

**KITSAP COUNTY HEALTH DISTRICT  
WATER QUALITY PROGRAM  
BARKER CREEK WATERSHED RESTORATION PROJECT**



**FINAL REPORT**

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E C O L O G Y

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**Kitsap County Health District**  
*Pollution Identification and Correction Program*

**BARKER WATERSHED RESTORATION PROJECT**  
*Executive Summary*

The Barker Creek Restoration Project addressed a fecal coliform bacteria contamination problem in Barker Creek and in its marine receiving waters. The purpose of the project was to reduce the bacterial contamination of the stream and the marine waters near its mouth so that the shellfish closure zone established by Washington State Department of Health can be lifted.

Fifteen (15) FC sources were identified during the project, including 9 failing on-site sewage systems, one inadequate trailer dump station, 1 pet waste violation, and 4 livestock waste handling problems. Twelve (12) of the FC sources have been corrected. The remaining three involve livestock waste handling practices that need further investigation.

All stream trend monitoring stations are showing some improvement. The mouth station (BK01) had half as many Part 2 (state FC standard) violations in 2007 as it had in 2004. Station BK02 FC levels are dropping over the last three years [statistically significant improving trend (short term)]. Station BK03 FC levels have dropped by 50% since 2004. The marine station at the mouth of Barker Creek currently meets the state FC standard with a stationary trend.

The Health District makes the following recommendations to watershed residents, and commits to the following actions to protect Barker Creek for future generations:

- The Health District will continue to be involved in the Barker Creek and the Windy Point shoreline. Involvement will be through complaint response, trend monitoring, and follow-up of operation and maintenance (O&M) reports submitted to the District.
- Local residents are encouraged to continue to be proactive in OSS maintenance.
- Residents with livestock are encouraged to work with the Kitsap Conservation District on maintaining best management practices or implementing best management practices on their properties.
- The Health District should monitor the stormwater leaving the Island Lake boat ramp, to see whether paving the parking lot decreased the FC counts entering Island Lake.
- The Health District will further investigate the three agricultural properties with possible water quality violations. If water quality violations can be proven, enforcement will require residents to implement the advice already given by KCD.
- The Health District recommends conducting future shoreline surveys along Windy Point to look for new FC sources.

**Kitsap County Health District**  
*Pollution Identification and Correction Program*

**BARKER WATERSHED RESTORATION PROJECT**  
**FINAL REPORT**

**1.0 BACKGROUND AND PROBLEM STATEMENT**

**Summary**

This project addressed a fecal coliform bacteria (FC) contamination problem in the Barker Creek/Windy Point watershed in Kitsap County. Health District FC data collected at three stations within Barker Creek since 1996 show ongoing violations of the fresh water FC standard. Barker Creek has been listed on the Clean Water Act Section 303(d) list (303d list) for FC contamination since 1996. In addition, the FC problem led the Washington State Department of Health to establish a commercial shellfish closure zone around the mouth of Barker Creek, the southern boundary of which is the sanitary line for the “Conditionally Approved” portion of the North Dyes Inlet Commercial Shellfish Growing area.

See **Appendix A** for a more complete summary of the historical FC data for Barker Creek. Surface water quality standards are established by the Washington Department of Ecology in Chapter 173-201A of the Washington Administrative Code (WAC). In August 2003, revisions to the surface water quality standards were implemented by Ecology. The Barker Creek Watershed Restoration Project Quality Assurance Project Plan was approved referencing the 1997 standards. Therefore, Health District data have been compared against those standards.

The “Water Quality Standards for Surface Waters of the State of Washington” are codified in Chapter 173-201A of the Washington Administrative Code. The Class A fresh water standard for fecal coliform bacteria (freshwater FC standard) is:

*“Fecal coliform organism levels shall both not exceed a geometric mean value of 100 colonies/100 mL, and not have more than 10 percent of all samples obtained for calculating the geometric mean value exceeding 200 colonies/100 mL.”*

The marine water FC standard is:

*“Fecal coliform organism levels shall both not exceed a geometric mean value of 14 colonies/100mL, and not have more than 10 percent of all samples obtained for calculating the geometric mean value exceeding 43 colonies/100mL.”*

A hydrographic study of North Dyes Inlet was completed in 2003, and the information was used to upgrade the northern portion of Windy Point. However, southern Windy Point still remains closed to shellfish harvest.



In addition to addressing FC issues within Barker Creek and along Windy Point, this project also addressed water quality problems in Island Lake. Island Lake is located in the headwaters of Barker Creek. The most recent data and observations for this lake indicate the trophic state of Island Lake is “mesotrophic”. This indicates a moderate amount of nutrients which can fuel aquatic weed and algae growth.

## **2.0 PROJECT AREA DESCRIPTION**

Please see **Figures 1, 2, and 3** for a map of the Barker Creek Watershed and sub-project areas. These maps also include trend and impact monitoring station locations, and FC “hot spots” identified during the Windy Point shoreline survey. The headwaters of Barker Creek originate at Island Lake. As the stream meanders south, Hoot Creek, Wally Creek (also called Waldo Creek), Pinsch Creek, and many small tributaries combine with the main channel, which discharges to the east shore of Dyes Inlet. The total main channel and tributary length extends more than six miles. Land use in the Barker Creek drainage is a combination of predominately agricultural, rural residential, urban residential, and some commercial.

The main stem of Barker Creek originates at Island Lake. Please see Figure 1 for a map of the Island Lake Watershed and project area. Island Lake is a spring-fed lake. Island Lake flows into the Barker Creek stream channel through overflow and a control valve during wet weather events. Land use in Island Lake is mostly urban residential. Public access to this lake is at Island Lake County Park at the north end, and Island Lake Camp at the south end. During the dry months, ponds to the south of the Island Lake Camp property are the headwaters of Barker Creek. As presented in the “Soil Survey of Kitsap County Area, Washington” (SCS, 1980) the soils on the east shoreline and uplands of Island Lake primarily consist of Alderwood gravelly sandy loams. Alderwood soils are rated as “poor” for on-site sewage system (OSS) performance. The west shore of Island Lake is predominantly Indianola loamy sand. These soils are considered suitable for gravity OSS.

Barker Creek flows from its headwaters in Island Lake, between Ridgetop and Central Valley Roads. Please see Figure 2 for a map of the Barker Creek watershed and project area. Streamside parcels are primarily rural residential lots, and small farms. The Kitsap Conservation District identified 37 farm properties north of Waaga Way in the Barker Creek Watershed. Development along Ridgetop Boulevard is urban residential, served by sewer. Barker Creek continues south, crossing Waaga Way and Washington State Highway 303, heading southwest to Tracyton Boulevard. Streamside properties are rural residential south of the Waaga Way crossing, and there is one farm property south of Waaga Way. South of Waaga Way, urban residential parcels are built along tributaries of Barker Creek, and run along the south end of Central Valley and Nels Nelson Roads. Sewage disposal for residential lots along Baker Creek is mostly by OSS, though sewer serves many upland properties. Sewer lines originate from 1972. Soils along the main stream corridor are a mixture of the Indianola and Alderwood soils described in the Island Lake section. Norma fine sandy loam is found in the vicinity of Sigurd Hansen Road, and at the confluence of Barker and Hoot Creeks. OSS in Norma soils are susceptible to wetness and ponding in the drainfield area.

