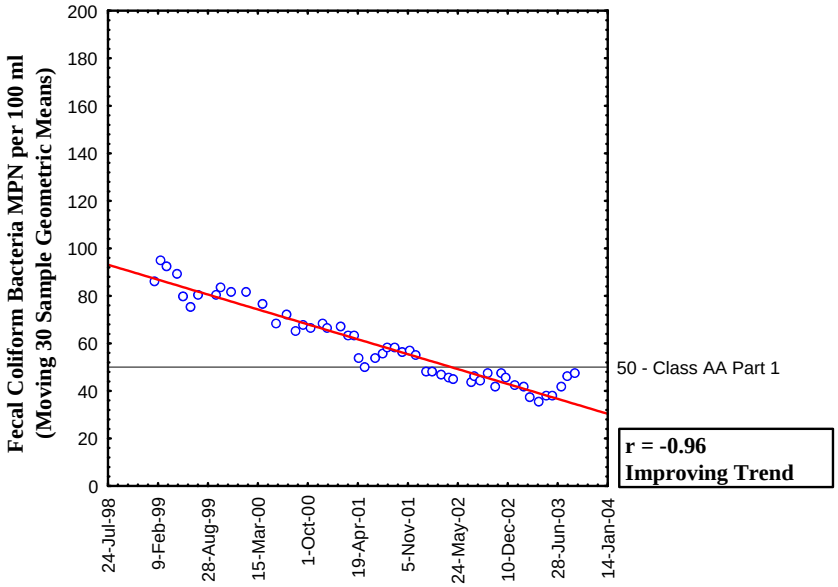
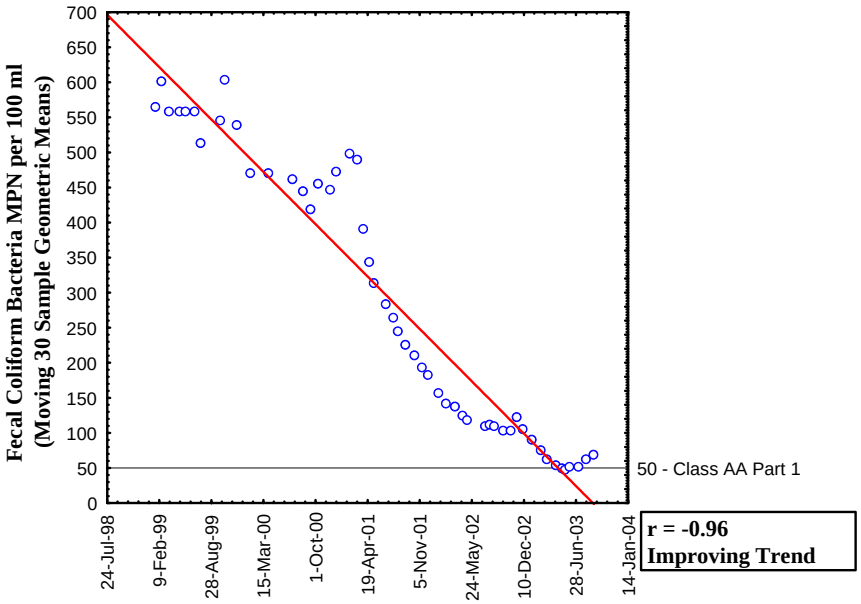


Table 5
Fresh Water Stream Fecal Coliform (FC) Results
Dogfish Creek (ED01), Water Years 1996-2003

Water year	Number of Samples	Range (FC/100ml)	GMV[1] (FC/100ml)	# Samples >100 FC/100ml	% Samples >100 FC/100ml	Meets WQ Standard[2]
96	5	80 - ≥1600	879	4	80%	NO
97	9	23 - ≥1600	424	7	78%	NO
98	12	30 - ≥1600	526	9	75%	NO
99	11	70 - 1600	610	10	91%	NO
00	7	4 - 900	158	5	71%	NO
01	12	2 - ≥1600	110	8	67%	NO
02	12	13 - 30	87	6	50%	NO
03	12	<2 - 900	44	5	42%	NO

Shaded entries indicate an exceedance of the applicable water quality standard (Chapt.173 – 201A-030 WAC)
[1] Geometric mean value
[2] FC levels shall not exceed a GMV of 50 FC/100ml and not have more than 10% of all samples exceed 100 FC/100 ml.

