Palos Verdes Shelf Superfund Site

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Remedial Investigation Report Completed; Feasibility Study Underway

The Palos Verdes Shelf Superfund site is an area of contaminated sediment off the Palos Verdes Peninsula. The contaminated sediment lies in the Pacific Ocean at depths of 150 ft. and more, too deep for human contact. However, the fish found in the Palos Verdes Shelf area contain high concentrations of DDT and PCBs. Although current concentrations have dropped from historical highs, concentrations of DDT and PCBs in fish continue to pose a threat to human health and the natural environment.

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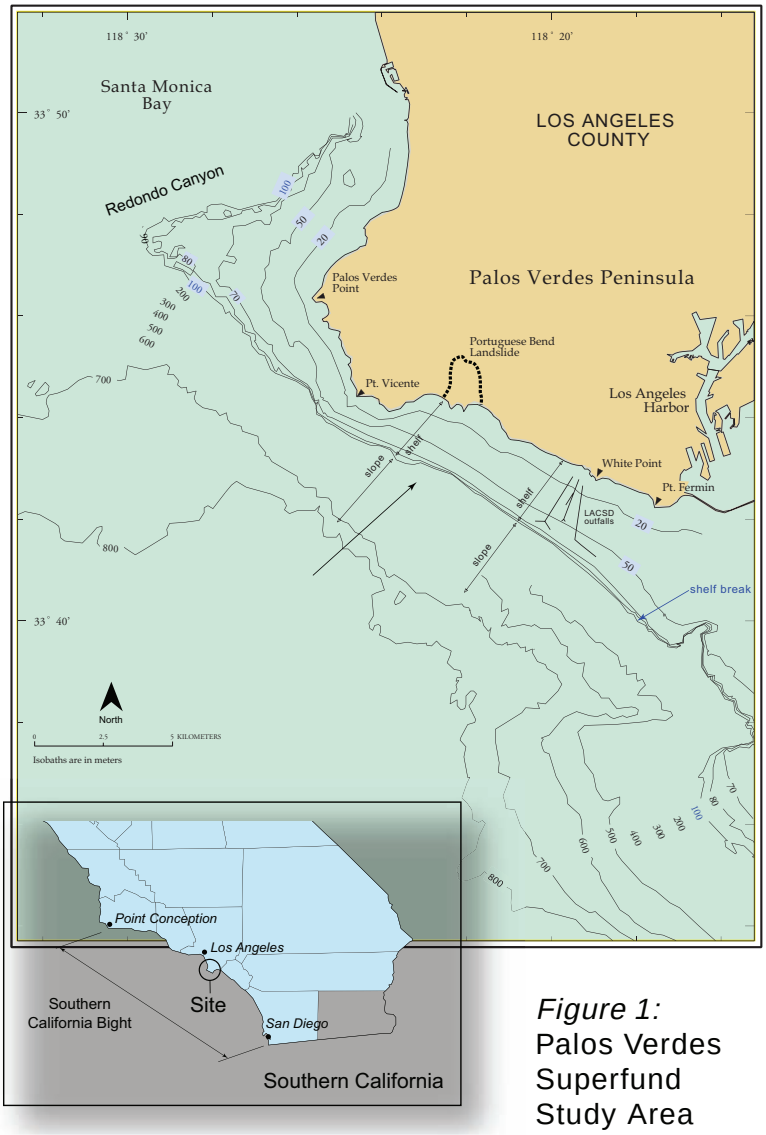

Figure 1: Palos Verdes Superfund Study Area

Remedial Investigation Report At-A-Glance

The Remedial Investigation (RI) summarizes:

- the nature and extent of contamination,
- the transport and fate of the contamination
- current risk to human health and the environment from the site.