Figure 1  
Barker Creek Project Area and Monitoring Stations

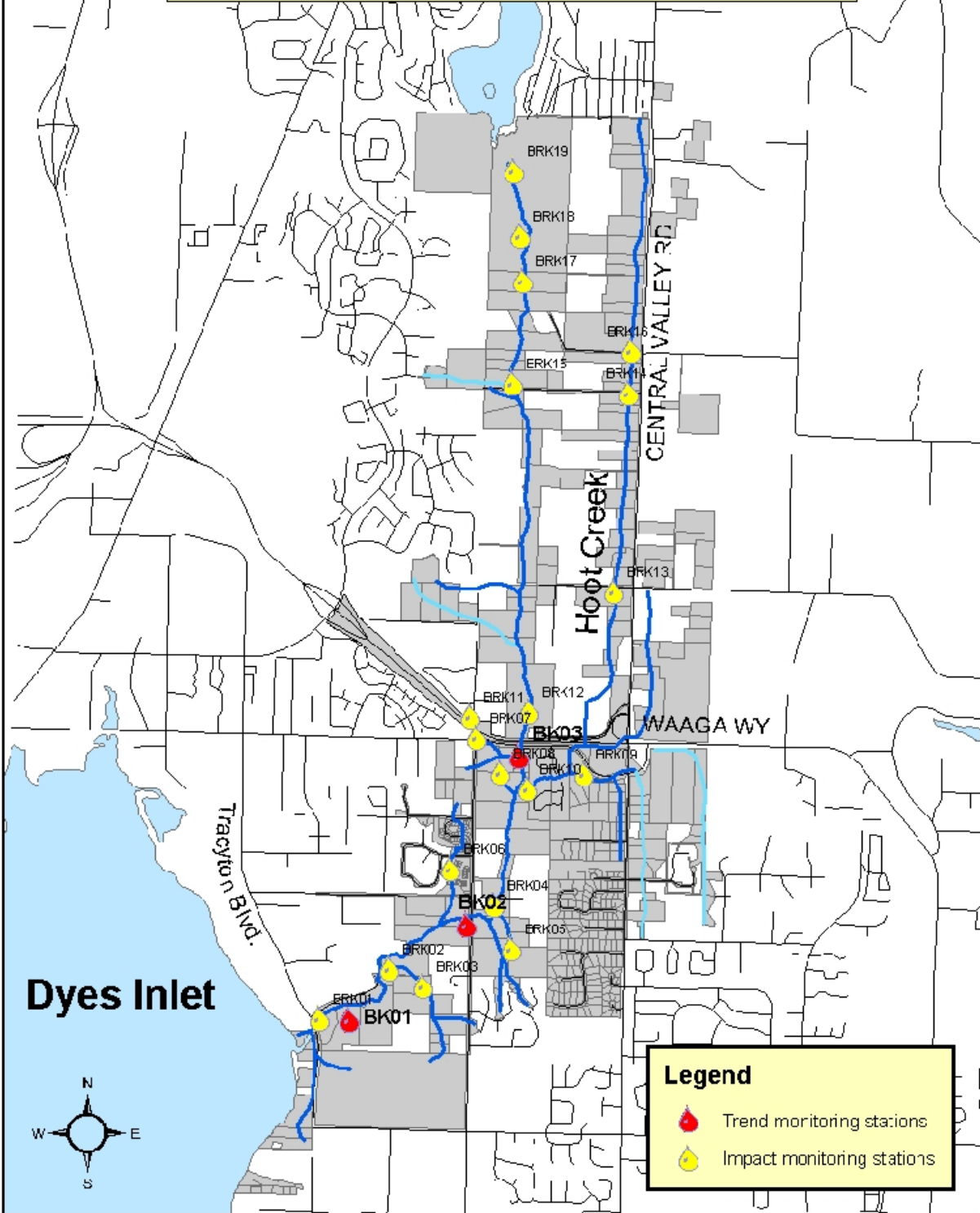


Figure 2  
Island Lake Survey Project Area and  
Monitoring Stations

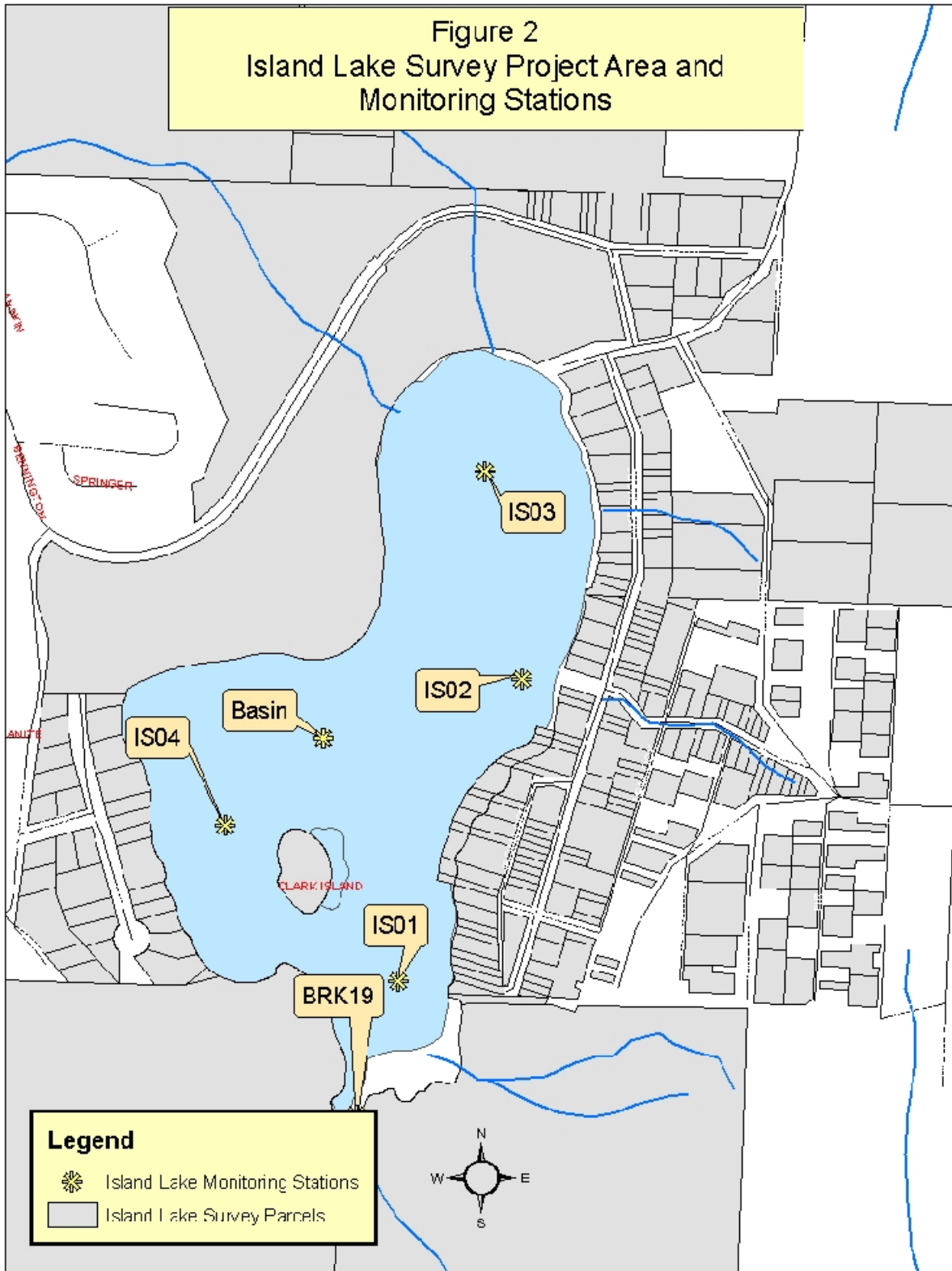
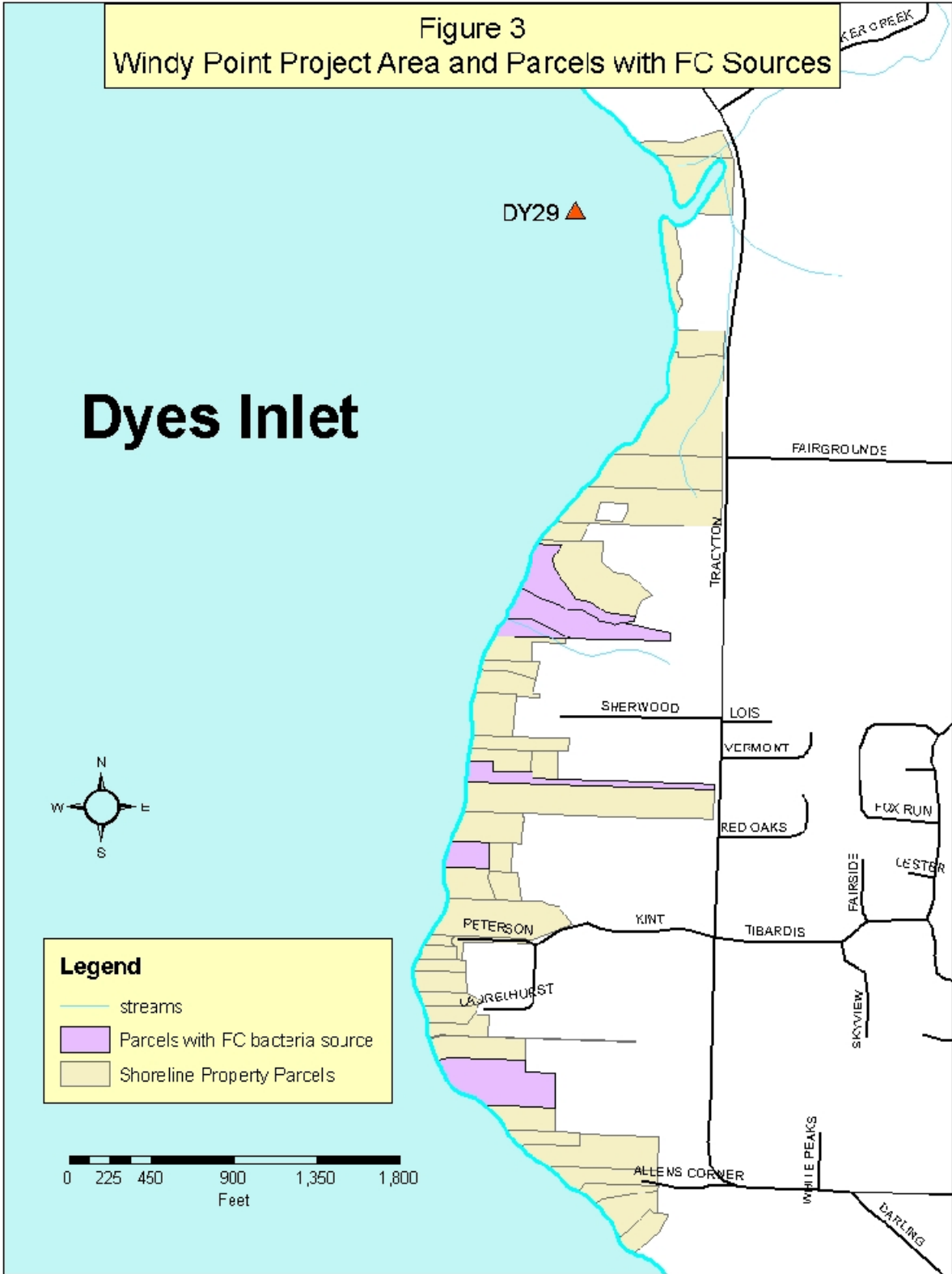


Figure 3  
Windy Point Project Area and Parcels with FC Sources



Despite the suburban landscape, Kitsap County and a community group called the Chums of Barker Creek (“Chums”) have worked together to keep the stream corridor intact. Homes are not visible when wading in the stream. There is limited public access to Barker Creek, despite numerous conservation easements and county-owned property along the stream corridor. There are no maintained trails along the stream corridor, and road access to most public areas is via private land. There is a Montessori school along Barker Creek.

Hoot Creek originates from a pond on a piece of property that is used as a nursery. During winter storms, runoff from a chain of ponds, and an older development along Island Lake Parkway, drain into Hoot Creek. Hoot Creek is highly channelized, and runs parallel to Barker Creek on the west, and Central Valley Road on the east. Hoot Creek crosses Waaga Way through a complex series of storm drains, and receives water from several tributaries before entering Barker Creek on private property east of a mobile home park on Bucklin Hill Road. Sewage disposal for properties in the Hoot Creek watershed is by OSS, except for the mobile home park, which is served by sewer. Public access on Hoot Creek is limited to mobile home park residents and their guests. Many fences cross this stream, and most driveway and road culverts are perched. Soils along Hoot Creek are Alderwood which are rated as “poor” for OSS. Kapowsin gravelly loam soils are found south of Sigurd Hansen Road. These soils work inadequately for OSS in wet weather. As mentioned previously, Norma fine sandy loam is found in the vicinity of Sigurd Hansen Road, and at the confluence of Barker and Hoot Creeks.

The headwaters of Wally Creek consist of a stormwater pond and a small spring in the “Fairwood Ranch “ development off of Nels Nelson Road. Wally Creek then runs across an undeveloped parcel and single family residence, before entering Barker Creek on the east side of Nels Nelson Road. Public sewer serves all developed parcels on Wally Creek. The sewer system dates from the 1980’s.

Pinsch Creek originates at the north end of the Kitsap County Fairgrounds, past developments off of Raven Creek Drive, and into salmon rearing ponds on private property, before entering Barker Creek at the end of Barker Creek Road. Flows from the east side of Nels Nelson Road, that formerly flowed into Pinsch Creek, were re-routed to drain into Wally Creek. Flows from Kitsap County’s Gordon Athletic Field have been re-routed from Pinsch Creek to an unnamed tributary that runs along the east side of Tracyton Boulevard. All parcels on Pinsch Creek use OSS for sewage disposal, except for the Kitsap County Fairgrounds. Parcels in the area of Pinsch Creek have Alderwood soils that hinder OSS performance.

Please see Figure 3 for a map of the Windy Point Shoreline Survey Project Area. Please note that the southernmost mapped stream is located one parcel north of its mapped location. Land use along the section of Dyes Inlet shoreline, between the mouth of Barker Creek and the north side of Windy Point, is rural residential, with mostly high- bank waterfront. Anna Smith Children’s Park, and the Peterson Drive road end, provide public access to this shoreline. Tracyton Boulevard runs east of this shoreline.

The stretch of shoreline between the mouth of Barker Creek and Anna Smith Park consists of Indianola loamy sand. The section in the vicinity of the mapped stream consists of Indianola/Kitsap Complex soils, which percolate slowly and filter poorly when used for OSS. The portion of the shoreline survey south of the mapped stream is found in Alderwood soils.

### **3.0 GOALS AND OBJECTIVES**

The Barker Creek Watershed Restoration Project is a cooperative effort of the Health District and the local community to conduct an intensive sanitary survey of Island Lake, Barker Creek, and its tributaries, as well as the Windy Point marine shoreline (see Figures 1,2 and 3).

#### **Goals**

The goals of the Barker Creek Watershed Restoration Project were to:

- Reduce FC levels from Island Lake, Barker Creek, and other fresh water drainages to Barker Creek and the Windy Point Shorelines.
- Prevent future water quality problems through an intensive public education campaign, targeted at OSS operation and maintenance, and proper animal waste management practices.
- If source corrections and water quality improvements are adequate, DOH can remove the closure zone around the mouth of Barker Creek, and WSDOE can re-classify Barker Creek from Category 5 on the 303(d) List to Category 1 (“Meets Tested Standards”).

#### **Objectives**

The objectives of the Barker Creek Watershed Restoration Project were to:

- Solicit and foster community support and stewardship of water quality through informing, educating, and involving the public in the project area; and
- Identify and correct sources of FC pollution in the Barker Creek Watershed. Water quality monitoring in the Barker Creek Watershed will identify specific sources of bacterial pollution, determine the effectiveness of agricultural best- management practices, and monitor fecal coliform bacterial trends.

### **4.0 PROJECT DESIGN AND METHODS**

This survey was conducted in accordance with the Health District’s comprehensive and proven “Manual of Protocol: Fecal Coliform Bacteria Pollution Identification and Correction Projects”, Version 9 (a copy of this document was attached to the Quality Assurance Project Plan). The project consisted of the following components:

#### **Pollution Identification and Correction Survey**

The property 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. Owner/residents were given OSS records and site-specific tips regarding how to get the most life possible from their OSS.

Based upon the results of each survey, OSS were categorized as “Failing”, “Suspect”, “Non-Conforming”, “No Records”, or “No Apparent Problems” (see **Appendix B** for rating category criteria). Properties found to be vacant, or rated as Suspect, were re-contacted and surveyed when changes were noted. Failing OSS were corrected pursuant to Kitsap County Health District OSS regulations.

High priority, non-OSS FC sources in the watershed were also assessed. The Health District and KCD were both subcontracted for this project. KCD provided services for this project, including: develop and maintain a prioritized inventory of agricultural sites in the watershed, develop farm plans for landowners, create Best Management Practice (BMP) designs for landowners, assist landowners with BMP implementation, and provide community outreach and education.

KCD conducted an inventory of the Barker Creek watershed, which prioritized agricultural sites on the “potential to pollute”. Conditions were noted relative to number of livestock, type of livestock, livestock confinement, pasture conditions, barns and outbuildings, and proximity of agricultural land use activity to surface waters. The “potential to pollute” used a rating of 1 to 5, with 1 and 2 being “high” priority.

All properties with livestock in the watershed were contacted, and were surveyed for FC sources. Owners and operators were referred to KCD for technical assistance and cost-share opportunities. FC monitoring was conducted on parcels not voluntarily cooperating with KCD. The Health District attempted to complete five sample events so that FC results could be properly compared to the state FC standard. If the property was judged to be creating water pollution through mismanagement of livestock waste, corrections were pursued as outlined in the “Interlocal Agreement between the Kitsap County Health District and the Kitsap Conservation District Concerning Investigation and Correction Procedures for Livestock Waste Handling Violations. **Appendix C** contains a copy of this agreement.

### **Water Quality Monitoring**

Water quality monitoring was conducted pursuant to the “Barker Creek Watershed Restoration Project Quality Assurance Project Plan” (January 2005).

### **Trend Monitoring**

The Health District has conducted trend monitoring of Kitsap County streams and marine waters since January 1996, using Kitsap County Surface and Stormwater Management Program (SSWM) funding. Trend monitoring of the Barker Creek Watershed began in October 1997. Monitoring is conducted pursuant to the Health District’s Trend Monitoring Plan.

The Health District conducted monthly trend monitoring of three (3) stations in the Barker Creek Watershed during the project period. Please see **Appendix D** for a list of monitoring stations, and Figures 1, 2 and 3 for their locations.

## **Stream Impact Monitoring**

The purpose of impact monitoring was to characterize FC water quality of watershed stream segments. Please see Appendix D for a list of Impact Monitoring stations, and Figures 1 and 2 for their locations. Impact monitoring began with semi-monthly sampling of three trend stations, and seventeen impact monitoring stations, in the project area. Additional impact stations were added during the project to facilitate source identification. Sample frequency was adjusted to monthly in 2005, to better utilize resources.

## **Island Lake Impact Monitoring**

In response to concerns from the community, Island Lake was added to the project area in February 2006. Stormwater outfalls to Island Lake were sampled, as part of a limited investigation, twice during the 2006-2007 wet season. The Health District conducted an offshore study of Island Lake in January and February of 2007. The lake was sampled for FC and EC in six locations. Please see Appendix D for a list of monitoring stations, and Figure 2 for their locations.

## **Stormwater Impact Monitoring**

Portions of the Barker Creek watershed are subject to significant stormwater runoff. The stormwater infrastructure is a mix of 1980's detention ponds, roadside ditches and recent retrofits using Low Impact Development methods. Stormwater originates from residential and commercial land uses. FC pollution from stormwater can be significant (May and Cullinan, 2005). The source of FC in stormwater can be from pet waste, leaking sewer infrastructure, inadequate OSS treatment, or wildlife. Additionally, poor maintenance of stormwater systems can contribute FC contaminated sediments to stream corridors where they remain (Fohn, 2007).

The Health District was contracted to investigate stormwater impacts to Barker Creek. The Health District participated in Kitsap County Surface and Stormwater Management Program's mapping of stormwater outfalls to Barker Creek during the summer of 2005. Mapped outfalls were sampled for FC three times during the 2005-2006 and 2006-2007 wet seasons. Drainages with FC geometric mean values (GMV) > 200 were subject to further sampling, source control, and educational efforts. Please see Appendix D for a list of monitoring stations and their locations.

## **Sewer Crossing Impact Monitoring**

Sanitary sewer mains cross Barker Creek at Nels Nelson Road, and at Highway 303 (Waaga Way/Bucklin Hill Road). Sanitary sewer mains also cross Hoot Creek at Highway 303. Health District staff conducted a study during August of 2006 to assess whether these sewer mains had an impact on Barker Creek. Sampling occurred between 6:30 and 7:30 AM, when residents preparing for work and school may be maximizing water use. Barker and Hoot Creeks were sampled weekly, above and below each sewer main crossing, for FC, *Escherichia coli* ("*E. coli*", or EC) bacteria, and ammonia. Ammonia was selected as a tracer for sewage from sewers because



of its lack of presence in environmental water samples. Please see Appendix D for a list of monitoring stations and their locations.

### **Best Management Practice Effectiveness (BMPE) Monitoring**

BMPE monitoring was conducted (if possible) on properties that were documented FC contributors to surface waters. The intent of the monitoring is to verify whether or not the oss repair or the bmp installation was successful in reducing FC contamination.

### **Windy Point Shoreline Surveys**

Six shoreline surveys were completed along the Windy Point Shoreline project area. More surveys were added to the project to accomplish the goal of FC source corrections. The conditions varied from survey to survey. Three surveys were conducted during the wet season, and three during the dry season. Due to the wide variance in weather conditions, the number of samples taken for each event varied. There were five sites with an FC count equal to or higher than the 200 FC/100/ml threshold found during the project. All of these “hotspots” were confirmed by re-sample.

