

Tables

Table 1. Evaluation of Sites at Naval Amphibious Base, Little Creek

Site	Site Description and History	Investigation Results/Environmental Monitoring Results	Corrective Action and/or Current Status	Evaluation of Public Health Hazard
Installation Restoration Program (IRP) and Miscellaneous Sites				
Site 4 - Reserve Center Oil Disposal Area	Site 4 is the location of an outdoor vehicle maintenance pad, where about 2,000 gallons of waste oils and antifreeze a year were disposed of into a storm sewer between 1967 and 1981. Oil in the ground around the pad would be expected to migrate to the groundwater and then to Piers 9 and 10, about 300 feet to the northeast.		Mitigation measures were recommended for this site to prevent migration of contaminants from oil soaked soils to nearby surface waters. The site is closed with no further action required under CERCLA..	No information provided for evaluation.

Table 1. Evaluation of Sites at Naval Amphibious Base, Little Creek (continued)

Site	Site Description and History	Investigation Results/Environmental Monitoring Results ¹	Corrective Action and/or Current Status	Evaluation of Public Health Hazard
Site 5 - Building T-9 and T-11 Motor Oil Disposal Area	Site 5 consist of Building T-9 and Building T-11. Reportedly, 50,000 gallons of oil and antifreeze were dumped on the ground between the two buildings. But Marsden matting (solid steel plates under steel braces) in the disposal area would have made it virtually impossible for disposal of this magnitude to have occurred. Also, 43,000 gallons of oil and antifreeze were reportedly dumped in cable tanks in Building T-11. No physical/visual evidence was ever found, however, to substantiate improper disposal either between the building or in Buildings T-11.	<p>Groundwater: Volatile organic compounds (VOCs) and lead were detected in groundwater but at levels below the EPA's risk-based concentrations (RBC) for tap water.</p> <p>Soil: Low levels of total petroleum hydrocarbons were detected.</p>	No further action is planned.	No identified public health hazards are associated with this IRP site under past or present use. There is limited potential or public contact with contaminated soil and no one uses the groundwater at the site as a drinking water source.

Table 1. Evaluation of Sites at Naval Amphibious Base, Little Creek (continued)

Site	Site Description and History	Investigation Results/Environmental Monitoring Results ¹	Corrective Action and/or Current Status	Evaluation of Public Health Hazard
Site 7 - Naval Amphibious Base (NAB) Landfill	<p>The 30-acre landfill located in the south-central portion of the facility operated from 1962 to 1979, initially as a trench-style landfill then as an area landfill. The area was once an arm of Little Creek Cove, but was filled with dredged soil before it was used as a landfill. The majority of the waste at the landfill likely consisted of municipal refuse. Potentially hazardous materials disposed of at the landfill include paints, acids, polychlorinated biphenyls (PCBs), and pesticides. After closure in 1979, the area was used as a metal collection and transfer station. No waste storage or burning activities have occurred since the 1980s. Runoff/drainage drains the site via a drainage ditch toward Little Creek Cove.</p>	<p>Groundwater: Metals were detected.</p> <p>Surface Soil: Semivolatile organic compounds (SVOCs), metals, and PCBs, as Aroclor 1260, were detected in the soil.</p>	<p>Buildings and traveled roads are prohibited at the site. At the time of closure the landfill was covered with 24 inches of soil. In October 1994 two to three additional layers of topsoil were spread over the area and then revegetated. As part of the remedial investigation in 1998, 610 cubic yards of soil were removed, 20,000 cubic yards of soil were then added and vegetated, and the fence around the landfill was replaced. Also in 1998, groundwater sampling for long-term monitoring began at the site. Today, because of the additional soil cover, the landfill waste lies below ground surface.</p>	<p>No identified public health hazards are associated with this IRP site under past or present use. There is limited potential for public contact with contaminated soil from the contents of the landfill and no one uses the groundwater at the site as a drinking water source. Some contamination could have reached Little Creek Harbor via a drainage canal, possibly contaminating harbor sediment and fish. Recreational swimmers should not come in contact with harmful levels of contaminants in sediment and restrictions against taking fish or shellfish has been issued for the harbor.</p> <p>ATSDR recommends that the Navy consider potential movement of landfill gases before constructing any future buildings near the former landfills</p>

Table 1. Evaluation of Sites at Naval Amphibious Base, Little Creek (continued)

Site	Site Description and History	Investigation Results/Environmental Monitoring Results ¹	Corrective Action and/or Current Status	Evaluation of Public Health Hazard
Site 8 - Demolition Debris Landfill	The 2-acre Demolition Debris Landfill was operated from 1971 to 1979 for the disposal of demolition debris. Material disposed of at the landfill potentially contained mercury-contaminated carpet, building debris, and concrete piping.	<p>Groundwater: Metals, including arsenic, were detected.</p> <p>Soil: During 1998 site investigation activities, metals and pesticides (dieldrin) were detected.</p> <p>Sediment: Polycyclic aromatic hydrocarbons (PAHs) and metals were detected in sediment.</p>	The Navy will conduct another round of groundwater sampling to support a quantitative baseline human health and ecological risk assessment. The Navy is also in the process of preparing a remedial investigation RI/feasibility study (FS) report for Site 8.	No identified public health hazards are associated with this IRP site under past or present use. There is limited potential for public contact with contaminated soil or the contents of the landfill and no one uses the groundwater at the site as a drinking water source. ATSDR recommends that the Navy consider potential movement of landfill gases before constructing any buildings in the future near the former landfills.

Table 1. Evaluation of Sites at Naval Amphibious Base, Little Creek (continued)

Site	Site Description and History	Investigation Results/Environmental Monitoring Results ¹	Corrective Action and/or Current Status	Evaluation of Public Health Hazard
Site 9 - Driving Range Landfill	Site 9 is the 6-acre Driving Range Landfill that served as the base's primary disposal area for solid waste between 1952 and the 1960s. This unlined landfill was situated in the northeastern section of the base, about 500 feet south of the shoreline of the Chesapeake Bay. Solid waste could have included pesticides refuse, solvents, heavy metals, PCBs, and incinerator ash. Before landfilling operations were started, the area was a marshy lowland. After closure, sludge from the Hampton Roads Sanitation Treatment Plant was added to encourage growth of grass. The area has since been used as a driving range. Runoff from the area moves towards a golf course lake and the Chesapeake Bay.	<p>Groundwater: Metals, including arsenic, barium, beryllium, lead, nickel, and zinc, have been detected.</p> <p>Surface Soil: VOCs (toluene) and pesticides (DDD, DDE, dieldrin, endrin) were detected.</p>	<p>Long-term groundwater monitoring is underway at the site.</p> <p>The site contains cover.</p>	No identified public health hazards are associated with this IRP site under past or present use. There is limited potential for public contact with contaminated soil or the contents of the landfill and no one uses the groundwater at the site as a drinking water source. Contamination in surface runoff is not directed toward Little Creek Harbor, possibly Therefore, recreational swimmers at the harbor should not come in contact with harmful levels of contaminants in sediment.

Table 1. Evaluation of Sites at Naval Amphibious Base, Little Creek (continued)

Site	Site Description and History	Investigation Results/Environmental Monitoring Results ¹	Corrective Action and/or Current Status	Evaluation of Public Health Hazard
Site 10 - Sewage Treatment Plant Landfill	<p>Site 10, the 7-acre Sewage Treatment Plant Landfill, is located in the northeast portion of the base, about 500 feet south of the Chesapeake Bay. Between 1941 and 1952, solid waste generated from base activities was deposited at the landfill. Waste was mostly non-hazardous, but could have included pesticides, paints, solvents, PCBs, and heavy metals. Early on, waste was deposited directly into the water at Desert Cove, eventually filling in 5 acres of land. Runoff from the landfill is believed to enter Desert Cove.</p>	<p>Groundwater: Metals, including arsenic, barium, beryllium, lead, nickel, and zinc, have been detected.</p> <p>Surface Soil: VOCs (toluene) and pesticides (DDD, DDE, dieldrin, endrin, and chlordane) were detected.</p>	<p>Today, the landfill is covered with soil and grass and a portion of the site has been used for baseball diamonds. Corrective actions were completed for underground storage tanks and long-term groundwater monitoring is underway at the site.</p>	<p>No identified public health hazards are associated with this IRP site under past or present use. There is limited potential for public contact with contaminated soil or the contents of the landfill and no one uses the groundwater at the site as a drinking water source. Contaminants may enter Desert Cove with runoff from Site 10, possibly contaminating harbor sediment and fish. Recreational swimmers should not come in contact with harmful levels of contaminants in sediment and restrictions against taking fish or shellfish has been issued for the harbor. ATSDR recommends that the Navy consider potential movement of landfill gases before constructing any buildings in the future near the former landfills.</p>

Table 1. Evaluation of Sites at Naval Amphibious Base, Little Creek (continued)

Site	Site Description and History	Investigation Results/Environmental Monitoring Results ¹	Corrective Action and/or Current Status	Evaluation of Public Health Hazard
Site 11 - School of Music Plating Shop, including the Neutralizing Tank, Contaminated Soil, and Groundwater	Site 11 is the tank, contaminated soil and groundwater associated with the School of Music Plating Shop, located in Building 3651 along the eastern portion of the base. Between 1964 and 1974, musical instruments were electroplated at the shop. Plating bath solutions containing silver cyanide, copper cyanide, chromic acid, nickel, acids, and lacquers were disposed of down a drain inside the shop. The material was then carried by an acid-resistant pipe to a concrete neutralization pit about 10 feet from the shop, before emptying into a storm sewer. Runoff from the area moves toward Desert Cove and Little Creek Cove.	Groundwater: VOCs and metals were detected. Recent investigations indicated that only the lower portion (17-21 feet below ground surface) of the surficial aquifer was contaminated with VOCs, where trichloroethylene (TCE) and dichloroethylene (DCE) were measured. Concentrations in the shallow portion (8-12 feet below ground surface) of the surficial aquifer are being investigated. Soil: Metals were detected.	During 1995 and 1996, the tank and its contents and inlet and outlet piping were removed. About 190 gallons of hazardous liquids and about 11 tons of debris were removed. Contaminated materials along the pipeline and below the tank also were removed, including 94 tons of contaminated soil and almost 11 tons of debris (tank, concrete floor, piping). Following the removal, the excavated area was backfilled, the floor and cooling towers were replaced, and the area was spread with topsoil.	No identified public health hazards are associated with this IRP site under past or present use. There is limited potential for public contact with contaminated soil and no one uses the groundwater at the site as a drinking water source. Contaminants may reach Desert Cove and Little Creek Cove in runoff from Site 11, possibly contaminating harbor sediment and fish. Recreational swimmers should not come in contact with harmful levels of contaminants in sediment and restrictions against taking fish, crabs, and shellfish have been issued for the harbor.