Although discharge of DDT and PCBs stopped over 30 years ago, these persistent pollutants remain in the sediment off Palos Verdes Peninsula. The RI found the quantity of DDT and PCBs has dropped over the years. Some of the contaminants have been carried off the shelf into deeper waters, some have been diluted by mixing with cleaner sediment, and within the contaminated sediment deposit we found evidence that DDT—but not PCBs—is slowly breaking down. The RI report used new fish data to recalculate the risk to human health posed by the site and found that fish, especially bottom-feeders like white croaker, still contain levels of DDT and PCBs that warrant fish advisories (see Table 1, Pg. 7). The site still poses a threat to wildlife in the area as well, although we have seen some indications of recovery, like bald eagles nesting on the Channel Islands.

EPA has been addressing the immediate threat to human health by working with state and local agencies as well as community groups to reduce consumption of fish species most likely to contain high concentrations of contaminants. The Institutional Controls program is described on Page 4. Concurrently, EPA began the Superfund process of investigation, risk assessment, and remedy selection.

This fact sheet summarizes EPA's Remedial Investigation (RI) Report that presents our current understanding of conditions in the Palos Verdes Shelf Study Area. The full RI Report for the Palos Verdes Shelf Superfund Site is available online at EPA's Region 9 website: www.epa.gov/region09/waste/sfund/pvshelf.

Following the RI, EPA will formulate potential remedies to reduce the risk to human health and the environment posed by the site. These alternative remedial actions will be described in a Feasibility Study, scheduled to be released for public review in Fall 2008. EPA will describe its preferred alternative in a proposed plan that will be available for comment at public meetings in the San Pedro/Palos Verdes Peninsula vicinity.

Site Characteristics

The California coast from Pt. Conception to the Mexican border curves inward, forming a large bay called the "Southern California Bight." The Palos Verdes Peninsula is a small but prominent land mass extending into the Southern California Bight. It is bordered by Santa Monica Bay to the north and the San Pedro Shelf to the south. The Channel Islands lie to the west and northwest. The narrow underwater shelf off the Palos Verdes Peninsula is called the Palos Verdes Shelf. It is approximately 9 miles long and less than 1½ miles wide. The seabed over most of the shelf slopes at a gentle 1 to 3 degrees. The shelf breaks at a depth of 250 to 300 feet, then drops steeply over 2,300 feet to the ocean floor. (See **Figure 1**.)

A 1933 study of the Palos Verdes Shelf characterized it as an area of rocky outcrops and kelp beds. Since then, urbanization, the Portuguese Bend Landslide, and the White Point outfalls have changed that. From the 1930s through the 1980s, the White Point outfalls have discharged onto the shelf about 4 million tons of sediment. North of the outfalls, the Portuguese Bend Landslide has contributed an estimated 6 to 9 million tons of sediment onto the shelf since the 1950s. Engineering measures have stabilized the landslide; nevertheless, the toe of the landslide continues to erode and act as a source of sediment.

The current and wave patterns along the Palos Verdes Shelf vary by season and location. **Figure 2** shows the general flow patterns for the Southern California Bight. Dominant ocean circulation patterns include the southward-flowing California Current, the northward-flowing California Countercurrent, and seasonal influences by the northward-trending Davidson Countercurrent. Surface and bottom waters are typically separated in spring through fall by a pycnocline (a zone of rapid change in seawater density) occurring at depths of 30 to 100 ft. Currents below the pycnocline on the shelf generally flow to the northwest, parallel to seabed contours. In contrast, surface currents flow predominantly southeastward, although they shift to a westerly flow in late autumn and early winter when westerly winds weaken. Most of the time, near-bottom waves and currents do not resuspend sediment; however, episodically, primarily during storms, currents and waves resuspend and move sediment across and off the shelf.

