

PORT GAMBLE BAY/GAMBLEWOOD SANITARY SURVEY PROJECT
FINAL REPORT

1.0 INTRODUCTION

The Bremerton-Kitsap County Health District's Sanitary Survey Program's 1995-96 Priority Area Work List rated the Port Gamble Bay/Gamblewood area most in need of a sanitary survey. (BKCHD, 1995) This rating was based on historical on-site sewage system information, water quality data, and warnings from Washington State Department of Health (State Health) that the commercial shellfish classification of the Cedar Cove portion of Port Gamble Bay could be downgraded to "*Prohibited*". In response to the early warning, the Health District initiated the Port Gamble Bay Sanitary Survey Project in November 1995. The goal of the project was to protect human health and the environment by locating and correcting failing on-site sewage systems (OSS) and to prevent future failing OSS in the project area through public education regarding proper operation and maintenance.

The Cedar Cove area was downgraded to *Prohibited* by State Health in August 1996 due to marine fecal coliform levels in excess of Part 2 of the National Shellfish Sanitation Program (NSSP) water quality criteria for *Approved* shellfish growing areas. (State Health, 1996). As a result of the commercial shellfish downgrade, Kitsap County was required to implement a closure response effort pursuant to RCW 90.72, "Shellfish Protection Districts". In accordance with this statute, a Shellfish Closure Response Committee was formed in July of 1996, and an Initial Shellfish Closure Response Strategy (Strategy) for Southern Port Gamble Bay was developed in November 1996. (SCRC, 1996). The Strategy identified the Health District's Water Quality Program as the lead agency for the effort to identify and eliminate the sources of fecal coliform bacteria (FC) pollution, which caused the downgrade in Cedar Cove. The Health District's sanitary survey project was incorporated into this overall closure response effort.

The Health District developed the "Nonpoint Source Tracking and Identification Monitoring Plan for Southern Port Gamble Bay" (Health District, Amended December 1997) to track and identify sources of FC pollution in the project area's surface waters. The Health District implemented the Plan's semi-monthly monitoring of surface and storm water stations from October 1996 through 1999. In addition to Plan monitoring, the Health District also conducts ongoing baseline monitoring of the fresh and marine waters of Port Gamble Bay as part of its county-wide water quality monitoring effort through the Kitsap County Surface and Storm Water Management Program (SSWM). These two monitoring efforts were coordinated to maximize efficiency and avoid unnecessary duplication.

By merging intensive stream and storm water monitoring, extensive public education efforts through door-to-door pollution surveys, and broadening the sanitary survey to address livestock and domestic pet waste, the Health District assessed FC concentrations and loads to Port Gamble Bay and Cedar Cove, and identified and corrected pollution on more than 40 properties in the southern Port Gamble bay watershed, including seven in the Cedar Cove area. Newly developed microbial source tracking technology confirmed pollution sources found in the project area.

In May 1999, State Health upgraded to status of the commercial shellfish beds in Cedar Cove from *Prohibited* to *Approved*.

The purpose of this report is to summarize the findings of the Port Gamble Bay/Gamblewood Sanitary Survey Project. This project is funded by a Special On-Site Sewage / Shellfish Grant Agreement with the Washington State Department of Ecology and the Kitsap County Surface and Storm Water Management Program.

2.0 PROJECT AREA DESCRIPTION

2.1 PORT GAMBLE BAY

Port Gamble Bay is located on the eastern shoreline of the Hood Canal, approximately five miles south of the entrance to Hood Canal. Port Gamble Bay is approximately two and one half miles long, three quarters of a mile wide at its widest point, and occupies an area of approximately 1,210 acres. The mouth of Port Gamble Bay, which is its narrowest point, is approximately 700 feet wide. Due to this narrow opening, the bay is poorly flushed.

The unincorporated town of Port Gamble, located on the northwest shoreline at the mouth of the bay, is served by a secondary sewage treatment plant that discharges treated effluent outside of Port Gamble Bay. Additionally, the homes on the Port Gamble S'Klallam Reservation utilize a Septic Tank Effluent Pump (STEP) system that disposes its effluent to a land based recirculating gravel filter. Areas served by sewer were not included in the sanitary survey project area.

