

Nearshore sediment monitoring for the Stormwater Action Monitoring (SAM) program, Puget Sound, Western Washington



Robert Black¹, Abby Barnes², Colin Elliot³, Jennifer Lanksbury⁴

1. USGS Washington Water Science Center; 2. WDNR; 3. KCEL; 4. WDFW TBiOS

Contact: Robert W. Black, rwblack@usgs.gov

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- Chemical concentrations of metals and organics in nearshore sediments adjacent to Urban Growth Areas are generally low.
- Nearshore sediment chemical concentrations are significantly related to Puget Sound Drift Cells.

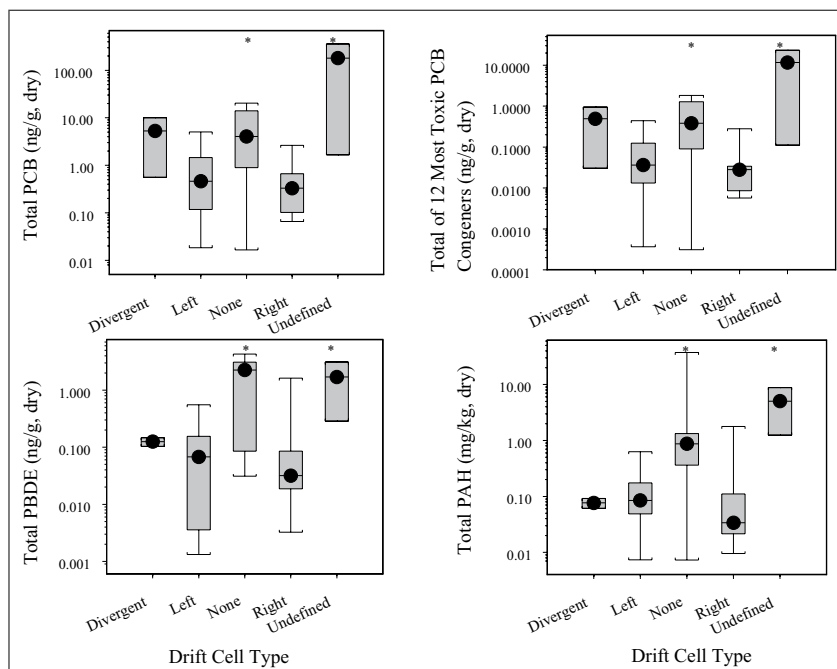
Chemicals such as metals and organics (polychlorinated biphenyl [PCBs], polybrominated diphenyl ethers [PBDEs], polycyclic aromatic hydrocarbons [PAHs], and phthalates) continue to enter Puget Sound from point sources, combined sewer outfalls, and non-point sources. Runoff during storm events has been identified as a major source of contamination entering Puget Sound and has been implicated in the degradation of nearshore habitats and biota. Metals, organic chemicals, and other pollutants are known to accumulate in sediments such as those present along the shoreline of Puget Sound. As part of the Stormwater Work Group of Puget Sound's strategy to address sediment conditions in the nearshore, a regional monitoring program was designed to inform requirements for municipal stormwater permits issued by the Washington State Department of Ecology (Ecology). The monitoring program is referred to as the Stormwater Action Monitoring (SAM).

The focus of the initial monitoring effort was to characterize the status, spatial extent, and quality of Puget Sound sediment chemicals in nearshore sediment adjacent to Urban Growth Areas

(UGAs). Sampling sites were selected using a spatially balanced probabilistic Generalized Random Tessellation Stratified (GRTS) sampling design. A benefit of the GRTS sampling design is that it allows one to extrapolate from a small number of sampled nearshore sites to the entire UGA nearshore shoreline of Puget Sound.

A total of 41 randomly selected sites were sampled in late summer of 2016. All sampling sites were located at 6 feet below the Mean Lower Low Water line. The top 2–3 centimeters of sediment were collected using a box corer and sieved to 2 millimeters and analyzed for PCBs, PBDEs, PAHs, phthalates, metals, total organic carbon, and grain size. Multiple statistical approaches were used to examine relations between chemical concentrations and land cover within the watersheds adjacent to sampling sites. The influence of marine hydrodynamic factors on nearshore sediment chemical concentrations was evaluated by assigning each site to one of five nearshore drift cell types based on its location. Each drift cell represents a long-term directional transport of sediment from its source to its depositional zone.

The nearshore sediment chemical concentrations for organics and metals were low, and in most cases less than criteria. The concentrations of some PAHs were greater than criteria, but these exceedances were limited to one or two sites. Based on study findings, 96% of the 1,344 km of UGA Puget Sound shoreline have PAH sediment concentrations less than criteria, while PCBs and PBDEs concentrations are less than criteria at more than 98% of the UGA shoreline. For metals, 100 percent of the nearshore sediment had concentrations less than criteria. While measured watershed attributes adjacent to the sampling sites were weakly related to chemical concentrations, concentrations were significantly related to drift cell types. Sediment chemical concentrations were significantly higher in drift cells with limited sediment movement compared to those with higher sediment transport energy. The results of this study will help Ecology refine municipal stormwater permit requirements as well as help other agencies develop nearshore and marine monitoring and restoration programs.



Box plots summarizing nearshore sediment chemistry concentrations by drift cell type. Divergent: drift cells with divergent flow, Left: drift cells flowing left to right looking at the shore, None: low energy drift cells with no specific flow direction, Right: cells flowing right to left looking at the shore, Undefined: cells with undefined flow (for this study, these cells were low energy). *: significantly higher concentrations.

RECOMMENDED CITATION

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