Figure 8
Fecal Coliform Bacteria Trend Analysis
East Fork Dogfish Creek (Station ED01), 1996-2003



6.3.1 FC Trend Monitoring (Continued)

The project started in water year 00, and water year 03 is representative of the post corrective monitoring conducted for this project. As you can see, the main channel and each main tributary of Dogfish Creek are experiencing improving trends in FC concentrations. In addition, while none of the stations currently meet standard, the reductions in FC concentrations have been tremendous, especially in the East Fork and the Main Channel of the stream.

In the East Fork watershed, a large farm was documented to have a serious fecal coliform bacteria contamination problem. The owner was approached by the Health District and was presented with the monitoring data. In lieu of implementing a farm plan that was developed by the Conservation District, and accepting a financing plan that would have paid for the majority of the work, the owner decided to remove the cattle from the property. Fecal coliform levels have been reduced by a factor of 14 since the project began in 1999. These improvements can be partially attributed to animals being removed from this farm.

In the Main Channel (DF01), reductions in FC concentrations can be partially attributed to FC source corrections throughout the project area, excluding the South Fork of the stream which enters the Main Channel below station DF01.

In the South Fork (SF01), storm water was determined to be the primary source of FC contamination. Please see Section 6.3.4 for more information. Additional improvements in FC concentrations are expected after the City of Poulsbo completes implementation of recommendations outlined in the final report for the "City of Poulsbo Nonpoint Pollution Impacts to South Fork of Dogfish Creek" project.

Improvements in FC concentratations can also be attributed to public education and outreach related to the project. Educational materials were distributed during the door-to-door sanitary survey, and during four public meetings that were conducted during project period. In addition, the Health District has found that once a community understands that they have a water quality problem, residents tend to rally to the cause and voluntarily change their practices.

6.3.2 Turbidity Trend Monitoring

Pursuant to the QAPP, trend monitoring for turbidity was conducted on the main channel and the three main tributaries. Please see Appendix G for raw data. Due to the fact that a suitable background station for comparison could not be located (since the entire watershed has been disturbed), a background station was established at the headwaters of Gamble Creek. Gamble Creek is located due east of Dogfish Creek, and therefore works well as a "paired" watershed.

Please see **Table 6** for an analysis of turbidity trend monitoring for this project. As you can see, 100 samples for turbidity analysis were collected during the project. Only 17 (17%) of samples exceeded background conditions. Six (6) exceedances occurred at the mouth of the south fork, 5 at the mouth of the west fork, 4 within the main channel, and 2 at the mouth of the east fork.