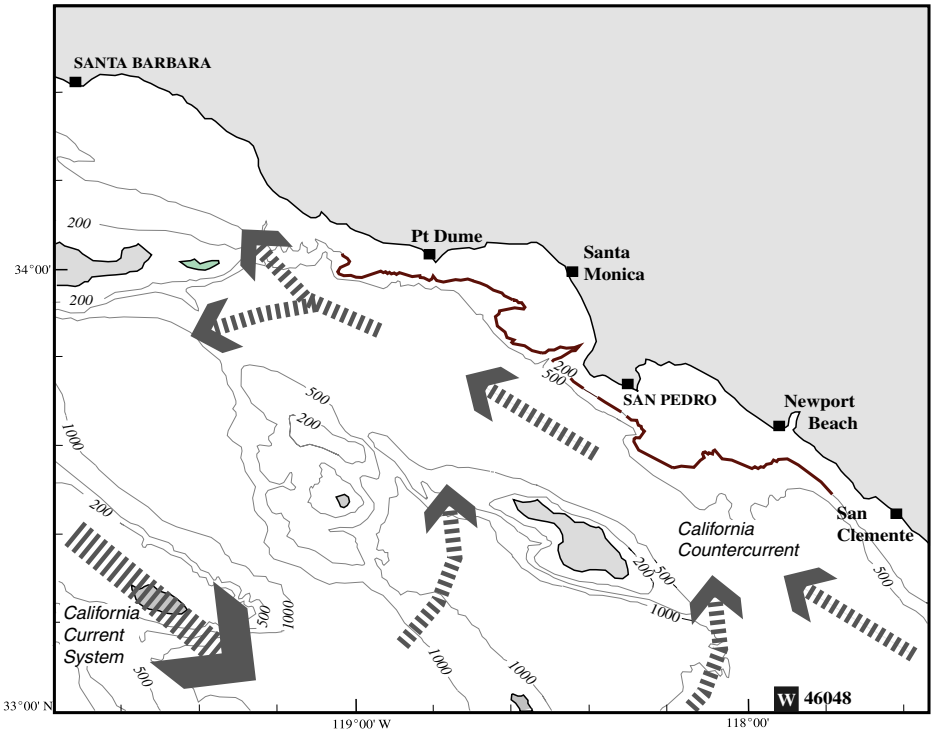

Figure 2: General flow patterns for the Southern California Bight

Figure 3 (DDT deposit map): The effluent-affected (EA) deposit is over 2 feet thick and has surface DDT concentrations of 200 ppm (parts per million) at the outfalls. As the deposit fans out to the northwest, surface contaminant concentrations drop to 2 to 10 ppm, with concentrations less than 1 ppm closer to shore and 3 to 15 ppm over the shelf break. Beneath this top layer of 6 to 12 inches, the sediments contain contaminant concentrations in the 100 to 200 ppm range.

Why are there tons of DDT and PCBs on Palos Verdes Shelf?

Los Angeles County wastewater (effluent) has discharged at White Point off the Palos Verdes Shelf since 1937. Sewage is treated at the Joint Water Pollution Control Plant in the City of Carson before it enters the outfalls. The Los Angeles County Sanitation District (LACSD) is in charge of the county's sanitation system. Among the many industries that used the sewer system was the Montrose Chemical Corp., the nation's largest manufacturer of DDT. From the 1950s to 1971 tons of DDT and associated manufacturing waste entered the sewer system to be discharged ultimately from the outfalls at White Point. In 1971, the last year Montrose used the county sewers, an estimated 50,500 lbs. of DDT were discharged from the outfalls. PCBs, another persistent hazardous substance, also formed part of the industrial waste stream that was discharged to the sewer system until their ban in 1976. After these persistent pollutants ceased to dominate the waste steam, LACSD continued discharging treated waste onto Palos Verdes Shelf. This created a layer of cleaner sediment on top of the DDT- and PCB-contaminated sediment.

