



## Marine and Sediment Assessment Group 2011 Work Plan

*The best decisions are based on Sound information.*

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**Date:** January 6, 2011

**To:** Recipients

**From:** Scott Mickelson and Kim Stark

**Subject:** Transmittal of the 2011 Work Plan for the Marine and Sediment Assessment Group

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This memorandum and attachments present the 2011 Work Plan for the Marine and Sediment Assessment Group of the King County Department of Natural Resources and Parks. The work plan includes both routine marine monitoring programs and Wastewater Treatment Division capital support projects such as the Brightwater marine outfall, Sediment Management Plan, and East Waterway and Lower Duwamish Waterway Superfund projects. Included with the memorandum are matrix tables that provide sampling locations, sampling frequency, and parameters measured for the 2011 routine monitoring programs, as well as maps showing sampling locations. Also included are summaries of projects in the proposal phase for 2011 and the Marine and Sediment Assessment Group's work accomplishments for 2010.

Station locations and analytical parameters may change from year to year. Any changes are based on an evaluation of previous years' data to determine if the data collected are meeting monitoring objectives for both the ambient and outfall monitoring programs and/or budgetary constraints. Marine and Sediment Assessment Group staff evaluate data each year to determine what changes are necessary, including what parameters should continue to be analyzed. A summary of how the marine monitoring program has changed over time, both in locations sampled and water quality constituents monitored, may be found on-line in the 2009 Work Plan at <http://green.kingcounty.gov/marine/Reports/2009-Marine-Group-Work-Plan.pdf>.

Due to budget cuts, two major changes to the routine marine monitoring program will occur in 2011. The shellfish monitoring program has been discontinued and the marine beach water monitoring program has been reduced by approximately 29%.

### **2011 Marine Offshore Water Column Monitoring Program**

Water column samples will be collected monthly from 18 stations. Nine outfall monitoring stations are located at outfalls for the West Point, South, and Vashon treatment plants, the Alki and Carkeek combined sewer overflow (CSO) treatment plants, the Elliott West and Henderson/MLK/Norfolk CSO treatment facilities, the Barton Street CSO, and the Hanford CSO. Nine ambient monitoring stations are located at Point Wells, Point Jefferson, Elliott Bay,

Fauntleroy/Vashon, East Passage, the Lower Duwamish Waterway (2 stations), and Quartermaster Harbor (two stations). Discrete water samples will be collected from between one and seven depths at each offshore station, depending on the total station depth. Conductivity, temperature, depth (CTD) profiles will be conducted throughout the entire water column at 15 of the 18 stations – those collected from King County’s research vessel *Liberty*.

Laboratory analytes will include fecal coliform and enterococcus bacteria, chlorophyll-*a* and pheophytin pigments, suspended solids, and nutrients (ammonia, nitrite/nitrate nitrogen, orthophosphate and silica). Total Kjeldahl nitrogen has been analyzed on a subset of nine samples for the past two years. For 2011, this parameter will be replaced with analysis of Total Nitrogen on the same 9-sample subset. Also a change for 2011, orthophosphate will be analyzed rather than total phosphorous, the previous phosphorus form measured since 1995. Bacteria samples will be collected from all sampling depths at each of the outfall monitoring stations but only from the surface at ambient monitoring stations, with the exception of the Quartermaster Harbor and Duwamish River samples.

Bacteria samples will be collected from both depths at each Quartermaster Harbor and Duwamish River ambient station. All other laboratory parameters will be analyzed on samples collected from every depth. Electronic *in situ* data will be collected at all but three offshore stations using a CTD sensor array. CTD data will include the following parameters; dissolved oxygen, salinity, temperature, density (calculated), transmissivity, photosynthetically active radiation (PAR), and fluorescence (as a measure of chlorophyll). Surface PAR and Secchi depth measurements will also be collected at all of the offshore stations collected from the *Liberty*. Secchi depth is collected as well at the two Quartermaster Harbor stations. Field measurements for dissolved oxygen and temperature will be collected using a Hydrolab<sup>®</sup> instrument at the two Quartermaster Harbor stations and the Henderson/MLK/Norfolk CSO station.

### **Marine Moorings**

Marine moorings that include *in situ* water quality data gathering sensors are currently deployed at two locations – the Seattle Aquarium (two depths) and Dockton Park (one depth). A third system, which has been deployed at the entrance to Quartermaster Harbor will be moved in January 2011 to a location near the Alki CSO Treatment Plant outfall. The Alki mooring system will be deployed on an oceanographic buoy and have sensors near the surface. The other two moorings are shore-based deployments, located on piers.

These marine mooring systems gather data for dissolved oxygen, salinity, temperature, fluorescence (chlorophyll), turbidity, pH, and meteorological parameters (shore-based systems only). The buoy mooring system deployed at Alki will also gather nitrate nitrogen data. The fourth *in situ* mooring system which is not currently in use, is expected to be deployed at a single depth at the Quartermaster Harbor Yacht Club in early 2011. This location was used for a previous mooring in 2008 but was moved to the current Dockton Park location. Concern over low dissolved oxygen values in the inner Harbor provided the impetus to place the fourth mooring at this location. Cost of the EcoNet/YSI web hosting of mooring data will lead to an equipment change at the Seattle Aquarium location sometime in 2011. The EcoNet system will be replaced with a telemetered system similar to that used on the freshwater profiling buoys.

Continuous data gathering involves a high degree of data management, quality control, and website maintenance to make the data available publicly. The marine mooring web page was redesigned in 2009 to facilitate better public access to the data and enhanced data analysis and reporting tools. The Marine and Sediment Assessment Group will continue to provide support for web maintenance, quality control, and data analysis.

### **2011 Marine Beach Water Quality Monitoring Program**

Due to budget cuts, the 2011 marine beach water quality monitoring program was decreased by approximately 29%, resulting in discontinuing monitoring at 8 marine beach stations. In 2011, water samples will be collected monthly from 20 beach stations and 1 stream station. Nine outfall-vicinity monitoring stations are located inshore of the West Point (two stations) and Vashon treatment plant outfalls, the Alki (two stations), Carkeek, and Elliott West CSO treatment plant outfalls, and the Magnolia and Barton CSO outfalls.

All nine of the outfall-vicinity monitoring stations will be sampled monthly for analysis of fecal coliform and enterococcus bacteria, temperature, salinity, and nutrients (ammonia, nitrite/nitrate nitrogen, and orthophosphate). All 11 of the ambient beach stations will also be monitored for bacteria, temperature, nutrients, and salinity. The Piper's Creek stream station will be monitored for bacteria, temperature, and nutrients. A subset of six beach water samples, which had been analyzed for total Kjeldahl nitrogen, will be analyzed for Total Nitrogen in 2011.