Table 1. Evaluation of Sites at Naval Amphibious Base, Little Creek (continued)

Site	Site Description and History	Investigation Results/Environmental Monitoring Results ¹	Corrective Action and/or Current Status	Evaluation of Public Health Hazard
Site 11A - Area of Elevated TCE Contamination	Site 11A is a separate area discovered during the investigation of Site 11. The TCE contamination is unrelated to Site 11 and the source of contamination at Site 11A has not yet been determined. The TCE contamination is believed to be as a result of an isolated dumping of a small volume of TCE.	Groundwater: TCE concentrations were detected at levels slightly above EPA's MCL and ATSDR's CV of 5 ppb.	This site is being worked on along with Site 11.	No identified public health hazards are associated with Site 11A because no one uses the groundwater at the site as a drinking water or industrial water source.

Table 1. Evaluation of Sites at Naval Amphibious Base, Little Creek (continued)

Site	Site Description and History	Investigation Results/Environmental Monitoring Results ¹	Corrective Action and/or Current Status	Evaluation of Public Health Hazard
Site 12 - Exchange Laundry Waste Disposal Area	Site 12, the Exchange Laundry Waste Disposal Area, consists of Building 3323 the site of base dry cleaning operations from 1973 until 1978. Waste containing tetrachloroethylene (PCE), soap, and dyes were dumped into a catch basin which emptied into a storm sewer. The sewer flows north into a 9-foot-deep drainage canal that connects with Lake Bradford and Little Creek Cove. A Base Exchange/Commissary was built on the property in 1993. Runoff /drainage via a drainage canal moves from the area toward Little Creek Cove.	<p>Groundwater: VOCs (primarily PCE) were detected.</p> <p>Surface Soil: VOCs, SVOCs, and lead were detected in soil.</p> <p>Surface Water/Sediment: In 1993, VOCs (TCE and PCE) were detected in the canals, but in 1991 and 1997 sampling VOCs were not detected.</p>	In 1987 Building 3323 was demolished and the catch basin and a portion of the storm sewer were removed. Eventually the rest of the storm sewer was removed and the area regraded to prepare for the construction of the Base Exchange/Commissary. The Navy has equipped the new building with a passive gas removal system to remove vapors in the event they should seep into the building from nearby groundwater contamination. The Navy is evaluating multiple options for groundwater remediation in the Feasibility Study.	No identified public health hazards are associated with this IRP site under past or present use. There is limited potential for public contact with contaminated soil and no one uses the groundwater at the site as a drinking water source. Some contamination could have reached Little Creek Cove via a drainage canal, possibly contaminating harbor sediment and fish. Recreational swimmers should not come in contact with harmful levels of contaminants in sediment and restrictions against taking fish or shellfish has been issued for the harbor. Groundwater contamination in the area is not expected to affect indoor air quality of the new Base Exchange/ Commissary.

Table 1. Evaluation of Sites at Naval Amphibious Base, Little Creek (continued)

Site	Site Description and History	Investigation Results/Environmental Monitoring Results	Corrective Action and/or Current Status	Evaluation of Public Health Hazard
Site 13 - Pentachlorophenol (PCP) Dip Tank and Wash Rack Area	Between 1960 and 1975 a PCP Dip Tank and a Wash Rack were used to treat wood with PCP. Wash racks near the dip tank were used for cleaning vehicles and equipment with steam or solvents and the drying rack was used for treated wood. Solutions on the treated materials could have dripped onto the ground. Runoff from the area is directed toward Little Creek Cove.	Groundwater: VOCs (TCE and PCE) were detected. Surface Soil: SVOCs were detected.	All PCP contaminated soil was removed in 1999. In 2000, a pilot study was conducted using Oxygen Release Compound to remediate groundwater at the site. Several remedial alternatives are being evaluated for groundwater remediation.	No identified public health hazards are associated with this IRP site under past or present use. There is limited potential for public contact with contaminated soil and no one uses the groundwater at the site as a drinking water source. Runoff from Site 13 enters Little Creek Cove, possibly transporting contaminants that could be taken up by harbor sediment or fish. Recreational swimmers should not come in contact with harmful levels of contaminants in sediment restrictions against taking fish or shellfish has been issued for the harbor.

Table 1. Evaluation of Sites at Naval Amphibious Base, Little Creek (continued)

Site	Site Description and History	Investigation Results/Environmental Monitoring Results	Corrective Action and/or Current Status	Evaluation of Public Health Hazard
Site 15 - PCB Capacitor Spill - Fire Station No. 1	Site 15 is the soil beneath the capacitor pole behind Fire Station No. 1, where a capacitor was damaged by lightning in the early 1980s. Reportedly, less than 5 gallons of dielectric fluid leaked onto the ground in the immediate area of the spill. Migration of the contaminants is unlikely.	Groundwater: No data were available. Soil: PCBs (up to 170,061 milligrams per kilogram [mg/kg]) were detected.	PCB contaminated soils were removed in 2002. No further action for this site.	Under past or present use no identified public health hazards are associated with this IRP site. There is only limited potential for public contact with contaminated soil, and no one uses the groundwater at the site as a drinking water source.
Site 16 - Pole # 425 PCB Capacitor Spill	Site 16 is the location of a PCB-containing dielectric fluid leak. The spill of less than 5 gallons resulted when lightning struck the capacitor on pole #425 pole.	Soil: PCBs, as Aroclor 1260, were detected in soil.	The PCB-contaminated soil, the pole, and the surrounding vegetation were removed in 1995, as approved by the state and EPA. PCB contaminated soils were removed in 2002. No further action for this site.	Under past or present use, no identified public health hazards are associated with this IRP site. There is only limited potential for public contact with contaminated soil and no one uses the groundwater at the site as a drinking water source.

Table 1. Evaluation of Sites at Naval Amphibious Base, Little Creek (continued)

Site	Site Description and History	Investigation Results/Environmental Monitoring Results ¹	Corrective Action and/or Current Status	Evaluation of Public Health Hazard
SWMUs				
SWMU 1 - Small Transformer Storage Area	Beginning in 1975, the Navy used this area for storage of small, non-PCB transformers and repairs of PCB transformers. , Whether releases of PCBs have occurred is, however, unknown.	<p>Groundwater: None tested.</p> <p>Soil: PCBs were detected but at levels below risk-acceptable, industrial risk-based concentrations (RBCs). SVOCs and pesticides were also detected</p>	This site is proposed for no further action.	No identified public health hazards are associated with this SWMU under past or present use. There is only limited potential for public contact with contaminated soil and no one uses the groundwater at the site as a drinking water source.

Table 1. Evaluation of Sites at Naval Amphibious Base, Little Creek (continued)

Site	Site Description and History	Investigation Results/Environmental Monitoring Results ¹	Corrective Action and/or Current Status	Evaluation of Public Health Hazard
SWMU 3 - Pier 10 Sandblast Yard	<p>From 1962 to 1984 this area was used for sandblasting activities for boats, and from 1980 to 1995 for anchors and anchor chains. Items were sandblasted on a concrete pad. Periodically, the residue was removed from the area. No hazardous materials were found on the site, but some residue was found along the unpaved ground extending from the concrete pad to the shore of Little Creek Harbor. In 1982 a fence was constructed to limit windblown residue migration, and, in 1993 an asphalt cover and catch basin were added.</p>	<p>Groundwater: VOCs and metals detected in groundwater.</p> <p>Soil: Metals and PAHs were detected in soil.</p> <p>Sediment: Metals and PAHs were detected in sediment.</p>	<p>Additional groundwater monitoring and completion of a quantitative risk assessment are proposed for this SWMU. This SWMU will also be followed as part of a multi-site ecological risk assessment.</p>	<p>No identified public health hazards are associated with this SWMU. A fence limits any possibility of public contact with contaminated soil and no one uses the groundwater at the site as a drinking water source.</p>

Table 1. Evaluation of Sites at Naval Amphibious Base, Little Creek (continued)

Site	Site Description and History	Investigation Results/Environmental Monitoring Results ¹	Corrective Action and/or Current Status	Evaluation of Public Health Hazard
SWMU 4 - Special Boat Squadron 2 Battery Storage Yard	This 300 to 400-square foot area was used from 1943 to 1980 for storage of lead-acid batteries, paint waste, and scrap metals. The site is surrounded by a fence and a controlled security gate. Pavement covers the area, except in the grassy area along the fence and near a building.	Groundwater: Metals were detected in groundwater. Soil: Metals were detected in soil.	This SWMU could be recommended for further investigations.	No identified public health hazards are associated with this SWMU under past or present use. A fence limits the possibility for public contact with contaminated soil and no one uses the groundwater at the site as a drinking water source.
SWMU 6 - SeaBee Area	The General Services Administration used the area to stockpile mineral ores. Most of the ores have been removed. Currently, the ore storage area consists of three grass-covered piles ranging from 40 to 70 feet high.	Groundwater: VOCs were detected, but generally at low levels. Antimony, arsenic, beryllium, cadmium, chromium, and lead were also detected. Surface Soil: No data were available. Sediment: Sediment contained PAHs and PCBs, but generally at low concentrations.	The area has been paved.	No identified public health hazards are associated with this SWMU under past or present use. Pavement covering the area prevents public exposure with exposed soil and no one uses the groundwater at the site as a drinking water source.

Table 1. Evaluation of Sites at Naval Amphibious Base, Little Creek (continued)

Site	Site Description and History	Investigation Results/Environmental Monitoring Results ¹	Corrective Action and/or Current Status	Evaluation of Public Health Hazard
SWMU 8 - West Annex Sandblasting Areas	This SWMU consists of a vacant lot which 1949 to 1971 was used for sandblasting of boats. Sandblasting residue accumulated on the ground to an average thickness of 4 inches. Periodically, the residue was removed and disposed of off base.	<p>Groundwater: VOCs and metals were detected in groundwater.</p> <p>Soil: Metals, primarily lead, and PAHs were detected in surface soil.</p> <p>Sediment: Metals and PAHs were detected in soil.</p>	The Navy delineated the boundaries of grit at SWMU 8 and a nearby water tower. the Navy also removed lead contaminated soil within those areas to levels for residential settings.	No identified public health hazards are associated with this SWMU IRP site under past or present use. Contaminated soil has been removed from this SWMU and no one uses the groundwater at the site as a drinking water source. Residential property lies about 100 feet from the water tower. ATSDR is concerned that in the past lead-contaminated soil could have migrated to the off-base property where children might live or play. No sampling or comprehensive exposure (blood lead levels) data are available to state definitely whether lead exposure could have or has occurred. ATSDR recommends blood lead level screening for all children age 6 or under.

Sources: NEESA 1984, OHM/IT 2001.

