Pesticide Warehouse I

Arecibo, Puerto Rico
EPA Facility ID: PRD987367349
Basin: Cibuco-Guajataca
HUC: 21010002

Executive Summary

The Pesticide Warehouse I site is an active pesticide warehouse in a rural-industrial area of Arecibo, Puerto Rico. The facility is approximately 3 km (2 mi) south of a 2,200-ha (5,436-acre) estuarine wetland area called Caño Tiburones, which has been designated as a natural reserve by the Puerto Rico Department of Natural Resources. Since 1953, pesticides, insecticides, herbicides, and fertilizers have been prepared and stored at the facility. Metals, PAHs, and pesticides have been detected in soil and groundwater samples taken from the Pesticide Warehouse I site. The primary contaminants of concern to NOAA are metals and pesticides. The habitat of primary concern to NOAA in the vicinity of the site is the Caño Tiburones. NOAA trust resources present in the Caño Tiburones wetland include catadromous and amphidromous fish species and amphidromous invertebrates, including blue crab and several prawn and shrimp species. Groundwater is the primary pathway for the migration of contaminants from the site to NOAA trust resources.

Site Background

The Pesticide Warehouse I site is an active pesticide warehouse in a rural-industrial area of Arecibo, Puerto Rico. The Pesticide Warehouse I property is approximately 0.4 ha (1 acre) in area. The site is bordered to the south by State Road 2, to the north by Interstate 22, and to the east and west by agricultural lands. The facility is approximately 3 km (2 mi) south of a 2,200-ha (5,436-acre) estuarine wetland area called Caño Tiburones (Figure 1), which has been designated as a natural preserve by the Puerto Rico Department of Natural Resources.

Since 1953, pesticides, insecticides, herbicides, and fertilizers have been prepared and stored at the facility for use on pineapple crops in the surrounding area. An underground storage tank, a gasoline pump, two warehouses, and a small shed are present on the property. The layout of the Pesticide Warehouse I site is shown on Figure 2.

During preparation, pesticides are mixed in tanker trucks with water taken from a well that is southeast of the property; mixing occurs on a bermed platform adjacent to the main warehouse. During the mixing process, excess pesticides enter a grate-covered sump under the mixing platform. The wastewater is reportedly collected and recycled daily (Weston 2003a). An unlined pathway carries surface runoff, which flows to the east from the mixing platform. Drain outlets in the floor of the main warehouse discharge directly to the ground (Roy F. Weston 1997).

During a 1988 preliminary assessment, the Puerto Rico Environmental Quality Board documented that excess pesticides had been discharged directly to the ground during the mixing process and during weekly cleaning of the main warehouse. In addition, empty pesticide containers and bags were observed in an excavated pit in the northwest corner of the property (Weston 2003a). During numerous investigations conducted by the U.S.

