Executive Summary

As part of the restoration of intertidal habitat in south Sequim Bay, Washington, creosoted pilings were removed from a former log yard west of the mouth of Jimmycomelately Creek. In a partnership with the Environmental Protection Agency (USEPA) Brownfields Program, the Jamestown S'Klallam Tribe (the Tribe) conducted a monitoring program associated with the piling removal. The purpose of this report is to summarize the results of monitoring activities that occurred prior to, during, and after piling removal. The potential for human health and environmental risk associated with polycyclic aromatic hydrocarbons (PAHs) in the former log yard and vicinity was evaluated prior to and following piling removal. The human health risk assessment evaluated risks to the general public and Tribal members, based on USEPA human health standards. Environmental risk was evaluated relative to the State of Washington sediment quality standards.

The pilings and their associated "footprint" occupied valuable tidelands that were once rich eelgrass and mudflat habitats and supported shellfish and salmon prey resources. In order to protect recovering salmon runs, remove a potential source of creosote contamination, and restore the historic habitat and important shellfish beds, the Tribe removed 99 creosoted pilings from the former log yard.

Creosote is a coal tar distillate used to preserve wood pilings and is composed primarily of PAHs. In some cases, creosote has been shown to leach from pilings into the marine and freshwater environment, resulting in elevated concentrations of PAHs in the surrounding waters and sediments. Creosote-derived PAHs have been linked with sediment toxicity and elevated tissue concentrations in biota. Creosote also represents a potential human health risk associated with harvest and consumption of PAH-contaminated shellfish.

In order to determine whether the sediment and harvestable shellfish in the former log yard were contaminated with PAHs and to determine whether piling removal activities resulted in changes in the distribution of these PAHs, monitoring was conducted prior to, during, and after piling removal.

Prior to piling removal: The assessment of sediments prior to piling removal indicated that PAH contamination from the former log yard activities was not spread throughout the south Sequim Bay. Furthermore, PAHs were found to be highly localized within the former log yard, limited to those sediments within 12" to 48" of the pilings. Concentrations of PAHs in pre-removal sediments collected from the immediate vicinity of pilings ranged from 677 to over 189,868 µg/kg dry weight (dw). Total PAH concentrations showed a steep gradient away from the pilings, with sediment collected from 2" away from the pilings having PAH concentrations on average 29 times greater than that of the 6" stations and 90 times that of the 12" stations. PAHs were mostly limited in their

distribution to surface sediments, with substantially lower concentrations in the compacted sands found at depth greater than 2 ft. below the sediment surface. However, there were a few discrete areas with higher concentrations of PAHs in subsurface sediment as well as surface sediment.

Tissues from intertidal Japanese littleneck (*Tapes japonica*) and native littleneck (*Prototheca staminea*) clams, that were collected from the immediate vicinity of the pilings (within 24"), showed some evidence of creosote contamination; however, this was also found to be highly localized. Little or no detectable PAHs were found in clams collected from locations approximately 48" from pilings and from the control sites 150 m and 500 m from the former log yard. A human health risk assessment was conducted using the PAH concentrations in the clam tissues. The assessment used consumption rates for Tribal and non-Tribal people, adults and children, harvesters and shellfish consumers. It showed that incremental human health risks from the consumption and harvest of clams from the former log yard and control sites, prior to removal, were within acceptable limits for both cancer-causing and non-carcinogenic PAHs, as defined by the USEPA (1989).

During piling removal: The pilings were removed using a vibratory hammer suspended from a crane stationed on the deck of a barge. The barge was maneuvered from one group of pilings to the next by a tug boat. Extracted pilings were placed on the deck of the barge within a containment basin. In an effort to contain any oil sheens and creosoted wood debris, floating oil booms and absorbent pads were placed to encircle each piling(s) prior to removal. Methods for vibratory extraction, sheen and debris containment, and piling disposal were approved by USEPA and the U.S. Fish and Wildlife Service (USFWS).