Sampling stations were labeled in numerical sequence from the starting point to the ending point of the survey. As new locations were added they were photographed, noted, and global positioning system (GPS) coordinates were taken. Location descriptions were recorded at each sample station, and the flow was photographed.

The conditions for each survey varied by time of year and weather conditions. Two of the surveys were conducted in a north-to-south direction, and four surveys were conducted south-to-north. Surveys were conducted on varying days of the week, to increase the opportunity to locate a contaminated flow that might be time- or condition- sensitive.

Sample stations testing at or above 200 FC/100ml were re-sampled. If the conformation sample also resulted in 200 FC/100ml or higher, then Health District staff investigated to locate FC sources. An OSS is considered “failed” when a dye test proves a hydraulic connection to a high FC sample location. Once an OSS was declared, “failed”, Health District staff worked with the homeowner to assist with the repair process. This assistance often required several visits with the homeowner and designer/installers. Drainages that did not result in confirmation during a single shoreline survey, but had high FC counts during different shoreline surveys, were also investigated. In addition to OSS failures, pet and livestock waste sources were investigated. Repeated shoreline surveys helped to verify corrections made through compliance with BMP’s, and through repaired OSS failures.

### **Educational Activities**

The Health District’s homeowner/resident OSS survey included a strong educational component to educate property owners about how to properly operate and maintain their OSS, to identify any non-conforming conditions that could cause premature OSS failure, reduce nutrient contamination, and to adequately manage animal waste. Educational brochures and water-conserving fixtures were made available to all participants. In addition, three public

meetings were held in the project area to provide project updates and more detailed education information.

KCD provided site-specific water quality recommendations to operators in the farm planning process. They maintained a public relations program to inform landowners about the status of water quality in the watershed, and steps that could be taken to improve it. They attended all educational events with the Health District.

Three public meetings were held. The Kitsap County Department of Community Development (DCD) hosted the initial public meeting, with the Health District and KCD attending. The second meeting was a workshop about pond operation, maintenance, and permitting. The third public meeting was held for Island Lake shoreline residents, after Island Lake was included in the project area.

The Health District sought out additional educational opportunities whenever possible. These included: a mobile homeowner's association meeting, stormwater educational signs, working with the local 4-H group, and door-to-door pet waste education. Health District staff were also available to answer questions from the public and the local community group (the "Chums") in the field, and via phone or e-mail.

## **5.0 RESULTS AND DISCUSSION**

### **Pollution Identification and Correction**

#### **OSS Survey Results**

The Pollution Identification and Correction (PIC) OSS surveys were conducted from October 2004 to September 2007. The project area consisted of 435 parcels. The OSS survey consisted of two parts. First, there was an interview with the homeowner that involved a discussion of the existing septic system, and its care and operation. The second part was a physical inspection of the system, which involved walking the disposal field, and examining the exposed portions of the system, including observation ports, tank covers, transport lines, curtain drains. Suggestions were offered to the homeowner as to how he/she could improve OSS performance. Often these inspections revealed potential problems, such as improper placement of downspouts, damage to a drainfield by parking vehicles over the laterals, or unwanted growth of blackberry and tree roots that could plug the disposal lines.

Some of the surveys required additional inspection due to conditions that suggested a failing OSS. These "suspect" systems might require laboratory samples of surface water and dye testing the OSS. A system with suspect conditions, such as a saturated drainfield area, or a clean dye test with high FC counts, received a rating of "suspect", and the homeowner was encouraged to take the necessary steps to improve the operation of the OSS. When an OSS received a rating of "non-conforming", such as non-permitted repairs or alterations, or additional bedrooms added to the home, the homeowner was informed of the issues, their impact on the OSS, and the necessary steps to resolve the issues.

Suspect and non-conforming systems found during this project were recorded without corrective enforcement. Health District records were flagged to keep a record of the issue.

Table 1 summarizes the project OSS survey results. OSS were rated according to “Criteria for Rating OSS Inspection Results” in Appendix A. As presented in Table 1, a project total of 8 OSS failures (2%) were found. A descriptive list of the OSS failures is contained in Appendix E. The 2% failure rate found in the Barker Creek Watershed is at the low end of the range of failure rates (2% - 16%) found in other areas of Kitsap County surveyed by the Health District over the last twelve years.

**Table 1**  
**Barker Creek Restoration Project**  
**Summary of Pollution Identification and Correction Results**  
**2004 - 2007**

	Participating Properties	Failing		Suspect		Non Conforming		No Records		No Problems	
		#	%	#	%	#	%	#	%	#	%
<b>Stream side</b>	137	7	5%	0	0	16	12%	32	23%	83	60%
<b>Stream Upland</b>	98	1	1%	0	0	6	6%	7	7%	84	86%
<b>Lake side</b>	47	1	2%	1	2%	13	25%	7	13%	25	47%
<b>Lake Upland</b>	51	0	0%	2	4%	2	2%	4	5%	43	50%
<b>Total</b>	<b>333</b>	<b>8</b>	<b>2%</b>	<b>3</b>	<b>1%</b>	<b>37</b>	<b>11%</b>	<b>50</b>	<b>15%</b>	<b>235</b>	<b>71%</b>

### Analysis of Failures

Five of nine (56%) of the failing OSS were located adjacent to surface waters (<100 feet), and four of nine (44%) were located 100 feet or more from surface waters. Two failing OSS discharged directly to a pipe that flowed to the Windy Point marine shoreline.

Three of the nine (33%) failures were found during routine survey inspections by Health District staff. Two of the nine (22%) failures were reported by maintenance professionals, and occurred after an initial survey inspection had been conducted. Two of the nine (22%) failing OSS were found during Windy Point shoreline surveys. One of the nine (11%) failures was due to greywater discharges, and flowed into Pinsch Creek during wet weather. The homeowner reported one of the failures (11%), on the Island Lake shoreline.

The following factors have been related to OSS failure in previous surveys:

- Age of the OSS;
- 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.

Of these, the age of the OSS, and homeowner maintenance of the OSS, have been the most prevalent causes of failure:

Analysis of failing OSS found in the Barker Creek project area showed that:

- Six of nine (66%) of the failing OSS were 20 years old or older;
- One of nine (11%) of the failing OSS had failed, and was repaired 10 years previously;
- Five of nine (56%) of the failing OSS were located less than 100 feet from surface waters;
- One of nine (11%) of the failing OSS was the result of grey water discharges; and
- One of nine (11%) of the failing OSS was linked to system abuse through hydraulic overload - seven people used a 3-bedroom OSS.

As shown above, age of the system and proximity to surface waters were the most common cause(s) of failure.

### Types of OSS Repairs and Maintenance Requirements

One of the nine failing OSS is pending repair, and began the repair process on September 17, 2007. Nine of nine (100%) failing OSS have been repaired: four (44%) were repaired with alternative on-site systems, one (11%) was repaired with a standard gravity system, one (11%) was repaired by vacating a residence, one (11%) was repaired by homeowner repair *and* vacating a residence, and two (23%) were repaired by an on site sewage operation and maintenance provider.

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 currently in place, and were applied to OSS issues during this project. 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.

### Public Participation

**Table 2**  
**Barker Creek Restoration Project**  
**Summary of Public Participation**  
**2004 - 2007**

	Total Properties	Participating Properties	Did Not Participate	Denied Access	Vacant
<b>Stream side</b>	175	137	19	11	7
<b>Stream Upland</b>	125	98	23	2	2
<b>Lake side</b>	53	47	2	1	3
<b>Lake Upland</b>	82	51	28	0	3
<b>Total</b>	<b>435</b>	<b>333</b>	<b>72</b>	<b>14</b>	<b>15</b>

**Table 2** summarizes the public participation in the OSS survey. As presented in Table 2, 333 of 435 (77%) of the homes in the project area were surveyed, 15 (3%) were vacant, 72 (17%) did not participate, and 14 (3%) 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 high compared to other recently completed projects (1 – 2%). These property owners displayed general distrust of governmental agencies. Some property owners cited the June 2005 sewage spill as worse than any issues inspectors might find on their properties. (A tributary to Barker Creek was contaminated by a sewage spill on June 21, 2005. During a culvert replacement, Kitsap County Public Works personnel mistakenly hit a pressure sewer main, spilling 150,000 gallons of untreated sewage into this tributary. The force of this spill pushed sewage into an upstream pond, as well as contaminating Barker Creek downstream).

The rate of “did not participate” was also high. Obviously the distrust mentioned above is one possible reason for this. Other possibilities are a general lack of interest in cleaning up a stream that only failed one part of the state FC standard. In other words, water quality wasn’t bad enough to spark local concern.

### **Agricultural BMP Results**

KCD submitted their initial agricultural inventory and prioritization to the Health District in September 2004. Properties were prioritized based upon their potential to pollute surface and groundwater due to pasture condition, livestock access to surface water, runoff potential, etc. Over the project period, the inventory was modified based upon information gathered by KCD, and by Health District staff, during field inspections, including observations of animal waste and pasture management practices, and water sampling above and below the property. Table 3 presents the 2004 (start of project) inventory versus the 2007 (end of project) inventory. As you can see, good progress was made in reducing the number of high and medium-high priority farms from a total of 19 in 2004 to a total of 7 in 2007.

**Table 3  
Summary of Agricultural Priority Properties 2004 & 2007**

Priority	2004	2007
1 - High priority	2	2
2 - Medium high	17	5
3 - Medium	16	11
4 - Medium Low	10	9
5 - Low	5	16
Total Priority Landowners	50	43

(Kitsap Conservation District, 2004, 2007)

See KCD's final report for more detailed information. During the project, Health District staff collected numerous samples for FC analysis from drainages entering, originating and/or leaving farm properties. Four property owners received letters and/or a telephone call that detailed water quality problems potentially related to their livestock, and a recommendation that they work with KCD on solutions. Of the four property owners who received notification of a water quality problem, one has signed a cooperator agreement, but cannot implement until Summer 2008. The second worked with KCD on a farm plan, but refused to implement it. The third refused to work with KCD, so no action was taken. And the fourth implemented best management practices that were confirmed to correct the water quality problem. The Health District will follow up with these properties by the end of 2008.

## **Windy Point Shoreline Surveys**

Five shoreline surveys were conducted: September 2004, February 2005, February 2006, January 2007, and May 2007. The shoreline sampling was successful in locating FC sources along the Windy Point shoreline. Also, shoreline surveys were used to determine OSS repair effectiveness. See **Appendix E** for the complete list of shoreline survey stations and sample results.

Sample results from the shoreline surveys helped to locate 2 of the 9 project failures, and one suspect failure. These failures would not have been located without shoreline work. A failing OSS rarely flows at a constant rate; looking for those 'tell-tale' signs, and following them to a sample location may produce a location that can be sampled at a later date. KCHD staff put a high importance on locating all of the flows possible - even a weak flow - because the next time an attempt is made to sample a site, it could be flowing. Other "tell-tale" signs can be temperature of the sample, or matting around a bulkhead pipe, crack, or stairs. Culvert location markings on a road might help locate a buried culvert on the beach. An unnatural pile of rocks on the beach can hide an outlet pipe.

An interesting side effect of the extensive shoreline work was the increased familiarity of the Health District staff with the residents who live along the Windy Point shoreline. Seeing the Health District actively sampling, photographing, and recording data in field books caused many residents to question the water quality staff and report issues that concerned them. Shoreline survey work helped residents to understand how upland activities affect the shoreline.

## **Other BMP's**

There were four corrections made during the course of the project that were not directly related to OSS failure or livestock waste. The first was the decision by homeowners near the Peterson Drive road end to keep unleashed dogs off of the beach. This was following a door-to-door pet waste education campaign by the Health District. The second took place in June of 2005 when Kitsap County Wastewater Program submitted a list of actions to Ecology that are designed to improve their utility location and excavation practices. This will help prevent future sewage spills into Barker Creek. The third corrective measure was Kitsap County Parks' installation of a concrete pad around their trailer dump site. This will prevent sewage from running onto the ground from the trailer dump during the Kitsap County Fair and other events. Finally, Kitsap

County Parks also paved the parking lot at the Island Lake County Park, in an effort to prevent turbid runoff from entering the lake. This turbid runoff may have contributed to high FC counts taken from the stormwater system that drained parking lot runoff from the park.

## Water Quality Monitoring

### **Best Management Practice Effectiveness (BMPE) Monitoring**

**Table 4** summarizes BMPE monitoring results for the project. These locations offered an opportunity to view a sample set “before and after” the BMP.

BMPE monitoring was performed on the following properties:

123 Avery Lane: When this property was sampled, no water ran onto the property, and turbid water ran off of the livestock area. Flow from this property was sampled once, with a result of 1600 CFU FC/100mL. The property owners voluntarily cooperated with KCD, and installed best management practices to fix the problems. No flows from the property were observed during four visits to the property. This was expected, as a major portion of the improvements on this property were drainage-related.

7017 Tracyton Boulevard: This failure was located on a parcel adjacent to a shoreline survey station.

212 Bucklin Court: This parcel is located adjacent to an investigative station on Hoot Creek. Livestock management practices were improved, using technical and financial assistance from KCD. Livestock were removed in February of 2006, and replaced following BMP improvements. An OSS repair was completed for this property in August, 2007. This may lead to further water quality improvements.

6571 Tracyton: This property had a broken sewage transport line that was leaking into a drainage system that discharged to Windy Point Shoreline. It was repaired soon after being discovered.

**Table 4**  
**Summary of Pre and Post Correction results**  
**for parcels adjacent to sample stations.**

Station Location	Before Correction GMV FC/100ml (# of samples)	After Correction GMV FC/100ml (# of samples)	Type of correction
123 Avery Lane	1600	No more flow	BMP installation
7017 Tracyton Boulevard	1141 (3)	27 (3)	OSS replacement, ATU to drip irrigation drainfield
212 Bucklin Court	92 (23)	55 (16)	Livestock removal and BMP
6571 Tracyton	1090 (3)	46 (2)	Broken sewage transport line

## Trend Monitoring - Stream

Trend monitoring has been conducted in the Barker Creek watershed since February 1996. A summary of the freshwater and marine water results are listed in **Table 5, 6 and 7** below.