Like most of Hood Canal, Port Gamble Bay is an abundant shellfish, crab and finfish harvest area. As presented in the "Annual Inventory of Commercial and Recreational Shellfish Areas in Puget Sound" (State Health, 1994), Port Gamble Bay contains approximately 28% of the approved commercial shellfish harvest area in Kitsap County. Until State Health's downgrade in classification from approved to prohibited for 16.4 acres of commercial shellfish beds in Cedar Cove (located at the southeast end of Port Gamble Bay), a total of 1,210 commercial acres were approved for harvest in Port Gamble Bay.

The Port Gamble S'Klallam Tribe and Cedar Cove Shellfish Company (currently closed due to the downgrade) are the only two commercial growers in the bay. Although specific data for Port Gamble Bay are not available at this time, shellstock figures from the Washington State Department of Fish and Wildlife are available for an expanded catch area which includes Port Gamble Bay (reaching from the Hood Canal Bridge at the south, to a northern boundary between Foulweather Bluff and Olele Point). Between 1984 and 1993, a total of 452,812 pounds of clams and 29,035 pounds of oysters were harvested in this area for a total estimated commercial value of \$335,190 and \$848,924, respectively. This means that during this ten-year period, a total of 481,847 pounds of shellfish were harvested in the area with an estimated commercial value of

\$1,184,114. For Cedar Cove Shellfish Company specifically, approximately \$26,000 was generated from sales of shellfish between 1991 and 1995 (Ross, 1996).

The shellfish resource is a critical element in the culture of the Port Gamble S'Klallam Indian Tribe. More than 600 members of the Port Gamble S'Klallam tribe harvest clams, oysters, geoduck, and crab from Port Gamble Bay for daily subsistence (Bahls, 1996), and the tribe consumes shellfish at an annual rate nearly fifty times greater than non-tribal recreational shellfish consumers (Hood Canal Technical Work Group, 1995).

In addition to the Tribal and commercial shellfish operations in the bay, many private property owners along the Port Gamble Bay shoreline, and residents of the Gamblewood development (who have access to tidelands from the Gamblewood Community Park), harvest clams and oysters recreationally. For most of them, this is a major feature of living on the Port Gamble Bay shoreline. Approximately one million recreational shellfish trips for clams and oysters were made in Hood Canal, including Port Gamble Bay, in both 1992 and 1993 (Hood Canal Technical Work Group, 1995).

In summary, clams, oysters, crab, shrimp, and finfish have been gathered from this area for thousands of years. These activities are an important element in the cultural heritage and community identity of local residents. The inability to harvest shellfish due to habitat degradation (e.g., poor water quality resulting from failing OSS, etc.) represents a loss of these values that will reduce the quality of life (culturally, economically, and recreationally) for all people in the region.

2.2 SANITARY SURVEY PROJECT AREA

Port Gamble Bay is located approximately five miles south of the entrance to Hood Canal along the Canal's eastern shoreline in North Kitsap County. Given that Port Gamble Bay contains approximately 28% of Kitsap County's approved commercial shellfish harvesting area, the project area and shellfish protection district were expanded from the Cedar Cove area to the entire southern Port Gamble Bay watershed (see **Figure 1**). The project area includes the drainage basins of southern Port Gamble Bay, with an emphasis on Gamble and Martha-John Creeks. Five hundred thirty two (532) properties were surveyed in the project area. Only 28 of these properties are located within the Cedar Cove drainage sub-basin. The other 504 properties were surveyed proactively in order to prevent future FC contamination problems. All surface waters in the project area are classified by the State of Washington as Class A waters (Chapter 173-201A WAC).

The Port Gamble Bay/Gamblewood area is an older residential area originally platted in the 1960's. According to area residents, many of the homes along the marine shoreline were originally constructed as vacation homes and were only occupied intermittently, primarily during the summer months. Most of these homes are now occupied year round, but a few of them still remain as vacation homes.

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Figure 1 Project Area Location Map

There are a total of 595 homes in the project area. Two hundred of these are adjacent to marine or fresh water shoreline, and 395 are in upland areas, primarily in the Gamblewood development. Lot sizes range from 0.25 acres in the Gamblewood development, to 1.25 acres along State Highway 104, Gamble Bay Road NE. and Gamble Place NE, to properties on five or more acres along Gamble and Martha-John Creeks. Due to the timeframe (1960's) in which development occurred in this area, most of the OSS in the project area are standard gravity type with the drainfield located downgradient of the building structure.