### **2011 Subtidal Sediment Monitoring Program**

King County restructured its ambient marine subtidal sediment monitoring program in 2007 to both supplement the Washington State Department of Ecology's sediment monitoring program and to provide focused monitoring of sediment quality in Elliott Bay. Subtidal sediments are collected every two years from eight stations in Elliott Bay and every five years from six additional stations outside of Elliott Bay, including three stations in the main basin of Puget Sound and three associated embayments. All 14 stations were first sampled in 2007 and the eight Elliott Bay stations were sampled again in 2009.

In 2011, the eight Elliott Bay stations will be sampled. Sediment samples will be analyzed for conventional parameters (total solids, total organic carbon, particle size distribution, ammonia, sulfides), metals, and organics (semivolatile compounds, chlorinated pesticides, PCBs, and PDBEs (flame retardants)). The 2009 sampling and analysis plan will be updated and amended as warranted for the 2011 sampling event. Data generated from the ambient subtidal sediment monitoring program are used, in part, to provide information for the County's KingStat environmental indicators program.

### **Brightwater Permit-Required Studies and Technical Support**

Marine monitoring to support the Brightwater marine outfall project has been conducted since 1999. Although there is less work than in previous years, the following Brightwater marine outfall project work will be undertaken during 2011:

- Conducting the final pre-operation baseline sediment survey at the outfall diffusers. The sampling and analysis plan will be amended and updated as needed, with sampling stations relocated slightly, based on outfall as-built diagrams. This work will be conducted in October.

- Conducting the final nearshore benthic survey at the trench construction site. This work will be conducted in October.
- Consultant oversight and input during preparation of the final report for the intertidal biota surveys.
- Consultant oversight and coordination for eelgrass survey activities and reports;
- Conducting one ROV survey of the eelgrass transplant areas in early summer;
- Development of eelgrass and intertidal biota project web pages;
- Support during negotiations for the Brightwater NPDES permit; and
- Agency meetings and updates as necessary.

**Denny Way/Lake Union CSO Control Project Sediment Monitoring Program**

On-going sediment monitoring at this project site is being performed in accordance with the Biological Opinion issued for the project under the Endangered Species Act Section 7 consultation. Sediment monitoring is also being performed in support of NPDES permit requirements as well as the nearshore interim sediment cleanup project in Cleanup Areas A and B (completed in 2008) and the monitoring of natural recovery of sediment in Cleanup Areas C, D, and E. In 2011, sediment monitoring is only required for the cleanup areas. Therefore, sediment samples will be collected from only 7 of the 16 routine monitoring stations, with analysis performed only for sediment chemistry. A new sampling and analysis plan will be created for the 2011 sampling event.

**West Point and South Treatment Plants – NPDES Permit-Related Work**

New NPDES permits for both the West Point and South treatment plants were issued in 2009. The following work will be undertaken in 2011 in support of NPDES permit requirements:

- The West Point Treatment Plant outfall sediment sampling event will occur in April. Samples will be collected from eight stations for concurrent chemistry, benthic, and toxicity analyses. If warranted, a sediment toxicity identification evaluation (TIE) process would be necessary. Sampling for the TIE process would occur in June or July. The sampling and analysis plan for this event has received conditional approval from Ecology.
- The first round of sampling for the NPDES receiving water characterization for the West Point and South Treatment Plants and CSO treatment facilities will occur in July. This event will involve collection of samples for analysis of ultra-trace-level metals and conventional parameters. The sampling and analysis plan for this study has received approval from Ecology. A second sampling event for 2011 will occur in December.
- The South Treatment Plant outfall sediment sampling event will occur in July. Samples will be collected from eight stations for chemistry analysis. If warranted, toxicity testing will be performed on any samples that exceed sediment quality standards. Sampling for toxicity testing would occur in September. Any station that requires sampling for toxicity testing will also be sampled for synoptic sediment chemistry and benthic community analysis. A sediment TIE process may be necessary. If required, this sampling would be performed in November. The sampling and analysis plan for this event has received conditional approval from Ecology.

### **Inter-Laboratory Nutrient Calibration Study**

King County will continue to partner with the Washington State Department of Ecology on an inter-laboratory nutrient calibration study. The goals of the study are to:

- determine direct comparability of nutrient data currently collected and analyzed for central Puget Sound sites;
- provide a means to share data and utilize each agency's results collected for current and historical monitoring projects in Puget Sound;
- provide an understanding (degree, extent, and affected species) of similarities/differences of nutrient results provided by each agency to be used for a combined water quality index assessment and trend analysis for Central Basin stations; and
- provide comparative data for evaluation of laboratory performance and methods, should a transition or need for utilization of another analytical lab arise for future monitoring/projects.

A second pilot study, similar to the one conducted in 2010, will be performed in February or March of 2011. Standards, prepared by Ecology staff, will be submitted to both the King County Environmental Laboratory and the University of Washington Oceanographic Laboratory for analysis of ammonia nitrogen, nitrate nitrogen, orthophosphorus, and silica. The pilot study is being repeated since Ecology staff discovered trace levels of ammonia nitrogen in their reagent water used to prepare standards during the original pilot study.

In addition to the pilot study, Ecology will prepare nutrient "check standards" that will be analyzed monthly by both laboratories in association with natural water samples from both King County's and Ecology's routine marine offshore water column sampling events. Once a quarter, both King County and Ecology will collect between 10 and 15 "split" samples during their respective offshore sampling events to submit to both laboratories for analysis.

Delivery of samples to the University of Washington will be coordinated between agency staff. King County and the University of Washington laboratories will follow their standard protocols for analysis of nutrients. King County staff, along with Ecology staff will analyze the results from this study and produce a study report.

### **Miscellaneous 2011 Work Items**

- Completion of Phase II of the Marine Monitoring web page, including uploading historical data and creation of web reporting tools.
- Completion of a new, web-based, marine water quality monitoring reporting system, beginning with the 2008 and 2009 data reports.
- Completion of an "existing conditions" study for all 38 CSOs in King County's system, looking at habitat characteristics. This work is required for the CSO 2012 update.
- Performance measure and environmental indicator updates.
- Preparation of sections for the RWSP Update report.
- Data validation for the CSO Effluent Characterization project and CSO Source Tracing project.
- Preparation of the 2012 marine and sediment assessment group work plan.
- Preparation of the 2010 Scientific Collection Permit report.

