

# Polybrominated Diphenyl Ethers (PBDEs) in Puget Sound Sediments (2004-2008)

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## Summary

- The PSAMP Sediment Component is establishing a baseline of PBDE concentrations in Puget Sound sediments. This baseline will be useful in future sediment management activity.
- BDE-47, -99, and BDE-209 were detected in sediments from 7 PSAMP surveys, and in the highest percent (70%, 38%, 26%, respectively) of 210 stations sampled. They are in highest concentrations in and near urban embayments. Puget Sound levels of these 3 congeners were higher than similar levels in some European and Asian sediments.
- BDE-184 and -191 were found only in Boundary Bay, in the path of the Fraser River sediment plume.



## II. PBDEs in Puget Sound Sediments

Results from 210 sediment stations in 4 monitoring regions, 2 urban embayments, and 10 long-term locations, collected from 2004-2008, are summarized and presented in Figure 1 and Table 1.

### Patterns seen in these data include:

- BDE-47, -99, and -209 were detected in sediments from all 7 PSAMP surveys, and in the highest percentage of stations – 70%, 38%, and 26%.
- BDE-209 was most frequently detected and had the highest concentrations (up to 27 ppb) in urban sediments, including Everett Harbor, deep Central Basin, Commencement Bay, Elliott Bay/Lower Duwamish, and Sinclair Inlet.

## I. Introduction

**Polybrominated diphenyl ethers (PBDEs)** are a class of brominated hydrocarbons which have been in wide commercial production and use since the early 1970s. They are used as flame retardant additives in plastics, foams, textiles, adhesives, coatings, and other household and commercial products.

Structurally similar to polychlorinated biphenyls (PCBs), PBDEs are now known to break down and enter the ecosystem. PBDEs have been classified as **Persistent Bioaccumulative Toxics (PBTs)**, and the **Washington State Chemical Action Plan** for PBDEs calls for baseline monitoring in Puget Sound.

The Washington State Department of Ecology's Marine Sediment Monitoring Team has measured PBDE levels in Puget Sound sediments since 2004 as part of the **Puget Sound Assessment and Monitoring Program (PSAMP) Sediment Component**.

- BDE-47 had the second highest concentrations in urban sediments (up to 8 ppb in Elliott Bay/Lower Duwamish).
- BDE-49 was also detected in sediment from all PSAMP surveys except the Strait of Georgia, and in 15% of all stations.
- BDE-100, -153, -154, -183, -184, and -189 were detected in  $\leq 7\%$  of all stations.
- BDE-66, -71, and -138 were never detected in these stations.
- With the exception of BDE-209 and -47, BDE concentrations were generally below 1 ppb.
- BDE-184 and -191 were only detected in the Strait of Georgia in 5 Boundary Bay stations; possibly a contaminant signal from the Fraser River.



Table 1. Number and percent of stations with detected levels of each PBDE congeners collected throughout Puget Sound.

Sampling Year	Study area	Number of Stations Sampled	Number of Stations with Detected Levels of each PBDE Congener												
			BDE 47	BDE 49	BDE 66	BDE 71	BDE 99	BDE 100	BDE 138	BDE 153	BDE 154	BDE 183	BDE 184	BDE 191	BDE 209
2004	Hood Canal	30	17	NA	NA	NA	10	1	NA	1	0	NA	NA	NA	NA
2005	Puget Sound Temporal	10	7	1	0	0	4	4	0	0	0	0	0	NA	5
2006	Strait of Georgia	40	29	0	0	0	14	1	0	2	1	0	6	5	1
2007	Whidbey Basin	40	22	2	0	0	4	0	0	0	1	0	0	0	1
2007	Elliott Bay	30	24	14	0	0	13	1	0	0	1	1	0	0	8
2008	Central Sound	30	21	6	0	0	12	2	0	0	0	1	0	0	10
2008	Commencement Bay	30	28	4	0	0	22	5	0	5	4	1	0	0	21
		<b>Total:</b>	<b>210</b>	<b>148</b>	<b>27</b>	<b>0</b>	<b>79</b>	<b>14</b>	<b>0</b>	<b>8</b>	<b>7</b>	<b>3</b>	<b>6</b>	<b>5</b>	<b>46</b>
		<b>Percent of stations with detected congeners:</b>	<b>70</b>	<b>15</b>	<b>0</b>	<b>0</b>	<b>38</b>	<b>7</b>	<b>0</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>26</b>

## III. Comparison of sediment BDE levels nationally and worldwide

Sediment BDE data were compared with values measured in San Francisco and various European and Asian estuarine and marine surveys (Figure 2).

- As in Puget Sound, BDE-47, -99, and -209 were the prevalent congeners accumulating in sediments. Other congeners, if measured, were detected at minimal levels.
- Levels of BDE-47, -99, and -209 in Puget Sound sediments were higher than or similar to levels measured in sediment surveys conducted in the Baltic Sea, Norway, Denmark, and Korea.
- Levels of BDE-47, -99, and -209 in Puget Sound sediments were lower than levels measured in sediments from surveys in San Francisco Bay and the United Kingdom.