TABLE 6
Summary of Turbidity Trend Data for Dogfish Creek

DATE	SFO1	DFO1	WDO1	EDO1	DFBT (Background)	24 Hour Rainfall	48 Hour Rainfall
8/15/2001	4.7	1.9	2.4	1.1	2	0	0
9/18/2001	2.3	6.6	9.1	3	1.88	0	0
10/16/2001	1.61	1.47	2.2	1.28	6.1	0	0
11/13/2001	8.2	9.4	6.2	47	1.1	0.42	0.42
12/5/2001	13.7	4.6	5.7	4.6	1.28	0.15	0.49
1/15/2002	6.2	5.7	8.4	2.8	1.57	0	0.33
2/12/2002	5.6	4.3	4.2	2.4	0.47	0	0.25
3/19/2002	5.6	2.3	2.7	3.3	0.35	0.55	0.55
4/16/2002	5.1	3.2	3.5	2.8	2.2	0.11	0.13
5/7/2002	5.7	2.6	3.4	3.6	1.26	0.23	0.36
7/16/2002	2.7	1.56	2.4	4.8	4.1	0	0
7/31/2002	2.1	2.7	1.89	2.1	2.4	0.07	0.17
8/20/2002	3.4	3.5	2.9	3.1	1.46	0	0
9/19/2002	2.1	3.9	6.1	1.84	2.6	0	0
10/22/2002	1.43	1.82	2.9	1.18	1.51	0	0.1
11/12/2002	23	34	33	29	5.5	0.61	0.69
12/3/2002	1.42	2.6	1.71	1.49	0.89	0	0
1/7/2003	8.1	6.7	7.2	3.4	0.93	0.01	0.01
2/13/2003	3.2	6.3	3.1	2.5	0.64	0	0
4/10/2003	3.1	3.7	2.3	3.4	1.41	0	0.01
5/15/2003	18.2	2.5	3.2	2.4	3.1	0.09	0.11
6/5/2003	2.2	1.45	1.2	1.58	2.2	0	0
7/10/2003	2.3	7	2.3	2.5	4.1	0	0
8/7/2003	1.82	1.12	1.05	0.97	0.72	0	0.1
9/4/2003	1.5	1.68	1.25	2.5	2.1	0	0
24 Rainfall Correlation	**0.62**	**0.63**	**0.60**	**0.68**	**0.09**		
48 Rainfall Correlation	**0.67**	**0.57**	**0.59**	**0.55**	**-0.04**		
# of Exceedances	**6**	**4**	**5**	**2**	**NA**		

*Highlighted stations exceed State Class AA Freshwater Standard of Not>5 NTU over background

No turbidity result exceeded 47 ntu during the project period. As expected, strong positive correlations were noted between 24 and 48-hour rainfall and levels of turbidity in the stream.

Trend analysis was performed on all turbidity data collected from Dogfish Creek since January of 1996. Please see **Appendix H** for a description of the technique and the results. Since 1996, turbidity data has been collected from Dogfish Creek (DF01, SF01, WD01 and ED01) pursuant to the Health District / SSWM water quality monitoring program. Pursuant to the QAPP, the Health District also began collecting water samples for turbidity analysis at these stations, and a background station on August 15, 2001.

In order to make trend analysis possible, the hydrolab dataset and the water sample dataset had to be combined. The results of the analysis show the following: DF01 (Main Channel): No change. ED01 (East Fork): Improving. SF01 (South Fork): No Change. And WD01 (West Fork): Worsening. However, the improving trend for the East Fork and the worsening trend for the West Fork (while statistically significant) were not judged to be important. So, we have to conclude that there has been no significant change in turbidity concentrations in Dogfish Creek since 1996.