- Phytoplankton sampling (along with water quality parameters) will continue at three existing marine water column stations, twice a month, from April through September. Due to the extended phytoplankton bloom season in Quartermaster Harbor, sampling will be expanded to include sampling in March and November at this site, resources permitting.
- Technical support for the EPA Quartermaster Harbor Nitrogen Study grant.
- Technical support for the Wastewater Treatment Division's Sediment Management Plan.
- Technical support for the Puget Sound Partnership.
- Data downloading and analysis for outside agencies, educational facilities, private entities, and the general public;
- Preparation of talks and/or posters, session organization, and participation in the Estuarine Research Federation's 2011 biennial meeting.
- Preparation of talks and/or posters and participation in the Puget Sound/Georgia Basin Ecosystem Conference for 2011.
- Preparation of talks and/or posters and participation in the Pacific Estuarine Research Society's 2011 annual meeting.

### **Potential Project for 2011**

The Marine and Sediment Assessment Group will likely propose the following project in 2011, which will be dependent on budget and resources.

#### **Bacteria Source Tracking**

Monthly bacteria sampling as part of the Ambient Monitoring Program has shown chronic fecal coliform problems at several marine beaches over the last several years. One of those sites, north of the Redondo Pier, has shown high fecal coliform bacteria levels over the past few years. The state BEACH program, which samples weekly during the summer months, has also detected high bacteria counts at this location. Possible sources include leaking sewer pipes from the pier and nearby storm drains. To address the high bacteria counts, a sampling and analysis plan would be developed and implemented to assess the extent of the high bacteria counts and possible sources. Results would then be used to develop an action plan, if warranted.

#### **CSO Sediment Characterizations**

King County received a new NPDES permit for the West Point Wastewater Treatment Plant in June 2009. In addition to the West Point plant, facilities regulated under this NPDES permit include all of the County's combined sewer overflows (CSOs). The permit required the County to submit a comprehensive report of sediment quality at all CSO discharge locations. The County received a memorandum in May 2010 from Ecology that made recommendations for sediment sampling at CSO sites. The memorandum outlined three priorities – high, medium, and low – for sediment investigations proximal to CSO discharges. Those CSOs that received a “high” priority were to be investigated during the current permit cycle. One of the CSOs receiving a “high” priority designation is located within the boundaries of the Lower Duwamish Waterway Superfund site – the Brandon Street CSO.

The Brandon Street CSO, along with up to five other CSOs may be sampled for sediment chemistry 2011 in support of the County's Sediment Management Plan and to provide data needed for field verification and calibration of the nearfield sediment model. If sampling is

performed, between 10 and 12 sediment samples will be collected at each site and submitted for analysis of conventional, metal, and organic parameters, as stipulated by the Sediment Management Standards. This work would be performed under the capital budget associated with the Lower Duwamish Water Superfund project.

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#### **Summary of Changes to the Routine Marine Monitoring Program for 2011**

- The routine semiannual shellfish monitoring program has been discontinued.
- The routine monthly beach water quality monitoring program has been reduced by approximately 29%, with the discontinuance of sampling at 8 out of 32 stations.
- The marine mooring system (buoy mounted) that was previously deployed at the entrance to Quartermaster Harbor will be relocated to south Alki Point.
- Total Kjeldahl Nitrogen, which has been analyzed on a subset of marine water samples will be replaced with Total Nitrogen. Total phosphorus will be replaced by orthophosphate.

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#### **King County Marine and Sediment Assessment Group – 2010 List of Accomplishments**

The following work items were accomplished by staff of the King County Marine and Sediment Assessment Group during 2010:

##### **Ambient and Outfall Monitoring Programs**

- Coordinated and implemented the collection of marine water, sediment, and shellfish tissue for both the ambient and outfall monitoring programs.
- Acted as the liaison between the Science Section and Environmental Laboratory to facilitate communication and project success.
- Completed internal programmatic annual review.
- Updated the KingStat marine environmental indicators.
- Provided sections for the annual RWSP update report.
- Completed the 2010 Sampling and Analysis Plan for intertidal sediments.
- Completed a major update to the marine photos webpage.
- Received all the permits to move the YSI water quality buoy from Quartermaster Harbor to Alki.
- Completed analysis and quality control of 2008 and 2009 marine data, including mooring data.
- Completed several of the data summaries for the new annual reporting format on the marine group webpage.
- Presented a poster on *Occurrence of Polybrominated Diphenyl Ethers (PBDEs) in Marine Sediment and Shellfish Tissue in the Central Basin of Puget Sound* at the 2011 Annual Meeting of the Pacific Estuarine Research Society.

##### **NPDES Permit-Related Work**

- Contributed sections for the CSO sediment data summary report.

- Wrote the SAP for the West Point outfall sediment monitoring 2011 sampling event. Approval has been received from Ecology.
- Wrote the SAP for the South Plant outfall sediment monitoring 2011 sampling event. Approval has been received from Ecology.
- Designed a receiving water characterization study for bacteria, nutrients, and trace metals and wrote the SAP. Approval has been received from Ecology.

#### Brightwater Marine Outfall

- Completed the second post-construction eelgrass SCUBA diver survey and data report. We met the project short-term project performance standards and the eelgrass plants did well in 2010!
- Completed the last of five post-construction intertidal biota surveys.
- Completed two underwater video ROV surveys at the eelgrass transplant site (with the ESS ROV team). The ROV team also collected great video footage of how the outfall pipes are providing habitat for various marine organisms.
- Sent all 2010 eelgrass reports to agency representatives per permit requirements.

#### Lower Duwamish Waterway and East Waterway Superfund Projects

- Completed four major data validation efforts for the CSO effluent characterization study and Hanford/Lander source tracing study.

#### Miscellaneous Project Work

- Provided support for the EPA Quartermaster Harbor Nutrient Management Study grant.
- Designed and prepared a SAP for a sediment characterization study in Quartermaster Harbor.
- Completed 20 major data requests for internal clients, outside agencies, educational institutions, consultants, and the general public.

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The attachments that accompany this work plan include:

- A color-coded map showing the locations of all 2011 routine marine monitoring stations and marine moorings.
- A table of all routine marine monitoring sampling locations with stratum sampled (stream, beach, offshore), matrices monitored, and station coordinates.
- Matrix tables showing outfall and ambient stations and the sampling regime for each.
- Maps and analytical matrix tables for each of the four routine marine monitoring programs for 2011 – offshore water column, beach water, and subtidal sediment.

