

EXECUTIVE SUMMARY

The King County Department of Natural Resources and Parks Wastewater Treatment Division operates and maintains three wastewater treatment plants (West Point, South Plant, and Vashon Island) and two combined sewer overflow treatment plants (Alki and Carkeek) that discharge treated effluent into the Central Puget Sound Basin. King County conducted monitoring in 2002 and 2003 as part of a routine marine monitoring program to verify that these discharges are not degrading water quality within the vicinity of the treatment plant outfalls and to identify pollution problems from other sources. The monitoring program consisted of two components: outfall monitoring focusing on areas near treatment plant discharges and ambient monitoring focusing on areas outside the immediate vicinity of treatment plant discharges. Monitoring areas outside the influence of outfall discharges is necessary in order to assess background conditions in central Puget Sound. The marine monitoring program is part of an inter-governmental monitoring effort, the Puget Sound Ambient Monitoring Program (PSAMP).

In 2002 and 2003, 12 outfall sites were sampled: six offshore and six beach. Water samples were collected monthly at all 12 sites and analyzed for fecal indicator bacteria (fecal coliforms and enterococci). Nutrients and physical parameters were also analyzed at nine and ten sites in 2002 and 2003, respectively. Dissolved metals were analyzed in water samples from five beach sites in 2002. Sediment and shellfish were collected in August at four beach sites both years and analyzed for organic compounds, metals, and conventional parameters. Algae samples were collected at the same four sites and analyzed for metals. Offshore sediments were not collected at the treatment plant outfalls in either year, with the exception of the Denny Way CSO site where sediment was collected in 2002 and analyzed for organic compounds, metals, and conventional parameters. Sediments at the treatment plant outfalls are currently collected on a rotational basis once every five years based upon National Pollutant Discharge Elimination System (NPDES) permit cycles.

Twenty-six and twenty-two sites were sampled in 2002 and 2003, respectively, for the ambient monitoring program. In 2002, 11 offshore, 1 creek, and 14 beach sites were sampled and in 2003, 5 offshore, 1 creek, and 16 beach sites were sampled. Water was analyzed for fecal indicator bacteria at 20 and 22 sites in 2002 and 2003, respectively and at 10 sites for nutrients and physical parameters. Dissolved metals were analyzed in water samples from four beach sites in 2002. Offshore and beach sediments were collected at six and four sites respectively in 2002 and beach sediments were collected at three sites in 2003. Shellfish and algae were collected at two sites in 2002 and three sites in 2003. Sediment and shellfish were analyzed for organic compounds, metals, and conventional parameters and algae samples were analyzed for metals.

The Marine Outfall Siting Study (MOSS) sampling program was developed to assist in siting the marine outfall for the Brightwater Treatment System. Beach water sampling began in March 2000 for this program and continued until March 2002 at six sites; three sites were sampled monthly throughout 2002. Water samples were collected at all nine sites and analyzed for fecal indicator bacteria (fecal coliforms, enterococci, and *E. coli*), nutrients, and

physical parameters. Sediment, shellfish, and algae were collected at one site and analyzed for the same parameters as those analyzed for the outfall and ambient programs.

PRECIPITATION DATA

A drier than normal year occurred in 2002 with an annual rainfall total of 31.36 inches compared to the 30-year average of 36.54 inches. Between August and November, 2002 was an usually dry period with only 39% of the normal rainfall amount during these months. This prolonged dry spell also brought warm temperatures. A wetter than normal year occurred in 2003 with an annual rainfall total of 41.78 inches. It rained 5.02 inches on October 20, 2003. If the five inches that fell on this day are excluded from the annual rainfall total, 2003 would have been an average rainfall year.