**Appendix F** contains data analysis including wet/dry season splits, rainfall correlations, etc.

**Table 5**  
**Freshwater Trend Monitoring (FC) Results**  
**10/01/2004 to 9/30/2007**

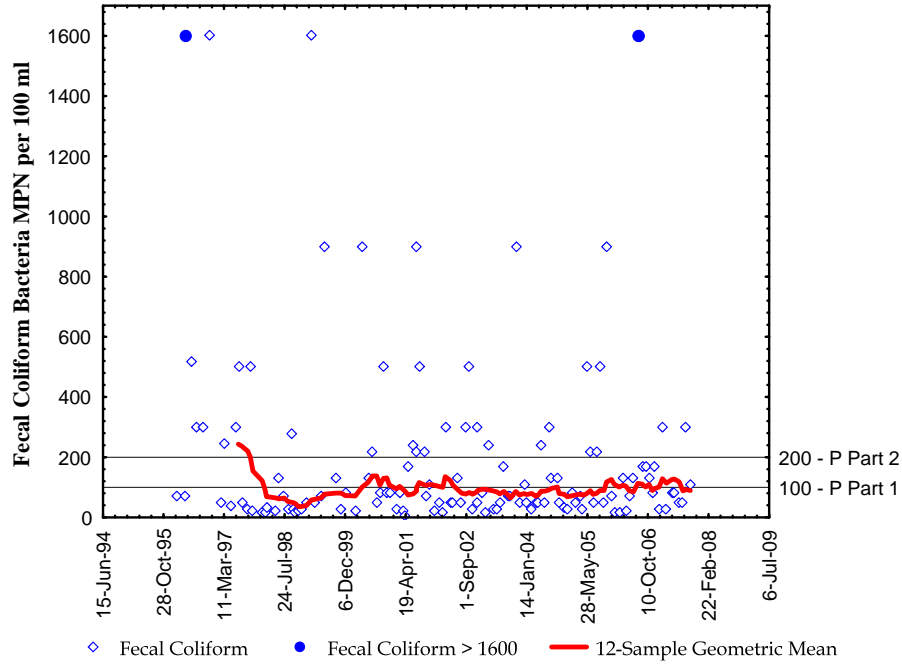
Station	Number of samples	Range (FC/100ml)	GMV (FC/100ml)	% Samples >200FC/100ml	Meets FC Standard?
BK01	36	17- 1601	93	22	No
BK02	36	4 - 1600	115	44	No
BK03	36	4 - 900	64	14	No

**Table 6**  
**Freshwater Trend Monitoring (FC) Results**  
**2005 - 2007 Water Years**

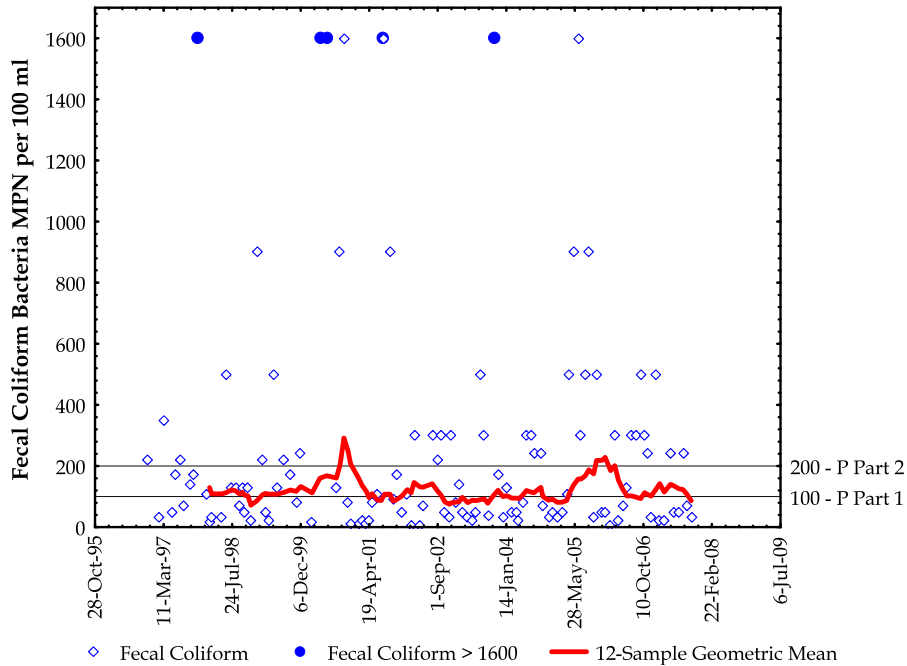
Water Year	Station	Number of samples	Range (FC/100ml)	GMV (FC/100ml)	% Samples >200FC/100ml	Meets FC Standard?
2005	BK01	12	30-500	89	33%	No
	BK02	12	30-1600	188	50%	No
	BK03	11	11-900	81	27%	No
2006	BK01	12	17-1600	101	17%	No
	BK02	12	4-500	93	42%	No
	BK03	12	4-170	53	0%	Yes
2007	BK01	12	30-300	89	17%	No
	BK02	12	23-500	86	42%	No
	BK03	12	17-500	62	17%	No



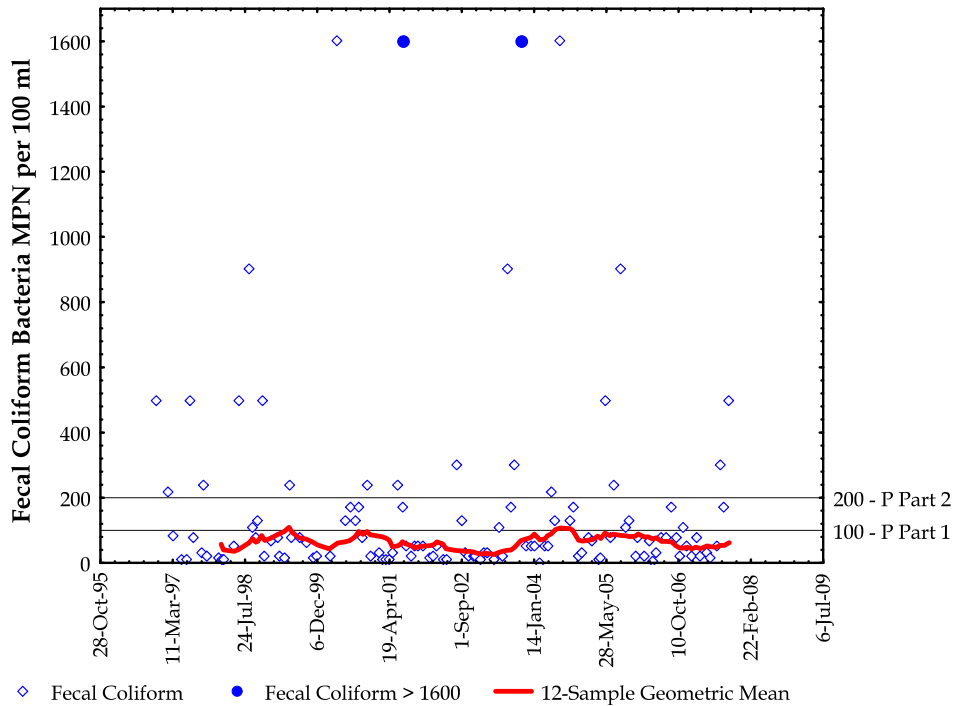
**Figure 4**  
**Fecal Coliform Bacteria Trend Analysis**  
**Barker Creek (Station BK01), 1996 - 2007**  
**Long Term Stationary, Short Term Stationary**



**Figure 5**  
**Fecal Coliform Bacteria Trend Analysis**  
**Barker Creek (Station BK02), 1996 - 2007**  
**Long Term Stationary, Short Term Improving**



**Figure 6**  
**Fecal Coliform Bacteria Trend Analysis**  
**Barker Creek (Station BK03), 1996 - 2007**  
**Long Term Stationary, Short Term Stationary**



As presented in Table 5, stations BK01, BK02 and BK03 fail the state FC standard. BK01 and BK03 met Part 1 of the standard, but failed Part 2 during the project period. BK02 failed both parts of the standard during the project period. However, some good news is apparent when we look at the data water year by water year. As seen in Table 6, when you compare the 2005 water year results with the 2007 water year results, all trend stations are showing some improvement in FC concentrations. BK01 had half as many Part 2 failures in 2007 as it did in 2004, and BK03 had more than a 50% reduction in the FC gmV over this time period. In addition, Figure 5 shows that station BK02 is experiencing a statistically significant short term improving trend.

Appendix F contains a seasonal analysis of the FC data. As you can see, the FC data for each station were separated by dry season (May - September) and wet season (November - April). This analysis indicates that FC levels are significantly higher during the dry season than during the wet season. The reasons for this are not clear.

## Trend Monitoring – Marine

**Table 7**  
**Marine Water Trend Monitoring (FC) Results**  
**10/01/2004 to 9/30/2007**

Station	Number of samples	Range (FC/100ml)	GMV (FC/100ml)	% Samples > 43 FC/100ml	Meets FC Standard?
DY29	30	<2 - 23	3	7%	Yes

Appendix G contains the analysis of the last 30 samples collected at station DY29. This station is located at the mouth of Barker Creek and meets the state marine water FC standard.

### Trend FC and rainfall correlations

FC trend data (October 2004 – September 2007) and previous 24-, 48-, and 72-hour rainfall depths accumulations were analyzed to determine if there was a correlation. FC and rainfall were not correlated. See Appendix F for additional information.

### Impact Monitoring

Freshwater impact monitoring of the Barker Creek watershed began in January 2005. Eight of the stations were located on the main channel of Barker Creek. Five stations were located on Hoot Creek. There were also two stations on Pinsch Creek. Due to the lack of OSS in the Wally Creek area, and low investigative sample results, Wally Creek was not included as an impact station. During the project, 39 impact monitoring events were conducted. The geometric mean of each station is shown in **Table 8**. There is variability in the number of samples, due to seasonality and access issues. Most of the stations had geometric mean values below the water quality standard (100 CFU FC/100mL). The four stations that violated Part 1 of the water quality standard, exceeded the standard by less than 30 CFU FC/100mL. All but three of the stations exceeded Part 2 of the water quality standard, which is consistent with the data for the trend stations. Please note that these data include samples taken during a storm event on November 1, 2005, when most of the sample values were 1600 CFU FC/100mL.

**Table 8**  
**Impact Monitoring (FC) results**  
**6/5/2003 to 8/22/2006**

Station	Number of Samples	Range (FC/100ml)	GMV <sup>1</sup> (FC/100ml)	# Samples >200 FC/100 ml	% Samples >200 FC/100ml	Meets WQ Standard <sup>2</sup>
BRK01	34	8->1600	96	8	24%	NO
BK01	39	<2-1600	101	10	26%	NO
BRK02	39	4-1600	56	11	28%	NO
BRK03	18	2->1600	37	2	5%	YES
BK02	39	17->1600	100	9	72%	NO
BRK04	38	11->1600	104	13	33%	NO
BRK05	38	8->1600	72	5	13%	NO
BRK06	13	13->1600	86	5	38%	NO
BRK07	37	<2-500	10	2	5%	YES
BRK08	38	<2->1600	26	4	11%	NO
BK03	39	<2->1600	76	7	18%	NO
BRK09	37	<2->1600	123	17	46%	NO
BRK10	38	11-1600	94	12	32%	NO
BRK11	33	<2-1600	15	5	15%	NO
BRK12	29	8-500	58	4	14%	NO
BRK13	33	4-900	48	5	15%	NO
BRK14	38	4->1600	71	14	37%	NO
BRK15	38	<2->1600	60	9	24%	NO
BRK16	34	4->1600	55	10	29%	NO
BRK17	18	4->1600	19	1	5%	YES

### Stormwater Impact Monitoring

Kitsap County Surface and Stormwater Management (SSWM) identified a total of 46 stormwater outfalls to fresh surface waters in the Barker Creek watershed during the summer of 2005. Nine outfalls discharge to Island Lake.

Storm event flows were collected from the 37 outfalls that flow to Barker Creek during the 2005-2006 wet season. Sample results for 26 of these outfalls are presented in **Table 9**. Results were not assessed for thirteen of the outfalls, due to lack of data. Data were insufficient due to access issues, or to lack of flow.

FC pollution can be transported by stormwater systems. Also, the sediments in the system may be the source itself due to binding of FC bacteria to fine particles which are then resuspended in stormwater runoff (May and Cullinan, 2005). A positive correlation between stormwater system maintenance (mainly the removal of sediments) and FC levels in stormwater flows was established. Of the 24 outfalls evaluated in 2006, 6 outfalls were a medium priority (GMV >200 FC/100ml) and 4 were high priority (GMV >500 FC/100ml).

Following 2006, the public and private stormwater systems were inspected for proper maintenance according to the Washington State Department of Ecology Stormwater Manual standards (2005). A stormwater system was considered “Deficient” if a criteria was not met. The criteria commonly exceeded was excess sediment in catch basins, stormwater vaults or other water-detaining structures. This criteria was corrected by simple sediment removal using a vactor truck system. Table 8 shows (in highlight) the 10 outfalls of medium and high priority in 2006. All (100%) of the stormwater systems were deemed “Deficient” upon inspection in 2006 whereas 14% (2 of 14) of the low priority outfalls (GMV <200 FC/100ml) were “Deficient” upon inspection.

Educational activities were performed following the 2006 wet season. Educational activities at medium and high priority drainages included a door hanger informing residents of the high FC pollution levels found in their neighborhood stormwater and potential sources (pet waste, failing OSS, and wildlife). Some of the basins with OSS were surveyed. No consistent relationship between the type of sewage management (OSS and sewer) and stormwater FC levels was found. Additionally, after correction of the stormwater deficient areas, FC levels the following wet season during storm event sampling was reduced at half of the outfalls (5 of 10); FC levels increased at 40% of the outfalls (4 of 10), and remained the same at one outfall. However, LMK641 showed marked reductions in FC concentrations (12,846 cfu/100ml to 158 cfu/100 ml) following sediment removal from catch basins and OSS surveys in the neighborhood.