Table 1. Evaluation of Sites at Naval Amphibious Base, Little Creek (continued)

Key	
ATSDR	Agency for Toxic Substances and Disease Registry
DCE	dichloroethylene
EE/CA	engineering evaluation/cost analysis
μg/L	micrograms per liter = ppb
μg/kg	micrograms per kilogram = ppb
mg/kg	milligrams per kilogram = ppm
PAH	polycyclic aromatic hydrocarbons
	PCBs
	PCE
	RBC
	ROD
	SVOCs
	SWMU
	TCE
	VOCs
	polychlorinated biphenyls
	tetrachloroethylene
	EPA's risk based concentration
	record of decision
	semivolatile organic compounds
	solid waste management unit
	trichloroethylene
	volatile organic compounds

Table 2. Exposure Pathways Evaluation Table

Pathway Name	Exposure Pathway Elements				Comments
	Source of Contamination	Environment Medium	Point of Exposure	Route of Exposure	Potentially Exposed Population
Completed Exposure Pathway					
Consumption of Local Fish and Shellfish from Little Creek Harbor	Mercury, tributyltin, and PCBs from the NAB Little Creek operations and numerous other sources associated with routine harbor activity	Local fish and shellfish populations	Consumption of locally caught fish and shellfish	Ingestion	Local anglers and harvesters of crab (who disregard the no fishing /shellfishing advisory)
					<p>Past: Fish and crab in Little Creek Harbor have been impacted by mercury and tributyltin. Contaminant levels in local fish/shellfish/crab could have posed a public health hazard if consumed in sufficient quantities.</p> <p>Current and Future: To best protect themselves against exposure to biologic and chemical contaminants, people should adhere to the Little Creek Harbor restrictions and advisory.</p>

Table 2. Exposure Pathways Evaluation Table (continued)

Pathway Name	Exposure Pathway Elements				Comments
	Source of Contamination	Environment Medium	Point of Exposure	Route of Exposure	Potentially Exposed Population
Potential Exposure Pathways					
Surface Soil - On base	Several areas of soil contamination associated with former site activities exist throughout NAB Little Creek.	Surface soil	Surface soil at nearby residential property	Dermal contact and incidental ingestion	Nearby off-base residents
					<p>Past: Exposure to contaminated surface soil at NAB Little Creek sites is largely prevented because the majority of the land's surface is paved, covered by buildings, fenced, or is in restricted land use locations. Any sporadic contact with or incidental ingestion of the contaminants detected in the base surface soil is not expected to have harmful effects.</p> <p>Current and Future: No public health hazards are occurring or are expected to occur.</p>

Table 2. Exposure Pathways Evaluation Table (continued)

Pathway Name	Exposure Pathway Elements				Comments
	Source of Contamination	Environmental Medium	Point of Exposure	Route of Exposure	Potentially Exposed Population
Surface Soil - Off base	NAB Little Creek SWMU 8 and Water Tower 1553: Lead is the primary contaminant of concern. Exposure to contaminated surface soil at other NAB Little Creek sites is largely prevented because the majority of the land's surface is paved, covered by buildings, fenced, or is in restricted land use locations.	Surface soil	Surface soil at nearby off-base residential property	Dermal contact and incidental ingestion	Nearby off-base residents
					<p>Past: Children at certain homes in the Turner Road area could have been exposed to site-related lead in soil if lead migrated from the base. Data are not available to confirm whether or to what extent migration occurred.</p> <p>Current and Future: No exposures are expected to occur; the grit has been removed from SWMU 8/ water tower. Furthermore, soil cover at the residential properties greatly reduces contact with possible residual lead in soil. Cumulative exposure to all possible sources of lead in the neighborhood could pose a risk for some children.</p>

Table 3. Contaminant Concentrations in Fish and Crab From Little Creek Harbor

Study	Sample Location	Species	Number of Individual Samples	Total Mercury (mg/kg)	Tributyltin (mg/kg)	PCBs (mg/kg)
Base Study 1994	Little Creek Harbor	Fish (Spot)	3	0.132	nd	na
		Fish (Croaker)	1	0.134	nd	na
		Crab	8	0.225	nd	na
		Crab	7	0.193	nd	na
Base Study 1995	Little Creek Canal	Crab	composite samples	0.097	0.028	na
	Pier 58	Fish (Croakers)	composite samples	0.148	0.006	na
VDEQ 1998	Little Creek Channel	Fish (Mummichog)	1	na	na	0.127
		Fish (Spot)	1	na	na	0.062

Source: Baker Environmental Inc. 1996.

Key: mg/kg = milligrams per kilogram; na = not analyzed; nd = not detected.

Note: EPA risk-based concentrations (RBCs) for contaminants detected in Little Creek Harbor fish/crab are: mercury, 0.14 mg/kg; tributyltin, 0.41 mg/kg; and PCBs, 0.0016 mg/kg. Concentrations of mercury and PCBs in fish and crab exceeded EPA's RBCs. Nevertheless, ATSDR's evaluation determined that exposure to the detected levels of these contaminants in fish/shellfish should not pose a health threat to those who ate fish or crab from the harbor in the past. The Navy currently maintains a no fishing advisory for the harbor based on bacteriological contamination. People can best protect themselves from exposure to all contaminants in fish and shellfish by adhering to the existing advisory.

Figures

Naval Amphibious Base, Little Creek

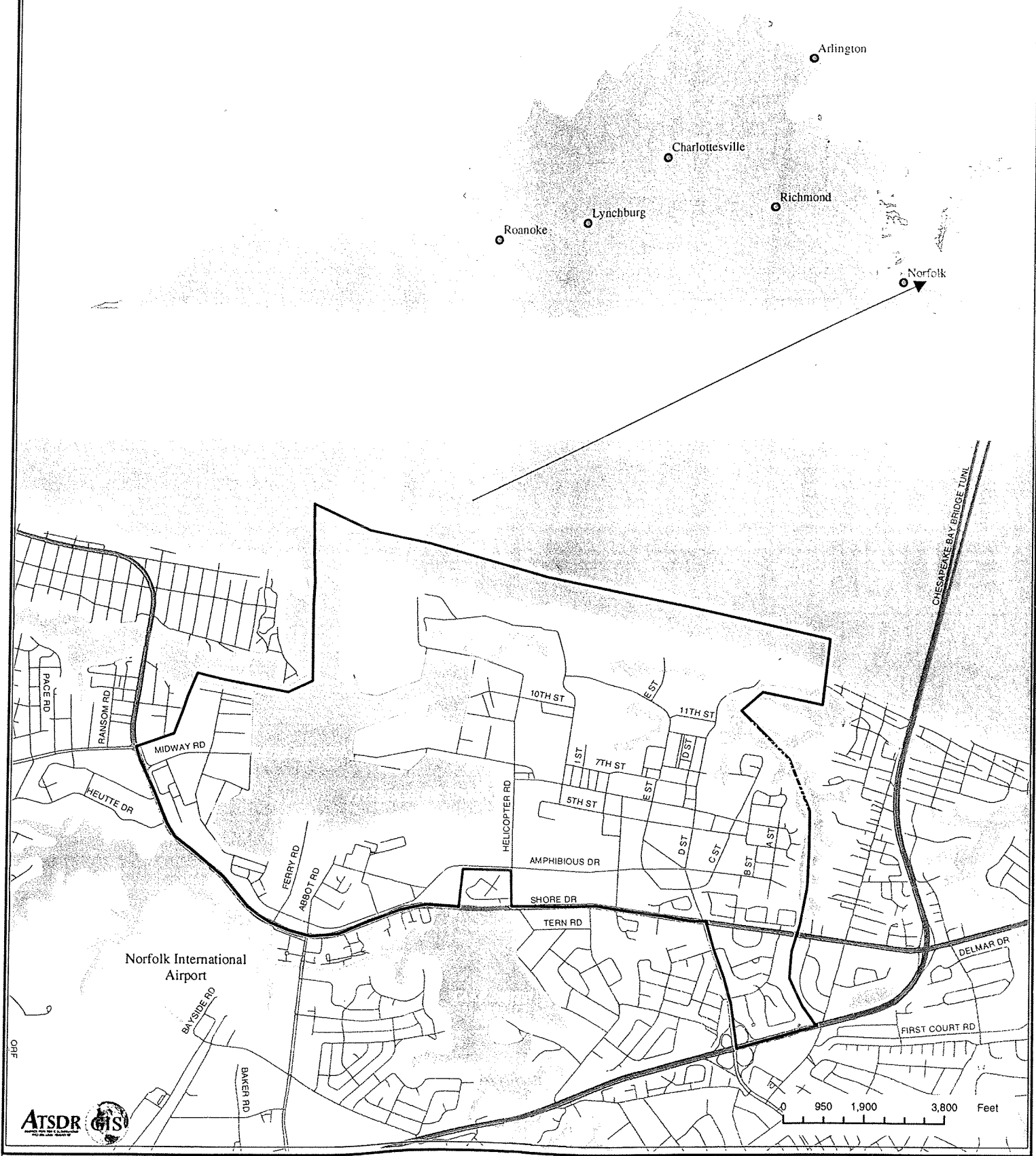
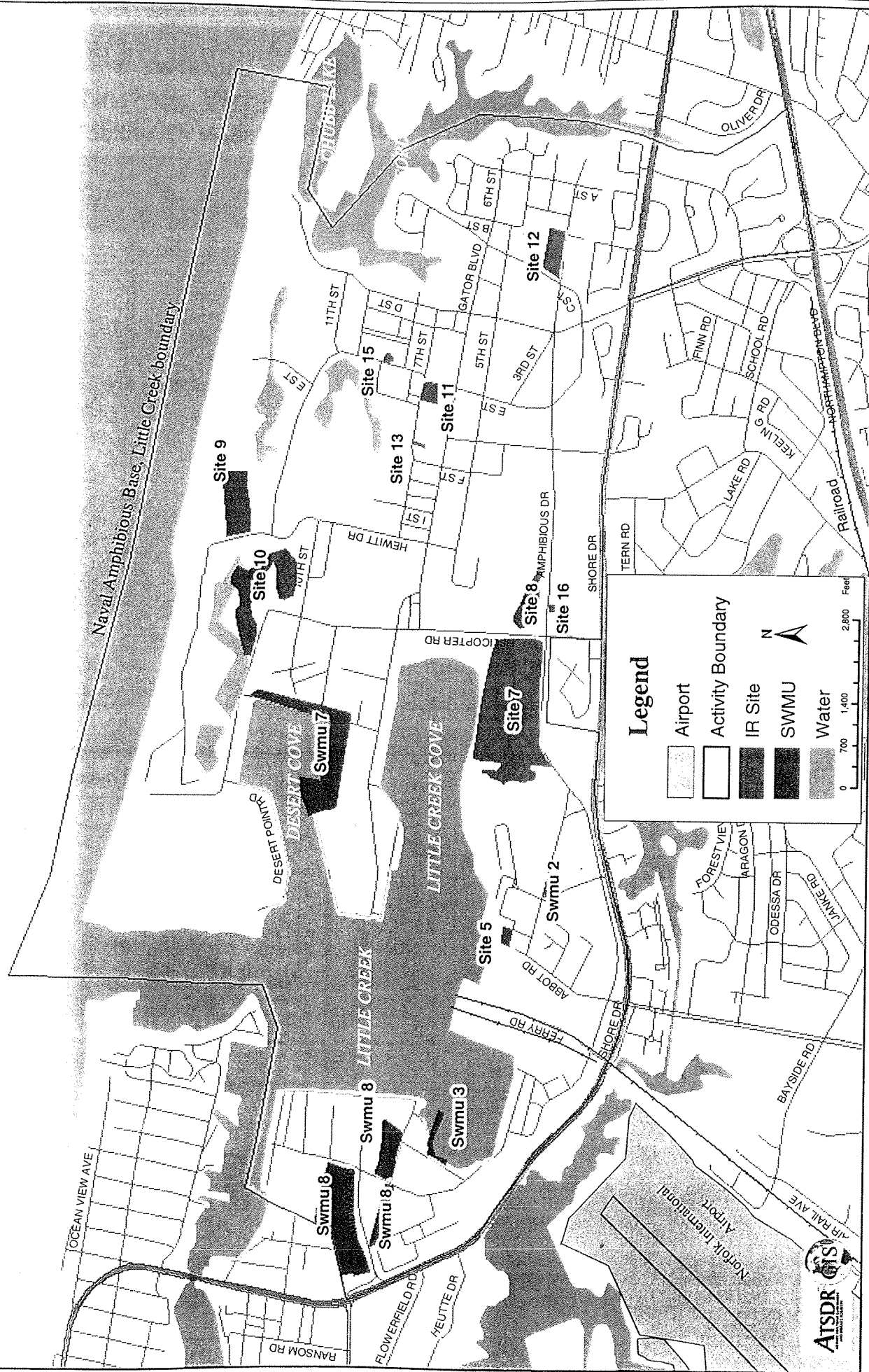