According to rainfall information collected by the Pope Resources Transplant Nursery located in Hansville, average annual rainfall in the project area is 28.54 inches. 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), the soils along the marine shoreline primarily consist of dystric xerorthents and Poulsbo-Ragnar complex (0 - 6% and 6 - 15% slopes). Soils in the upland areas (primarily Gamblewood) consist of Ragnar Fine sandy loam (0 - 6% and 6 - 15% slopes), Ragnar Poulsbo complex (15 - 30% slopes) and Kapowsin gravelly loam. Dystric xerorthents are considered poor for OSS because of moderate to rapid permeability and runoff potential. Poulsbo-Ragnar complex soils, Poulsbo gravelly sandy loam, and Kapowsin gravelly loam are considered poor for OSS because of the presence of a cemented hardpan (ranging in depth from 20 - 40 inches) and general wetness. Ragnar fine sandy loam (0 - 6% and 6 - 15% slopes) and Ragnar-Poulsbo complex are considered poor for OSS due to moderately rapid permeability that filters poorly.

3.0 HISTORY OF ON-SITE SEWAGE SYSTEM PERFORMANCE IN THE PORT GAMBLE BAY/GAMBLEWOOD AREA

State Health performed sanitary surveys of Port Gamble Bay in 1965 and 1973. During the 1965 survey, 140 inspections were completed and 30 failing OSS were identified for a 21% failure rate. Unfortunately, records on the number of failing OSS which were ultimately repaired are not available. During the 1973 survey, 153 inspections were completed and 9 failing OSS were identified for a 3% failure rate. According to Health District records, five of these failing OSS were repaired, but corrections could not be confirmed for the other four.

4.0 GOALS AND OBJECTIVES

The Port Gamble Bay Closure Response Strategy (SCRC, 1996) identified the Port Gamble Bay/Gamblewood Sanitary Survey Project as one part of an overall strategy to restore good water quality in Port Gamble Bay to allow the upgrade the Cedar Cove commercial shellfish beds to an *Approved* growing area classification, and to ensure that the remainder of Port Gamble Bay remains open for harvest. The goal of the Port Gamble Bay/Gamblewood Sanitary Survey Project was to protect human health and the environment by locating and correcting

sources of FC contamination (failing OSS and improper animal waste management practices), and to proactively prevent future FC contamination through public education on proper OSS operation and maintenance and animal waste management practices.

To meet this goal, the following objectives were developed and implemented during the project period:

- Track, isolate, and identify fecal pollution sources and areas in need of corrective action;
- Identify and correct failing OSS and improper animal waste management practices in the survey area; and
- Educate homeowners and occupants about proper OSS operation and maintenance and animal waste management practices.

5.0 PROJECT DESIGN AND METHODS

The project design consisted of four fundamental components:

5.1 WATER QUALITY MONITORING

The Plan called for twice monthly monitoring of fresh water streams and storm water ditches and outfalls in the project area. A total of 29 fresh water stream stations and 19 storm water stations were established. The locations of these stations are shown in **Figures 2a and 2b**. A detailed description of these station locations is contained in **Appendix A**. Monitoring stations were sited through a review of historical monitoring data, in consultation with the Port Gamble S'Klallam Tribe. Monitoring stations were sited to spatially and hydraulically represent each stream basin or storm water system and/or to segment different land use areas to help identify specific areas and sources of fecal pollution. Nearly all of the stream stations are located within the Gamble Creek and Martha-John Creek basins. More than half of the storm water stations were located within or near the Gamblewood development.

Semimonthly monitoring of SSWM marine water stations HC37 (Cedar Cove) and HC38 (near Gamblewood park) was added to the Plan in mid-1997 primarily to track marine water quality conditions in the shellfish closure area concurrently with stream and storm water quality conditions.

All water sample collection activities were conducted according to applicable Puget Sound Estuary Program Protocols (Tetra Tech, In., 1990). Fecal coliform analysis were performed using the Most Probable Number (MPN) Multiple Tube A-1 Method, SM 9221C (APHA, 1992). Please refer to the Plan for quality assurance/quality control procedures for monitoring events.

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Figure 2a Port Gamble Bay Marine and Martha-John Creek Monitoring Stations

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Figure 2b Gamble Creek Monitoring Stations

5.2 SANITARY SURVEY

The sanitary survey consisted of an OSS record search, homeowner/occupant interview, field survey, and if necessary, a water sample and dye test. The purpose of the survey was to identify failing OSS and other potential sources of FC contamination. The 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 failure of the OSS.