Please note that the four programmatic maps and matrix tables are for sampling “runs.” Three of the “offshore” stations, for logistical purposes, are sampled as part of the marine beach water sampling run. These three stations are: LTXQ01 – Henderson/MLK/Norfolk CSO; MSWH01 – Quartermaster Harbor Yacht Club; and NSAJ02 – Dockton Park. These three offshore stations appear on the marine beach water map and matrix table.

**Marine and Sediment Assessment Program  
2011 Ambient Stations, Laboratory Parameters, and Frequency Measured**

Station	Location	Stratum	Number of Depths for Water Samples	Water		Sediment			Budget Information		
				Bacteria <sup>1</sup>	Conventionals	Conventionals	Metals	Organics	Program	Customer	Funding Source
JSUR01	Brightwater	Offshore	7	◆ 12	◆ 12				Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
KSBP01	Jefferson Head	Offshore	7	◆ 12	◆ 12				Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
LTKE03	Duwamish River	Offshore	2	◆ 12	◆ 12				Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
LTUM03	Duwamish River	Offshore	2	◆ 12	◆ 12				Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
LSNT01	Fauntleroy/Vashon	Offshore	7	◆ 12	◆ 12				Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
NSEX01	East Passage	Offshore	7	◆ 12	◆ 12				Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
MSWH01	Quartermaster Harbor	Offshore	2	◆ 12	◆ 12				Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
NSAJ02	Quartermaster Harbor	Offshore	2	◆ 12	◆ 12				Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
LTED04	Elliott Bay	Offshore	6	◆ 12	◆ 12	◆ 1	◆ 1	◆ 1	Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
KSZY01	Elliott Bay	Offshore	--			◆ 1	◆ 1	◆ 1	Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
LTA02	Elliott Bay	Offshore	--			◆ 1	◆ 1	◆ 1	Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
LSCW02	Elliott Bay	Offshore	--			◆ 1	◆ 1	◆ 1	Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
LTCA02	Elliott Bay	Offshore	--			◆ 1	◆ 1	◆ 1	Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
LTDF01	Elliott Bay	Offshore	--			◆ 1	◆ 1	◆ 1	Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
LSHZ08	Elliott Bay	Offshore	--			◆ 1	◆ 1	◆ 1	Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
LTGF01	Elliott Bay	Offshore	--			◆ 1	◆ 1	◆ 1	Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
JSVW04	Richmond Beach	Beach	1	◆ 12	◆ 12				Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
ITCARKEEKP	Carkeek Park	Beach	1	◆ 12	◆ 12				Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
KTHA01	Piper's Creek	Stream	1	◆ 12	◆ 12				Ambient/PSAMP	WTD	WTD Operating
KSLU03	Golden Gardens	Beach	1	◆ 12	◆ 12				Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
LSGY01	Seacrest	Beach	1	◆ 12	◆ 12				Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
LSHV01	Alki Beach	Beach	1	◆ 12	◆ 12				Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
MTLD03	Normandy Park	Beach	1	◆ 12	◆ 12				Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
MTUJ01	Des Moines Pk.	Beach	1	◆ 12	◆ 12				Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
NTFK01	Redondo Beach	Beach	1	◆ 12	◆ 12				Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
NSJY01	Dumas Bay	Beach	1	◆ 12	◆ 12				Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
MSXK01	Burton Acres	Beach	1	◆ 12	◆ 12				Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
MSSM05	Tramp Harbor	Beach	1	◆ 12	◆ 12				Ambient/PSAMP	WTD/PSP/Kstat/Ecol.	WTD Operating
<b>Total Samples for 2011</b>				<b>300</b>	<b>648</b>	<b>8</b>	<b>8</b>	<b>8</b>			
<b>Total Samples on a Monthly Basis</b>				<b>25</b>	<b>54</b>	<b>8</b>	<b>8</b>	<b>8</b>			

<sup>1</sup>Bacteria samples collected only at the surface for offshore stations, with the exception of the two Duwamish River and two Quartermaster Harbor stations.