On the Palos Verdes Shelf, an estimated 5.7 million tons of sediment have been affected by the effluent discharged from the White Point outfalls. Mixed within these effluent-affected (EA) sediments are an estimated 110 tons of DDT and 11 tons of PCBs. The EA sediment forms an identifiable deposit over a mile offshore at a depth of 150 feet to the shelf break. The deposit ranges in thickness from 2 inches to over 2 feet, with the area of greatest accumulation at 200 feet. It is thickest and has the highest concentrations of DDTs and PCBs in the vicinity of the outfalls, then fans out to the northwest. See Figures 3 and 4 .

Fate and Transport of the EA Sediments

As stated earlier, discharge of DDT and PCBs onto Palos Verdes Shelf stopped in the 1970s and discharge of total suspended solids had been reduced 97 percent by 2003. Concentrations and quantities of DDT and PCBs in the EA sediment appear to be less today than in 1992. The EA deposit is buried under cleaner sediment; one of the questions that will determine how best to deal with the remaining contamination is will the deposit stay buried? The RI Report examines the various processes that affect the EA sediments, discusses how they interact, and attempts to quantify their importance for different parts of the shelf. Below are brief discussions of the biological, chemical, and physical processes that control the fate and transport of the EA sediment.

Institutional Controls Program

The Institutional Controls (ICs) program was put in place to address the human health risks associated with consumption of certain fish, such as white croaker, caught off the Palos Verdes Peninsula that typically contain high concentrations of DDTs and PCBs. The ICs program has three components: public outreach and education, fish monitoring, and enforcement. The program relies on partnerships with other federal, state and local agencies and community-based organizations to enforce the commercial catch ban and bag limit on white croaker and to educate the public on fishing practices and fish preparation methods that minimize exposure to contaminants. Information about the ICs program can be found online at www.pvsfish.org.

Biological

The roughly 1 foot of cleaner surface sediment covering the more contaminated layer still contains measurable concentrations of DDT and PCBs. How are the buried contaminants reaching the surface? One explanation is biological. The shelf floor is home to worms, sea cucumbers, shrimp, crabs and other invertebrates. Many of these pollutant-tolerant creatures turn the sediment just as earthworms work topsoil. Although most of the mixing occurs in the top 6 inches, some larger species, such as ghost shrimp, can bring up buried sediment from several feet below the surface. This vertical mixing adds DDT and PCBs to the surface sediments. The mixing also loosens the material, making it more susceptible to resuspension. However, the invertebrates also consolidate sediment as they eat its organic mat-

