Appendix C: Case Studies

Content: *This appendix details two case studies that compare actual sediment remedy monitoring at Bremerton Naval Complex and Wyckoff/Eagle Harbor to the guidance and information provided by the matrices. The case studies were conducted not only to validate and refine the matrices, but also to illustrate the use and interpretation of the matrices using real-world sediment remedy monitoring examples at the two case study sites.*

C.1. Validation and Refinement of the Matrices

Overall, the information and structure of the matrices corresponded well to the real-world monitoring plans reviewed in the case studies. The case studies provided a validation of the matrices, and in some instances, prompted minor refinements to detailed information. Key conclusions of the validation and refinement process include:

- **The matrices provide a comprehensive and accurate overview of possible sediment remedy monitoring needs and tools.** Greater than 90% of the monitoring needs and monitoring tools present or considered at these sites were presented and discussed in the matrices. Based on the case studies, the matrices present users with most of the monitoring needs likely to be encountered during monitoring and provide most of the monitoring tools available for addressing monitoring needs.

- **The organization and design of the matrices facilitate the retrieval of information on sediment monitoring planning.** All monitoring needs and tools of the case study monitoring plans could be organized and categorized according to organizational hierarchy of the matrices (classification according to remedy, then remedy need, etc.). This suggests that the organization of the matrices was able to place the wide variety of monitoring needs and tools into logical groups and categories. The organizational ability of the matrices is important because a good organizational hierarchy facilitates a user's understanding of sediment remedy monitoring and enables them to efficiently navigate the matrices in order to identify the most relevant need and tool information.

- **Monitoring tool information in the matrices provides relevant information to identify potential monitoring tools.** As highlighted in the case studies, many of the most important monitoring tool considerations noted by case study project managers are listed in the matrices. This confirms that monitoring tool information provided in the matrices is relevant and accurate compared to information routinely considered during sediment remedy monitoring. Accurate and relevant information enables matrices users to efficiently identify potential monitoring tools.

- **The matrices were refined based on case studies.** Based on new information collected during the case studies, such as new monitoring tool information or important details to consider for particular monitoring needs, approximately 5% of the fields contained in the matrix were modified. Approximately 3-4 new monitoring tools were added to the matrices.

Although the case studies represented a crucial internal validation and refinement step for this project, presenting an overview of each of the case studies in this section further illustrates how the matrices should be used. The case studies provide examples of how information in the matrices relates to "real world" remedial monitoring plans. In addition to many examples of how monitoring needs and tools were identified at the sites covered in these case studies, and how information in the matrices could be used to reach similar conclusions, a key message throughout the case studies is that readers should consider site-specific conditions during review of information provided by the matrices.

C.2 Bremerton, Washington (Puget Sound Naval Shipyard)

C.2.1 Site Description

Puget Sound Naval Shipyard (PSNS) is currently a 1,350 acre site that serves as a home port for Navy vessels, including aircraft carriers. The site has six major piers, six large dry docks, and more than 400 buildings supporting industrial operations throughout the complex. The site is contained in the marine environment of operable unit (OU) B which includes the nearshore portion of Sinclair Inlet that extend east and west along the shorelines of the Bremerton Naval Complex in Puget Sound, Washington.

C.2.2 Problem

The primary contaminants of concern are PCBs and mercury. The remedial investigation concluded that concentrations of these contaminants in fish tissue, assumed to be present due to elevated concentrations in site sediment, were associated with unacceptable levels of human health risk. Ecological risk was found to be insignificant.

C.2.3 Description of Selected Remedies

Remedies included dredging, capping, and monitored natural attenuation (Figure C.1).

C.2.3.1 Dredging

Approximately 200,000 cubic yards of sediment containing PCBs was dredged in an area of 32 acres and disposed of in excavated confined aquatic disposal (CAD) cells. CAD cells were located on Navy owned submerged land. Sediments with PCB concentrations greater than the remedial action level of 12 mg/kg organic carbon (OC) were removed by dredging. Sediments that were also dredged where mercury concentrations exceed 3 mg/kg and PCB concentrations exceed 6 mg/kg OC. An accumulation of sediments above the acceptable level at the mouth of Drydock 1 were also dredged. While PCBs in this area were below 6 mg/kg OC, mercury had been found above 3 mg/kg nearby.

The remedial design required that areas targeted for dredging be dredged to a minimum depth of 2 feet. With an allowance for overdredge depth and side slopes, the volume of impacted sediments dredged for environmental remediation is estimated at 200,000 in-place cubic yards. Dredging was accomplished mechanically with a clamshell bucket.