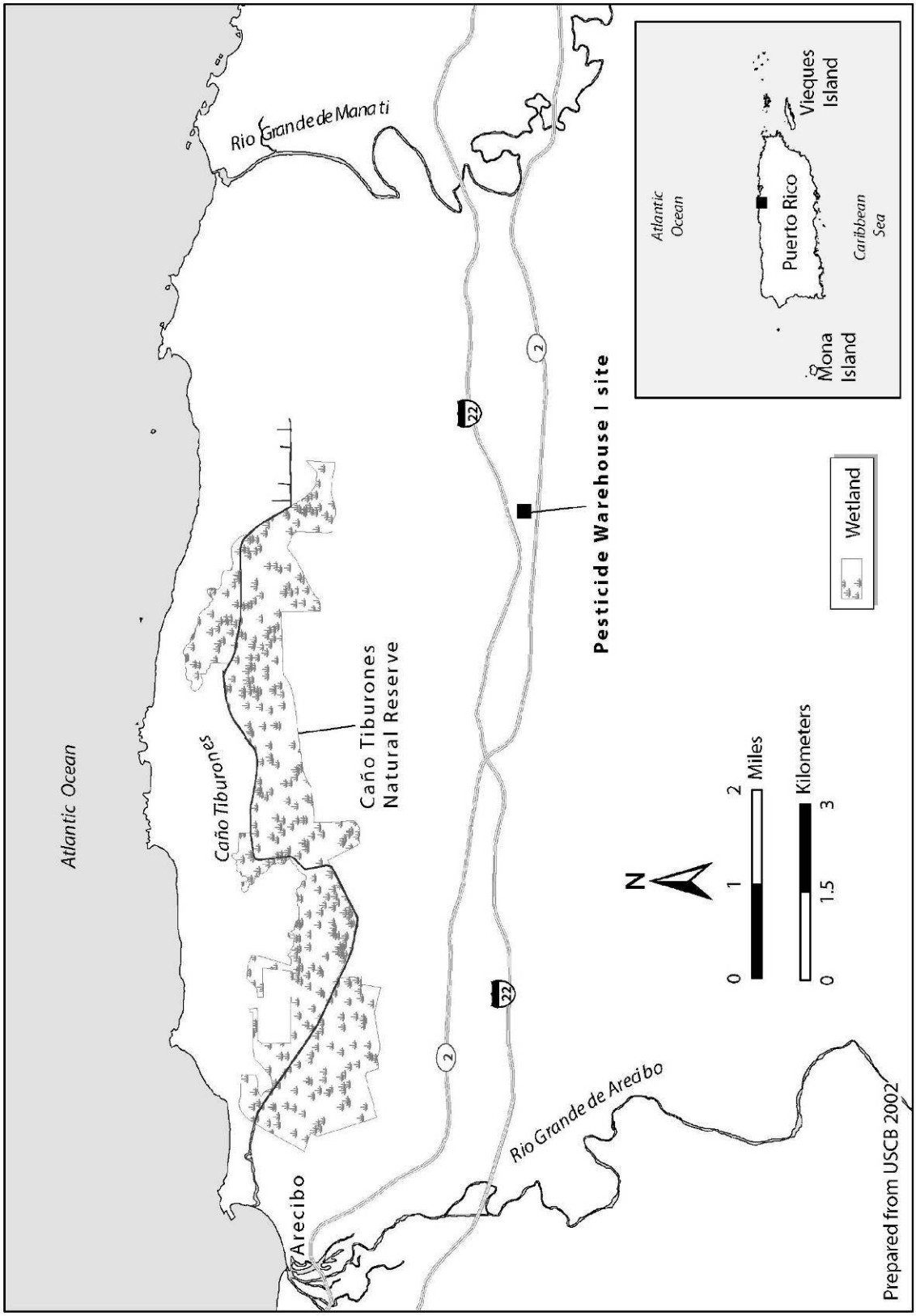

Figure 1. Location of the Pesticide Warehouse I site in Arecibo, Puerto Rico.