**Table 9**  
**Stormwater Monitoring Results**

Station	Location	2006 GMV (FC/100ml)	2007GMV <sup>1</sup> (FC/100ml)	Sewer or OSS?	Storm Inspection result ?	OSS Survey?
LMK 566	Barker Creek Rd.	25	N/A	OSS	Satisfactory	Yes
LMK 568	Tracyton Blvd (SW)	145	N/A	OSS	Satisfactory	Yes
LMK 569	Tracyton Blvd (SE)	72	N/A	OSS	Satisfactory	Yes
LMK 570	Kitsap County Fairgrounds	344	456	Both	Deficient	No
LMK 571	E. Fairwood pond	455	4	Sewer	Deficient	No
LMK 573	Nels Nelson RD (NE)	10	N/A	OSS	Satisfactory	Yes
LMK 575	Watson Pl. ravine	426	693	Sewer	Deficient	No
LMK 576	Watson Pl. pond	518	1086	OSS	Deficient	No
LMK 565	Silver Ridge Elementary	166	N/A	both	Satisfactory	No
LMK 596	Calypso Ct. pond	516	1601	Sewer	Deficient	No
LMK 597	Tulip Pl. pond	75	113	Sewer	Satisfactory	No
LMK 598	Gladiola Ct. pond	187	620	Sewer	Deficient	No

**Table 9  
Stormwater Monitoring Results (Continued)**

Station	Location	2006 GMV (FC/100ml)	2007GMV <sup>1</sup> (FC/100ml)	Sewer or OSS ?	SSWM Inspected ?	OSS Survey?
LMK 599	Poppy Ct. pond	127	N/A	Sewer	Satisfactory	No
LMK 600	Hoot Cr. Confluence	118	N/A	OSS	Satisfactory	Yes
LMK 602	Huckle Ridge pond	838	456	Sewer	Deficient	No
LMK 603 & 604	Confluence, E. Fairwood Ranch pond	54	N/A	Sewer	Deficient	No
LMK 606	Solnae Pl. pond	426	410	OSS	Deficient	Yes
LMK 607	Timershadow S	373	193	Sewer	Deficient	No
LMK 608	Timbershadow N	N/A	671	Sewer	Deficient	No
LMK 614	Paulson Rd. E	88	N/A	OSS	Satisfactory	Yes
LMK 616	Sigurd Hansen Rd.	89	N/A	OSS	Satisfactory	Yes
LMK 617	Central Valley Rd.	23	N/A	OSS	Satisfactory	Yes
LMK 618	Hoot Creek Channel	133	N/A	OSS	Satisfactory	No
LMK 641	Meadow Ln.	12846	158	OSS	Deficient	Yes
LMK 644	Raven Creek Rd.	330	219	OSS	Deficient	Yes
LMK 695	9300 Nels Nelson Rd.	N/A	35	Sewer	Satisfactory	No

### **Sewer Crossing Impact Monitoring**

A preliminary investigation of sanitary sewer mains as a potential FC source was performed. Sanitary sewer mains cross Barker Creek at Nels Nelson Road, and at Highway 303 (Waaga Way/Bucklin Hill Road). Sanitary sewer mains also cross Hoot Creek at Highway 303. Please see **Table 10** for a summary of the sewer crossing investigation, conducted during August of 2006. Sampling occurred weekly between 6:30 and 7:30 AM, when residents preparing for work and school may maximize water use. Barker and Hoot Creeks were sampled weekly, above and below each sewer main crossing, for FC, EC and ammonia. These data indicate that exfiltration from sewer crossings do not impact Barker Creek. In all three cases, the FC and EC GMV was higher upstream of the sewer line crossing than below.

**Table10  
Sewer Crossing Investigation Results**

Station	Stream	Location of Sewer Main	FC GMV (FC/100ml)	EC GMV (EC/100ml)	NH3 GMV
BK02 below	Barker	Nels Nelson Rd.	119	103.8	.02
BRK04 above	Barker	Nels Nelson Rd.	557	241.6	.02
BK03 below	Barker	Waaga Way/ SR303	153	101.5	.02
BRK12 above	Barker	Waaga Way/ SR303	327	188.0	.01
Hoot below	Hoot	Waaga Way/ SR303	268	75.6	.03
Gemmer above	Hoot	Waaga Way/ SR303	671	173.8	.03

### Island Lake Impact Monitoring

The Health District conducted limited monitoring of the stormwater outfalls to Island Lake. This monitoring served to support the inclusion of upland OSS parcels into the project area.

The results of the offshore study of Island Lake are summarized in **Table 11**. FC and EC geomean values for all five samples met the water quality standard. These samples were taken during January and February, when water levels were high in the lake, and flow into the Barker Creek channel was evident. These data, in addition to direct observations made during surveys, contradict community concerns about widespread flooding of lakeside drainfields. This data also indicates that any contamination from Island Lake does not enter Barker Creek.

**Table 11  
Island Lake Offshore Study Monitoring Results**

<b>Station</b>	<b>Location</b>	<b>FC GMV (FC/100ml)</b>	<b>EC GMV (EC/100ml)</b>
BRK19	Outflow to Barker Creek	2	1.2
IS01	South end, Island Lake Camp	3	3.1
IS02	East end, Bioswale at old boat ramp	1	1.6
IS03	North end, Island Lake County Park	7	6.3
Basin	Deepest part of lake, per Health District GPS coordinates.	2	2.0
IS04	West End, dock at 12844 Lake Avenue	5	3.2

**Educational Activities**

Educating homeowners on proper septic system operation and maintenance was a primary focus of the Barker Creek Project. Health District staff provided homeowners with educational brochures, a copy of the sewage disposal permit, and/or as-built Health District OSS plans for their home. Health District staff emphasized to homeowners that proper operation and maintenance is crucial to prevent premature septic system failures, and for protecting water and shellfish quality along the Barker Creek shoreline.

During the OSS inspection, the Health District staff shared site-specific ideas on how to get the most life out of the septic system. Any practice that might degrade the performance was pointed out, with possible solutions.

The “kick-off” public meeting with The Kitsap County Department of Community Development (DCD), the Health District, and the Kitsap Conservation District was held on September 28<sup>th</sup>, 2004, with 55 people attending. The Health District presented water quality data showing a FC pollution problem in the Barker Creek watershed, and explaining the pollution identification and correction process.

One Health District-sponsored educational workshop was conducted on December 3<sup>rd</sup>, 2005. Thirteen people attended this pond workshop. This workshop was designed to inform residents about pond maintenance to reduce FC loading in sediments that traveled to Barker Creek. There are many ponds in the Barker Creek watershed. Ponds can be a reservoir for FC-contaminated sediments, and a haven for undesirable wildlife. Representatives of eight different agencies were available to answer questions about topics including pond permitting, aquaculture, wildlife, and pond restoration. The Health District also gave a brief project update, which included a small homeowner septic portion where homeowners had an opportunity to seek help on specific issues that they felt hindered the performance of their OSS.



The Health District organized a third public meeting for shoreline residents of Island Lake on May 10, 2006. Lake trophic states, waterfowl, pet waste, and OSS maintenance were discussed during this meeting. Fifteen people attended this meeting. KCD did not attend this meeting.

Both the meetings and the workshop contained educational material on OSS maintenance. Brochures were made available, and Health District staff answered questions about OSS operation and maintenance.

In addition to these educational activities, the Health District and KCD attended a mobile homeowners' association meeting. About thirty people attended this meeting. This meeting stressed the importance of pet waste removal, wildlife feeding avoidance, and native plantings in wet areas. OSS was not discussed because sanitary sewer served this community.

Health District staff assisted local 4-H leaders by providing information about livestock and bacterial hazards for local 4-H groups. A representative of the Health District helped judge 4-H posters pertaining to bacteria and handwashing on August 18, 2006. These posters were for display at the Kitsap County Fair in 2006.

## **6.0 CONCLUSIONS**

The findings of the Barker Creek Watershed Restoration Project were:

- The purposes of the project, as outlined in Section 1 of the Quality Assurance Project Plan (QAPP) have been achieved. First, the public was involved in three community meetings, and received technical assistance on water quality and on-site sewage system issues. Second, eleven FC sources were identified during the project, including 9 failing on-site sewage systems, one inadequate trailer dump station, and 1 pet waste violation. All of these have been corrected.
- All stream trend monitoring stations are showing some improvement. The mouth station (BK01) had half as many Part 2 (state FC standard) violations in 2007 as it had in 2004. Station BK02 FC levels are dropping over the last three years [statistically significant improving trend (short term)]. Station BK03 FC levels have dropped by 50% since 2004. The marine station at the mouth of Barker Creek currently meets the state FC standard with a stationary trend.
- Stream FC data analysis shows that there is no correlation between FC and rainfall depths (24, 48 or 72). In addition, FC levels are typically higher in the dry season than in the wet season. The best theory to explain this is less dilution during the summer months and continuous "sluffing" of bacteria from the sediments into the water column.
- Project success was also achieved through close cooperation between the Health District and its Kitsap Conservation District partner on this project.
- Age of the on-site sewage system, and proximity to wet areas, were the primary reasons for OSS failure in the project area.

- Livestock waste does not appear to be a significant source of FC pollution for Barker Creek at this time. Watershed residents are encouraged to follow Kitsap Conservation District recommendations on proper waste handling.
- Ten of the 24 sampled stormwater outfalls exceeded the 200 CFU FC/100mL investigational level listed in the PIC Protocols in 2007. All ten drainage basins were in need of stormwater system maintenance (mainly sediment removal); whereas only 14% (2 of 14) of the drainage basins with low FC levels had deficient stormwater systems.
- There is no evidence that widespread drainfield flooding has led to FC contamination of Island Lake. Flooding of drainfields was only possible in 3 of the thirteen lakeside drainfields. No flooding was observed during this project. FC data gathered throughout Island Lake showed low levels of FC and EC bacteria.
- The percentage of property owners who either denied access, or could not be contacted, was high as compared to other projects. The Health District must continue to foster trust and develop innovative approaches for encouraging project support and participation.
- In the past, the Barker Creek area was a rural residential area, where most of the parcels were platted and developed prior to existing OSS regulations. The natural physical conditions of the area including surface and ground water conditions and soil types/depths are not ideal for the function of “standard gravity” OSS. Though many of these older systems remain functional, development of the surrounding upland parcels has increased the runoff to the streamside parcels, carrying polluted stormwater and degrading the ability of the area for OSS operation.
- The final OSS failure rate was 2% (9 failures) within the Barker Creek watershed. Eight of these were located on waterfront streamside or lakeside parcels.
- The large sewage spill in June of 2005 may have made water quality improvements difficult to detect. Most corrections were made during the final year of the project. The impact of these corrections may not be evident until after this report is completed.
- The majority of the repairs conducted were on older systems, which were installed when the existing regulations allowed drainfield placement in conditions now known to be problematic. The Barker PIC surveyed 168 gravity OSS that were 30 years or older, yet passed the survey inspection and or dye tests. Owners of these systems must treat them carefully to extend their useful life. They should also start financial planning for their eventual replacement.

## **7.0 RECOMMENDATIONS**

Based upon the conclusions of the Barker Creek Watershed Restoration Project, the Health District’s Water Quality Program offers the following recommendations.

- The Health District will continue to be involved in the Barker Creek and the Windy Point shoreline. Involvement will be through complaint response, trend monitoring, and follow-up of operation and maintenance (O&M) reports submitted to the District.
- Local residents are encouraged to continue to be proactive in OSS maintenance.
- The Health District should monitor the stormwater leaving the Island Lake boat ramp, to see whether paving the parking lot decreased the FC counts entering Island Lake.
- The Health District will further investigate the three agricultural properties with possible water quality violations. If water quality violations can be proven, enforcement will require residents to implement the advice already given by KCD.
- The Health District recommends conducting future shoreline surveys along Windy Point to look for new FC sources.

## **8.0 REFERENCES**

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**APPENDIX A.**

**HISTORICAL TREND RESULTS FOR BARKER CREEK WATERSHED MONITORING  
STATIONS**

**Table 1**  
**Class A Fresh Water Stream Fecal Coliform (FC) Results**  
**Dyes Inlet Watershed**  
**October 01, 2003 - September 30, 2004**

Station	Number of Samples	Range (FC/100ml)	GMV <sup>1</sup> (FC/100ml)	# Samples > FC/100ml	% Samples > 200 FC/100 ml <sub>2</sub>	Meets WQ
BK01	11	30 – 900	99	3	<b>27%</b>	<b>NO</b>
BK02	11	23 – ≥ 1600	124	4	<b>36%</b>	<b>NO</b>
BK03	10	2 – ≥ 1600	92	3	<b>30%</b>	<b>NO</b>

<sup>1</sup> Geometric mean value

<sup>2</sup> Class A. FC levels shall not exceed a GMV of 100 FC/100 ml and not have more than 10% of all samples exceed 200 FC/100 ml.

**Table 2**  
**Fresh Water Stream Fecal Coliform (FC) Results**  
**Barker Creek (BK01), Water Years 1996-2003**

Water year	Number of Samples	Range (FC/100ml)	GMV <sup>1</sup> (FC/100ml)	# Samples > 200 FC/100ml	% Samples > 200 FC/100ml	Meets WQ Standard <sup>2</sup>
96	5	70 - ≥1600	268	4	67%	No
97	8	30 - ≥1600	143	4	38%	No
98	10	17 - 500	54	2	20%	No
99	10	14 - 1600	79	2	20%	No
00	8	23 - 900	93	2	25%	No
01	13	8 - 900	121	6	46%	No
02	12	17 - 500	83	3	25%	No
03	12	17 - 300	65	2	17%	No

Shaded entries indicate an exceedance of the applicable water quality standard (Chapt.173 - 201A-030 WAC)

<sup>1</sup> Geometric mean value

<sup>2</sup> State FC Standard- FC levels shall not exceed a GMV of 100FC/100ml and not have more than 10% of all samples exceed 200 FC/100 ml.

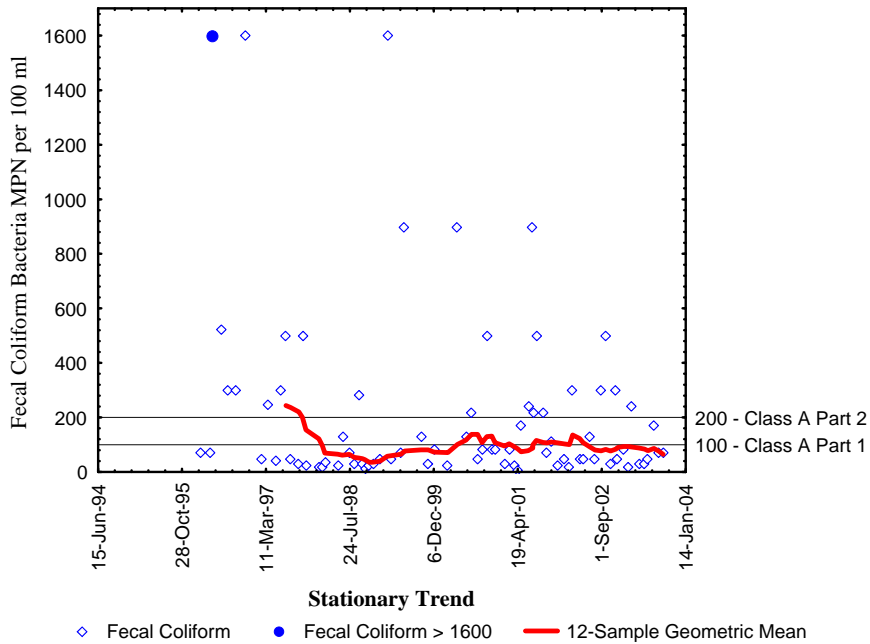
**Table 3**  
**Conventional Water Quality Parameters**  
**Sample Results for Barker Creek (BK01) Mouth Station 2003 Water Year**

Parameter	State Standard <sup>1</sup>	Range	# of Samples Meeting Standard	% Meeting Standard
Turbidity	N/A <sup>2</sup>	0.6 - 6.2 NTU	N/A <sup>2</sup>	N/A <sup>2</sup>
Temperature	≤18° C	5.0 - 13.5° C	12 of 12	100%
pH	6.5 - 8.5 units	7.4 - 8.4 units	12 of 12	100%
Dissolved Oxygen	> 8.0 mg/L	10.0 - 12.7 mg/L	12 of 12	100%

<sup>1</sup>Water quality standards are established in Chapt.173 - 201A-030 WAC.