**Marine and Sediment Assessment Program  
2011 Outfall Stations, Laboratory Parameters, and Frequency Measured**

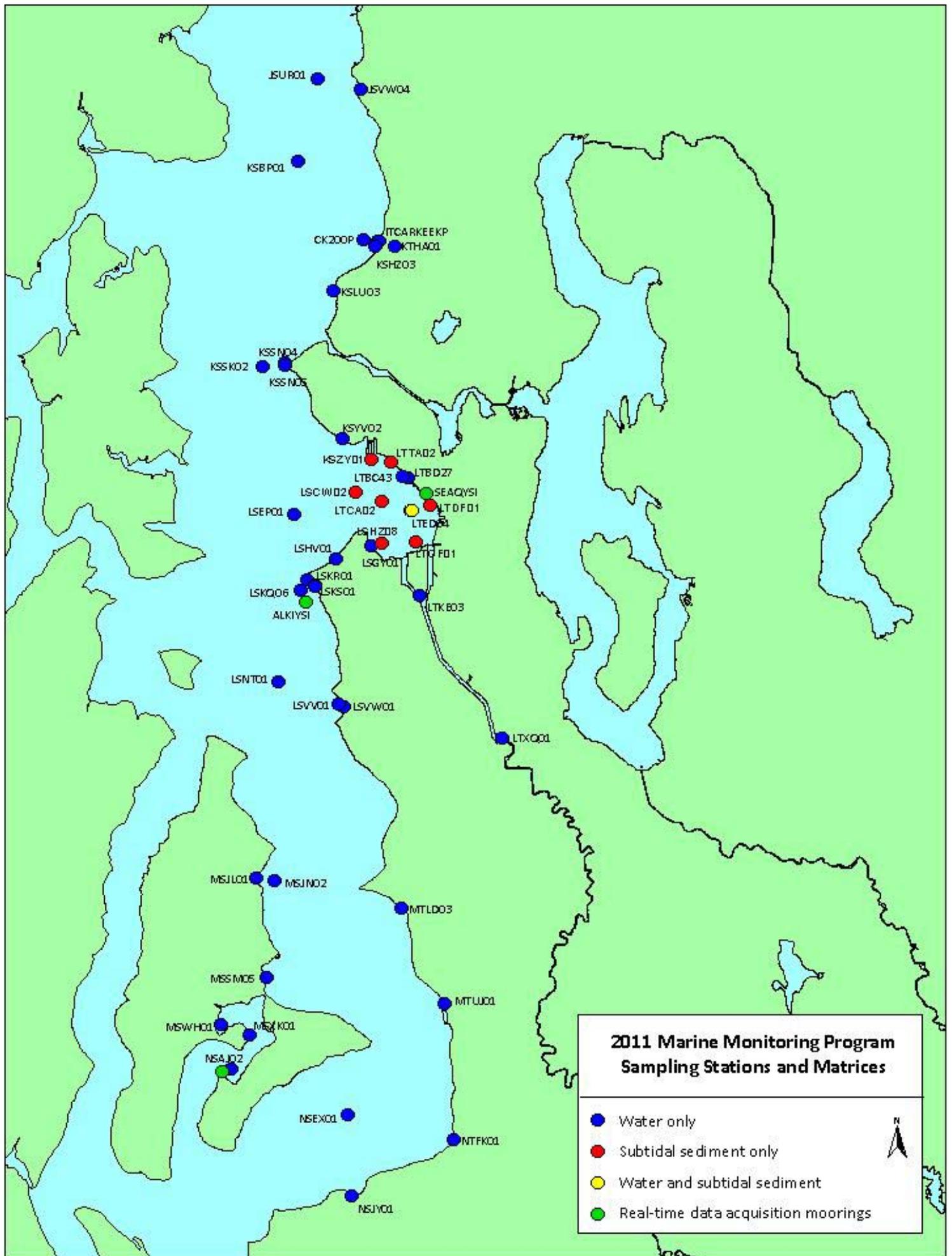
Station	Location	Stratum	Number of Depths for Water Samples	Water			Sediment			Budget Information		
				Bacteria	Metals	Conventionals	Conventionals	Metals	Organics	Program	Customer	Funding Source
CK200P	Carkeek Outfall	Offshore	5	◆ 12		◆ 12				Outfall Mon.	WTD/PSP/Kstat/Ecol.	WTD Operating
KSSK02	West Point Outfall	Offshore	5	◆ 12		◆ 12				Outfall Mon.	WTD/PSP/Kstat/Ecol.	WTD Operating
LTBC43	Denny Way Outfall	Offshore	2	◆ 12		◆ 12				Outfall Mon.	WTD/PSP/Kstat/Ecol.	WTD Operating
LSEP01	Renton Outfall	Offshore	7	◆ 12		◆ 12				Outfall Mon.	WTD/PSP/Kstat/Ecol.	WTD Operating
LSKQ06	Alki Outfall	Offshore	4	◆ 12		◆ 12				Outfall Mon.	WTD/PSP/Kstat/Ecol.	WTD Operating
MSJN02	Vashon Outfall	Offshore	5	◆ 12		◆ 12				Outfall Mon.	WTD/PSP/Kstat/Ecol./WaDNR	WTD Operating
LSVV01	Barton CSO Outfall	Offshore	2	◆ 12		◆ 12				Outfall Mon.	WTD/PSP/Kstat/Ecol.	WTD Operating
LTXQ01	Hend/MLK/Nfk Outfall	Offshore	1	◆ 12	◆ 12	◆ 12				Outfall Mon.	WTD/PSP/Kstat/Ecol.	WTD Operating
HNF/C1&2	Hanford/Lander CSOs	Offshore	2	◆ 12		◆ 12				Outfall Mon.	WTD/PSP/Kstat/Ecol.	WTD Operating
KSHZ03	Carkeek Park	Beach	1	◆ 12		◆ 12				Outfall Mon.	WTD/PSP/Kstat/Ecol.	WTD Operating
KSSN04	West Point North	Beach	1	◆ 12		◆ 12				Outfall Mon.	WTD/PSP/Kstat/Ecol.	WTD Operating
KSSN05	West Point South	Beach	1	◆ 12		◆ 12				Outfall Mon.	WTD/PSP/Kstat/Ecol.	WTD Operating
KSYV02	Magnolia CSO	Beach	1	◆ 12		◆ 12				Outfall Mon.	WTD/PSP/Kstat/Ecol.	WTD Operating
LTBD27	Sculpture Park	Beach	1	◆ 12		◆ 12				Outfall Mon.	WTD/PSP/Kstat/Ecol.	WTD Operating
LSKR01	Alki North	Beach	1	◆ 12		◆ 12				Outfall Mon.	WTD/PSP/Kstat/Ecol.	WTD Operating
LSKS01	Richey Viewpoint	Beach	1	◆ 12		◆ 12				Outfall Mon.	WTD/PSP/Kstat/Ecol.	WTD Operating
LSVW01	Fauntleroy Cove	Beach	1	◆ 12		◆ 12				Outfall Mon.	WTD/PSP/Kstat/Ecol.	WTD Operating
MSJL01	Vashon Island	Beach	1	◆ 12		◆ 12				Outfall Mon.	WTD/PSP/Kstat/Ecol./WaDNR	WTD Operating
<b>Total Samples for 2011</b>				<b>504</b>	<b>12</b>	<b>504</b>	<b>0</b>	<b>0</b>	<b>0</b>			
<b>Total Samples on a Monthly Basis</b>				<b>42</b>	<b>1</b>	<b>42</b>						