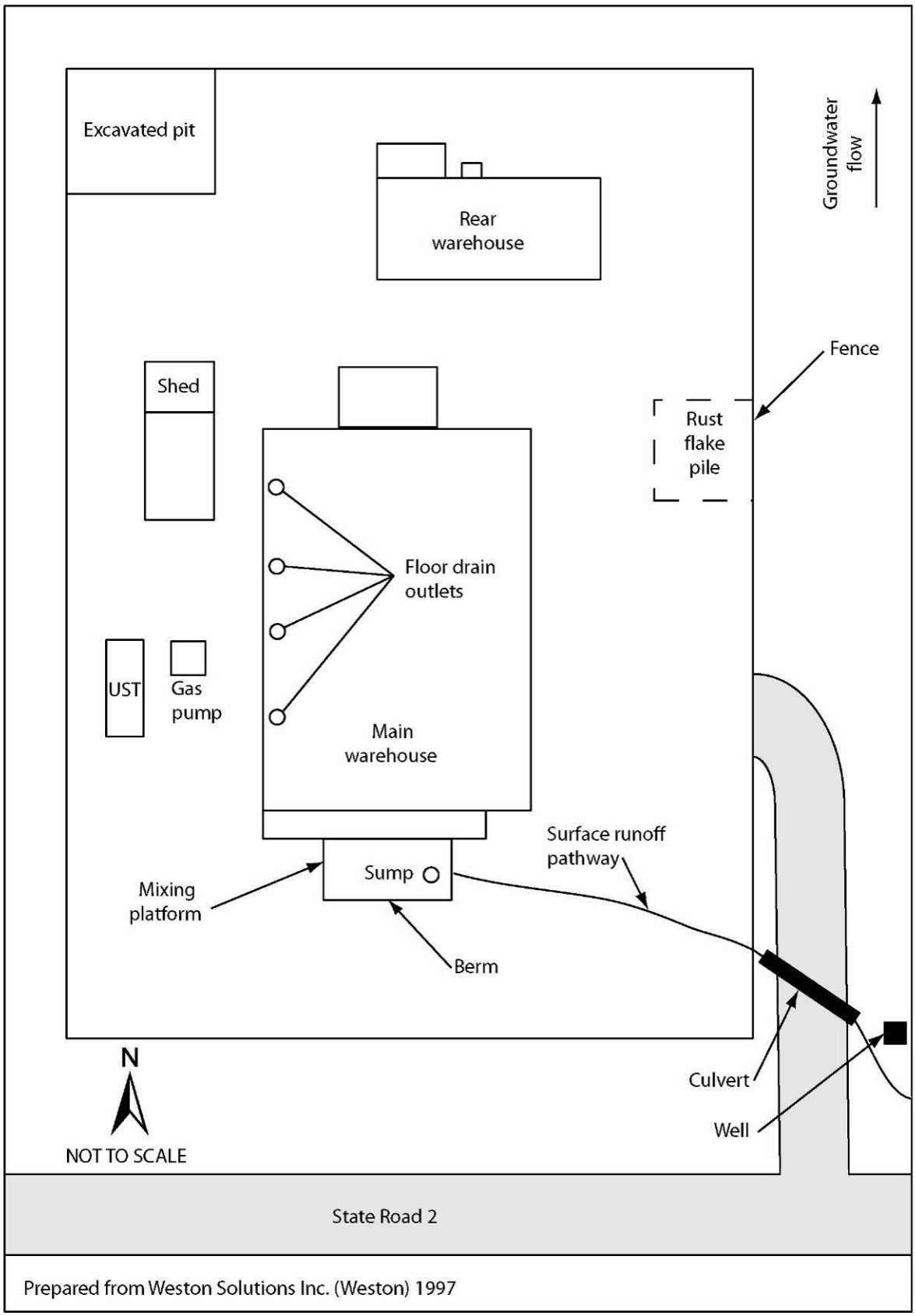

Figure 2. Detail of the Pesticide Warehouse I property.

Environmental Protection Agency (USEPA) and the Puerto Rico Environmental Quality Board, aldrin, endrin, endrin aldehyde, gamma-chlordane, toxaphene, diazinon, diuron, heptachlor epoxide, dieldrin, and 4,4'-DDE have been detected in soil and groundwater (Roy F. Weston 1997; Weston 2003a, 2003b). The site was proposed for placement on the National Priorities List on September 23, 2004 (USEPA 2006a).

Surface water runoff flows through the property before entering a culvert in the southeast corner; the culvert discharges into an off-site drainage ditch that parallels State Road 2. The drainage ditch continues past the property's well (Figure 2), where it dissipates into a vegetated area adjacent to the well.

Groundwater is the primary pathway for the migration of contaminants from the site to NOAA trust resources. The topography surrounding the site is characterized by numerous sinkholes and limestone hills. The aquifer under the site is a karst aquifer. Groundwater in the area flows north toward the Atlantic Ocean.

NOAA Trust Resources

The habitat of primary concern to NOAA is the Caño Tiburones, an estuarine wetland approximately 3 km (2 mi) north of the site that connects to the Atlantic Ocean. Historically, the Caño Tiburones was one of the largest freshwater wetlands in Puerto Rico, covering approximately 6,000 ha (15,000 acres). It included a canal system with weirs at its connections to the Atlantic Ocean (Yoshioka 2005). Today the wetland covers approximately 2,400 ha (6,000 acres); it is bounded to the west by the Rio Grande de Arecibo and to the east by the Rio Grande de Manati.