<sup>2</sup>See introduction for discussion on limitations of the Health District's turbidity data.

**Figure 1**  
**Fecal Coliform Bacteria Trend Analysis**  
**Barker Creek (Station BK01), 1996-2003**



<sup>1</sup> **Bold** and shaded entries indicate an exceedance of the applicable water quality standard (Chapt. 173-201A WAC)

<sup>2</sup> Geometric mean value

# **APPENDIX B**

## **OSS RATING CATEGORIES**



**CRITERIA FOR RATING OSS INSPECTION RESULTS**

<b>Rating Classification</b>	<b>Criteria for Meeting Classification<sup>1</sup></b>
<b>No Apparent Problems<sup>1</sup></b>	<ul style="list-style-type: none"> <li>• <b>Completed/signed</b> Sewage Disposal Permit on file at Health District, or available from owner.</li> <li>• No illegal repairs or alterations have been performed on OSS.</li> <li>• All applicable setbacks and conditions in effect at the time of permitting are in place.</li> </ul>
<b>No Records<sup>1</sup></b>	<ul style="list-style-type: none"> <li>• No <b>completed/signed</b> Sewage Disposal Permit on file at the Health District, or in possession of the owner/occupant .</li> <li>• No Non-Conforming, Suspect or Failure criteria were observed .</li> </ul>
<b>Non-Conforming<sup>2</sup></b>	<ul style="list-style-type: none"> <li>• Repairs or alterations have been performed on OSS without a permit</li> <li>• Additional bedrooms have been added to the home (or business) without a permit.</li> <li>• Non-conforming conditions exist (such as insufficient setbacks from surface waters or wells, no reserve area, vehicular traffic on drainfield).</li> </ul>
<b>Suspect<sup>2</sup></b>	<ul style="list-style-type: none"> <li>• Drainfield area is saturated.</li> <li>• Collected water sample results from bulkhead drains, curtain drains, or other pipes or seeps, at or above 500 FC/100 ml. <b>and</b> negative dye-test.</li> <li>• Collected water sample results from bulkhead drains, curtain drains, or other pipes or seeps, less than 500 FC/100 ml. <b>and</b> positive dye-test.</li> </ul>
<b>Failure<sup>2,3</sup></b>	<ul style="list-style-type: none"> <li>• Sewage backing up into, or not draining out of a structure caused by slow soil absorption of septic tank effluent.               <ul style="list-style-type: none"> <li>• Sewage leaking from a septic tank, pump tank, holding tank, or collection system.</li> <li>• Surfacing sewage in a documented drainfield area.</li> </ul> </li> <li>• Collected water sample result from bulkhead drains, curtain drains, or other pipes or seeps, at or above 500 FC/100 ml. <b>and</b> positive dye-test results.</li> <li>• Straight discharge (gray or blackwater) from any indoor plumbing is observed and documented.</li> </ul>

<sup>1</sup> All of the criteria in each rating classification must be met.

<sup>2</sup>One of the criteria must be met.

<sup>3</sup> As defined in the Kitsap County Board of Health Rules and Regulations Governing On-Site Sewage, 1996-8.

# **APPENDIX C**

**INTERLOCAL AGREEMENT WITH KITSAP CONSERVATION DISTRICT**

# MEMORANDUM OF AGREEMENT

## BETWEEN KITSAP COUNTY HEALTH DISTRICT AND KITSAP CONSERVATION DISTRICT

### CONCERNING INVESTIGATION AND CORRECTION PROCEDURES FOR LIVESTOCK WASTE HANDLING VIOLATIONS

**1.0 Purpose and Applicability.** This Memorandum of Agreement (hereinafter referred to as the “Agreement”) is between the Kitsap Conservation District (hereinafter referred to as the “Conservation District”) and the Kitsap County Health District (hereinafter referred to as the “Health District”). Recognizing the need to carry out the responsibilities for which each is charged under State law and under the Kitsap County Surface and Storm Water Management Program, the Conservation District and the Health District consent to enter into this Agreement. This Agreement serves as the foundation for an enduring, cooperative working relationship for the purpose of protecting public health, improving water quality, and promoting agriculture stewardship through the investigation, identification and correction of inadequate livestock waste handling practices that are found to be causing a nuisance or menace to health. For the purposes of this agreement, livestock waste sources are typically manures generated by animals that are stabled, pastured, or otherwise managed, whether for private or business reasons. In addition, a “nuisance or menace to health” includes but is not limited to the pollution of water, harboring of rodents and breeding of flies. Pollution of water is defined as violations or exceedances of Washington State Surface Water Quality Standards (Chapter 173-201A WAC, as amended) or Ground Water Quality Standards (Chapter 173-200 WAC, as amended).

This Agreement specifically addresses the Health District’s investigative response procedures and technical assistance referrals to the Conservation District related to livestock waste handling practices. Through this Agreement, inadequate livestock waste handling practices will be investigated by the Health District in response to public complaints or as part of a Pollution Identification and Correction project (hereinafter referred to as “PIC project”) undertaken by the Health District.

**2.0 Background.** The Conservation District is a non-regulatory agency that works cooperatively with landowners under guidelines established by the Washington State Conservation Commission (Chapter 89.08 RCW) and standards established by the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service. The Conservation District compiles farm status inventory information from targeted areas, and prioritizes agricultural operations based on standardized rating criteria. The Conservation District provides technical assistance to small farm owners and develops Farm Plan elements specifically designed and implemented to provide best management practices (BMP) for land supporting livestock or under cultivation. These BMPs address the potential loss of protective vegetation adjacent to streams, severe soil erosion, and pollution of ground and surface water by manure and agricultural chemicals.

The Health District is responsible for regulating animal waste handling under the authority provided in Bremerton-Kitsap County Board of Health Ordinance 2000-6, “Solid Waste Regulations”, (Solid Waste Regulations) as amended. These regulations provide minimum

standards for the safe handling of animal wastes, including, but not limited to, manure, dead animals, and agricultural wastes. The Health District coordinates with the Conservation District when conducting PIC projects or responding to complaints involving livestock wastes.

**3.0 Livestock Waste Handling Complaint Response Procedures.** The Health District and the Conservation District agree to undertake the following steps to respond to complaints of inadequate livestock waste handling practices filed with the Health District.

- 3.1 The Water Quality Program (WQ) will respond to livestock waste handling complaints. The only exceptions are complaints where livestock waste handling is one of multiple alleged violations. The Solid & Hazardous Waste Program will respond to these complaints utilizing their own procedures, which do not require notification to KCD that a violation has occurred.
- 3.2 An assigned WQ staff person will make an initial phone call to the complainant to verify information related to the complaint and, if needed, to collect additional information needed to respond to the complaint. Next, the Health District will conduct a site visit to confirm the livestock waste handling violation. In order to document a violation, the Health District must collect evidence (surface and/or drinking water samples, photographs, etc.) that livestock handling practices are creating (or may create) a “nuisance or menace to health” through the pollution of water (surface or ground water), harboring of rodents, or breeding of flies, etc. If a violation is confirmed, the Health District will present the collected findings to the landowner and refer them to the Conservation District for the development and implementation of a Waste Management Plan (WMP).
- 3.3 If the disposition of the livestock waste does not represent an imminent threat to public or environmental health (e.g., contamination of drinking water, the potential for direct public contact with contaminated runoff, contamination of shellfish resources, potential impacts to endangered species), the Health District will ensure correction of the violation in one of two ways:

#### Compliance Agreement

The landowner signs a “Compliance Agreement” with the Health District. The Compliance Agreement carries the full force and effect of an NOCV and establishes a timeline for the correction of the violation and development and implementation of the WMP. The landowner is responsible for contacting the Conservation District within ten (10) days, and the violation must be corrected within thirty (30) days. If one or both of these tasks is not completed within the specified time frames, the Health District will proceed to Section 3.6. If both of these items are complied with, the Health District will proceed to Section 3.5.

### Verbal Agreement

If the landowner has demonstrated a strong level of commitment and ability to correct the violation, the Health District may reach a verbal agreement with the landowner regarding correction of the violation and development of a WMP with the Conservation District. This verbal agreement will be formalized with a letter from the Health District specifying the agreement and associated timelines – the Conservation District will receive a copy of this letter. The landowner is responsible for contacting the Conservation District within ten (10) days, and the violation must be corrected within thirty (30) days. If one or both of these tasks is not completed within these time frames, a Notice and Order to Correct Violation (NOCV) letter will be sent (as specified in Section 3.4). If both of these items are complied with, the Health District will proceed to Section 3.5.

- 3.4 If the landowner is uncooperative in taking corrective actions to eliminate the livestock waste violation, or if the disposition of the livestock waste represents an imminent threat to public or environmental health, the Health District will send the landowner a Notice and Order to Correct Violation (NOCV) letter. The letter will be sent by certified mail requesting that they contact the Conservation District within ten (10) working days of receipt of the NOCV, and that corrective actions be made within thirty (30) working days of receipt of the NOCV. (BKCHD may require a shorter compliance period for completion of corrective actions if circumstances require it). In addition to including all items required in the Solid Waste Regulations, the NOCV will explain the nature of the complaint and document the public health nuisance associated with current livestock waste handling practices.
- 3.5 If, after receiving the Health District letter, the landowner completes the corrective actions within the specified time frame and agrees to work with the Conservation District on the development and implementation of a WMP, the complaint will be suspended pending completion of the Draft WMP. The Health District will have an opportunity to review the Draft WMP to confirm that it will prevent the livestock waste handling problem from occurring in the future. Once the WMP is finalized, the complaint and the Health District enforcement response will be suspended pending implementation of the WMP.
- 3.6 If, after receiving the Health District's certified letter, the landowner fails to correct the violations within the specified time period, or fails to contact the Conservation District within 10 working days of receipt of the certified letter, the Health District will issue a civil infraction notice as specified in the Solid Waste Regulations.
- 3.7 The Health District will terminate all complaints for cooperative landowners after verifying that the violations have been corrected. Verification will require a written notice from the Conservation District that the Waste Management Plan has been implemented, a Health District field inspection, and water quality monitoring (if feasible or necessary).

3.8 The Health District may refer owners of properties with potential livestock waste handling violations to the Conservation District by sending a copy of a letter to the landowner detailing the potential sources and recommending that they contact the Conservation District within ten (10) working days. A “blind” copy of the letter will be sent to the Conservation District for their reference. The Conservation District will notify the Health District when the landowner has made contact with them. If the landowner contacts the Conservation District within ten (10) days, the Health District will postpone its investigation pending development and implementation of a WMP and elimination of the potential source(s). However, if the landowner is uncooperative in taking corrective actions and does not contact the Conservation District within this time frame, the Health District will initiate an investigation.

3.9 The Health District may refer owners of properties that have no proven or suspected livestock waste handling violations to the Conservation District. These will not be considered formal referrals to the Conservation District and they are not required to notify the Health District if contact is made.

**4.0 Livestock Waste Handling PIC Procedures.** The Health District and Conservation District use procedures specified in both Section 3.0 of this document and the Health District’s “Manual of Protocol: Fecal Coliform Bacteria Pollution Identification and Correction Projects” (Version Eight, January 1999 or subsequent revisions) to correct livestock waste handling violations in PIC areas. However, due to the fact that the express purpose of a PIC project is to address bacterial contamination of surface waters (which can subsequently lead to contamination of ground waters), the Health District and the Conservation District will place highest priority on sites where animal waste management practices are causing surface and/or ground water pollution.

**5.0 Indemnity.** The Health District agrees to hold the Conservation District, its agents, officers and employees, harmless for all losses, claims and damages caused by the sole negligence of the Health District, its agents, officers and employees which arise directly or indirectly out of or in consequence of the Health District’s or its agents’ or officers’ or employees’ performance under this Agreement. The Conservation District agrees to hold the Health District, its agents, officers and employees, harmless for all losses, claims and damages caused by the sole negligence of the Conservation District, its agents, officers and employees which arise directly or indirectly out of or in consequence of the Conservation District’s or its agents’ or officers’ or employees’ performance under this Agreement.

**6.0 Dispute Resolution.** The parties to this agreement shall first attempt to resolve disputes informally at the staff level. In the event that the dispute cannot be resolved informally at the staff level, a dispute resolution procedure shall be followed. Each party to this agreement shall appoint one member to the Dispute Board. The members so appointed shall jointly appoint an additional member to the Dispute Board. The Dispute Board shall review the facts, terms, and applicable statutes and rules and make a determination of the dispute. The determination of the Dispute Board shall be binding on parties hereto. Each party to this agreement shall be responsible for paying for its own costs resulting from a

dispute. Any additional costs resulting from resolution of a dispute shall be shared equally by both parties.

**7.0 Modifications of this Agreement.** Modifications to this Agreement shall only be made in writing and with the written consent of both parties.

**8.0 Review of the Agreement.** The parties agree to review the Agreement, its provisions and procedures at least once each year. The review will consist of a meeting of the parties, or their designated representatives, whether by telephone or otherwise to review and evaluate the continued necessity of the Agreement and to recommend any modifications thereto.

**9.0 Termination.** This Agreement will continue in full force and effect until such time as it is terminated by one of the parties. Either party can terminate this Agreement by notifying the other party in writing at least thirty (30) days in advance of such termination.

**10.0 Signatures.** The undersigned representatives accept the provisions of this Agreement. This Agreement shall be in effect when signed by both parties.