## 2011 Routine Marine Monitoring Program

### Sampling Stations, Matrices Sampled, and Station Coordinates

Locator	Description	Stratum	Matrices	Northing <sup>1</sup>	Easting <sup>1</sup>
JSVW04	Richmond Beach/Point Wells	Beach	Water	286171	1257194
ITCARKEEKP	Carkeek Park	Beach	Water	263756	1259915
KSHZ03	Piper's Creek Mouth	Beach	Water	263736	1259784
KTHA01	Piper's Creek	Stream	Water	262962	1262305
KSLU03	Golden Gardens	Beach	Water	256354	1253305
KSSN04	West Point North	Beach	Water	245729	1246032
KSSN05	West Point South	Beach	Water	245272	1245980
KSYV02	Magnolia CSO	Beach	Water	234547	1254488
LTBD27	SAM Sculpture Park	Beach	Water	228851	1264297
LSGY01	Seacrest Park	Beach	Water	218711	1258776
LSHV01	Alki Beach	Beach	Water	216852	1253532
LSKR01	Alki North	Beach	Water	213666	1249416
LSKS01	Richey Viewpoint	Beach	Water	222222	1212121
LSVW01	Fauntleroy Cove	Beach	Water	194969	1254846
MTLD03	Normandy Park	Beach	Water	165142	1263285
MTUJ01	Des Moines Creek Park	Beach	Water	151129	1269533
NTFK01	Redondo Beach	Beach	Water	131067	1270899
NSJY01	Dumas Bay Park	Beach	Water	122831	1255835
MSJL01	Vashon Island - Gorsuch Creek	Beach	Water	169666	1241897
MSSM05	Tramp Harbor	Beach	Water	154908	1243459
MSXK01	Burton Acres Park	Beach	Water	146481	1240772
JSUR01	Point Wells	Offshore	Water	287580	1250910
KSBP01	Jefferson Head	Offshore	Water	275439	1248062
CK200P	Carkeek CSO TP Outfall	Offshore	Water	263819	1257728
KSSK02	West Point TP Outfall	Offshore	Water	245121	1242740
LTBC43	Elliott West CSO TP Outfall	Offshore	Water	228985	1263430
SEAQYSI	Seattle Aquarium	Offshore	Marine Mooring	225168	1267840
LTED04	Elliott Bay	Offshore	Water/Sediment	223909	1264675
KSZY01	Elliott Bay	Offshore	Sediment	231983	1258639
LTAA02	Elliott Bay	Offshore	Sediment	231054	1261260
LSCW02	Elliott Bay	Offshore	Sediment	227106	1256271
LTCA02	Elliott Bay	Offshore	Sediment	226303	1260915
LTDF01	Elliott Bay	Offshore	Sediment	225367	1267270
LSHZ08	Elliott Bay	Offshore	Sediment	218767	1259170
LTGF01	Elliott Bay	Offshore	Sediment	218854	1265592
HNF/C1/C2	East Waterway	Offshore	Water	214139	1267488
LTKE03	Duwamish River	Offshore	Water	211418	1265871
LTUM03	Duwamish River	Offshore	Water	196629	1274591
LTXQ01	Norfolk CSO Outfall	Offshore	Water	190313	1278053
LSEP01	South TP Outfall	Offshore	Water	223360	1247399
LSKQ06	Alki CSO TP Outfall	Offshore	Water	212065	1248334
ALKIYSI	South Alki	Offshore	Marine Mooring	211998	1248262
LSNT01	Fauntleroy/Vashon	Offshore	Water	198653	1245194
LSVV01	Barton CSO Outfall	Offshore	Water	195347	1253935
MSJN02	Vashon TP Outfall	Offshore	Water	169328	1244585
NSEX01	East Passage	Offshore	Water	134701	1255331
MSWH01	Quartermaster Harbor	Offshore	Water	147976	1236667
NSAJ02	Quartermaster Harbor	Offshore	Water/Marine Mooring	140223	1239011

<sup>1</sup>North American Datum 1983 (NAD83) - State Plane Coordinate System - Washington North 4601



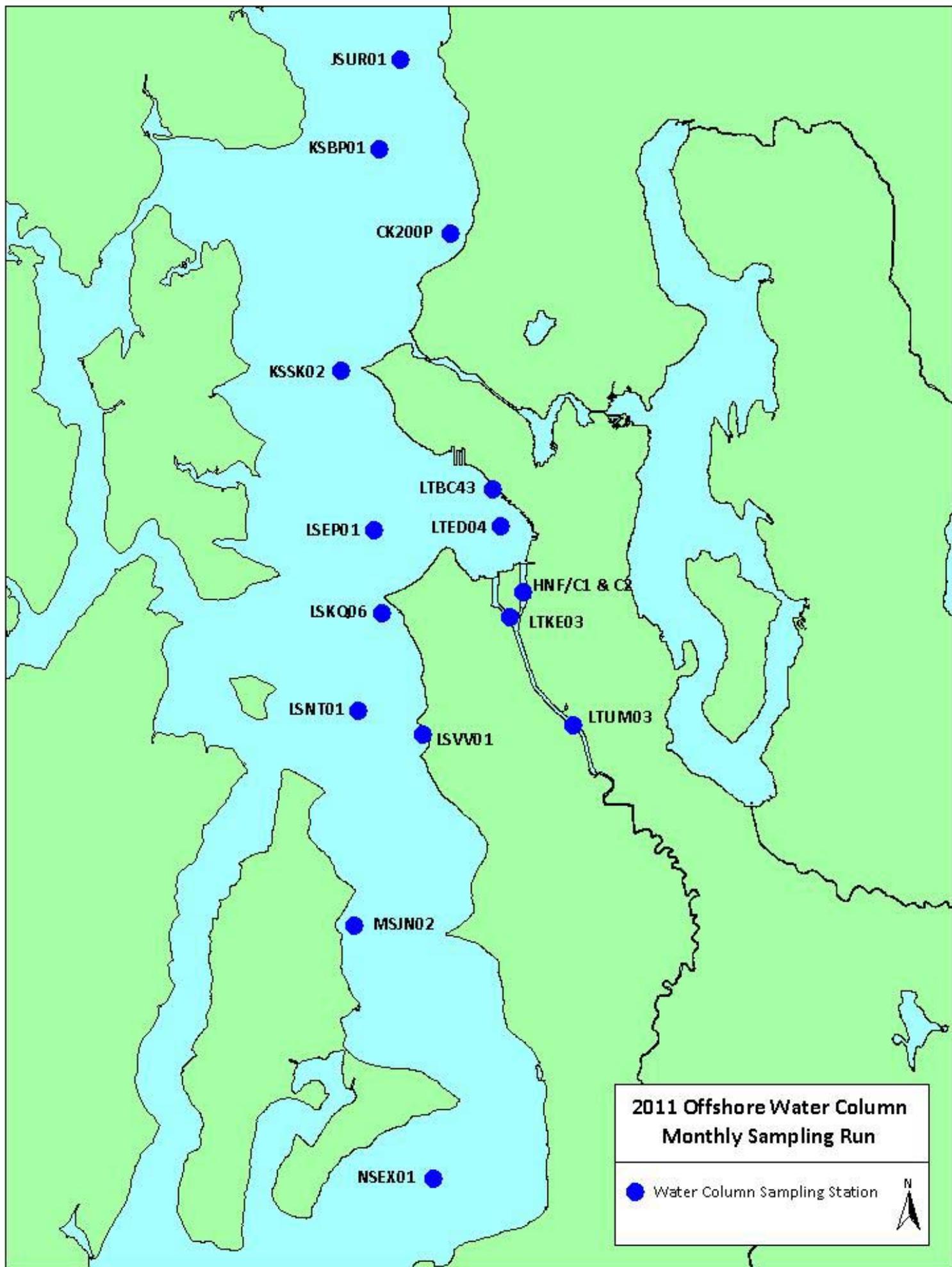
**2011 Marine Offshore Monitoring Program**  
**Monthly Ambient and Outfall Water Column Sampling**  
**Laboratory and Field Parameters**