MONITORING RESULTS

Water

Water quality monitoring results in 2002 and 2003 were consistent with past findings and indicated the following:

- Fecal coliforms in offshore waters were consistently low, with over 75% of all samples collected in 2002 and 2003 having either no detectable levels or 1 colony forming unit (CFU)/100 ml.
- Fecal indicator bacteria levels measured at the wastewater treatment plant outfalls were similar to ambient sites.
- Sites that failed fecal coliform water quality standards were in areas with reduced circulation and/or near a freshwater source.
- A downward trend in geometric means for beach stations was noted for the past several years, but may be related to annual precipitation patterns.
- A well-mixed water column persisted throughout most of the year (for both 2002 and 2003), with seasonal stratification occurring in the summer corresponding to a rise in air temperature and solar radiation.
- Dissolved oxygen concentrations were above the 7.0 mg/L extraordinary water quality standard for most of the year, except during late summer and fall when oceanic water containing naturally low amounts of dissolved oxygen entered the Sound. Concentrations rarely dropped below 5.0 mg/L.
- All ammonia concentrations were well below the Washington State ammonia chronic criterion. The highest ammonia concentrations were detected at the West Point and South Plant outfalls at the trapping depth of each outfall plume.
- Nutrient levels in the water column fluctuated seasonally with phytoplankton growth and uptake.

- The timing of phytoplankton blooms was similar to previous years. A strong bloom was evident at most stations in May and June of 2002 and in July and August in 2003.
- Dissolved metal concentrations at beach sites were below the water quality criterion for each metal and concentrations near wastewater and CSO outfalls were similar to ambient sites. Metal concentrations showed little variability, with the exception of copper. The highest copper values were detected at sites with heavy commercial vessel traffic, possibly corresponding to the use of copper-based antifouling paints on ship hulls. Copper is also a constituent in wood preservatives utilized on pilings.

Sediment

Sediments at the five treatment plant outfalls (West Point, South Plant, Vashon, Alki CSO, and Carkeek CSO) were not collected in either 2002 or 2003 as they are collected on a rotational basis per NPDES permits. Results from offshore sediments collected in 2002 at ambient sites and the Denny Way CSO outfall, and beach sediments collected in both 2002 and 2003 were similar to past findings and indicated the following:

- Silver was only detected in offshore sediments at the sites closest to the Seattle waterfront, where there is known historical contamination.
- Arsenic and mercury were detected in all offshore sediments but none of the beach sediments. Concentrations for both metals were highest at sites along the Seattle waterfront and mercury exceeded the Sediment Quality Standard (SQS) at two of the three waterfront sites.
- Beach sediments contained typical metal concentrations and no value exceeded an SQS.
- The highest concentrations of PCBs, PAHs, and tributyltin were detected at the three stations closest to the Seattle waterfront. PCB and PAH values did not exceed SQSs. An SQS does not exist for tributyltin.
- The phenol concentration measured at the station near the Shilshole Bay Marina exceed the SQS.
- Beach sediments near treatment plant and CSO outfalls (excluding the Denny Way CSO site along the waterfront) had concentrations of metals and organics comparable to or lower than ambient sites.

Shellfish

Shellfish tissues (butter clams) were collected in August of both 2002 and 2003 and analyzed for metals and organic compounds. A minimum of 5 clams were collected and composited into one sample for each site. Results indicated the following and were similar to past findings:

- Butter clams had a low lipids content, less than 1%.

- Tissues contained arsenic, cadmium, chromium, lead, and nickel concentrations below the Food and Drug Administration (FDA) Level of Concern for each of these metals. FDA Levels of Concern were established for the protection of human health from shellfish consumption.
- Mercury concentrations were below the FDA Action Level. Shellfish cannot be commercially traded if values are over this Action Level.
- Metal concentrations in clam tissues from sites near treatment plant outfalls were similar to tissue concentrations from ambient sites.
- Benzoic acid and beta-BHC were the only organic compounds detected.
- Fecal indicator bacteria levels in clam tissues were highly variable both spatially and temporally.

Macroalgae

Macroalgae (algae) samples consisting entirely of the edible algae, *Ulva fenestrata* (known as sea lettuce), were collected in August of 2002 and 2003. Results were consistent with past findings and indicated the following:

- Selenium, beryllium, and mercury were not detected in either year, nor in previous years.
- Metal concentrations varied spatially.
- Concentrations in samples collected near treatment plant outfalls were equivalent to concentrations measured in samples from ambient sites.