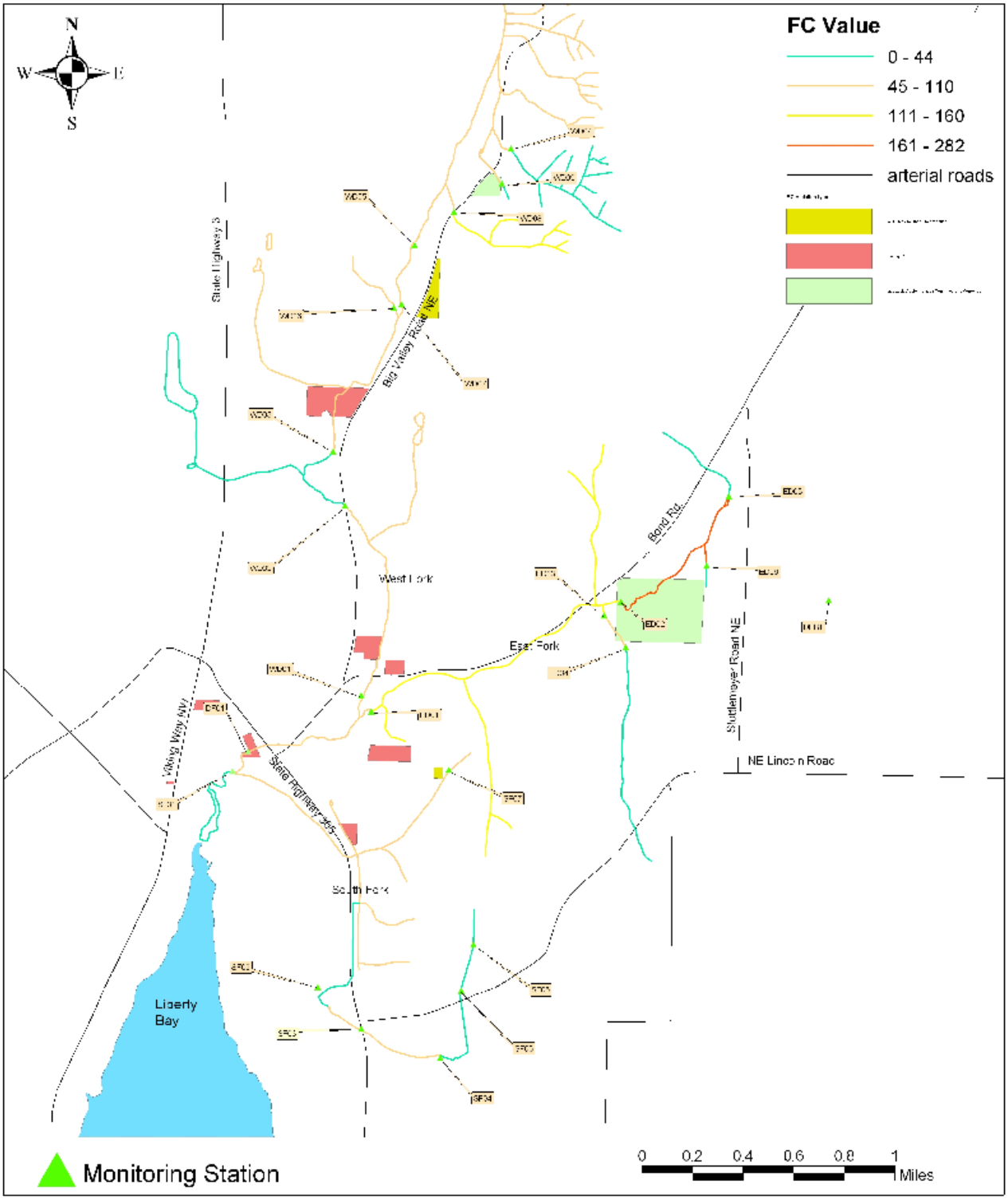
6.3.3 FC Impact Monitoring

FC impact monitoring was conducted to assist staff with locating FC pollution sources in the project area. In summary, 23 stations were monitored approximately twice per month between January 2000 and October 2002. Please see Appendix G for data analysis and the raw data. **Figure 9** displays FC impact data with the documented FC sources overlaid. As you can see, no failing OSS were associated with "hot" segments – denoted by red or yellow. However, two farms were associated with "hot" segments. One has since been corrected; the other is still under investigation.

Statistical correlations were calculated for 24/48-hour rainfall and FC concentrations for each station. Results indicate week 24 and 48-hour rainfall correlations. 48-hour correlations were generally stronger than 24 hour. In addition, we expected strong correlations at the South Fork stations, given that its watershed is (for the most part) heavily urbanized (high percentage of impervious surface). However, the data show very week correlations.

Impact monitoring was an effective tool for this project. However, it is important to note some important limitations of this data. First, it cannot be used as a measure of overall project effectiveness. As discussed in Section 5.A of the QAPP, trend data is the appropriate measure of project effectiveness. And secondly, as discussed in Section 5.B of the QAPP, the sole purpose of impact monitoring was to assist staff with locating specific sources of FC contaminating the main channel and three main tributaries. As a result, the Health District requests that this data not be used for any Clean Water Act Section 303(d) listing purposes, now or in the future.