Figure 2. Site Map

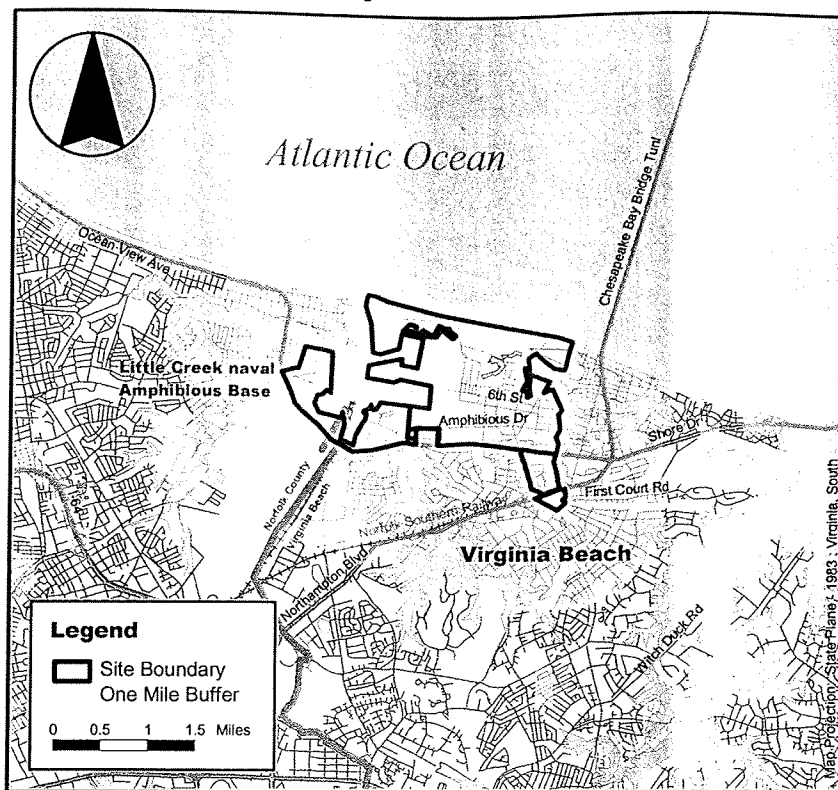
Naval Amphibious Base, Little Creek



Little Creek Naval Amphibious Base

Norfolk, Virginia
EPA Facility ID VA5170022482

FIGURE 3A. Demographics



Base Map Source: 1995 TIGER/Line Files



Site Location

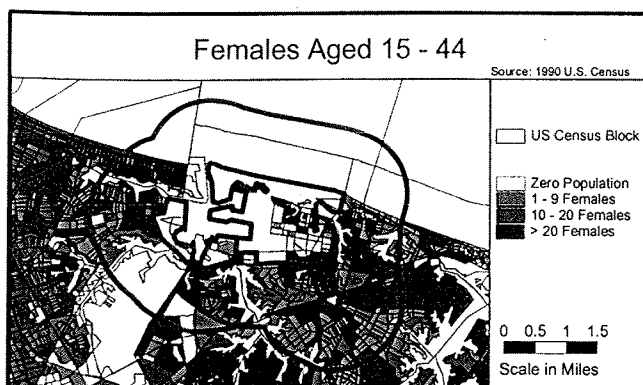
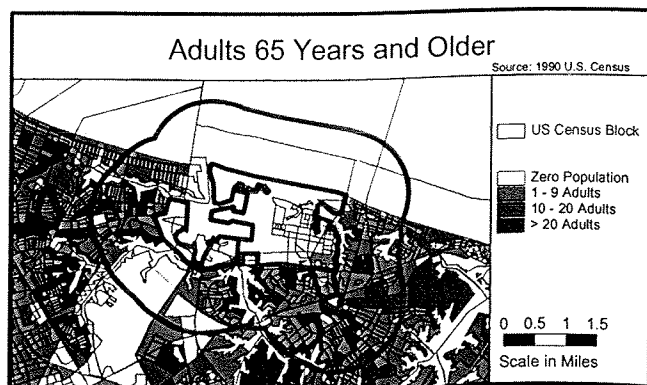
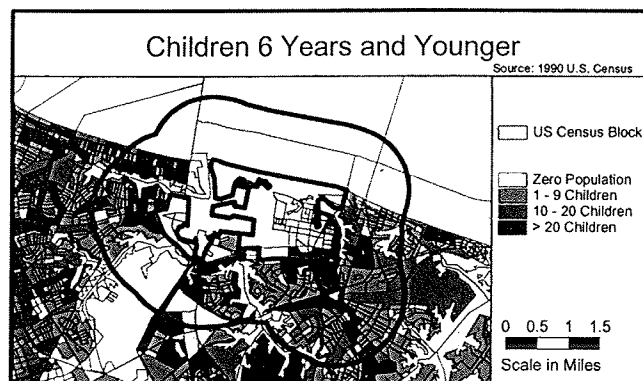
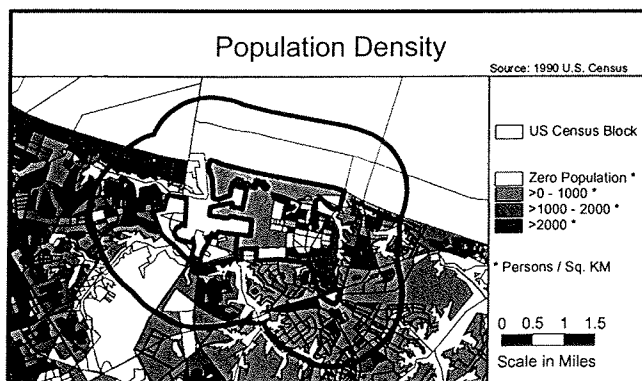
Virginia Beach (City), Virginia

Demographic Statistics Within One Mile of Site*

Total Population	35809
White	28240
Black	5955
American Indian, Eskimo, Aleut	141
Asian or Pacific Islander	855
Other Race	616
Hispanic Origin	1467
Children Aged 6 and Younger	4371
Adults Aged 65 and Older	2370
Females Aged 15 - 44	8491
Total Housing Units	13349

Demographics Statistics Source: 1990 US Census

*Calculated using an area-proportion spatial analysis technique

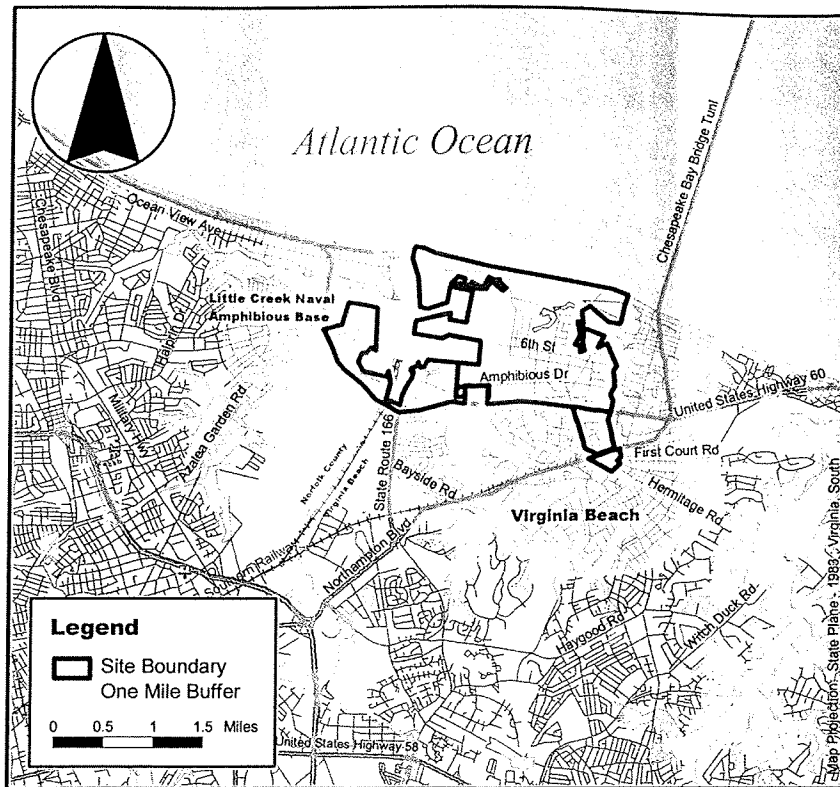


Little Creek Naval Amphibious Base

Norfolk, Virginia

EPA Facility ID VA5170022482

FIGURE 3B. Demographics



Base Map Source: 1995 TIGER/Line Files



Site Location

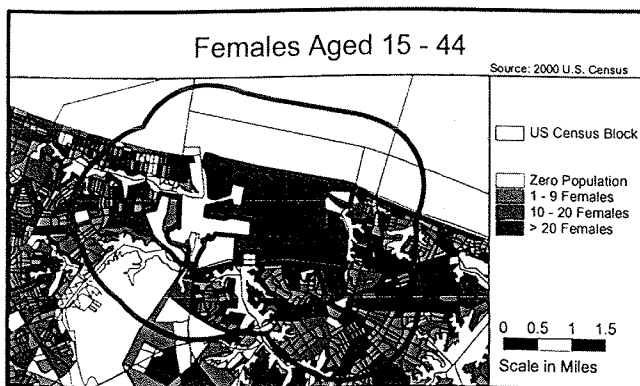
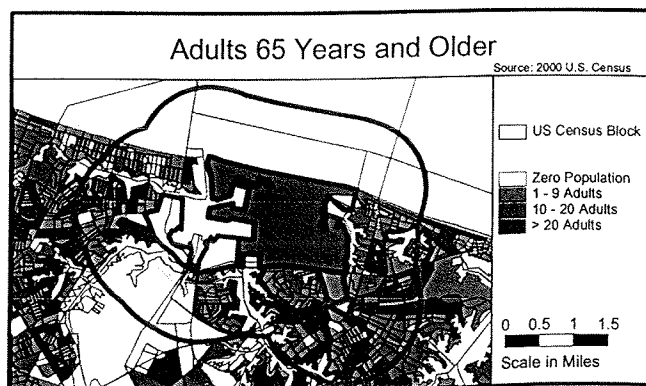
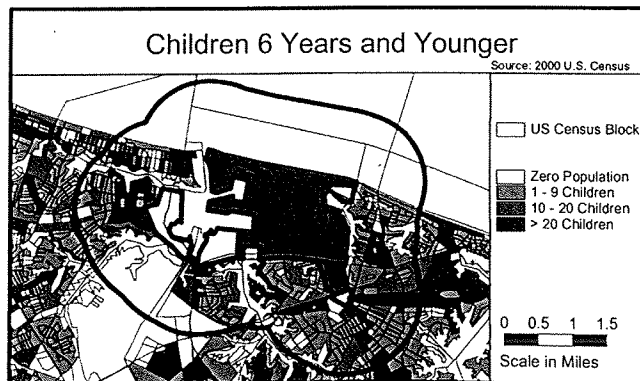
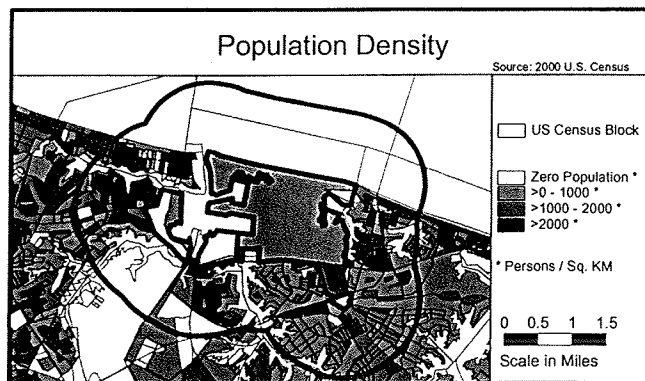
Virginia Beach (City), Virginia