Based upon the results of each survey, each OSS was categorized as Failing; Suspect; Non-Conforming; or No Apparent Problems (see **Appendix B** for rating category criteria.) Properties found to be vacant or rated Suspect were contacted annually and surveyed when changes were noted. Properties found to be failing were corrected pursuant to the Bremerton-Kitsap County Board of Health's Ordinance No. 1996-8, Rules and Regulations Governing On-Site Sewage Systems. (Adopted May 1, 1996, as amended January 1 and April 1, 1998) Health District's Inspectors also identified poor domestic and livestock waste management practices and investigated those properties for potential FC contamination of surface waters. Surface water pollution caused by animal manure is enforced under the Bremerton-Kitsap County Board of Health Ordinance No. 2000-6, Solid Waste Regulations (August 2, 2000).

All OSS survey work performed was conducted according to the methods contained in the "Manual of Protocol for Conducting On-Site Sewage Systems Surveys in Kitsap County, Washington" (BKCHD, 1995) and "Manual of Protocol: Fecal Coliform Bacteria Pollution Identification and Correction Projects" (BKCHD, 1999). The Health District's survey protocol manual has been approved by both the Washington Department of Ecology and State Health. This document is available to interested persons upon request.

5.3 SHORELINE SURVEY

The shoreline survey consisted of surveying, mapping, and sampling all flowing discharges to surface waters in the project area. The purpose of the shoreline survey was to monitor flowing discharges for the presence of fecal coliform bacteria to aid in prioritizing "hot spots", and to help document the impacts of failing OSS in the project area. Seven complete Port Gamble shoreline surveys and eight Cedar Cove shoreline surveys were conducted between 1995 and 2001. Five of the Port Gamble shoreline surveys were conducted between 1995 and 1997 and two follow-up shoreline surveys were conducted between 1997 and 1998. Eight shoreline surveys were conducted in the Cedar Cove portion of Port Gamble Bay between 1999 and 2001, the most recent occurring in March, 2001. No new sources were found.

6.0 RESULTS AND DISCUSSION

6.1 WATER QUALITY MONITORING

Despite the weighting of current data toward adverse pollution conditions, the marine waters of Cedar Cove now meet the NSSP water quality standard. The following results demonstrate that source correction implemented in this watershed have been successful:

- State Health upgraded the classification of commercial shellfish beds in Port Gamble Bay in June, 1999. State Health expressed their appreciation for the efforts of those the Health District who made the upgrade possible, “The Department of Health considers the restoration of water quality in Port Gamble Bay a model project, and we look forward to continued collaboration and successes in restoring and maintaining commercial and recreational shellfish beds in Kitsap County.” (corresp. June, 1999)
- State Health’s summary of marine water data from 3/21/96 to 12/31/00 for the Port Gamble growing area indicates that water quality meets both parts of the NSSP water quality standard at the Cedar Cove monitoring station in Port Gamble Bay.
- Over the course of the project, the marine water FC geometric mean value (GMV) and Estimated 90th Percentile for the State Health’s most recent 30 samples have each been reduced by about one-third (FC GMV reduced from 9.1 to 6 FC/100ml and 90th Percentile reduced from 47 to 31 FC/100ml).
- **Figure 3** illustrates the decreasing trend in 30-Sample FC GMVs at the marine station in the Cedar Cove area. Over the course of the project, the 30-sample GMV was reduced from 11 to 7 FC/100ml, a reduction of more than one-third (36%).
- **Table 1** is a summary of FC results at Cedar Cove marine station HC37 from 1995 through May 2001. The most recent set of 30-samples includes seven sample events prior to the repair of the final failing OSS in Cedar Cove. Excluding those seven sample events results in no change in Part 1 of the NSSP Water Quality Standard (National Shellfish Sanitation Program, 1997 Revision) at 7 FC/100ml. Part 2 of the Standard is a calculation of the 90th Percentile, which is 83 for the last 30 Samples but is reduced to 52 when the seven sample events conducted before the Cedar Cove failure was repaired are excluded.
- In response to intermittent high FC counts in Cedar Cove marine water, Health District staff conducted seven shoreline surveys of Cedar Cove to determine whether fresh water drainages were impacting marine water quality. No new sources were found.