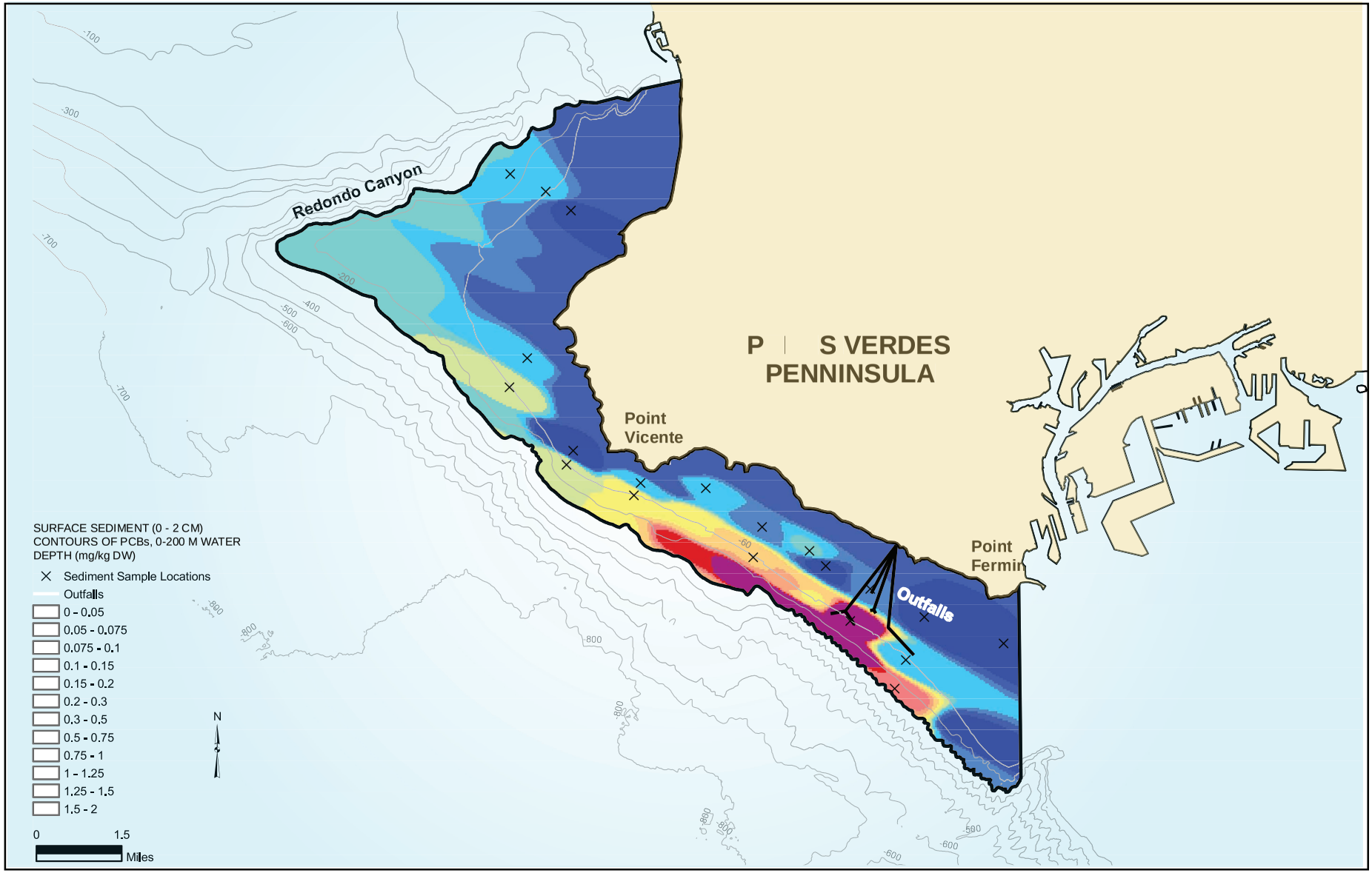

Figure 4 (PCBs map): Surface concentrations of PCBs are typically less than 0.5 ppm except in the vicinity of the outfalls. Recent data on PCB concentrations at depth are not available; however, in 1992, the concentrations a foot or more into the deposit ranged from 2 to 20 ppm.

ter and produce fecal pellets. A 1992 study found as much as 50 percent of the silt and clay fractions of the EA sediment had been pelletized.

Chemical

Most of the DDT on Palos Verdes Shelf converted quickly to DDE or DDD, two DDT-related compounds. Recent analysis indicates that, at least in some areas, the chemical breakdown process is continuing. EPA has limited but compelling data on the occurrence of this process, called reductive dechlorination. Sediment cores collected in1992 off Long Pt. at the 200 ft. depth were compared to cores collected from the same location in 2005. Analysis of the cores shows DDE is transforming into another a simpler, related chemical called DDMU. Other breakdown products have been identified in these cores, as well. However, very little is known about the toxicity of these breakdown products. Reductive dechlorination would explain the reduction in DDE concentrations that are seen at depth in the deposit. However, chemical analyses of sediment cores across the shelf would be required to determine if and to what degree this transformation is occurring. There is no evidence that PCBs, originally deposited on the shelf as industrial chemicals called "Aroclors," are undergoing reductive dechlorination. The observed loss of PCBs can be attributed to dispersion.