A large portion of the wetland system lies below sea level. Since 1949, the area has been pumped dry to recover land for agricultural purposes (ACJV 2005). In 1998, the Puerto Rico Department of Natural Resources designated the area as a natural reserve. As a result, a portion of the area is no longer pumped dry and has been allowed to flood, creating an estuarine wetland with deeper canals weaving through it. The Caño Tiburones natural reserve receives salt water from the Atlantic Ocean and fresh water from the karst aquifer to the south. Groundwater entering the wetland creates a range of salinities (Yoshioka 2005).

NOAA trust resources present in the Caño Tiburones include catadromous and amphidromous fish species and amphidromous invertebrates, including blue crab and several prawn and shrimp species (Table 1). Fishes likely to be found in the wetlands include migratory river species common to the tropics. Numerous prawn and shrimp species also are expected to spawn, rear, and forage in Caño Tiburones (Lilyestrom 2006; Yoshioka 2006).

The native freshwater fish and invertebrate species found in Puerto Rico are compulsory migrators that must spend a portion of their life cycle in estuarine or marine waters (Yoshioka 2002). Puerto Rican native freshwater fish and invertebrates are best described as amphidromous and iteroparous. The term amphidromous refers to predominately freshwater species that require estuarine or marine waters to complete their larval phases; iteroparous means they do not die after spawning. Following fertilization in fresh water, eggs and larvae are carried downstream by the current to estuaries, and fish and shrimp larvae spend several months maturing in marine or estuarine waters. Shrimp larvae enter marine and estuarine waters as non-feeders; when the salinity reaches 12 parts per thousand and above, the larvae molt and begin feeding before reentering freshwater

Table 1. NOAA trust resources present in Caño Tiburones near the Pesticide Warehouse I site (Lilyestrom 2006; Yoshioka 2006).

Species		Habitat Use			Fisheries	
Common Name	Scientific Name	Spawning Area	Nursery Area	Adult Habitat	Comm.	Recreational / Subsistence
CATADROMOUS FISH						
American eel	*Anguilla rostrata*		♦	♦		♦
AMPHIDROMOUS FISH						
Bigmouth sleeper	*Gobiomorus dormitor*	♦	♦	♦		♦
Bonefish	*Albula vulpes*					♦
Burro grunt	*Pomadasys crocro*				♦	
Common snook	*Centropomus undecimalis*		♦	♦	♦	♦
Dog snapper	*Lutjanus jocu*		♦	♦	♦	♦
Fat sleeper	*Dormitator maculatus*	♦	♦	♦		
Flagfin mojarra	*Eucinostomus melanopterus*				♦	♦
Horse-eye jack	*Caranx latus*		♦	♦	♦	♦
Irish pompano	*Diapterus auratus*				♦	♦
Mountain mullet	*Agonostomus monticola*	♦	♦	♦		♦
Permit	*Trachinotus falcatus*				♦	♦
Rhombic mojarra	*Diapterus rhombeus*				♦	♦
River goby	*Awaous banana*	♦	♦	♦		
Sirajo goby[a,b]	*Sicydium plumieri*	♦	♦	♦		♦
Spinycheek sleeper[a,b]	*Eleotris pisonis*	♦	♦	♦		
Swordspine snook	*Centropomus ensiferus*					
Tarpon	*Megalops atlanticus*	♦	♦	♦		♦
Tilapia[a]	*Oreochromis mossambicus*	♦	♦	♦	♦	♦
Western mosquitofish	*Gambusia affinis*	♦	♦	♦		
White mullet	*Mugil curema*		♦	♦	♦	
Yellowfin mojarra	*Gerres cinereus*		♦	♦	♦	♦
AMPHIDROMOUS INVERTEBRATES						
Blue crab	*Callinectes sapidus*		♦	♦		
Bocourt swimming crab	*Callinectes bocourti*		♦	♦		
Dana swimming crab	*Callinectes danae*		♦	♦		
Rugose swimming crab	*Callinectes exasperatus*		♦	♦		
Cascade river prawn	*Macrobrachium heterochirus*	♦	♦	♦		♦
Unnamed river prawn[c]	*Macrobrachium crenulatum*	♦	♦	♦		
Unnamed river prawn[c]	*Macrobrachium faustinum*	♦	♦	♦		
Bigclaw river shrimp	*Macrobrachium carcinus*	♦	♦	♦		♦
Cinnamon river shrimp	*Macrobrachium acanthurus*	♦	♦	♦		♦
Unnamed river shrimp[b,c]	*Atya innocous*	♦	♦	♦		♦
Unnamed river shrimp[b,c]	*Atya lanipes*	♦	♦	♦		♦
Unnamed river shrimp[b,c]	*Atya scabra*	♦	♦	♦		♦
Unnamed river shrimp[b,c]	*Jonga serrei*	♦	♦	♦		
Unnamed river shrimp[b,c]	*Micratya poeyi*	♦	♦	♦		
Unnamed river shrimp[b,c]	*Potimirrim americana*	♦	♦	♦		
Unnamed river shrimp[b,c]	*Potimirrim mexican*	♦	♦	♦		
Unnamed river shrimp[b,c]	*Xiphocaris elongata*	♦	♦	♦		