Monitoring during piling removal included measures of total suspended solids (TSS), turbidity, and PAHs in water. TSS and turbidity are measures of the amount of sediment and associated material that is stirred up from the bottom during removal activities. TSS was measured using fixed optical backscatter sensors (OBS) located within 1 m and 5 m of the pilings being removed, as well as from a control location upcurrent of the removal activities. Based on the TSS measures, the primary source for sediment resuspension during piling removal was prop wash from the tug boat as it maneuvered the barge to and from piling removal locations. This influence was increased by "live boating," the use of the tug props to continuously hold the barge on location, which was necessitated by the absence of operating spuds to hold the barge in position. Generally, elevated TSS concentrations did not remain for more than five to ten minutes after the tug had positioned the barge. It should be pointed out that the former log yard is located in very shallow waters and it is not uncommon to have elevated turbidity from wind waves in this area.

Activation of the vibratory hammer generally resulted in some increase in TSS, with average TSS concentrations of 25 mg/L (15 mg/L above the background level of approximately 10 mg/L). Generally, increases in turbidity during the activation of the vibratory hammer were highly localized, affecting only the OBS sensor within 1 meter of the piling. The extraction of pilings resulted in greater increases in TSS, with average concentrations of 40 mg/L near the piling and 26 mg/L at the sensor located 5 to 10 m from the piling (approximately 30 and 16 mg/L above background, respectively). It was difficult to determine how long the turbidity plume persisted, because the tug boat prop wash would overwhelm the signal from the piling removal soon after the piling was pulled.

TSS samples collected at the control site and along a transect across south Sequim Bay indicated that the sediment resuspension influence of the piling removal activities was limited to the area between the former log yard and the mouth of Jimmycomelately Creek.

PAHs were observed in the water column during the piling removal process. Generally, PAH concentrations were unchanged or increased only slightly during the activation of the vibratory hammer. The highest PAH concentrations were observed during the pull, with a visible sheen sometimes appearing at the surface. Total PAH concentrations ranged from <1 to 200 µg/L and typically decreased moving up in the water column and away from the bottom. Elevated PAH concentrations persisted five minutes after the pull; however, the ability to determine trends over time was limited by tug and barge activities. All observed PAH concentrations were below the published Lowest Observable Effects Concentrations of 300 µg/L (NOAA 2003).

Post piling removal: Following piling removal, sediment was collected from 50 randomly selected locations in the former log yard and vicinity. The post-removal PAH concentrations were very low, with total PAHs ranging from 0 to 500 µg/kg dw. Despite the detection of PAHs in the water column during piling removal and mobilization of sediments from the log yard, it did not appear to result in a redistribution of the higher PAH concentrations observed in the immediate vicinity of the pilings. All sediment-PAH concentrations observed following piling removal were below Washington Department of Ecology Sediment Quality thresholds (Washington Administrative Code [WAC] Chapter 173-204), indicating that sediments from the former log yard do not likely represent a significant environmental risk to invertebrates or fish.

A post-removal human health risk assessment was conducted using PAH concentrations in clam tissues. In post-removal clams collected from intertidal locations in the vicinity of the former log yard and control sites, PAHs were

either not detected, or were detected at very low concentrations. Based on the lack of any detectable levels of carcinogenic PAHs in the existing clam tissue, there would be no unacceptable increased cancer risk to tribal members or the public from the consumption of clams currently found in the former log yard. Based on the very low concentrations of non-carcinogenic PAHs observed in the post-removal clam tissues, there was also an absence of non-cancer risk from the consumption of clams currently found in the former log yard.

A second post-removal human health risk assessment was performed using modeled tissue concentrations that were based on post-removal sediment PAH concentrations collected from throughout the former log yard. Based on this assessment, the incremental increase in cancer and non-cancer health risks from the consumption and harvest of shellfish from all areas of the former log yard were within USEPA acceptable risk levels.

Conclusions: The results of this study indicated that PAHs in the sediment and clam tissues collected from the former log yard were highly localized in the immediate vicinity of the 99 pilings that were removed. While the piling removal process did result in some redistribution of log yard sediments, it did not appear to result in a spreading of the sediments with higher PAH concentrations that were documented in the immediate vicinity of the pilings prior to removal. Based on WDOE sediment quality standards, sediments from the former log yard do not likely represent a significant environmental risk to invertebrates or fish. Based on post-removal PAH concentrations in sediment and clam tissues, the human health risk associated with the harvest and consumption of shellfish from the areas of the log yard and control sites is within USEPA acceptable limits.