Figure 3 Cedar Cove Fecal Coliform 30-Sample GMVs and Trendline

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Table 1 Summary of Port Gamble Bay Marine Monitoring Results

6.2 OSS SANITARY SURVEY

The sanitary survey of OSS was conducted from February 1996 to December 1999. During this period, a total of **532** residences were surveyed, including **176** shoreline homes and **356** upland homes. In addition, OSS records were evaluated (if available), residents were interviewed, OSS were dye-tested (when necessary), and OSS were rated according to the protocols set forth in the Health and Ecology approved “Manual of Protocol for Conducting OSS Surveys in Kitsap County, Washington” (BKCHD, 1995). **Table 2** and **Figures 4 and 5** summarize the project period OSS survey results.

- A project total of **30** OSS failures (**6%**) were found. As presented in “Criteria for Rating On-Site Sewage System Sanitary Survey Results” in Appendix A, OSS are classified as failing for reasons including: (1) Sewage backing up into, or not draining out of, a structure caused by slow soil absorption of septic tank effluent; (2) Sewage leaking from a septic tank, pump tank, holding tank, or collection system; (3) Visually positive dye-test observed and documented; (4) Collected water sample result from surfacing effluent in drainfield area is at or above 500 FC/100ml. **and** no animal waste is present at the time of collection; (5) Collected water sample result from bulkhead drains, curtain drains, or other pipes or seeps, at or above 500 FC/100ml. **and** positive dye-test results; (6) Straight discharge (gray or blackwater) from any indoor plumbing is observed and documented. **Figure 8** shows the approximate locations of OSS failures and suspects; a descriptive list of the OSS failures is contained in **Appendix C**. The 6% failure rate found in the Port Gamble Bay/Gamblewood Area is at the lower end 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 **10** suspect OSS (**2%**) were found. OSS are classified as suspect generally for one or combination of the following reasons: (1) Drainfield area is saturated; (2) Surface water is present in the drainfield area and collected water sample results are less than 500 FC/100ml. **and** no animal waste is present or observed. (3) Collected water sample results from bulkhead drains, curtain drains, or other pipes or seeps, at or above 500 FC/100ml. (no animal waste present/observed at the time of collection) **and** negative dye-test results. (4) Collected water sample results from bulkhead drains, curtain drains, or other pipes or seeps, less than 500 FC/100ml. (no animal waste present at the time of collection) **and** positive dye-test results.
- A project total of **80** non-conforming OSS (**15%**) were found. As presented in **Appendix B**, OSS are classified as non-conforming if a sub-regulation condition exists in any part of the OSS. Non-conforming conditions include: (1) Repairs or alterations have been performed on OSS without permit; (2) Additional bedrooms have been added to the home/business without a permit; (3) Field inspection suggests that non-conforming conditions exist (insufficient setbacks from surface waters or wells, no reserve area, vehicular traffic on drainfield, etc.)

- A project total of **67 OSS (13%)** with no records were found. OSS are classified as no records if: (1) no completed/signed Sewage Disposal Permit is on file at the Health District, or in possession of the owner/occupant; (2) No Non-Conforming, Suspect or Failure criteria were observed.
- A project total of **345 OSS (65%)** were rated as no apparent problems. As presented in **Appendix B**, OSS are classified as no apparent problems if (at the time of the inspection), the OSS appeared to be functioning properly, a completed/signed Sewage Disposal Permit is on file at the Health District or in possession of the owner/occupant, no illegal repairs or alterations have been performed, and all applicable set-backs and conditions at the time of installation are still in place.
- Properties with poor domestic and livestock waste management practices were identified during the survey and were investigated for potential FC contamination of surface waters. Four water quality violations related to livestock waste management practices were identified in the project area. Three of these were located in the Cedar Cove area. A horse was removed from one property and one farm completed some water quality improvements in 1998. The other farm worked with the Kitsap Conservation District and completed a farm plan addressing pasture, manure, mud and roof runoff management in 1997. Stream and wetland protection fencing and livestock crossings were completed in 1998. Livestock numbers were reduced in 1999 and additional livestock stream crossings and roof runoff management will be implemented in the summer of 2001.
- The Kitsap Conservation District developed ten farm plans for properties in the project area; eight of these properties are located in Gamble Creek watershed and two are located in the Martha-John Creek watershed that drains into Cedar Cove.
- **Figure 5** illustrates a summary of visited residences in the project area. Eighty-nine percent of the homes in the project area were surveyed and six percent were vacant. All of the 28 properties that denied access or could not be contacted were investigated by sampling all drainages leaving the property. No contaminated drainages were found leaving these properties. When contamination is found and confirmed, Health District staff present the sample results to the property owner and try to find upstream sampling stations to isolate impacts from the parcel in question. In most cases, property owners allow access to determine the sources of contamination.