Demographic Statistics Within Area of Concern*

Total Population	31230
White alone	22255
Black alone	6220
Am. Indian and Alaska Native alone	157
Asian alone	958
Native Hawaiian and Other Pacific Islander alone	29
Some other race alone	619
Two or More races	991
Hispanic or Latino	1473
Children Aged 6 and Younger	3468
Adults Aged 65 and Older	2983
Females Aged 15 - 44	7259
Total Housing Units	12565

Demographics Statistics Source: 2000 US Census

*Calculated using an area-proportion spatial analysis technique



The map displays the Little Creek Naval Amphibious Base and surrounding areas. Key features include:

- Activity Boundary:** A thick black line delineates the base's perimeter, with a label "Naval Amphibious Base, Little Creek boundary" along the western side.
- IR Sites:** Shaded gray areas labeled Site 7, Site 8, Site 9, Site 10, Site 11, Site 12, Site 13, Site 14, Site 15, and Site 16.
- SWMUs:** Shaded dark gray areas labeled Swmu 3, Swmu 4, Swmu 5, Swmu 6, Swmu 7, Swmu 8, and Swmu 9.
- Geographical Features:** Little Creek Channel, Little Creek Cove, Dussott Cove, Little Creek Reservoir, Lake Shore, and various lakes and ponds.
- Infrastructure:** Roads (e.g., Highway 1, Highway 2, Highway 3), bridges, and buildings.
- Legend:**
 - IR Site (Shaded gray)
 - SWMU (Shaded dark gray)
 - Activity Boundary (Thick black line)
- Scale:** A scale bar at the bottom right indicates distances of 1.125, 2.250, and 4.50 miles.



SECRET



Figure 7. Wetlands Map

Naval Amphibious Base, Little Creek

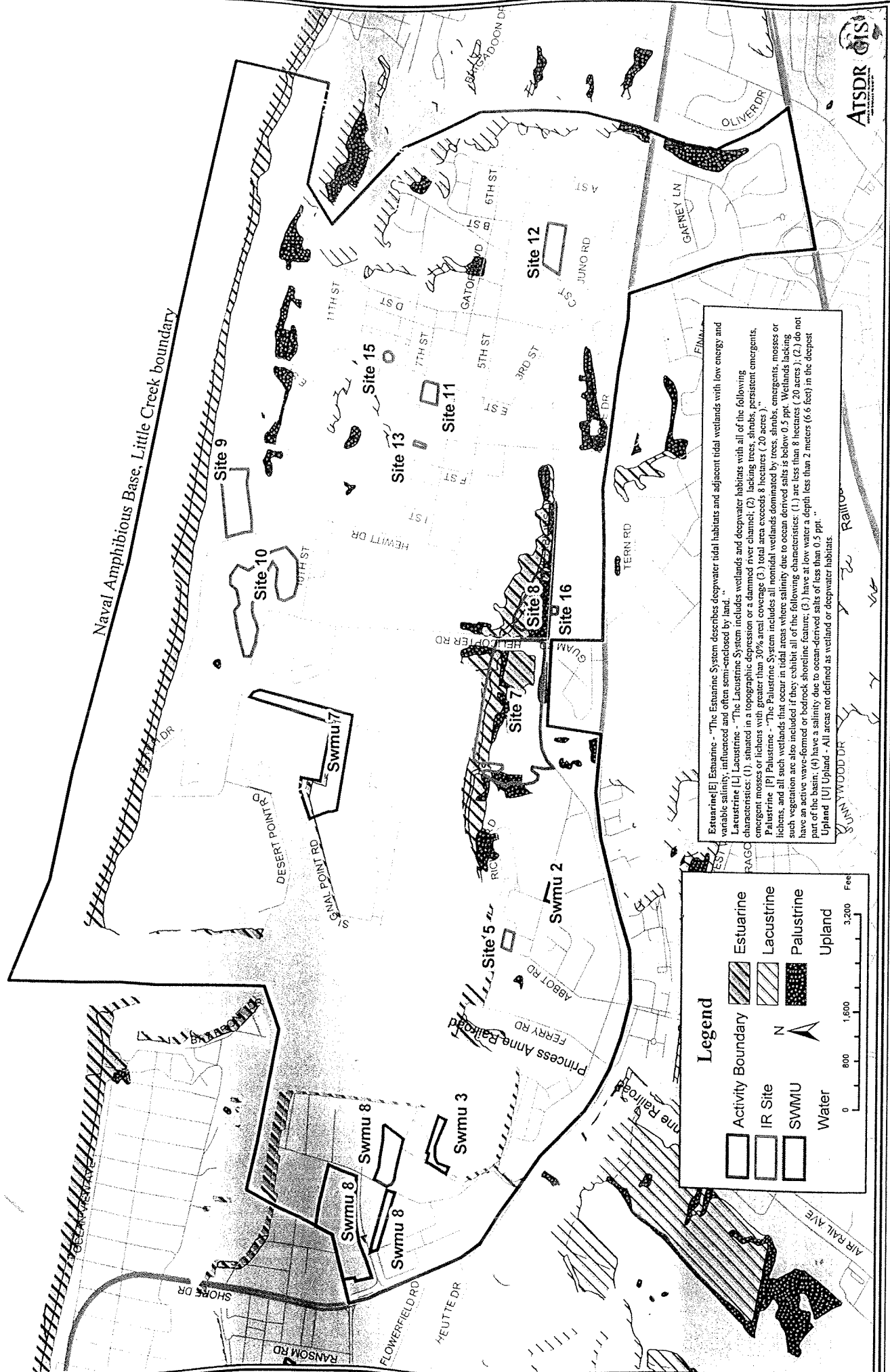
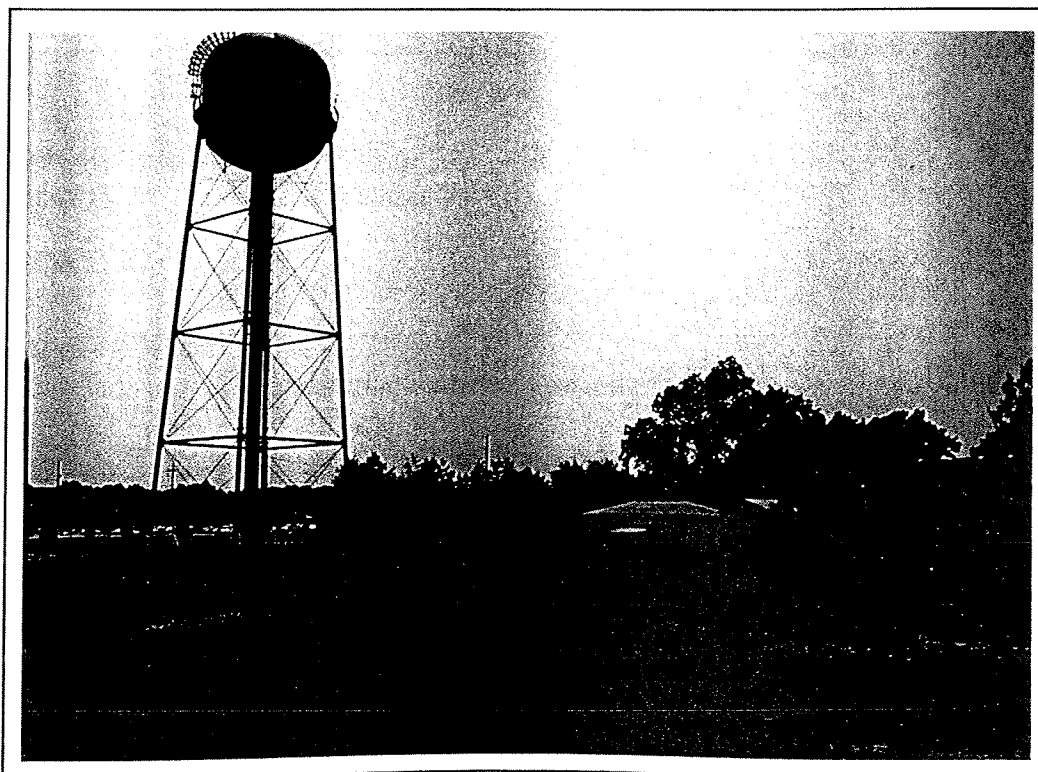
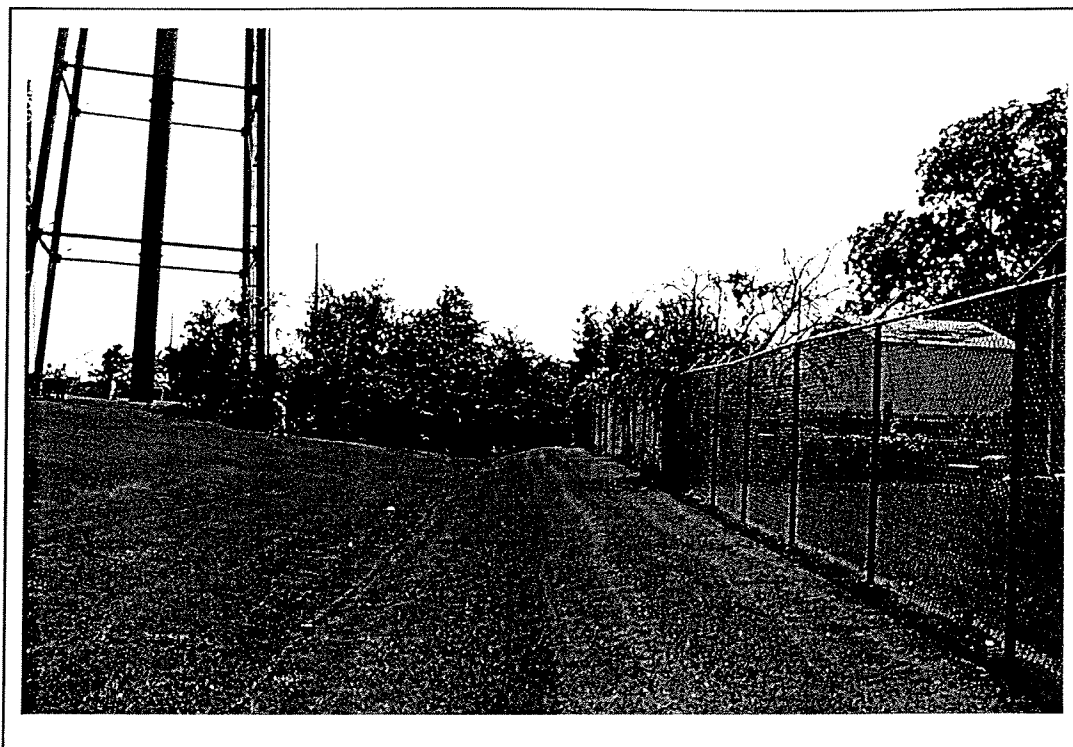


Figure 8

Solid Waste Management Unit (SWMU) 8 Near Water Tower 1553



Appendix A. Glossary

Adverse Health

Effect: A change in body function or the structures of cells that can lead to disease or health problems.