a: Common names are from Lilyestrom 2006.
b: Scientific names are from Yoshioka 2006.
c: No common names were available.

systems as juveniles. These fish and shrimp spend the majority of their life cycles in the middle to upper reaches of natural freshwater rivers and lagoons (Yoshioka 2002).

Commercial fisheries in the Caño Tiburones include burro grunt, common snook, dog snapper, horse-eye jack, Irish pompano, permit, tilapia, white mullet, and flagfin, rhombic, and yellowfin mojarra. Recreational fishing and subsistence fishing for most of the fish and invertebrate species listed in Table 1 occurs in the Caño Tiburones (Lilyestrom 2006; Yoshioka 2006). Sirajo goby, considered a delicacy, is fished in its larval stage. The larger *Macrobrachium* prawns, *Atya* shrimp, American eel, and several species of amphidromous fishes are among the NOAA trust species that are fished recreationally in the Caño Tiburones (Lilyestrom 2006; Yoshioka 2006). Many of the larger shrimp species are important for native celebrations. No fish consumption advisories are in effect for the Caño Tiburones at this time (Lilyestrom 2006).

Site-Related Contamination

Groundwater and soil samples were collected at the Pesticide Warehouse I site during environmental investigations conducted in 1996 and 2003. The samples were analyzed for metals, semivolatile organic compounds (including polycyclic aromatic hydrocarbons [PAHs]), volatile organic compounds, pesticides, and polychlorinated biphenyls (PCBs). The primary contaminants of concern to NOAA are metals and pesticides.

Table 2 summarizes the maximum concentrations of contaminants of concern to NOAA detected during the site investigations, and compares them to relevant screening guidelines. Site-specific or regionally specific screening guidelines are always used when available. In the absence of such guidance, the screening guidelines for groundwater are the ambient water quality criteria (AWQC; USEPA 2006b), and the screening guidelines for soil are the Oak Ridge National Laboratory final preliminary remediation goals (ORNL-PRGs; Efroymson et al. 1997) and the USEPA's ecological soil screening guidelines (USEPA 2005). Exceptions to these screening guidelines, if any, are noted on Table 2. Only maximum concentrations that exceeded relevant screening guidelines, or for which there are currently no screening guidelines, are discussed below. When known, the general sampling locations are also provided for maximum concentrations that exceeded screening guidelines or do not have screening guidelines. The general sampling locations discussed below are depicted on Figure 2.

Groundwater

Two pesticides were detected in groundwater samples collected from the Pesticide Warehouse I site at maximum concentrations that exceeded screening guidelines. The maximum concentrations of dieldrin and heptachlor epoxide were detected in samples collected from the well southeast of the Pesticide Warehouse I property. The maximum concentration of heptachlor epoxide exceeded the AWQC by one order of magnitude, and the maximum concentration of dieldrin exceeded the AWQC by a factor of four.