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Table 2 Summary of OSS Sanitary Survey Results

Figure 4 Summary of Results by Rating Category

Figure 5 Summary of Visited Residences in Project Area

There does not appear to be any specific pattern or trend to the locations of failing and suspect OSS in the project area. Sixteen of the 30 (53%) failing OSS were located adjacent to a fresh or marine water body, while 14 (47%) were located in upland areas. Three of the 30 failures (10%) were direct discharges to marine water, one of which was located in Cedar Cove. Four of the 30 (13%) failures were located in Cedar Cove.

As discussed in **Section 6.3**, although certain portions of storm water system in the Gamblewood development were noted to contain elevated levels of fecal coliform bacteria, the actual impact on Port Gamble Bay/Cedar Cove marine waters from Gamblewood storm waters would appear to be nearly negligible at this time due to relatively low flow volumes, high infiltration rates, and biofiltration benefits from the grass-lined swales and roadside ditches. Kitsap County Surface and Stormwater Management installed a Continuous Deflector System on the drainage from the Gamblewood development in August 2000. The unit is designed to remove gross pollutants, sediments, and floatable debris. Large flows will not re-suspend materials out of the unit.

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; and
- Number of previous repairs (failure history).

Relative to these factors, the Port Gamble Bay/Gamblewood survey results showed that:

- 19 (63%) of the 30 failing OSSs were 15 years old or older;
- 14 (47%) of the failing OSS were linked to system abuse through poor installation or damage to the drainfield area.
- 11 (37%) of the failing OSSs were located less than 100 feet from a marine or fresh water body;
- 5 (17%) of the failing OSSs had failed, and been repaired, at least once in the past.

As shown above, age of the OSS and poor installation/damage to the drainfield would appear to be the two factors most in common with failing OSS the Port Gamble Bay/Gamblewood area. As shown in **Appendix C**, only five failures (thus far) have been linked to the age and size of the system, and none have been linked to improper operation and maintenance. All but one failing OSS (sand filter) were either standard gravity OSS or pump-to-gravity systems.

All of the 30 failing OSS have been repaired. Seven were repaired with alternative systems, 17 were repaired with gravity OSS, and 6 were “simple fix” repairs including replacing a broken pump, making a septic tank water-tight by backfilling with clay soils and compacting, and tying gray water discharges into the septic tank.

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.

Proper septic system operation and maintenance was one of the primary focuses of the Port Gamble Bay Sanitary Survey Project. Health District staff provided homeowners with educational brochures and (if available) a copy of the sewage disposal permit/as-built on file at the Health District for their home. Health District staff emphasized to homeowners that proper operation and maintenance is crucial to prevent future septic system failures and protect water and shellfish quality in the Port Gamble Bay / Cedar Cove area.

6.3 SHORELINE SURVEY

A project area shoreline survey was conducted on five separate occasions. All flowing discharges were mapped and sampled for fecal coliform bacteria to help identify the location of failing OSS, and to help determine the sources of fecal coliform impacts to Port Gamble Bay. Shoreline survey results are summarized in **Table 3**.

All of the sampled discharge points with fecal coliform concentrations greater than 200 FC/100ml (an "action level" established by the Health District) warrant further study. This "action level" is twice the State Class A freshwater fecal coliform standard of 100 FC/100ml. Fecal coliform concentrations at, or above, 1,600 FC/100ml are generally considered strong indicators of raw sewage because, using standard dilutions, the uppermost limit of the MPN test is 1,600. Two "follow-up" events were conducted on May 2 and June 3, 1997 to confirm discharges with sample results exceeding the "action level". In addition, eight Cedar Cove shoreline surveys were conducted. A detailed list of shoreline survey sample collection points is contained in **Appendix D**.