Figure 2. Mean ( $\pm 1$  std error) concentration (ppb) of 13 BDE congeners measured in marine sediments in Puget Sound and worldwide.

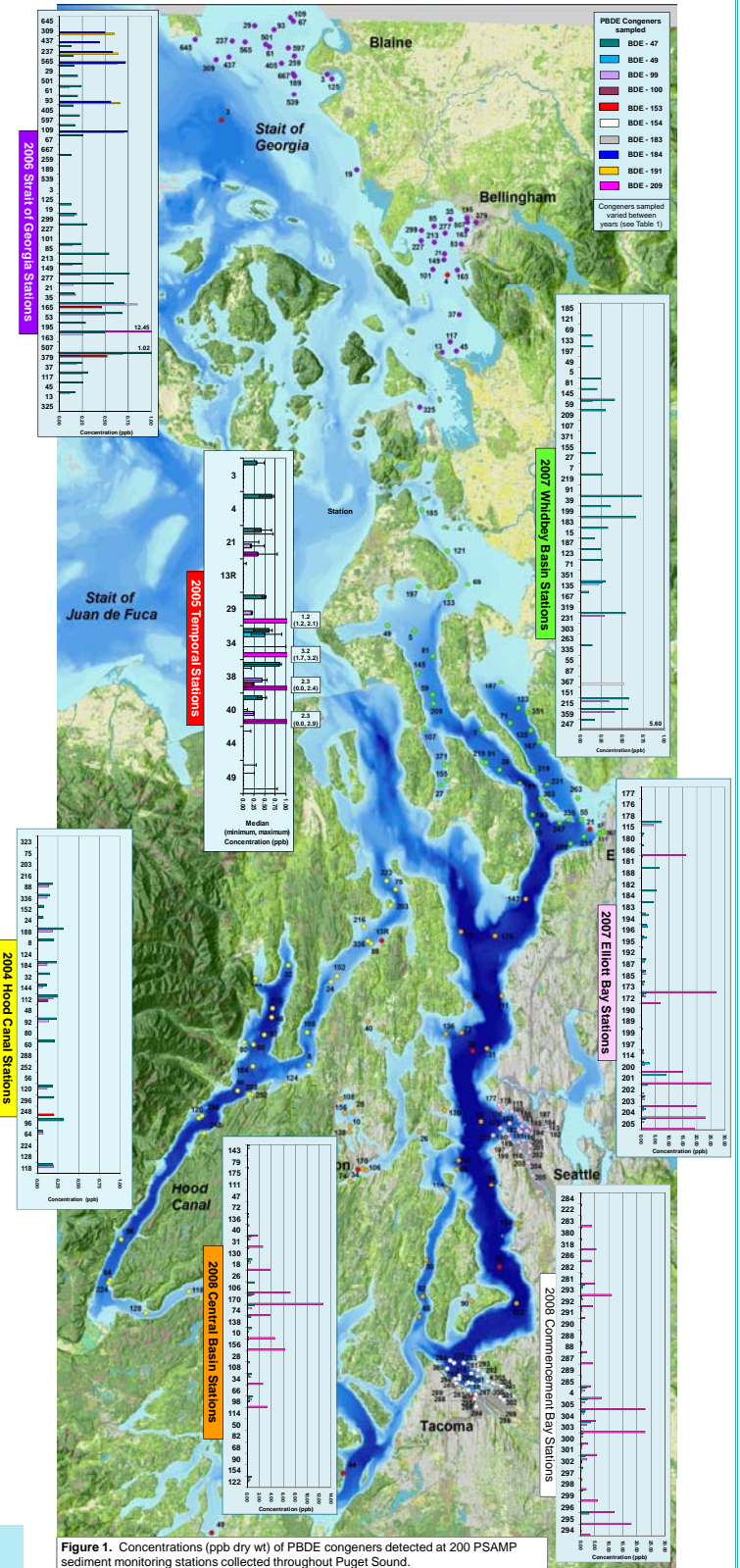
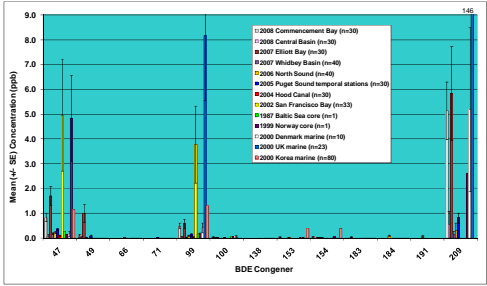


Figure 1. Concentrations (ppb dry wt) of PBDE congeners detected at 200 PSAMP sediment monitoring stations collected throughout Puget Sound.