Soil

Eight metals were detected in soil samples taken from the Pesticide Warehouse I site at maximum concentrations that exceeded screening guidelines. The maximum concentrations of arsenic and chromium were detected in soil samples taken from the surface runoff pathway in the southeastern corner of the property. The maximum

Table 2. Maximum concentrations of contaminants of concern to NOAA at the Pesticide Warehouse I site. Contaminant values in bold exceed or are equal to screening guidelines (Roy F. Weston 1997; Weston 2003a; 2003b).

	Soil (mg/kg)		Water (µg/L)	
Contaminant	Soil	ORNL-PRG[a]	Groundwater	AWQC[b]
METALS/INORGANICS				
Arsenic	**23**	9.9	0.38	150
Cadmium	**2.9**	0.36[c]	ND	0.25[d]
Chromium[e]	**73**	0.4	5.2	11
Copper	**150**	60	8.4	9.0[d]
Lead	**63**	40.5	1.7	2.5[d]
Mercury	**0.23**	0.00051	ND	0.77[f]
Nickel	**50**	30	0.94	52[d]
Selenium	ND	0.21	0.80	5.0[g]
Silver	1.6	2	0.029	3.2[d,h]
Zinc	**1,900**	8.5	10	120[d]
PAHs				
Fluoranthene	0.043	NA	ND	NA
Phenanthrene	0.052	NA	ND	NA
Pyrene	0.12	NA	ND	NA
PESTICIDES/PCBs				
Aldrin	0.007	NA	ND	3.0[h]
4,4'-DDD	0.000096	NA	ND	0.6[h,i]
4,4'-DDE	0.0019	NA	0.2	1050[h,i]
4,4'-DDT	0.00011	NA	ND	0.001[j]
Dieldrin	ND	0.000032[c]	**0.22**	0.056
Endrin	0.021	NA	0.0098	0.036
Gamma-BHC (Lindane)	0.00005	NA	ND	0.95[h]
Heptachlor	0.0043	NA	ND	0.0038
Heptachlor Epoxide	0.0011	NA	**0.05**	0.0038
Toxaphene	3.7	NA	ND	0.0002

a: Oak Ridge National Laboratory (ORNL) final preliminary remediation goals (PRG) for ecological endpoints (Efroymson et al. 1997).

b: Ambient water quality criteria for the protection of aquatic organisms (USEPA 2006b). Freshwater chronic criteria presented.

c: Ecological soil screening guidelines (USEPA 2005).

d: Criterion expressed as a function of total hardness; concentrations shown correspond to hardness of 100 mg/L $CaCO_3$.

e: Screening guidelines represent concentrations for $Cr.^{+6}$

f: Derived from inorganic, but applied to total mercury.

g: Criterion expressed as total recoverable metal.

h: Chronic criterion not available; acute criterion presented.

i: Lowest observable effects level (LOEL; USEPA 1986).

j: Expressed as total DDT.

NA: Screening guidelines not available.

ND: Not detected.

concentration of chromium exceeded the ORNL-PRG by two orders of magnitude, and the maximum concentration of arsenic exceeded the ORNL-PRG by a factor of two.

The maximum concentration of cadmium, which was detected in a soil sample taken from an area just south of the surface runoff pathway in the southeastern corner of the property, exceeded the USEPA's ecological soil screening guideline by a factor of eight.

The maximum concentrations of copper, lead, and nickel were detected in soil samples taken from the eastern border of the property in the vicinity of the rust flake pile. The maximum concentration of copper exceeded the ORNL-PRG by a factor of 2.5, and the maximum concentrations of lead and nickel exceeded the ORNL-PRGs by a factor of 1.5.

The maximum concentration of mercury, which was detected in a soil sample taken from an area just west of the property, exceeded the ORNL-PRG by two orders of magnitude.

The maximum concentration of zinc, which was detected in a soil sample taken from the area just west of the main warehouse, also exceeded the ORNL-PRG by two orders of magnitude.

Three PAHs were detected in soil samples taken from the Pesticide Warehouse I property. The maximum concentrations of fluoranthene, phenanthrene, and pyrene were detected in soil samples taken from the drainage ditch just south of the well that is southeast of the property. No screening guidelines are currently available for comparison to the maximum concentrations of these three PAHs detected in the soil samples.