ATSDR: The Agency for Toxic Substances and Disease Registry. ATSDR is a federal health agency in Atlanta, Georgia that deals with hazardous substance and waste site issues. ATSDR gives people information about harmful chemicals in their environment and tells people how to protect themselves from coming into contact with chemicals.

Background Level: An average or expected amount of a chemical in a specific environment. Or, amounts of chemicals that occur naturally in a specific environment.

Cancer: A group of diseases which occur when cells in the body become abnormal and grow, or multiply, out of control.

Carcinogen: Any substance shown to cause tumors or cancer in experimental studies.

CERCLA: See Comprehensive Environmental Response, Compensation, and Liability Act.

Chronic Exposure: A contact with a substance or chemical that happens over a long period of time. ATSDR considers exposures of more than one year to be *chronic*.

Completed Exposure

Pathway: See Exposure Pathway.

Comparison Value:

(CVs) Concentrations or the amount of substances in air, water, food, and soil that are unlikely, upon exposure, to cause adverse health effects. Comparison values are used by health assessors to select which substances and environmental media (air, water, food and soil) need additional evaluation while health concerns or effects are investigated.

**Comprehensive Environmental
Response, Compensation, and Liability**

Act (CERCLA): CERCLA was enacted in 1980. It is also known as **Superfund**. This act concerns releases of hazardous substances into the environment and the cleanup of these substances and hazardous waste sites. ATSDR was created by this act and is responsible for looking into the health issues related to hazardous waste sites.

Concern: A belief or worry that chemicals in the environment might cause harm to people.

Concentration: How much or the amount of a substance present in a certain amount of soil, water, air, or food.

Contaminant: See **Environmental Contaminant**.

Dermal Contact: A chemical getting onto your skin. (see **Route of Exposure**).

Dose: The amount of a substance to which a person may be exposed, usually on a daily basis. Dose is often explained as “amount of substance(s) per body weight per day”.

Duration: The amount of time (days, months, years) that a person is exposed to a chemical.

Environmental Contaminant: A substance (chemical) that gets into a system (person, animal, or the environment) in amounts higher than that found in **Background Level**, or what would be expected.

Environmental Media: Usually refers to the air, water, and soil in which chemicals of interest are found. Sometimes refers to the plants and animals that are eaten by humans. **Environmental Media** is the second part of an **Exposure Pathway**.

**U.S. Environmental
Protection**

Agency (EPA): The federal agency that develops and enforces environmental laws to protect the environment and the public’s health.

Epidemiology: The study of the different factors that determine how often, in how many people, and in which people will disease occur.

Exposure: Coming into contact with a chemical substance. (For the three ways people can come in contact with substances, see **Route of Exposure**.)

Exposure Assessment: The process of finding the ways people come in contact with chemicals, how often and how long they come in contact with chemicals, and the amounts of chemicals with which they come in contact.

Exposure Pathway: A description of the way that a chemical moves from its source (where it began) to where and how people can come into contact with (or get exposed to) the chemical.

ATSDR defines an exposure pathway as having 5 parts:

- 1 Source of Contamination,
- 2 Environmental Media and Transport Mechanism,
- 3 Point of Exposure,
- 4 Route of Exposure, and
- 5 Receptor Population.

When all 5 parts of an exposure pathway are present, it is called a **Completed Exposure Pathway**. Each of these 5 terms is defined in this Glossary.

Frequency: How often a person is exposed to a chemical over time; for example, every day, once a week, twice a month.

Hazardous Waste: Substances that have been released or thrown away into the environment and, under certain conditions, could be harmful to people who come into contact with them.

Health Effect: ATSDR deals only with **Adverse Health Effects** (see definition in this Glossary).

Indeterminate Public

Health Hazard: The category is used in Public Health Assessment documents for sites where important information is lacking (missing or has not yet been gathered) about site-related chemical exposures.

- Ingestion:** Swallowing something, as in eating or drinking. It is a way a chemical can enter your body (See **Route of Exposure**).
- Inhalation:** Breathing. It is a way a chemical can enter your body (See **Route of Exposure**).
- MRL:** **Minimal Risk Level.** An estimate of daily human exposure—by a specified route and length of time—to a dose of chemical that is likely to be without a measurable risk of adverse, noncancerous effects. An MRL should not be used as a predictor of adverse health effects.
- NPL:** The **National Priorities List.** (Which is part of **Superfund**.) A list kept by the U.S. Environmental Protection Agency (EPA) of the most serious, uncontrolled or abandoned hazardous waste sites in the country. An NPL site needs to be cleaned up or is being looked at to see if people can be exposed to chemicals from the site.
- No Apparent Public Health Hazard:** The category is used in ATSDR's Public Health Assessment documents for sites where exposure to site-related chemicals could have occurred in the past or is still occurring but the exposures are not at levels expected to cause adverse health effects.
- No Public Health Hazard:** The category is used in ATSDR's Public Health Assessment documents for sites where there is evidence of an absence of exposure to site-related chemicals.
- PHA:** **Public Health Assessment.** A report or document that looks at chemicals at a hazardous waste site and reports whether people could be harmed from coming into contact with those chemicals. The PHA also reports whether possible further public health actions are needed.
- Plume:** A line or column of air or water containing chemicals moving from the source to areas further away. A plume can be a column or clouds of smoke from a chimney or contaminated underground water sources or contaminated surface water (such as lakes, ponds and streams).
- Point of Exposure:** The place where someone can come into contact with a contaminated environmental medium (air, water, food or soil). Examples include

an area of a playground with contaminated dirt, a contaminated spring used for drinking water, the location where fruits or vegetables are grown in contaminated soil, or a backyard area where someone might breathe contaminated air.

Population: A group of people living in a certain area; or the number of people in a certain area.

Public Health Assessment(s): See **PHA**.

Public Health Hazard: The category is used in PHAs for sites that have certain physical features or evidence of chronic, site-related chemical exposure that could result in adverse health effects.

Public Health Hazard Criteria: PHA categories given to a site which tell whether people could be harmed by conditions present at the site. Each are defined in the Glossary. The categories are:

1. Urgent Public Health Hazard
2. Public Health Hazard
3. Indeterminate Public Health Hazard
4. No Apparent Public Health Hazard
5. No Public Health Hazard

Receptor Population: People who live or work in the path of one or more chemicals, and who could come into contact with them (See **Exposure Pathway**).

Reference Dose (RfD): An estimate, with safety factors (see **safety factor**) built in, of the daily, life-time exposure of human populations to a possible hazard that is not likely to cause harm to the person.

Route of Exposure: The way a chemical can get into a person's body. The three exposure routes are

- breathing (also called inhalation),
- eating or drinking (also called ingestion), and
- or getting something on the skin (also called dermal contact).

- Safety Factor:** Also called **Uncertainty Factor**. When scientists do not have enough information to decide if an exposure will cause harm to people, they use “safety factors” and formulas in place of the information that is not known. These factors and formulas can help determine the amount of a chemical that is not likely to cause harm to people.
- SARA:** The Superfund Amendments and Reauthorization Act in 1986 amended CERCLA and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from chemical exposures at hazardous waste sites.
- Source (of Contamination):** The place where a chemical comes from, such as a landfill, pond, creek, incinerator, tank, or drum. Contaminant source is the first part of an **Exposure Pathway**.
- Special Populations:** People who might be more sensitive to chemical exposures because of certain factors such as age, a disease they already have, occupation, sex, or certain behaviors (like cigarette smoking). Children, pregnant women, and older persons are often considered special populations.
- Superfund Site:** See **NPL**.
- Toxic:** Harmful. Any substance or chemical can be toxic at a certain dose (amount). The dose is what determines the potential harm of a chemical and whether it would cause someone to get sick.
- Toxicology:** The study of the harmful effects of chemicals on humans or animals.
- Tumor:** Abnormal growth of tissue or cells that have formed a lump or mass.
- Uncertainty Factor:** See **Safety Factor**.
- Urgent Public Health Hazard:** This category is used in ATSDR’s Public Health Assessment documents for sites that have certain physical features or evidence of short-term (less than 1 year), site-related chemical exposure that could result in adverse health effects and require quick intervention to stop people from being exposed.

Appendix B. ATSDR's Exposure Evaluation Process

INFORMATION ON HOW ATSDR ASSESSES EXPOSURE

What is meant by exposure?

ATSDR's public health assessments are driven by exposure or contact. Chemicals released into the environment have the potential to cause harmful health effects. Nevertheless, *a release does not always result in exposure*. People can only be exposed to a chemical if they come in contact with that chemical. If no one comes into contact with a chemical, then no exposure occurs, thus no health effects could occur. Often the general public does not have access to the source area of the environmental release; this lack of access becomes important in determining whether the chemicals are moving through the environment to locations where people could come into contact with them.

The five elements of an exposure pathway are: (1) source of contamination, (2) environmental media, (3) point of exposure, (4) route of human exposure, and (5) receptor population. The source of contamination is where the chemical was released. The environmental media (i.e., groundwater, soil, surface water, air, etc.) transport the chemical. The point of exposure is where people come in contact with the contaminated media. The route of exposure (i.e., ingestion, inhalation, dermal contact, etc.) is how the chemical enters the body. The persons actually exposed are the receptor population.

The route of a chemical's movement is the *pathway*. ATSDR identifies and evaluates exposure pathways by considering how people might come into contact with a chemical. An exposure pathway could involve air, surface water, groundwater, soil, dust, or even plants and animals. Exposure can occur by breathing, eating, drinking, or by skin contact with a substance containing the chemical.

situations to evaluate?