Physical

Waves and currents suspend, deposit, and transport sediment along and away from the shelf. When the finer and more organic particles that make up the EA sediment are suspended, the contaminants they contain are transported along with them. If more sediment is transported into an area than is transported out, sediment will accumulate. This tends to bury the existing EA sediment, which appears to have happened north of the outfalls. The opposite occurs if sediment transport out of an area is higher than the rate of transport in; in which case the contaminated sediment is eroded. The area southeast of the outfalls appears to be erosive. Material resuspended from the EA deposit, especially slowly settling particles, can travel off the Palos Verdes Shelf before settling back to the bottom. Individual particles may undergo the process of resuspension, transport, and deposition many times and will gradually disperse from the shelf, typically ending up in on the slope or in the deeper basins where they are resuspended less frequently. The top layer of sediment is most affected by these processes. Over time, the fine sediment is winnowed out, leaving coarser, heavier sediment, less susceptible to resuspension by waves and currents.

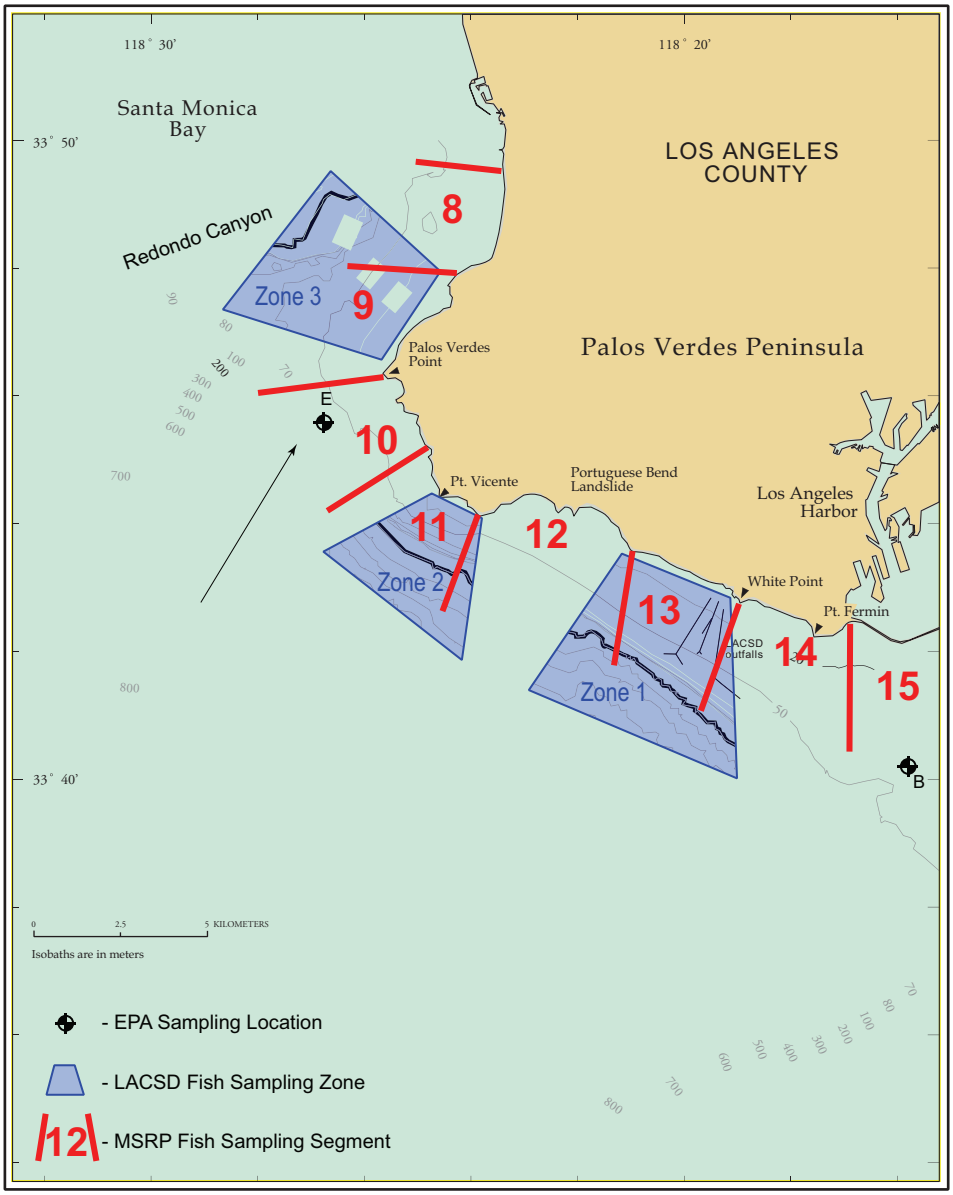

Figure 5: Palos Verdes Shelf fish sampling locations

Human Health and Environmental Risks Reassessed

EPA prepared a Human Health Risk Evaluation in 1999 using fish data from multiple sources and years. For the RI Report, EPA used more recent data from the 2002 EPA-Montrose Settlement Restoration Program Joint Ocean Fish Survey and from LACSD's 2002 fish sampling (see **Figure 5**) to reassess the human health risk. The harm posed by the site is in the transfer of contaminants from the sediment into the food chain. Fish accumulate DDTs and PCBs when they eat worms, crabs and other creatures living in the sediment. The reassessment analyzed DDT and PCB tissue concentrations found in six species of fish collected from the Palos Verdes Shelf Study Area: kelp bass, white croaker, barred sandbass, rockfish, surfperches, and California scorpionfish.