KITSAP CONSERVATION DISTRICT

KITSAP COUNTY  
HEALTH DISTRICT

\_\_\_\_\_  
Sharon Call  
Chair, District Board of Supervisors

\_\_\_\_\_  
Scott W. Lindquist, MD, MPH  
Director of Health

\_\_\_\_\_  
Date

\_\_\_\_\_  
Date

# APPENDIX D

## MONITORING STATION LISTS



**Barker Creek Watershed Monitoring Station Location Descriptions  
Trend and Impact Sampling in Barker Creek Watershed**

Station ID	Stream Type	Type	Location Description	GPS Coordinates
BRK01	Stream Type	Impact	Tracyton Blvd Barker Creek crossing	47.63723° N, 122.67126° W
BK01	Main Channel	Trend & Impact	Barker Creek Road culvert crossing	47.63950° N, 122.66732° W
BRK02	Main Channel	Impact	Tributary at bridge behind garage Private residence End of Barker Creek Road	47.63973° N, 122.66538° W
BRK03	Tributary (Pinsch Creek)	Impact	Raven Creek Drive (unpaved) culvert crossing	47.63897° N, 122.66372° W
BK02	Tributary (Pinsch Creek)	Trend & Impact	Nels Nelson Road crossing culvert	47.64188° N, 122.66089° W
BRK04	Main Channel	Impact	Creekside Lane bridge	47.64311° N, 122.65906° W
BRK05	Main Channel	Impact	Creekside Lane footpath bridge	47.64298° N, 122.65901° W
BRK06	Tributary	Impact	Huckle Ridge Townhouses	47.64452° N, 122.66236° W
BRK07	Tributary	Impact	Nels Nelson / Bucklin Hill Rd intersection Downstream of sewer lift station	47.65058° N, 122.66058° W
BRK08	Tributary	Impact	659 Bucklin Hill Road Footbridge on tributary from pond	47.64921° N, 122.65947° W
BK03	Tributary	Trend & Impact	Bucklin Hill Road Crossing	47.65027° N, 122.65787° W
BRK09	Main channel	Impact	Silver Creek Meadows Mobile Home Park - Inflow Bucklin Hill Road	47.64901° N, 122.65448° W
BRK10	Tributary (Hoot Creek)	Impact	Silver Creek Meadows Mobile Home Park -Outflow at Footbridge	47.64827° N, 122.65725° W
BRK11	Tributary (Hoot Creek)	Impact	Intersection of Nels Nelson and Waaga Way culvert crossing	47.65172° N, 122.66123° W
BRK12	Tributary	Impact	Joyce's Barber Shop 574 NW Bucklin Ct	47.65124° N, 122.65737° W
BRK13	Main Channel	Impact	Paulson Road culvert Crossing	47.65774° N, 122.65163° W

**Barker Creek Watershed Monitoring Station Location Descriptions  
Trend and Impact Sampling in Barker Creek Watershed  
(Continued)**

Station ID	Stream Type	Type	Location Description	GPS Coordinates
BRK14	Tributary (Hoot Creek)	Impact	Sigurd Hansen Road culvert	47.66675° N, 122.65097° W
BRK15	Tributary (Hoot Creek)	Impact	855 Sigurd Hanson Rd Puhn rental	47.66679° N, 122.65887° W
BRK16	Main Channel	Impact	Walker Road crossing culvert	47.66861° N, 122.65093° W
BRK17	Tributary (Hoot Creek)	Impact	Walker Road residence at end of road Ponds- headwaters of Barker Creek	47.67178° N, 122.65801° W

**Barker Creek Watershed Restoration Project****Stormwater Monitoring Stations**

<b>Outfall ID</b>	<b>Latddd</b>	<b>Longddd</b>	<b>DIAM</b>	<b>Material</b>	<b>FieldComm</b>
LMK566	47.63748334	-122.6716167	12	CMP	Cross culvert under Barker Ck Rd from ditch on Tracyton Blvd north of creek.
LMK568	47.63658333	-122.6713333	8888	Ditch	Ditch on the southwest side of creek on Tracyton Blvd.
LMK569	47.6368	-122.6712333	8888	Ditch	Ditch on opposite side of road as LMK568. Has flow, but too little to sample.
LMK570	47.63491669	-122.6629333	24	CMP	Two outfalls from north of Fairgrounds Pavilion pond and swale. The east standpipe outfall is abandoned.
LMK571	47.63953336	-122.6582333	12	CMP	Outfalls from pond at end of Winchester Ct. Two pipes, upstream one has flow. Pond #322
LMK573	47.64239998	-122.6611333	12	CMP	Outfall at Nels Nelson Rd, newer culvert. Drains northeast side ditch line to creek.
LMK575	47.64421666	-122.6489167	12	CMP	Outfall from two catch basins which collect stormwater from Watson Ct between Central Valley Rd and where circle begins.
LMK576	47.64538333	-122.6449667	18	RCP	Outfall from SSWM pond at head waters of creek trib.
LMK596	47.65883331	-122.6610667	18	CMP	Outfall from pond at the corner of Calypso Cr and Pocus Pl. Could not find the end of the pipe. Sampled from the control structure. Pond #112
LMK597	47.66148332	-122.6612167	18	CMP	Outfall from pond with access from the end of Tulip Pl. Pond #126.
LMK598	47.66283334	-122.6609333	12	ADS	Outfall from pond at end of Gladiola Ct. Flow too little to sample. Pond #180
LMK599	47.66395003	-122.66095	12	CMP	Outfall from pond at end of Poppy Ct (also accessible from Gladiola Ct access road). Pond #426
LMK600	47.65014998	-122.6543333	36	CMP	Two pipes: Drainage from State DOT pond and ditch coming from east along Bucklin Hill Rd and another ditch from the west. Next to mailbox for 4
LMK602	47.64329999	-122.6616833	24	CMP	Downstream of Huckle Ridge development. Feeds into trib from unmaintained pond behind sewer lift station on Nels Nelson Rd.
LMK603	47.63988336	-122.6589666	12	CMP	Ground water seep and perforated pipe curtain drain below two CMP's pipes. Not enough flow to sample. Outfall from west pond #323 near LMK57
LMK604	47.63988336	-122.659	24	CMP	Pond(s) overflow from above LMK603.
LMK606	47.64309998	-122.65475	24	CMP	Pond outlet across the street from "Castle" house with shed at 411 Solnae Pl. Pond #305
LMK607	47.6698	-122.6622167	12	CMP	Outfall is next to man hole near lift station. Outfall from pond #23 at the end of very long access road just north of Monterey Ct.
LMK608	47.67041664	-122.6621333	12	CMP	North end outlet from same pond #23 as LMK607.
LMK614	47.65808334	-122.6514	8888	Ditch	Drains Central Valley Rd north of Paulson Rd in to trib (Hoot Ck).
LMK616	47.66681665	-122.6508666	8888	Ditch	Sigurd Hanson Rd ditch captures some ditching on Central Valley. Flows into Hoot Ck.
LMK617	47.67664998	-122.6496333	12	RCP	Central Valley cross culvert at 12511 (Roadhouse Nursery), it is ditched around to lower end of pond on property. Pond is the year-round headwater
LMK618	47.67958336	-122.6509333	24	ADS	Large pipe from ditch up the road, smaller pipe collects more water (according to resident) from a drain in a nearby field.
LMK641	47.64413331	-122.6526	12	CMP	Outfall from catch basin at end of Meadows Ln, ditched down hill towards trib to creek.
LMK644	47.63893331	-122.6636167	8888	Ditch	Ditch from small private pond below Raven Creek Dr, also collects from curtain drains of upper homes.
LMK695	47.64763336	-122.6586667	8888	Swale	Outfall from pond (dry) at Central Kitsap Presbyterian Church. Pond flows to swale and out towards creek. Private pond needs maintenance, unable

**Barker Creek Watershed Restoration Project, Island Lake Stations**

<b>Station ID</b>	<b>Monitoring Type</b>	<b>Station Description</b>	<b>GPS</b>
<b>BRK19</b>	Island Lake FC+EC	Barker Creek inflow at Christa Camp. South of weir near cedar tree and bathhouses. Flows during wet winters when Island lake overflows into Barker Creek.	47.67695° N 122.66060° W
IS01	Island Lake FC+EC	Near bridge to Christa Camp Wetland	47.67897° N 122.66031° W
IS02	Island Lake FC+EC	Just north of "old boat ramp" offshore of undev. parcel south of LMK 621	47.68239° N 122.65806° W
IS03	Island Lake FC+EC	Lines up with footbridge crossing Stream north of swimming beach, (LMK 613)	47.68530° N 122.65911° W
IBasin	Island Lake FC+EC	Island lake basin (deepest part) location based on most recent GPS coordinates. Between park dock and island.	47.68176° N 122.66062° W
IS04	Island Lake FC+EC	N. of Lake Avenue culvert (LMK 609). Near poorly maintained dock	47.68129° N 122.66321° W

# **APPENDIX E**

WINDY POINT SHORELINE SURVEY DATA

## Windy Point Shoreline Surveys

Location	Survey One				Survey Two				Survey Three				Survey Four				Survey Five				notes	
	#	Date	FC/100ml	Confirm	#	Date	FC/100ml	Confirm	#	Date	FC/100mL	Confirm	#	Date	FC/100ml	Confirm	#	Date	FC/100mL	Confirm		
Barker Cr.	1	9/8/04	170		1	02/01/05	25		1	02/16/06	8		1	1/24/07	SCC		1	5/21/2007			Confirmations not necessary	
80		9/8/04	dry			02/01/05	dry			02/16/06	dry		22	1/24/07	dry			5/21/2007	dry			
seep 1		9/8/04	dry		24	02/01/05	4			02/16/06	dry		20	1/24/07	2			5/21/2007	dry			
760-		9/8/04	dry		28	02/01/05	30			02/16/06	dry		21	1/24/07	2			5/21/2007	dry			
seep 2		9/8/04	dry			02/01/05	dry		24	02/16/06	17			1/24/07	dry			5/21/2007	dry			
7137		9/8/04	dry		22	02/01/05	<2			02/16/06	dry		19	1/24/07	<2			5/21/2007	dry			
7135 & 7139	2	9/8/04	300	900	21	02/01/05	50		28	02/16/06	80		18	1/24/07	SCC	80	10	5/21/2007	SCC	240		3 negative dye tests
N. of 7153		9/8/04	dry		20	02/01/05	350	80	22	02/16/06	2		17	1/24/07	2			5/21/2007	dry			
7158		9/8/04	dry			02/01/05	dry		21	02/16/06	1601	500	16	1/24/07	500	70	8	5/21/2007	170			Suspicious negative dye test.
716-		9/8/04	dry		19	02/01/05	1500	50		02/16/06	dry		15	1/24/07	1600	130	7	5/21/2007	8			
S. of 7161		9/8/04	dry		18	02/01/05	130			02/16/06	dry			1/24/07	dry			5/21/2007	dry			
N. of dock	3	9/8/04	80		17	02/01/05	4			02/16/06	dry		14	1/24/07	50			5/21/2007	dry			
S. of dock	4	9/8/04	220	30	16	02/01/05	?			02/16/06	dry		13	1/24/07	4			5/21/2007	dry			
65	5	9/8/04	15		15	02/01/05	4			02/16/06	dry		12	1/24/07	<2		6	5/21/2007	2			
70-7		9/8/04	N/A			02/01/05	N/A		15	02/16/06	4			1/24/07	dry			5/21/2007	dry			pipe part of phased repair
70-7	6	9/8/04	1601	1601	18	02/01/05	220		14	02/16/06	8		10	1/24/07	50		5	5/21/2007	22			Brown, Foiled, Repaired
N. fork	7	9/8/04	900	110	12	02/01/05	<2		?	02/16/06				1/24/07				5/21/2007				pat waste issues, numbers
confluence		9/8/04	N/A		11	02/01/05	30		13	02/16/06	30		9	1/24/07	<?		4	5/21/2007	80			improved following door
S fork	8	9/8/04	1601	900	10	02/01/05	8		12	02/16/06	lost		8	1/24/07	50		3	5/21/2007	30			to door education.
over pipe		9/8/04	dry		9	02/01/05	lost		11	02/16/06	2			1/24/07	dry			5/21/2007	dry			
stream	9	9/8/04	80		8	02/01/05	2		10	02/16/06	4		8	1/24/07	80		2	5/21/2007	70			
seep 4	10	9/8/04	90			02/01/05	dry			02/16/06	dry			1/24/07	dry			5/21/2007	dry			
seep 5		9/8/04	dry		7	02/01/05	<?		9	02/16/06	<?		6	1/24/07	<?			5/21/2007	dry			
seep 6		9/8/04	dry		6	02/01/05	<2		8	02/16/06	<2		5	1/24/07	80			5/21/2007	dry			
6" pipe		9/8/04	dry		5	02/01/05	4		7	02/16/06	<2		4	1/24/07	8			5/21/2007	dry			
4" pipe		9/8/04	dry		4	02/01/05	<2		6	02/16/06	4		3	1/24/07	<2			5/21/2007	dry			
clay drip		9/8/04	dry			02/01/05	dry		5	02/16/06	<2		2	1/24/07	170	<2		5/21/2007	dry			
clay drip 2		9/8/04	dry			02/01/05	dry		4	02/16/06	<2			1/24/07	dry			5/21/2007	dry			
clay drip 3		9/8/04	dry			02/01/05	dry		3	02/16/06	<?			1/24/07	dry			5/21/2007	dry			
657-		9/8/04	dry		3	02/01/05	2		2	02/16/06	2		1	1/24/07	SCC	9	1	5/21/2007	500	500	Clark's, Packed, in progress	
6535		9/8/04	dry		2	02/01/05	1		1	02/16/06	1		1A	1/24/07	1			5/21/2007	dry			

Locations determined by GPS, photograph, and written description.  
 Numbers listed in "location" column refer to house numbers on Tracyton Boulevard.