How does ATSDR determine which exposure

ATSDR scientists evaluate site-specific conditions to determine whether people are being exposed to site-related contaminants. When evaluating exposure pathways, ATSDR identifies whether exposure to contaminated media (soil, water, air, waste, or biota) is occurring through ingestion, dermal (skin) contact, or inhalation.

If exposure is possible, ATSDR scientists then consider whether contamination is present at levels that might affect public health. ATSDR selects chemicals for further evaluation by comparing

them against health-based comparison values. Comparison values are developed by ATSDR from available scientific literature concerning exposure and health effects. Comparison values are derived for each of the media and reflect an estimated chemical concentration that is *not expected* to cause harmful health effects for a given chemical, assuming a standard daily contact rate (e.g., amount of water or soil consumed or amount of air breathed) and standard body weight.

Comparison values are not thresholds for harmful health effects. ATSDR comparison values represent chemical concentrations many times lower than levels at which no effects were observed in experimental animal or human epidemiologic studies. If chemical concentrations are above comparison values, ATSDR further analyzes exposure variables (e.g., duration and frequency) for health effects, including the toxicology of the chemical, other epidemiology studies, and the weight of evidence.

Some comparison values used by ATSDR scientists include ATSDR's environmental media evaluation guides (EMEG), reference dose media evaluation guides (RMEG), and cancer risk evaluation guides (CREG). EMEGs, RMEGs, and CREGs are non-enforceable, health-based comparison values developed by ATSDR for screening environmental contamination for further evaluation. Risk-based concentrations (RBCs) and soil screening levels (SSLs) are health-based comparison values developed by EPA Region III to screen sites not yet on the National Priorities List (NPL), respond rapidly to citizens inquiries, and spot-check formal baseline risk assessments.

More information about the ATSDR evaluation process can be found in ATSDR's Public Health Assessment Guidance Manual at <http://www.atsdr.cdc.gov/HAC/HAGM/> or by contacting ATSDR at 1-888-42-ATSDR. For reference, Appendix A defines some of the technical terms used in this public health assessment and a List of Acronyms is available after the Table of Contents.

If someone is exposed, will they get sick?

Exposure does not always result in harmful health effects. The type and severity of health effects that occur in an individual as the result of contact with a chemical depend on the exposure concentration (how much), the frequency and duration of exposure (how long), the route or pathway of exposure (breathing, eating, drinking, or skin contact), and the multiplicity of exposure (combination of chemicals). Once exposure occurs, characteristics such as age, sex, nutritional status, genetics, lifestyle, and health status of the exposed individual influence how that individual absorbs, distributes, metabolizes, and excretes the chemical. Taken together, these factors and characteristics determine the health effects that can occur as a result of exposure to a chemical in the environment.

Considerable uncertainty exists regarding the true level of exposure to environmental contamination. To account for that uncertainty and to protect public health, ATSDR scientists typically use high-end, worst-case exposure level estimates to determine whether harmful health

effects are possible. These estimated exposure levels are usually much higher than the levels to which people are really exposed. If the exposure levels indicate harmful health effects are possible, a more detailed review of exposure, combined with scientific information from the medical, toxicologic, and epidemiologic literature about the health effects from exposure to harmful substances, is performed.

Overview of ATSDR's Methodology for Evaluating Potential Public Health Hazards

To evaluate exposures at NAB Little Creek, ATSDR evaluated available data to determine whether contaminants were above ATSDR's comparison values. For those that were, ATSDR derived exposure doses (see text box for definition) and compared them against health-based guidelines. ATSDR also reviewed relevant toxicologic and epidemiologic data to obtain information about the toxicity of contaminants of interest. Exposure to a certain chemical does not always result in harmful health effects. The type and severity of health effects expected to occur depend on the exposure concentration, the toxicity of the chemical, the frequency and duration of exposure, and the multiplicity of exposures.

An exposure dose is the amount of chemical a person is exposed to over time.

Comparing Data to ATSDR's Comparison Values

Comparison values are derived using conservative exposure assumptions. Comparison values reflect concentrations that are much lower than those that have been observed to cause adverse health effects. Thus, comparison values are protective of public health in essentially all exposure situations. As a result, *concentrations detected at or below ATSDR's comparison values are not considered to warrant health concern*. While concentrations at or below the relevant comparison value may reasonably be considered safe, it does not automatically follow that any environmental concentration that exceeds a comparison value would be expected to produce adverse health effects. It cannot be emphasized strongly enough that comparison values are not thresholds of toxicity. The likelihood that adverse health outcomes will actually occur depends on site-specific conditions and individual lifestyle and genetic factors that affect the route, magnitude, and duration of actual exposure, and not an environmental concentration alone.

For this public health assessment ATSDR reviewed soil data that were collected from SWMU 8 and water tower 1553 because these areas are located near off-base residential property. We also reviewed fish and crab tissue data collected from Little Creek Harbor to determine whether people were exposed to contaminant concentrations that exceeded ATSDR's comparison values. The majority of detected contaminants fell at or below comparison values and were not evaluated further. Contaminants that were above comparison values were evaluated further, prompting ATSDR to estimate exposure doses using assumption specific to this site.

Exposure Dose Equation for Soil and Fish Exposures

$$\text{Estimated dose} = \frac{\text{Conc.} \times \text{IR} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

† Soil has a conversion factor of 1×10^{-6} .

ATSDR analyzes the weight of evidence of available toxicologic, medical, and epidemiologic data to determine whether exposures might be associated with harmful health effects (noncancer and cancer). As part of this process, ATSDR examines relevant health effects data to determine whether estimated doses are likely to result in harmful health effects. As a first step in evaluating noncancer effects, ATSDR compares estimated exposure doses to conservative health guideline values, including ATSDR's minimal risk levels (MRLs) and EPA's reference doses (RfDs). The MRLs and RfDs are estimates of daily human exposure to a substance that are unlikely to result in noncancer effects over a specified duration. *Estimated exposure doses that are less than these*

values are not considered to be of health concern. To maximize human health protection, MRLs and RfDs have built in uncertainty or safety factors, making these values considerably lower than levels at which health effects have been observed. The result is that even if an exposure dose is higher than the MRL or RfD, it does not necessarily follow that harmful health effects will occur.

For carcinogens, ATSDR also calculates a theoretical increase of cancer cases in a population (for example, 1 in 1,000,000 or 10^{-6}) using EPA's cancer slope factors (CSFs), which represent the relative potency of carcinogens. This is accomplished by multiplying the calculated exposure dose by a chemical-specific CSF. Because they are derived using mathematical models which apply a number of uncertainties and conservative assumptions, risk estimates generated by using CSFs tend to be overestimated.

If health guideline values are exceeded, ATSDR examines the health effect levels discussed in the scientific literature and more fully reviews exposure potential. ATSDR reviews available human studies as well as experimental animal studies. This information is used to describe the disease-causing potential of a particular chemical and to compare site-specific dose estimates with doses shown in applicable studies to result in illness. For cancer effects, ATSDR compares an estimated lifetime exposure dose to available cancer effects levels (CELs), which are doses that produce statistically significant increases in the incidence of cancer or tumors, and reviews genotoxicity studies to understand further the extent to which a chemical might be associated with cancer outcomes. This process enables ATSDR to weigh the available evidence in light of uncertainties and offer perspective on the plausibility of harmful health outcomes under site-specific conditions.

Using other methods to evaluate potential health hazards

When dealing with exposure to lead, ATSDR uses an additional approach to the traditional methodologies described above. A substantial part of human health effects data for lead are expressed in terms of blood lead level rather than exposure dose. Thus, ATSDR developed a secondary approach to utilize regression analysis with media-specific uptake parameters to estimate what cumulative blood lead level might result from exposure to a given level of contamination. This is accomplished by multiplying the detected concentration by a media-specific slope factor, which is 0.0068 micrograms per deciliter ($\mu\text{g}/\text{dL}$) per mg/kg of lead ingested in soil (ATSDR 1999c). The Centers for Disease Control and Prevention (CDC) has determined that health effects are more likely to be observed if blood lead levels are at or above 10 $\mu\text{g}/\text{dL}$.

Essential nutrients (e.g., calcium, magnesium, potassium, and sodium) are important minerals that maintain basic life functions; therefore, certain doses are recommended on a daily basis. Because these chemicals are necessary for life, MRLs and RfDs do not exist for them. They are found in many foods, such as milk, bananas, and table salt. Ingestion of these essential nutrients at the concentrations found at NAB Little Creek will not result in harmful health effects.

Sources for health-based guidelines

By Congressional mandate, ATSDR prepares toxicological profiles for hazardous substances found at contaminated sites. These toxicological profiles were used to evaluate potential health effects from contamination at NAB Little Creek. ATSDR's toxicological profiles are available on the Internet at <http://www.atsdr.cdc.gov/toxpro2.html> or by contacting the National Technical Information Service at 1-800-553-6847. EPA also develops health effects guidelines, and in some cases, ATSDR relied on EPA's guidelines to evaluate potential health effects. These guidelines are found in EPA's Integrated Risk Information System (IRIS)—a database of human health effects that could result from exposure to various substances found in the environment. IRIS is available on the Internet at <http://www.epa.gov/iris>. For more information about IRIS, please call EPA's IRIS hotline at 1-301-345-2870 or e-mail at Hotline.IRIS@epamail.epa.gov.

Evaluation of Health Hazards Associated with Contamination at NAB Little Creek

Surface Soil at SWMU 8 and Water Tower 1553

The majority of the chemicals in the surface soil at SWMU 8 and water tower 1553 were detected below comparison values. Table B-1 lists the chemicals that were detected above comparison values, including benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, arsenic, and lead.

ATSDR estimated exposure doses from incidental ingestion of surface soil for each chemical listed in Table B-1 using the formulas and assumptions described previously. Exposure doses for all chemicals except lead are compared to ATSDR's MRLs or EPA's RfDs. As indicated in Table B—1, the exposure doses are below their respective MRL or RfD and, therefore, are not at levels of health concern. Given this finding, those exposed via incidental ingestion even to the highest detected level of contaminants in surface soil at NAB Little Creek (specifically SWMU 8 and the water tower) are not expected to develop adverse health effects.

To conservatively assess potential increase in blood lead levels for a child eating soil, ATSDR multiplied the maximum concentration of lead in soil (1,820 ppm) by the media-specific slope factor for soil of 0.0068 micrograms per deciliter ($\mu\text{g}/\text{dL}$) per mg/kg of lead ingested in soil. As mentioned, the CDC has determined that health effects are more likely to be observed if blood lead levels are at or above 10 $\mu\text{g}/\text{dL}$. ATSDR estimated contribution to blood lead levels for a child eating soil containing the *maximum contaminant concentration detected on base* is 12 $\mu\text{g}/\text{dL}$. While this level is slightly higher than CDC's recommended action level of 10 $\mu\text{g}/\text{dL}$, ATSDR believes that children in the Turner Road neighbor probably incurred much lower lead exposures, if any, and are not at risk of developing adverse health effects. In effort to be protective, ATSDR had evaluated the maximum detected concentration found *on base*, recognizing that, in any reasonable exposure situation, it is highly unlikely that a child could have been continuously exposed to the similarly high concentrations in their yards over time.