Both PCBs and DDT are known to have deleterious health effects and are probable human carcinogens. EPA uses a Hazard Index developed from a daily exposure or reference dose to quantify potential noncancer health effects. A hazard quotient of 1.0 is considered the threshold to indicate an exceedance of the reference dose. EPA assumes there is no safe exposure threshold for carcinogens; therefore, EPA calculates risk from probable carcinogens as potential increased cancer risk over a lifetime.

In reassessing human health risk for the RI Report, EPA used two consumption scenarios: a reasonable maximum exposure (RME) (i.e., consumption) of 107.1 grams of fish a day and for high end consumers, 115.7 g/day (about a quarter pound of fish a day). The other scenario, called a central tendency exposure (CTE), represents a more varied diet, where fish consumption would equal 21.4 g/day (one 5-ounce serving a week). Table 1 shows potential health risks under these scenarios for each of the six fish. It is worth noting that these health risks used DDT and PCB concentrations found in fish tissue only. Both DDT and PCBs are lipophilic, i.e., they accumulate in fat. Therefore, whole fish concentrations are typically 8 to 10 times higher than tissue concentrations. As a result, these risk values underestimate exposure for people who consume whole fish, such as in stews and other dishes.

	Reasonable Maximum Exposure		Central Tendency Exposure	
Fish Species	**Cancer Risk**	**Noncancer HQ** (>1 exceeds reference dose)	**Cancer Risk**	**Noncancer HQ** (>1 exceeds reference dose)
White Croaker	6×10^{-3}	183	6×10^{-4}	37
Kelp Bass	1×10^{-4}	5	1×10^{-5}	0.9
Rockfish	1×10^{-4}	5	1×10^{-5}	0.9
Surfperch	7×10^{-5}	2	6×10^{-6}	0.5
CA Scorpionfish	3×10^{-4}	8	3×10^{-5}	2
Barred Sandbass	3×10^{-4}	10	3×10^{-5}	2

Table 1: Cancer and noncancer health risks based on the 95 percent UCL (upper confidence limit) of the mean concentration of contaminants found in these six species of fish caught from the Palos Verdes Shelf Study Area. The Reasonable Maximum Exposure assumes a consumption rate of about a meal a day. The Central Tendency Exposure assumes a consumption rate of about a meal a week.

Palos Verdes Shelf Superfund Site Update

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