Figure 9
Dogfish Creek Restoration Project
Results of Fecal Coliform Impact Monitoring
Water Quality Program



6.3.4

Turbidity Impact Monitoring

Turbidity impact monitoring was conducted within the south fork given historical problems in that area. This work was conducted as part of the "City of Poulsbo Nonpoint Pollution Impacts to South Fork of Dogfish Creek" project. Please see Appendix D for a copy of this report, and sections 5.1.3 and 5.1.4 for detailed monitoring results.

In summary, turbidity sampling of eight stormwater outfalls was conducted during three rainfall events. In addition, five stations within the south fork of the stream were monitored for turbidity (and other parameters) during an additional rain event. Outfall monitoring results showed turbidity contamination ranging from 14.6 ntu to 168 ntu. Stream monitoring results showed turbidity contamination ranging from 13.6 ntu to 37.5 ntu during. Therefore, the report concluded the following related to turbidity contamination:

- "Turbidity data from the five stream segment stations showed the greatest wet weather impacts at the stream's lower reach at Liberty Road, Little Valley Road and Bond Road.
- "Stormwater contributes turbidity to South Fork of Dogfish Creek above stream background levels at all outfalls sampled."

The report recommended that the City of Poulsbo Public Works Department take the following actions to correct these and other problems:

- Establish a maintenance program for the stormwater collection system,
- update stormwater drainage maps to show all current stormwater drainage systems,
- repair or reconstruct outfalls 974A, 959A and 1016A,
- locate and inspect outfalls 750A and 598B,
- perform an illicit connection survey of the stormwater system in the South Fork of Dogfish Creek drainage during the summer of 2002,
- perform a public education program to residents of the drainage basin of the South Fork of Dogfish Creek regarding the impacts of nonpoint sources of pollution from everyday activities with an emphasis on pet waste disposal and car washing.
- implement an inspection program of private stormwater systems and oil/water separators,
- continue a sampling program of the stormwater outfalls and stream stations for total and dissolved zinc, hardness, TSS, FC, TPH, nutrients and turbidity for the purpose of further evaluating water quality impacts, and
- perform a stormwater system inspection of detention ponds and bioswales.

In addition to work within the south fork, a complaint investigation was conducted regarding turbidity impacts to the main channel of the stream related to storm runoff from a development. The problem was confirmed and was formally referred to Ecology for investigation (Bob Penhale, Water Quality Program) on November 24, 2003.

The Quality Assurance Project Plan (QAPP) required turbidity impact monitoring throughout the Dogfish Creek system. Unfortunately, impact monitoring was only conducted in the South Fork - as described above. This was due to a communication error between the project manager and field staff.

After reviewing the QAPP (specifically the design of turbidity impact monitoring), it is clear that the project was not damaged in any significant way by this oversight. Wet weather conditions were not a requirement for turbidity impact monitoring. So, although impact events occurred twice per month, the number of times we collected samples during rain events ended up being very small. Even smaller was the number of events where it rained sufficiently to cause runoff. Therefore, the design of impact monitoring was flawed because it did not provide staff with enough chances to see problems and track them back.

In the future, turbidity impact monitoring should involve both targeted storm event sampling and a volunteer network that can inspect the system on a regular basis and report any problems.

6.3.5 Best Management Practice Effectiveness (BMPE) Monitoring

BMPE monitoring was conducted only on properties that were documented FC contributors to surface waters. Please see Appendix G for the raw data. BMPE monitoring was performed on the following properties:

24330 Big Valley Rd: This property was documented to have FC impacts to Dogfish Creek related to livestock waste management problems. The property owners voluntarily cooperated with KCD and installed best management practices to fix the problems. No flows from the property were observed during two visits to the property. This was expected since a major portion of the improvements on this property were drainage related.