Consumption of fish, shellfish, crab from Little Creek Harbor

ATSDR estimated exposure doses to the maximum levels of mercury, tributyltin, and PCBs in fish or crab using the formulas and assumptions described previously. All exposure doses were at or below their respective MRLs and RfDs and therefore not at a level of health concern. Given the findings and the conservative assumptions used in deriving the estimates, ATSDR does not expect those who ate fish or crab from the harbor to incur any adverse health effects from the chemicals that were sampled.

Table B-1
Exposure Doses for Chemicals Above Comparison Values at NAB Little Creek

Chemical	Maximum Detected Concentration (mg/kg)	Estimated Exposure Dose (mg/kg/day)		Oral Health Guideline (mg/kg/day)	Basis for Health Guideline
		Adult	Child		
Surface Soil at SWMU 8 and Water Tower 1553					
Benzo(a)anthracene	2.7	0.000003	0.00003	0.03 (for pyrene)	chronic RfD
Benzo(a)pyrene	1.7	0.000002	0.00002	0.03 (for pyrene)	chronic RfD
Benzo(b)fluoranthene	2.7	0.000003	0.00003	0.03 (for pyrene)	chronic RfD
Dibenz(a,h)anthracene	0.51	0.0000007	0.000006	0.03 (for pyrene)	chronic RfD
Ideno(1,2,3-cd)pyrene	1.3	0.000001	0.00001	0.03 (for pyrene)	chronic RfD
Arsenic	16	0.00002	0.0002	0.0003	chronic MRL
Lead	1,820	0.002	0.02	no value	
Fish and Crab from Little Creek Harbor					
Mercury	0.225	0.0001	0.0003	0.0003	chronic MRL for
Tributyltin	0.028	0.00002	0.00004	0.0003	chronic RfD
PCBs	0.0016	0.000001	0.000002	0.00002	chronic MRL

Appendix C. ATSDR's Responses to Public Comments

The Agency for Toxic Substances and Disease Registry released the Naval Amphibious Base (NAB) Little Creek Public Health Assessment (PHA) for public review and comment on May 27, 2003. The public comment period was announced in a press release on June 10, 2003. Copies of the PHA were made available for review at the Bayside Area and Central Libraries in Virginia Beach and the Little Creek and the NAB Little Creek Libraries in Norfolk, Virginia. The PHA was also sent to state and federal agencies and interested members of the general public.

ATSDR received the following comments during the public comment period (May 27 to July 11, 2003).

1. **Comment:** Two reviewers commented that the date listed in the summary of the public health assessment for NAB Little Creek placement on the National Priorities List (NPL) is incorrect.

Response: ATSDR has modified the text in the Summary section of the PHA to reflect the correct date of May 10, 1999, that the U.S. Environmental Protection Agency added NAB Little Creek to the NPL.

2. **Comment:** One reviewer commented that the discussion on page 9 of the PHA about pollution sources affecting Little Creek Harbor should include NAB Little Creek operations as well as other non-base sources.

Response: ATSDR has stated in several places in the PHA that sources other than NAB Little Creek operations have contributed to the pollutant load in the harbor. As suggested, ATSDR has also added this information to page 9 of the PHA.

3. **Comment:** One reviewer commented signs about bacterial contamination of fish and shellfish should be posted at Little Creek Harbor.

Response: ATSDR agrees that the public should be notified about bacterial contamination of fish and shellfish at NAB Little Creek Harbor. Due to this contamination, shellfish taking from the harbor is prohibited. In 1938, the Virginia Department of Health (VDH), Division of Shellfish Sanitation, restricted shellfish taking in Little Creek Harbor because of bacteriological contamination. The "restricted" status allowed shellfish taking during warm weather months, as long as the fisher had a permit (issued by marine police and VDH) and transferred the shellfish to another water body, where they would undergo a cleaning-out period. In 1990, the status was changed from "restricted" to "prohibited" to comply with the National Shellfish Sanitation Program. "Prohibited" means no shellfish taking is allowed. Signs are currently in place along the harbor at NAB Little Creek

warning people against fish and crabbing due to security reasons. Through the PHA assessment process, ATSDR has coordinated discussion with Virginia Marine Resources Commission (VMRC), Navy Environmental Health Center (NEHC) and NAB Little Creek on the signage at the base that warns about the shellfish prohibition along Little Creek Harbor. VMRC has offered to provide or post signs along the harbor if the Navy judges it necessary to do so.

4. **Comment:** One reviewer commented that the PHA states that the primary contaminants of concern listed in the Summary is misleading. The reviewer comments that the discussion is too vague with respect to distribution of contaminants in soil at NAB Little Creek. The reviewer adds that EPA's Hazard Ranking System, which was the supporting document for the NPL listing of NAB Little Creek, made no such reference to the aforementioned contaminants in fish and crabs.

Response: The reference to contaminants of concern in the Summary section of the PHA is not meant to describe which contaminants placed NAB Little Creek on the NPL. Rather, this sentence is intended to note those contaminants that are of concern to ATSDR from a public health perspective. ATSDR has modified the sentence to clarify this distinction.

5. **Comment:** One reviewer commented that generic reference to groundwater contamination beneath the base in the Summary of the PHA is misleading because the contamination is not base wide. The reviewer adds that VOC contamination should be defined by location.

Response: ATSDR has modified the statement in the Summary of the PHA to reflect that localized contamination appears in groundwater in certain portions of the base.

6. **Comment:** A reviewer noted that the Summary of the PHA implies that the Navy removed only the highest levels of surface soil when, in fact, the Navy removed all surface soils at levels above residential cleanup standards.

Response: ATSDR has modified the sentence in the Summary to indicate that the Navy removed surface soil with levels above residential guidance in the area of the water tower.

7. **Comment:** Several comments took exception to ATSDR's discussion about possible contaminant migration to off-base properties. They state that there is no supporting evidence that contamination, particularly lead, from SWMU 8 (or the water tower) was transported to the residential area adjacent to Turner Road. They further state that the PHA should explain that the Navy has delineated the area of contamination and removed all the lead contaminated soil in the vicinity of the former sandblasting area and the water tower and that soil concentrations between the abrasive blasting material (ABM) source area and the residential area showed no elevated concentrations of lead, or contaminant gradient between the ABM source area and the residential area.

Response: ATSDR emphasizes that the goal of its PHA is to help put environmental data into meaningful public health perspective for the community. That is, ATSDR tries to answer the question of whether environmental exposure occurred and whether any such exposure might be harmful. One of the challenges we face is to evaluate potential health hazards given the lack of environmental monitoring data at points of human exposure. As noted, sampling showed that lead was present in soil at the water tower and SWMU 8, and decreased in concentration with distance from the tower. However, the area between the water tower and residential areas are in areas of flood plains and increased drainage of surface water and transport of associated material. Although vegetated along the banks part of the drainage ditch near the fence line is deeply eroded and scouring is ongoing. Information on the different wind direction and wind speeds during each of the paint removal operations is not available. Sampling data to help us understand soil quality off base near the SWMU 8 and water tower, where local residents live, was not available. While the available information about contaminant concentrations helps in our evaluation, without information at the point of exposure, ATSDR cannot state with certainty whether contaminants might have migrated off site.

8. **Comment:** Several comments noted incorrect demographics data in the Demographics section of the PHA.

Response: ATSDR has updated its demographics discussion to reflect the correct demographic statistics for the area around NAB Little Creek as presented in Tables 3A and 3B of the PHA.

9. **Comment:** A reviewer noted that surface water collected from various surface water sources undergoes treatment and testing by public utilities.

Response: The comment refers to drinking water at the base and in the communities of Norfolk, Virginia Beach, and Chesapeake that is drawn from Lake Smith, Lake Wright, Lake Whitehurst, Lake Lawson, Stumpy Lake, Little Creek Reservoir, and three lakes to the west of the city of Suffolk. ATSDR has added the treatment and testing information to the text of the PHA.

10. **Comment:** A reviewer noted that the landfills at NAB Little Creek were closed in accordance with Virginia landfill closure regulations, which consisted of a 2-foot soil cover and a long-term monitoring program to ensure the integrity of the remedy.

Response: ATSDR has added information about the soil cover depth and long-term monitoring groundwater monitoring to its discussion on landfill closure as suggested.

11. **Comment:** A reviewer commented that soil sampling conducted after the removal action confirmed that no soil contaminants (not just lead) were left in place that exceeded residential risk-based criteria.

Response: This comment addresses the extent of soil removed from the water tower area located near SWMU 8. ATSDR has modified the text to reflect that the confirmatory sampling conducted at and near SWMU 8 verified that soil contaminated with lead and other contaminants was removed to levels below or at residential cleanup standard for each contaminant.

12. **Comment:** One reviewer expressed concern that ATSDR's information on sites 7, 9, 10, 11, 12, and 13 contributing to Little Creek Harbor is misleading. The comment adds that the Navy has undertaken many measures to prevent site releases from entering Little Creek Harbor at these sites. These measures include adding soil covers and conducting groundwater monitoring at Sites 7, 9, and 10, and removing contaminated soil and implementing groundwater pilot studies at Sites 11 and 13.

Response: The comment refers to ATSDR's discussion that mentions that these six sites contribute runoff or were connected to canals or drainage systems that eventually led to Little Creek Harbor. ATSDR's discussion that mentions these sites is intended to describe surface water flow pattern at the base that might discharge water into the harbor. ATSDR is aware of and commends the Navy's efforts on the measures they have taken to reduce or prevent contamination from entering surface water that might reach the harbor. These measures help ensure that contamination now and in the future will not enter the harbor.

13. **Comment:** One reviewer comments on the sentence "For some properties, potentially contaminated soil has possibly been removed." This sentence is in the conclusion section of the PHA. The reviewer suggests that ATSDR remove the word *possibly* from the sentence as the Navy has conducted confirmatory sampling in these locations.

Response: The comment refers to ATSDR's conclusions about exposure to lead in soil at and near the on-base SWMU 8 and the water tower. ATSDR acknowledges that the Navy has removed contaminated soil to residential standards on base near SWMU 8 and the water tower. The particular sentence in question, however, refers to soil at the neighboring off-base properties along Turner Road. While ATSDR does not know with certainty, we believe that it is possible that some soil at these off-base properties has been removed over time when homes were constructed or landscaped.

14. **Comment:** Several comments provided ATSDR with updated information on the status of site activity at NAB Little Creek.

Response: ATSDR has updated information into the Public Health Action Plan and/or Table 1 (Evaluation of Sites at Naval Amphibious Base, Little Creek) portions of the PHA as suggested, including:

- Sites 1, 4, 15, and 16 have been closed out by the Navy, EPA, and VDEQ with no further action required under CERCLA IR program.
- Site 17 has been removed from the CERCLA process and included in the UST program.
- The Navy will continue to monitor groundwater at Sites 11, 11a, and 13 and will evaluate options for groundwater treatment
- Site 4 is closed with no further action required under the CERCLA IR program.

- 15. Comment:** One comment indicated that surface water runoff and groundwater from Site 9 are not directed toward Little Creek Harbor.

Response: This comment notes the description of surface water runoff and groundwater flow from at Site 9 in Table 1 of the document. ATSDR has modified the description in the text to reflect the suggested change.