Station	Depth (m)	Bacteria		Conventionals										CTD							Field				
		Enterococcus	Fecal Coliform	Ammonia Nitrogen	Chlorophyll-a	Dissolved Organic Carbon	Dissolved Oxygen - Winkler	Nitrite + Nitrate Nitrogen	Phaeophytin	Salinity	Silica	Total Nitrogen	Total Organic Carbon	Orthophosphate	Total Suspended Solids	Chlorophyll, Field	Density, Field	Dissolved Oxygen, Field	Light Intensity (PAR), Field	Salinity, Field	Sample Temperature, Field	Surface Light Intensity (PAR), Field	Transmissivity, Field	Sample Depth	Sample Start Time
JSUR01	1	1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	15			1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	25			1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	35			1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	55			1				1		1			1	1	1	1	1	1	1	1	1	1	1	1	1
	100			1				1		1			1	1	1	1	1	1	1	1	1	1	1	1	1
	175			1				1		1			1	1	1	1	1	1	1	1	1	1	1	1	1
KSBP01	1	1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	15			1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	25			1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	35			1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	55			1				1		1			1	1	1	1	1	1	1	1	1	1	1	1	1
	100			1				1		1			1	1	1	1	1	1	1	1	1	1	1	1	1
	200			1				1		1			1	1	1	1	1	1	1	1	1	1	1	1	1
CK200P	1	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	15	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	25	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	35	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	55	1	1	1	1			1		1			1	1	1	1	1	1	1	1	1	1	1	1	1
KSSK02	1	1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	15	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	25	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	35	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	55	1	1	1				1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LTBC43	1	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	15	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
LTED04	1	1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	15			1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	25			1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	35			1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	55			1				1		1			1	1	1	1	1	1	1	1	1	1	1	1	1
	75			1				1		1			1	1	1	1	1	1	1	1	1	1	1	1	1
LTKE03	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	variable <sup>1</sup>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LTUM03	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	variable <sup>1</sup>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
HNF/C1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
HNF/C2	variable <sup>1</sup>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LSEP01	1	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	15	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	25	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	35	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	55	1	1	1				1		1			1	1	1	1	1	1	1	1	1	1	1	1	1
	100	1	1	1				1		1			1	1	1	1	1	1	1	1	1	1	1	1	1
	180	1	1	1				1		1			1	1	1	1	1	1	1	1	1	1	1	1	1
LSKQ06	1	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	15	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	25	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	35	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
LSNT01	1	1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	15			1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	25			1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	35			1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	55			1				1		1			1	1	1	1	1	1	1	1	1	1	1	1	1
	100			1				1		1			1	1	1	1	1	1	1	1	1	1	1	1	1
	180			1				1		1			1	1	1	1	1	1	1	1	1	1	1	1	1
LSVV01	1	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	5	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
MSJN02	1	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	15	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	25	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	35	1	1	1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	55	1	1	1				1		1			1	1	1	1	1	1	1	1	1	1	1	1	1
NSEX01	1	1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	15			1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	25			1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	35			1	1			1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1
	55			1				1		1			1	1	1	1	1	1	1	1	1	1	1	1	1
	100			1				1		1			1	1	1	1	1	1	1	1	1	1	1	1	1
	170			1				1		1			1	1	1	1	1	1	1	1	1	1	1	1	1

Total Samples/Records per Month 41 41 70 44 6 6 70 44 6 70 7 6 70 70 70 70 70 70 70 70 70 70 70 16 15  
 Total Samples/Records for 2011 492 492 840 528 72 72 840 528 72 840 84 72 840 840 840 840 840 840 840 840 840 840 840 192 180

Variable<sup>1</sup> - Sample collected one meter above the bottom (depth variable with tidal height)

**Modification for 2011**  
 Replace Total Kjeldahl Nitrogen with Total Nitrogen on 7 samples per month.  
 Replace Total Phosphorus with Orthophosphate on all samples.