# **APPENDIX F**

## **TREND DATA ANALYSIS**

<b>BK01 ALL DATA</b>			<b>RAIN 24</b>	<b>RAIN 48</b>	<b>RAIN 72</b>	<b>24 CORREL</b>	<b>48 CORREL</b>	<b>72 CORREL</b>
EK01	50	10/07/04	0.00	0.23	0.00	<b>0.016</b>	<b>0.026</b>	<b>0.097</b>
EK01	34	11/17/04	0.05	0.08	0.11			
EK01	30	12/14/04	0.56	0.02	0.00			
EK01	80	01/19/05	1.10	1.49	0.61			
EK01	50	02/22/05	0.00	0.00	0.00			
EK01	70	03/30/05	0.01	0.33	0.06			
EK01	30	04/20/05	0.00	0.00	0.00			
EK01	500	05/19/05	0.59	0.64	0.16			
EK01	220	06/21/05	0.00	0.00	0.00			
EK01	50	07/14/05	0.00	0.00	0.00			
EK01	220	08/11/05	0.00	0.00	0.00			
EK01	500	09/08/05	0.00	0.00	0.00			
EK01	50	10/13/05	0.11	0.00	0.01			
EK01	900	11/02/05	0.17	0.77	1.22			
EK01	70	12/13/05	0.01	0.11	0.00			
EK01	17	01/04/06	0.10	0.39	0.24			
EK01	17	02/14/06	0.00	0.05	0.00			
EK01	130	03/16/06	0.19	0.07	0.03			
EK01	23	04/11/06	0.00	0.01	0.09			
EK01	70	05/10/06	0.00	0.00	0.00			
EK01	130	06/13/06	0.00	0.01	0.01			
EK01	1601	07/18/06	0.00	0.00	0.00			
EK01	170	08/23/06	0.00	0.00	0.00			
EK01	170	09/21/06	0.10	0.16	1.08			
EK01	130	10/18/06	0.14	0.14	0.17			
EK01	80	11/16/06	0.00	1.35	1.38			
EK01	170	12/06/06	0.00	0.01	0.01			
EK01	30	01/10/07	0.03	0.20	0.20			
EK01	300	02/06/07	0.04	0.04	0.06			
EK01	30	03/12/07	0.08	0.98	1.42			
EK01	80	04/26/07	0.00	0.00	0.04			
EK01	80	05/16/07	0.00	0.00	0.00			
EK01	50	06/26/07	0.00	0.00	0.08			
EK01	50	07/26/07	0.00	0.00	0.00			
EK01	300	08/22/07	0.00	0.01	0.49			
EK01	110	09/25/07	0.00	0.00	0.00			
<b>OVERALL GMV:</b>	<b>93</b>							
<b>OVERALL PART 2:</b>	<b>22%</b>							
<b>MEETS:</b>	<b>NO</b>							



<b>BK01 WET DATA</b>			<b>RAINFALL 24</b>	<b>RAINFALL 48</b>	<b>RAINFALL 72</b>
BK01	50	10/07/04	0.00	0.23	0.00
BK01	34	11/17/04	0.05	0.08	0.11
BK01	30	12/14/04	0.56	0.02	0.00
BK01	80	01/19/05	1.10	1.49	0.61
BK01	50	02/22/05	0.00	0.00	0.00
BK01	70	03/30/05	0.01	0.33	0.06
BK01	30	04/20/05	0.00	0.00	0.00
BK01	50	10/13/05	0.11	0.00	0.01
BK01	900	11/02/05	0.17	0.77	1.22
BK01	70	12/13/05	0.01	0.11	0.00
BK01	17	01/04/06	0.10	0.39	0.24
BK01	17	02/14/06	0.00	0.05	0.00
BK01	130	03/16/06	0.19	0.07	0.03
BK01	23	04/11/06	0.00	0.01	0.09
BK01	130	10/18/06			
BK01	80	11/16/06			
BK01	170	12/06/06			
BK01	30	01/10/07			
BK01	300	02/06/07			
BK01	30	03/12/07			
BK01	80	04/26/07			
<b>WET GMV:</b>	<b>62</b>				
<b>WET PART 2:</b>	<b>10%</b>				
<b>MEETS:</b>	<b>YES</b>				

<b>BK01 DRY DATA</b>			<b>RAINFALL 24</b>	<b>RAINFALL 48</b>	<b>RAINFALL 72</b>
BK01	500	05/19/05	0.59	0.64	0.16
BK01	220	06/21/05	0.00	0.00	0.00
BK01	50	07/14/05	0.00	0.00	0.00
BK01	220	08/11/05	0.00	0.00	0.00
BK01	500	09/08/05	0.00	0.00	0.00
BK01	70	05/10/06	0.00	0.00	0.00
BK01	130	06/13/06	0.00	0.01	0.01
BK01	1601	07/18/06	0.00	0.00	0.00
BK01	170	08/23/06	0.00	0.00	0.00
BK01	170	09/21/06			
BK01	80	05/16/07			
BK01	50	06/26/07			
BK01	50	07/26/07			
BK01	300	08/22/07			
BK01	110	09/25/07			
<b>DRY GMV:</b>	<b>164</b>				
<b>DRY PART 2:</b>	<b>40%</b>				
<b>MEETS:</b>	<b>NO</b>				

<b>BK02 ALL DATA</b>			<b>RAIN 24</b>	<b>RAIN 48</b>	<b>RAIN 72</b>	<b>24 CORREL</b>	<b>48 CORREL</b>	<b>72 CORREL</b>
EK02	70	10/07/04	0.00	0.23	0.00	<b>0.010</b>	<b>-0.03</b>	<b>0.005</b>
EK02	34	11/17/04	0.05	0.08	0.11			
EK02	50	12/14/04	0.56	0.02	0.00			
EK02	30	01/19/05	1.10	1.49	0.61			
EK02	50	02/22/05	0.00	0.00	0.00			
EK02	110	03/30/05	0.01	0.33	0.06			
EK02	500	04/20/05	0.00	0.00	0.00			
EK02	900	05/19/05	0.59	0.64	0.16			
EK02	1600	06/21/05	0.00	0.00	0.00			
EK02	300	07/14/05	0.00	0.00	0.00			
EK02	500	08/11/05	0.00	0.00	0.00			
EK02	900	09/08/05	0.00	0.00	0.00			
EK02	30	10/13/05	0.11	0.00	0.01			
EK02	500	11/02/05	0.17	0.77	1.22			
EK02	50	12/13/05	0.01	0.11	0.00			
EK02	50	01/04/06	0.10	0.39	0.24			
EK02	4	02/14/06	0.00	0.05	0.00			
EK02	300	03/16/06	0.19	0.07	0.03			
EK02	23	04/11/06	0.00	0.01	0.09			
EK02	70	05/10/06	0.00	0.00	0.00			
EK02	130	06/13/06	0.00	0.01	0.01			
EK02	300	07/18/06	0.00	0.00	0.00			
EK02	300	08/23/06	0.00	0.00	0.00			
EK02	500	09/21/06	0.10	0.16	1.08			
EK02	300	10/18/06	0.14	0.14	0.17			
EK02	240	11/16/06	0.00	1.35	1.38			
EK02	30	12/06/06	0.00	0.01	0.01			
EK02	500	01/10/07	0.03	0.20	0.20			
EK02	23	02/06/07	0.04	0.04	0.06			
EK02	23	03/12/07	0.08	0.98	1.42			
EK02	240	04/26/07	0.00	0.00	0.04			
EK02	50	05/16/07	0.00	0.00	0.00			
EK02	50	06/26/07	0.00	0.00	0.08			
EK02	240	07/26/07	0.00	0.00	0.00			
EK02	70	08/22/07	0.00	0.01	0.49			
EK02	30	09/25/07	0.00	0.00	0.00			
<b>OVERALL GMV:</b>	<b>115</b>							
<b>OVERALL PART 2:</b>	<b>44%</b>							
<b>MEETS:</b>	<b>NO</b>							

BKD2	70	10/07/04	0.00	0.23	0.00
BKD2	34	11/17/04	0.05	0.08	0.11
BKD2	50	12/14/04	0.56	0.02	0.00
BKD2	30	01/19/05	1.10	1.49	0.61
BKD2	50	02/22/05	0.00	0.00	0.00
BKD2	110	03/30/05	0.01	0.33	0.06
BKD2	500	04/20/05	0.00	0.00	0.00
BKD2	30	10/13/05	0.11	0.00	0.01
BKD2	500	11/02/05	0.17	0.77	1.22
BKD2	50	12/13/05	0.01	0.11	0.00
BKD2	50	01/04/06	0.10	0.39	0.24
BKD2	4	02/14/06	0.00	0.05	0.00
BKD2	300	03/16/06	0.19	0.07	0.03
BKD2	23	04/11/06	0.00	0.01	0.09
BKD2	300	10/18/06			
BKD2	240	11/16/06			
BKD2	30	12/06/06			
BKD2	500	01/10/07			
BKD2	23	02/06/07			
BKD2	23	03/12/07			
BKD2	240	04/26/07			
<b>WET GMV:</b>	<b>73</b>				
<b>WET PART 2:</b>	<b>33%</b>				
<b>MEETS:</b>	<b>NO</b>				

BKD2	900	05/19/05	0.59	0.64	0.16
BKD2	1600	06/21/05	0.00	0.00	0.00
BKD2	300	07/14/05	0.00	0.00	0.00
BKD2	500	08/11/05	0.00	0.00	0.00
BKD2	900	09/08/05	0.00	0.00	0.00
BKD2	70	05/10/06	0.00	0.00	0.00
BKD2	130	06/13/06	0.00	0.01	0.01
BKD2	300	07/18/06	0.00	0.00	0.00
BKD2	300	08/23/06	0.00	0.00	0.00
BKD2	500	09/21/06			
BKD2	50	05/16/07			
BKD2	50	06/26/07			
BKD2	240	07/26/07			
BKD2	70	08/22/07			
BKD2	30	09/25/07			
<b>DRY GMV:</b>	<b>215</b>				
<b>DRY PART 2:</b>	<b>60%</b>				
<b>MEETS:</b>	<b>NO</b>				

BKD3	170	10/07/04	0.00	0.23	0.00	24 CORREL	48 CORREL	72 CORREL
BKD3	21	11/17/04	0.05	0.08	0.11	0.047	-0.027	-0.098
BKD3	30	12/14/04	0.56	0.02	0.00			
BKD3	80	01/19/05	1.10	1.49	0.61			
BKD3	70	02/22/05	0.00	0.00	0.00			
BKD3	11	03/30/05	0.01	0.33	0.06			
BKD3	17	04/20/05	0.00	0.00	0.00			
BKD3	500	05/19/05	0.59	0.64	0.16			
BKD3	80	06/21/05	0.00	0.00	0.00			
BKD3	240	07/14/05	0.00	0.00	0.00			
BKD3		08/11/05	0.00	0.00	0.00			
BKD3	900	09/08/05	0.00	0.00	0.00			
BKD3	110	10/13/05	0.11	0.00	0.01			
BKD3	130	11/02/05	0.17	0.77	1.22			
BKD3	23	12/13/05	0.01	0.11	0.00			
BKD3	80	01/04/06	0.10	0.39	0.24			
BKD3	23	02/14/06	0.00	0.05	0.00			
BKD3	70	03/16/06	0.19	0.07	0.03			
BKD3	4	04/11/06	0.00	0.01	0.09			
BKD3	30	05/10/06	0.00	0.00	0.00			
BKD3	80	06/13/06	0.00	0.01	0.01			
BKD3	80	07/18/06	0.00	0.00	0.00			
BKD3	170	08/23/06	0.00	0.00	0.00			
BKD3	80	09/21/06	0.10	0.16	1.08			
BKD3	23	10/18/06	0.14	0.14	0.17			
BKD3	110	11/16/06	0.00	1.35	1.38			
BKD3	50	12/06/06	0.00	0.01	0.01			
BKD3	23	01/10/07	0.03	0.20	0.20			
BKD3	80	02/06/07	0.04	0.04	0.06			
BKD3	23	03/12/07	0.08	0.98	1.42			
BKD3	30	04/26/07	0.00	0.00	0.04			
BKD3	17	05/16/07	0.00	0.00	0.00			
BKD3	50	06/26/07	0.00	0.00	0.08			
BKD3	300	07/26/07	0.00	0.00	0.00			
BKD3	170	08/22/07	0.00	0.01	0.49			
BKD3	500	09/25/07	0.00	0.00	0.00			
<b>OVERALL GMV:</b>	<b>64</b>							
<b>OVERALL PART 2:</b>	<b>14%</b>							
<b>MEETS:</b>	<b>NO</b>							

BKD3	170	10/07/04	0.00	0.23	0.00
BKD3	21	11/17/04	0.05	0.08	0.11
BKD3	30	12/14/04	0.56	0.02	0.00
BKD3	80	01/19/05	1.10	1.49	0.61
BKD3	70	02/22/05	0.00	0.00	0.00
BKD3	11	03/30/05	0.01	0.33	0.06
BKD3	17	04/20/05	0.00	0.00	0.00
BKD3	110	10/13/05	0.11	0.00	0.01
BKD3	130	11/02/05	0.17	0.77	1.22
BKD3	23	12/13/05	0.01	0.11	0.00
BKD3	80	01/04/06	0.10	0.39	0.24
BKD3	23	02/14/06	0.00	0.05	0.00
BKD3	70	03/16/06	0.19	0.07	0.03
BKD3	4	04/11/06	0.00	0.01	0.09
BKD3	23	10/18/06			
BKD3	110	11/16/06			
BKD3	50	12/06/06			
BKD3	23	01/10/07			
BKD3	80	02/06/07			
BKD3	23	03/12/07			
BKD3	30	04/26/07			
<b>WET GMV:</b>	<b>39</b>				
<b>WET PART 2:</b>	<b>0%</b>				
<b>MEETS:</b>	<b>YES</b>				

BKD3	500	05/19/05	0.59	0.64	0.16
BKD3	80	06/21/05	0.00	0.00	0.00
BKD3	240	07/14/05	0.00	0.00	0.00
BKD3		08/11/05	0.00	0.00	0.00
BKD3	900	09/08/05	0.00	0.00	0.00
BKD3	30	05/10/06	0.00	0.00	0.00
BKD3	80	06/13/06	0.00	0.01	0.01
BKD3	80	07/18/06	0.00	0.00	0.00
BKD3	170	08/23/06	0.00	0.00	0.00
BKD3	80	09/21/06			
BKD3	17	05/16/07			
BKD3	50	06/26/07			
BKD3	300	07/26/07			
BKD3	170	08/22/07			
BKD3	500	09/25/07			
<b>DRY GMV:</b>	<b>132</b>				
<b>DRY PART 2:</b>	<b>33%</b>				
<b>MEETS:</b>	<b>NO</b>				



DY29	1	05/21/03
DY29	1	06/12/03
DY29	1	07/21/03
DY29	1	08/19/03
DY29	1	09/17/03
DY29	4	10/14/03
DY29	23	01/14/04
DY29	8	02/25/04
DY29	13	04/12/04
DY29	2	06/09/04
DY29	1	08/05/04
DY29	4	10/06/04
DY29	4	12/20/04
DY29	1	02/23/05
DY29	1	04/19/05
DY29	4	06/14/05
DY29	8	08/16/05
DY29	1	10/11/05
DY29	4	12/14/05
DY29	17	01/03/06
DY29	2	03/14/06
DY29	2	05/09/06
DY29	8	07/17/06
DY29	2	09/28/06
DY29	17	11/15/06
DY29	1	01/30/07
DY29	1	03/01/07
DY29	1	05/10/07
DY29	2	07/25/07
DY29	21	09/04/07
<b>GMV</b>	<b>3</b>	
<b>RANGE</b>	<b>&lt;2 - 23</b>	
<b>MEETS?</b>	<b>YES</b>	