Nine pesticides were detected in soil samples taken from the Pesticide Warehouse I site. The maximum concentrations of aldrin, endrin, heptachlor, and toxaphene were detected in soil samples taken from the surface runoff pathway in the southeastern corner of the Pesticide Warehouse I property. The maximum concentration of 4,4'-DDD was detected in a sample taken from the area just west of the excavated pit in the northwestern portion of the property. The maximum concentration 4,4'-DDE was detected in a sample taken from the area just west of the main warehouse. The maximum concentration of 4,4'-DDT was detected in a sample taken just west of the property. The maximum concentrations of gamma-BHC (Lindane) and heptachlor epoxide were detected in samples taken from the area just west and north, respectively, of the rear warehouse. No screening guidelines are currently available for comparison to the maximum concentrations of these nine pesticides detected in the soil samples.

References

Atlantic Coast Joint Venture (ACJV). 2005. North American waterfowl management plan, draft waterfowl implementation plan, revision. June. Available at: ACJV publications, http://www.acjv.org/resources.htm (accessed July 25, 2006).

Efroymson, R.A., G.W. Suter II, B.E. Sample, and D.S. Jones. 1997. Preliminary remediation goals for ecological endpoints. August 1997. Prepared for U.S. Department of Energy, Oak Ridge, TN. Available at: Environmental Services Division, Oak Ridge National Laboratory, http://www.esd.ornl.gov/programs/ecorisk/documents/tm162r2.pdf (accessed May 12, 2005).

Lilyestrom, C. Director of Marine Resources for the Puerto Rico Department of Natural Resources. Personal communication July 25, 2006.

Roy F. Weston, Inc. 1997. Final site inspection report, Pesticide Warehouse I, Arecibo, Puerto Rico. November 1997. Edison, NJ: U.S. Environmental Protection Agency.

U.S. Census Bureau (USCB), U.S. Department of Commerce. 2002. Tiger/line files 2002. Washington D.C.: U.S. Census Bureau, Geography Division.

U.S. Environmental Protection Agency (USEPA). 1986. Quality criteria for water 1986. EPA 440/5-86-001. Washington D.C.: U.S. Environmental Protection Agency, Office of Water.

U.S. Environmental Protection Agency (USEPA). 2005. Ecological soil screening levels. March 2005. Available at: USEPA, ECOTOX Database, http://www.epa.gov/ecotox/ecossl/ (accessed September 26, 2005).

U.S. Environmental Protection Agency (USEPA). 2006a. Superfund site progress profile Pesticide Warehouse I (EPA ID: PRD987367349). July 2006. Available at: USEPA Superfund Information System, http://cfpub.epa.gov/supercpad/cursites/csitinfo.cfm?id=0202985 (accessed July 14, 2006).

U.S. Environmental Protection Agency (USEPA). 2006b. National recommended water quality criteria: 2006b. Washington D.C.: U.S. Environmental Protection Agency, Office of Water.

Weston Solutions, Inc. (Weston). 1997. Site map Pesticide Warehouse I, Arecibo, Puerto Rico.

Weston Solutions, Inc. (Weston). 2003a. Hazard ranking system documentation package, Pesticide Warehouse I, Arecibo, Puerto Rico. CERCLIS ID No. PRD987367349. November 2003. Edison, NJ: U.S. Environmental Protection Agency.

Weston Solutions, Inc. (Weston). 2003b. Sampling trip report, Pesticide Warehouse I, Arecibo, Puerto Rico. CERCLIS ID No. PRD987367349. November 2003. Edison, NJ: U.S. Environmental Protection Agency.

Yoshioka, B. Marine biologist for the U.S. Fish and Wildlife Service. Personal communication October 15, 2002.

Yoshioka, B. Marine biologist for the U.S. Fish and Wildlife Service. Personal communication January 20, 2005.

Yoshioka, B. Marine biologist for the U.S. Fish and Wildlife Service. Personal communication July 25, 2006.