# 2011 Marine Beaches Monitoring Program

## Monthly Water Quality Sampling Run - Laboratory and Field Parameters

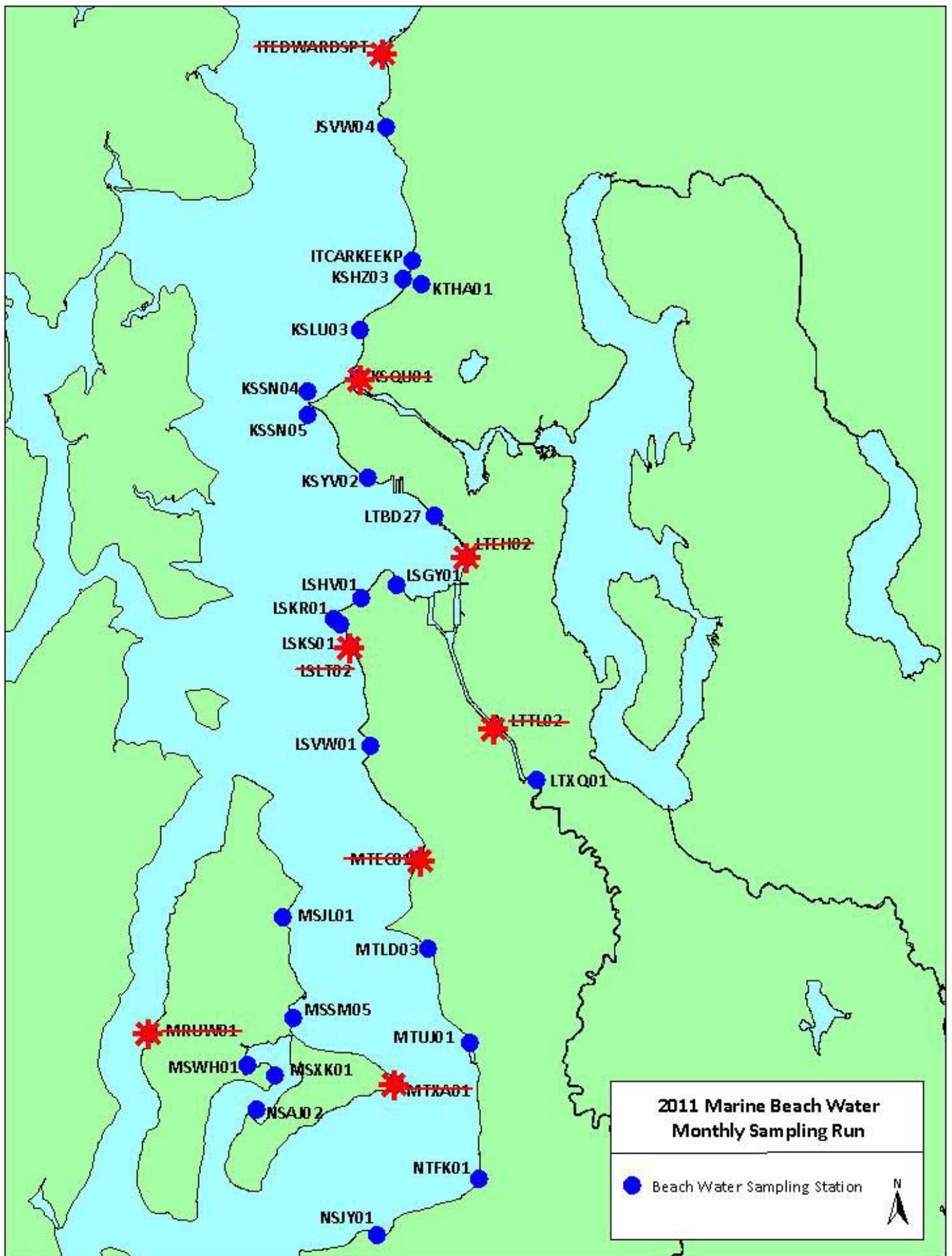
Locator	Station Description	Bacteria		Conventionals									Field				
		Enterococcus	Fecal Coliform	Ammonia Nitrogen	Chlorophyll-a	Hardness by ICP	Nitrite + Nitrate Nitrogen	Phaeophytin	Salinity	Silica	Total Nitrogen	Orthophosphate	Total Suspended Solids	Dissolved Oxygen, Field	Sample Start Time	Sampling Method	Sample Temperature, Field
JSVW04	Richmond Beach	1	1	1			1		1						1	1	1
ITCARKEEK	Carkeek Park - North	1	1	1			1		1						1	1	1
KSHZ03	Carkeek Park - Piper's Creek Mouth	1	1	1			1		1						1	1	1
KTHA01	Carkeek Park - Piper's Creek Upstream	1	1	1			1								1	1	1
KSLU03	Golden Gardens	1	1	1			1		1						1	1	1
KSSN04	West Point - North	1	1	1			1		1						1	1	1
KSSN05	West Point - South	1	1	1			1		1						1	1	1
KSYV02	Magnolia CSO	1	1	1			1		1						1	1	1
LTBD27	SAM Sculpture Park Beach	1	1	1			1		1						1	1	1
LSGY01	Seacrest Park	1	1	1			1		1						1	1	1
LSHV01	Alki Beach	1	1	1			1		1						1	1	1
LSKR01	Alki Beach - Alki Plant North	1	1	1			1		1						1	1	1
LSKS01	Richey Viewpoint	1	1	1			1		1						1	1	1
LSVW01	Fauntleroy Cove	1	1	1			1		1		1	1			1	1	1
LTXQ01	Norfolk/Henderson/MLK CSO	1	1	1		1	1		1			1	1	1	1	1	1
MTLD03	Normandy Park	1	1	1			1		1						1	1	1
MTUJ01	Des Moines Creek Park	1	1	1			1		1						1	1	1
NTFK01	Redondo Beach	1	1	1			1		1		1	1			1	1	1
NSJY01	Dumas Bay Park	1	1	1			1		1		1	1			1	1	1
MSJL01	Vashon Island - Gorsuch Road	1	1	1			1		1			1			1	1	1
MSSM05	Vashon Island - Tramp Harbor	1	1	1			1		1			1			1	1	1
MSXK01	Vashon Island - Burton Acres Park	1	1	1			1		1		1	1			1	1	1
MSWH01	Vashon Island - QMH Yacht Club	2	2	2	2		2	2	2	2	2	2	2	2	2	2	2
NSAJ02	Maury Island - Dockton Park Pier	2	2	2	2		2	2	2	2	2	2	2	2	2	2	2
<b>Total Samples/Records per Month</b>		<b>26</b>	<b>26</b>	<b>26</b>	<b>4</b>	<b>1</b>	<b>26</b>	<b>4</b>	<b>25</b>	<b>4</b>	<b>8</b>	<b>26</b>	<b>5</b>	<b>5</b>	<b>26</b>	<b>26</b>	<b>26</b>
<b>Total Samples/Records for 2011</b>		<b>312</b>	<b>312</b>	<b>312</b>	<b>48</b>	<b>12</b>	<b>312</b>	<b>48</b>	<b>300</b>	<b>48</b>	<b>96</b>	<b>312</b>	<b>60</b>	<b>60</b>	<b>312</b>	<b>312</b>	<b>312</b>

### Modifications for 2011

Discontinued Stations  
 ITEWARDSPT - Edwards Point  
 KSQU01 - Ray's Boathouse  
 LTEH02 - Pier 48  
 LTTL02 - Duwamish Park

Discontinued Stations  
 LSLT02 - MeeKwaMooks Park  
 MTEC01 - Seahurst Park  
 MTXA01 - Point Robinson Park  
 MRUW01 - Lisabuela Park

Parameter Change  
 Replace Total Kjeldahl Nitrogen with Total Nitrogen at 7 stations (8 samples).  
 Replace Total Phosphorus with Orthophosphate at all stations.



**2011 Marine Offshore Program  
Ambient Subtidal Sediments  
Laboratory and Field Parameters**

Locator	Station Description	Laboratory									Field							
		BNAs (incl. Total Nonylphenols)	Chlorinated Pest/PCBs	PBDES	Butylin Isomers	Total Metals	Total Solids	Total Organic Carbon	PSD	Ammonia	Total Sulfide	Sample Start Time	Sample Depth	Sediment Sampling Depth	Sediment Sampling Range	SampcoordX	SampcoordY	Sediment Description
KSZY01	Elliott Bay - Pier 90/91	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LTAA02	Elliott Bay - Grain Terminal	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LSCW02	Elliott Bay - Outer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LTCA02	Elliott Bay - North Central	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LTDF01	Elliott Bay - Central Waterfront	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LTED04	Elliott Bay - South Central	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LSHZ08	Elliott Bay - Cove 2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LTGF01	Elliott Bay - Harbor Island	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
<b>Total Samples/Records</b>		<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>

**Notes**

Samples will be collected from the 0 to 2 cm depth stratum.

Samples will be composited from a single deployment of dual van Veen grab samplers, unless additional deployments are needed to get sufficient sediment for all analyses

Metals will include Al, As, Cd, Cr, Cu, Fe, Pb, Hg, Ni, Se, Ag, Sn, and Zn.

All analyses will be performed following QA1 guidance.

Sampling and analysis will follow the 2009 SAP, which will be updated and amended as appropriate