21722 Pugh Rd NE: this property removed their livestock in response to a Notice and Order to Correct Violation letter that documented FC pollution related to inadequate waste management. Table 3 presents BMPE monitoring for this site. Note that there are two tributaries that cross this property, the East Fork itself, and a tributary to the east fork. As you can see, removal of the livestock has led to a tremendous reduction in FC concentrations:

Table 7
BMPE Monitoring
21722 Pugh Road NE
Dogfish Creek Restoration Project

	East Fork (ED06) Above[a]	East Fork (ED02) Below[a]	Tributary (ED04) Above[a]	Tributary (ED03) Below[a]
Before Livestock Removal	32	282	12	71
After Livestock Removal	32[b]	49	12[b]	20

a. Geometric Mean Value (FC/100ml)
b. ED06 and ED04 not collected after livestock removal since they had already been thoroughly characterized before livestock removal (28 samples collected at ED04, and 35 at ED06).

Water quality improvements related to this property are a major factor in the improving FC trends were seeing in the East Fork

6.4 EDUCATIONAL ACTIVITIES

Four public meetings were conducted by Health District and Kitsap Conservation District staff during the project period: Project "Kick Off", Project Update & Nonpoint Source Pollution Meeting, Agricultural Waste BMP Program "Kick Off" Meeting, and the final "post project" meeting. Although direct mailings, press releases and other tactics were used to entice attendance, attendance was not as strong as desired. A total of **57** landowners attended these meetings.

Proper septic system operation and maintenance was one of the primary focuses of the Dogfish Creek Restoration Project. Health District staff provided homeowners with educational brochures and a copy of the sewage disposal permit/as-built on file at the Health District for their home. In addition, staff discussed the water quality of Dogfish Creek and tactics they could employ to prevent contamination.

7.0 CONCLUSIONS

The findings of the Dogfish Creek Restoration Project are:

- The purposes of the project as outlined in Section 1 of the QAPP have been achieved. First, the public was involved in four community meetings and received technical assistance on water quality and on-site sewage system issues. Second, ten FC sources were identified during the project, including 8 failing on-site sewage systems and 2 livestock waste violations. Eight (8) of those have been corrected. And third, FC levels have been dramatically reduced. The main channel, west fork, east fork and south fork of Dogfish Creek are all experiencing improving FC trends.

- Project success was also achieved through close cooperation between the Health District and its partners on this project (Kitsap Conservation District and the City of Poulsbo).

- Age of the on-site sewage system and grey water discharges were the primary reasons for OSS failure in the project area. No on-site sewage systems were determined to directly discharge to surface waters. However, at least three of eight (38%) were located within 100 feet of surface waters, so sewage was most likely transported to surface waters during storm events.

- Livestock waste is a significant source of FC pollution for Dogfish Creek. While seventeen farms implemented 46 best management practices, the Health District and KCD encourage other farm owners in the watershed to participate in KCD programs. Such cooperation can prevent future FC contamination of this stream.

- Consistent follow-up is essential to ensuring that all potential FC pollution sources are identified.

- The percentage of property owners who either denied access or could not be contacted was high as compared to previous projects. Therefore, the Health District must continue to develop innovative approaches for encouraging project support.

8.0 RECOMMENDATIONS

Based upon the conclusions of the Dogfish Creek Restoration Project, the Health District recommends the following:

- The Health District encourages community residents and other project participants to realize that further declines in FC levels in Dogfish Creek are going to take time. The streambed in some parts of the system has a relatively low gradient, leading to accumulation of sediments. FC are entrained in these sediments, and it will take time to flush them out.

- The Health District will continue monitoring Dogfish Creek fresh waters as part of the baseline water quality-monitoring program.

- The Health District will work with property owners to ensure that the two failing OSS remaining are corrected.

- The Health District will finish investigating nine (9) properties for FC sources. If sources are found, they will be corrected.

- Other Health Districts and County Health Departments are encouraged to pursue the use of local solid waste regulations to enforce correction of animal waste management practices causing water quality violations.

9.0 REFERENCES

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