As shown in **Table 3**:

- A total of 309 flowing discharges were sampled between November 30, 1995 and March 23, 2001;
- Only 44 (14%) of these stations had sample results \geq 200 FC/100ml;
- Five (11%) of these 44 stations were associated with failing OSS;

Shoreline survey results also show that, of the 44 stations with sample results \geq 200 FC/100ml, only two of these stations were located in the Cedar Cove closure area. Both were linked to failing OSS which have been repaired.

TABLE 3
PORT GAMBLE BAY/GAMBLEWOOD SANITARY SURVEY PROJECT
SUMMARY OF SHORELINE SURVEY RESULTS
November 1995 – March 2001

Date	Rainfall: 48 hours previous to sampling (inches) ^a	# of Stations Sampled	# of Stations with Results \geq 200 - <1,600 FC/100 ml.	% of Total	# of Stations with Results \geq 1,600 FC/100 ml.	% of Total
Event #1						
November 30, 1995	0.29	17	1	6%	1	6%
December 1, 1995	0.10	10	1	10%	1	10%
Event #2						
January 23, 1996	0.16	26	0	0%	0	0%
January 24, 1996	0.0	19	0	0%	0	0%
Event #3						
October 24, 1996	0.27	28	3	11%	1	4%
October 28, 1996	0.26	14	0	0%	0	0%
Event #4						
April 16, 1997	0.06	41	3	7%	9	22%
Event #5						
April 28, 1997	0.85	56	4	7%	4	9%
Follow-Up						
May 2, 1997	0.56	4	2	50%	2	50%
June 3, 1997	0.31	4	2	50%	2	50%
Cedar Cove #1						
March 25, 1998	0.58	16	2	12%	2	12%
March 26, 1998						
Cedar Cove #2						
February 25, 1999	0.50	11	0	0%	0	0%
Cedar Cove #3						
September 7, 1999	0.0	5	0	0%	1	20%
September 17, 1999	0.0	1	0	0%	0	0%
October 15, 1999	0.0	1	0	0%	0	0%
October 29, 1999	0.98	1	0	0%	0	0%
November 12, 1999	1.90	2	1	50%	0	0%
December 3, 1999	0.65	2	0	0%	0	0%
Cedar Cove #4						
January 4, 2000	0.65	10	1	10%	0	0%
Cedar Cove #5						
April 28, 2000	0.05	11	0	0%	0	0%
Cedar Cove #6						
June 8, 2000	0.30	8	1	12%	0	0%
Cedar Cove #7						
February 22, 2001	ND	11	0	0%	0	0%
Cedar Cove #8						
March 13, 2001	ND	11	0	0%	0	0%

A. Source of data: Kitsap Public Utility District, Station 35, Pope and Talbot Well Site.

6.4 STORM WATER MONITORING

The following discussion is summarized from “Nonpoint Pollution Source Tracking and Identification Project for Southern Port Gamble Bay, Status Report No. 3” (BKCHD, 1997).

Storm water monitoring results for Gamblewood showed that of 58 samples collected from nine different locations, nine (16%) exceeded 1,600 FC/100ml and 20 (35%) exceeded 200 FC/100ml. A FC count of 1,600/100ml is indicative of untreated sewage, and a FC count of 200/100ml is twice the state water quality FC standard (Part 1). Water quality results at the “mouths”, or end points, of the two primary drainages which discharge Gamblewood storm waters directly to Port Gamble Bay (GSW1 and GSW2) meet Part 1 of the FC standard.

Failing OSS and pet feces appear to be the main sources of contamination in the storm water system servicing the Gamblewood development. Ten of the 30 (33%) failing OSS found during the Port Gamble Bay/Gamblewood Sanitary Survey Project were located in the Gamblewood development. Additionally, 51 of the 60 (85%) properties noted to have problems with pet feces disposal were also located in the Gamblewood development.

However, realized impacts to Port Gamble Bay marine waters from the Gamblewood storm water system appear negligible at this time. Fecal coliform contributions to Port Gamble Bay from Gamblewood appear to be mitigated due to a combination of relatively low flow volumes, high infiltration rates, and biofiltration benefits from the grass-lined swales and roadside ditches.

Numerous site visits during wet weather conditions have confirmed that rainfall amounts and duration in the Gamblewood area are rarely sufficient to produce a surface discharge into Port Gamble Bay. Gamblewood storm waters account for only about 4% of the total FC loading into Port Gamble Bay. The flat to gently sloping topography of the area in combination with the area’s highly permeable soils reduces flow velocity and facilitates infiltration in the roadside ditches (SCS, 1980). Additionally, most of the roadside ditches are well vegetated and this, too, promotes infiltration and biofiltration as evidenced by the low fecal coliform concentrations at the “mouth” stations before discharge to Port Gamble Bay.

6.5 MICROBIAL SOURCE TRACKING

Please refer to **Appendix G**.

7.0 CONCLUSIONS

The findings of the Port Gamble Bay Sanitary Survey Project date are:

- Failing OSS do not appear to be a major source of fecal coliform contamination to the Port Gamble Bay / Cedar Cove area. Thirty (30) of 532 OSS were found failing for an OSS failure rate of 6%. This failure rate is at the lower range (3% - 16%) of failure rates found in other areas surveyed by the Health District over the last ten years. No overlying pattern or trend relating to the OSS failures was identified. Although five failing OSS were located adjacent to the marine shoreline, only three were found to be directly discharging sewage to the marine environment. Four OSS failures, one of which was a direct sewage discharge, were located in the Cedar Cove area.
- Properties with poor domestic and livestock waste management practices were identified during the survey and were investigated for potential FC contamination of surface waters. Four water quality violations related to livestock waste management practices were identified in the project area. Three of these were located in the Cedar Cove area. A horse was removed from one property and one farm completed some water quality improvements in 1998. The other farm worked with the Kitsap Conservation District and completed a farm plan addressing pasture, manure, mud and roof runoff management in 1997. Stream and wetland protection fencing and livestock crossings were completed in 1998. Livestock numbers were reduced in 1999 and additional livestock stream crossings and roof runoff management will be implemented in the summer of 2001.
- The Kitsap Conservation District developed ten farm plans for properties in the project area; eight of these properties are located in Gamble Creek watershed and two are located in the Martha-John Creek watershed that drains into Cedar Cove.
- Shoreline survey results showed that a total of 309 discharge points (stations) were sampled between November 30, 1995 and March 23, 2001. Only 44 (14%) of these stations had sample results ≥ 200 FC/100ml. Of these 44 stations, only five have been linked to failing and/or suspect OSS. Additionally, only three of these 44 stations (7%) are located in the Cedar Cove closure area. These stations were linked to two failing OSS and the final station was likely related to inadequate animal waste management on one property. Both failing OSS were repaired and the final property removed the animal.
- Failing OSS and pet feces have been contaminating certain portions of the storm water system servicing the Gamblewood development. However, fecal coliform impacts to Port Gamble Bay from this storm water system appear negligible at this time due to a combination of relatively low flow volumes, high infiltration rates, and biofiltration benefits from the grass-lined swales and roadside ditches. Kitsap County Surface and Stormwater Management installed a Continuous Deflector System on the drainage from the Gamblewood development in August 2000. The unit is designed to remove gross pollutants, sediments, and floatable debris. Large flows will not re-suspend materials out of the unit.
- Bob Woolrich of State Health's shellfish program was quoted in The Bremerton Sun on April, 18, 2001, "I think Kitsap County has a program that we would love to see in other

counties...They respond quickly to surface water problems in shellfish-growing areas. The citizenry there seems to have a heightened awareness of surface water problems.”

- Don Melvin of State Health’s Shellfish Restoration Program noted that “SSWM agency personnel were very effective in identifying sources of pollution and working with watershed residents on corrections. The improvements in water quality that resulted from this work made it possible for our office to reopen the area to shellfish harvest.” (corresp. March, 2001)
- Puget Sound Water Quality Action Team stated “The PIC [The Health District’s Pollution Identification and Correction] program has demonstrated success in addressing nonpoint pollution, and special credit should go to the cooperation, hard work and commitment of local staff that developed this innovative approach.” (corresp. March, 2001)

8.0 RECOMMENDATIONS

Based upon the conclusions of the Port Gamble Bay/Gamblewood Sanitary Survey Project, the Health District recommends the following:

- The Health District will continue monitoring Cedar Cove marine and fresh waters as part of the baseline water quality monitoring program. Pollution Identification and Correction staff will be notified when samples exceed water quality standards for the watershed and will follow-up by performing a shoreline survey of Cedar Cove fresh water drainages. All stations with sample results greater than 200 FC/100ml will be confirmed. If the geometric mean of all samples taken from the drainage exceed 200 FC/100ml, Health District staff will contact residents of adjacent properties to determine whether new sources of contamination exist.

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