ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

NAVAL WEAPONS STATION YORK TOWN (NWSY)
YORK TOWN, VIRGINIA
EPA FACILITY ID: VA8170024170
MAY 25, 2006

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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PUBLIC HEALTH ASSESSMENT

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Prepared by:

Federal Facilities Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

FOREWORD

The Agency for Toxic Substances and Disease Registry, ATSDR, was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the *Superfund* law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, EPA, and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements. The public health assessment program allows the scientists flexibility in the format or structure of their response to the public health issues at hazardous waste sites. For example, a public health assessment could be one document or it could be a compilation of several health consultations - the structure may vary from site to site. Nevertheless, the public health assessment process is not considered complete until the public health issues at the site are addressed.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to determine the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further public health actions are needed.

Conclusions: The report presents conclusions about the public health threat, if any, posed by a site. When health threats have been determined for high risk groups (such as children, elderly, chronically ill, and people engaging in high risk practices), they will be summarized in the conclusion section of the report. Ways to stop or reduce exposure will then be recommended in the public health action plan.

ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA, other responsible parties, or the research or education divisions of ATSDR. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also authorize health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the comments received from the public are responded to in the final version of the report.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention: Division of Health Assessment and Consultation, Agency for Toxic Substances and Disease Registry, 1600 Clifton Road (E-60), Atlanta, GA 30333.

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List of Abbreviations

ATSDR	Agency for Toxic Substances and Disease Registry
CAX	Cheatham Annex
CDC	child development center
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CV	comparison value
DOD	Department of Defense
DON	Department of Navy
EMEG	environmental media evaluation guide (ATSDR)
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency
ESQD	explosive safety quantity distance
FFA	federal facilities agreement
IAS	Initial Assessment Study
IRP	Installation Restoration Program
MCL	EPA's maximum contaminant level
MRL	ATSDR's minimal risk level
NACIP	Navy Assessment and Control of Installation Pollutants
NEESA	Navy Energy and Environmental Support Activity
NPL	National Priorities List
NWSY	Naval Weapons Station Yorktown
OU	operable unit
PAH	Polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PHA	public health assessment
ppb	parts per billion
ppm	parts per million
RBC	EPAs Region III risk-based concentrations
RCRA	Resource Conservation and Recovery Act
RfD	reference dose (EPA)
RMEG	reference media evaluation guide (ATSDR)
ROD	record of decision
SVOC	semi-volatile organic compound
SSA	site screening assessment
TPH	total petroleum hydrocarbons
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound
YCPD	York County, Virginia, Planning Division

Summary and Statement of Issues

The Agency for Toxic Substances and Disease Registry (ATSDR) prepared this public health assessment (PHA) to evaluate potential health hazards associated with past, current, and future exposures to contaminants originating from Naval Weapons Station Yorktown (NWSY). On the basis of the most current information available, ATSDR concludes that most site-related contamination has been or remains contained within soil or groundwater on site, where access is restricted, and not directly impacting nearby residents or NWSY personnel. Since environmental investigations began, the Navy has conducted numerous remedial actions to either remove or mitigate sources of soil, sediment, and groundwater contamination at the station. ATSDR evaluated potential exposures to contaminants from NWSY, via off-site migration of sediments and surface water and consumption of locally obtained fish. ATSDR has not found any completed exposure pathways that would result in adverse health effects

NWSY covers an area just over 10,600 acres located on the Virginia peninsula in York and James City Counties. NWSY is located approximately 30 miles northwest of Norfolk, Virginia and 80 miles east of Washington D.C. NWSY was originally commissioned in 1918 as the U.S. Mine Depot. The original mission of the depot was to provide support in the laying of mines in the North Sea during World War I. In 1959, the U.S. Mine Depot was redesignated Naval Weapons Station Yorktown. Since 1959, the station's primary objective has been to manufacture, develop, and test new explosives and ammunitions. These operations at NWSY have resulted in environmental contamination from past use and disposal of hazardous materials and wastes.

In 1983, a total of 19 potentially contaminated sites were identified at NWSY during an Initial Assessment Study (IAS). In 1992, NWSY was included on the U.S. Environmental Protection Agency's (EPA's) National Priority List primarily due to the facility's proximity to wetlands and the potential impact on the surrounding environment. Numerous site investigations have been conducted since the IAS in order to characterize the nature and extent of contamination at NWSY. To date, a total of 30 installation and restoration program (IRP) sites and 21site screening assessment (SSA) areas have been identified at NWSY.

ATSDR's public health assessment process is designed to identify populations who may have been or are being exposed to hazardous substances and determine the public health implications of the exposure. As part of this process, ATSDR conducted a recent site visit and met with representatives from the Navy and NWSY in March 2004. Information was gathered on the nature and extent of contamination associated with the site. ATSDR considered past, current, and potential future exposure situations.

Based on this evaluation, ATSDR determined that exposures to hazardous substances in soil do not pose a public health hazard because either (1) the area where the contamination is located is not widely used or accessible to the public, (2) contamination was detected only at low levels, or (3) the contamination has been removed from the site. ATSDR did identify two exposure situations in which the public could come in contact with site-related contaminants. ATSDR assessed the likelihood that people may be exposed under these situations and concluded the following:

- **Potential for past, current, or future migration of contaminated groundwater beneath Site 18 (Building 476 Discharge Area) to off-site private wells.**

  ATSDR concludes that past, current, and future exposures were and are not likely from contaminated groundwater beneath Site 18. Site 18 is a drainage ditch located in the industrial area behind Building 476 in the southeastern portion of the station. It was in use for approximately 20 years and during this time battery acid waste (e.g., hydrochloric acid and calcium hydroxide) and dissolved metals, including lead, cadmium, nickel, and antimony, were reportedly discharged to the drainage area. Hydrogeological investigations associated with Site 18 have determined that groundwater flow direction is toward the northwest, in the opposite direction of any off-site drinking water wells. Groundwater investigations have also characterized the nature and extent of contamination. Although contaminants have been detected at mostly low concentrations in the aquifer beneath Site 18, they were not at levels that would be harmful under most exposure situations.

- **Potential past, current, and future exposures from eating contaminated fish from on-site ponds at NWSY and nearby off-site surface water bodies.**

  On Site: *ATSDR concludes that past, current, and future consumption of fish from NWSY ponds have not resulted in harmful exposures.* Fishing on site is permitted for NWSY personnel at certain designated ponds. A review of the available fish sampling data for these on-site ponds showed mostly low-level contamination below levels known to cause illness or health effects. In addition, access to the on-site ponds is restricted to NWSY and other authorized personnel who would be using the ponds for recreational fishing purposes. Land use is not expected to change and access to fishing ponds will continue to be restricted to authorized personnel only. If land use were to change in the future and the ponds were available for unrestricted use, ATSDR would recommend additional sampling to ensure that fish are safe to eat for subsistence fishing scenarios.

  Off Site: *ATSDR concludes that past, current, and future consumption of fish from nearby off-site surface water bodies have not resulted in harmful exposures.* NWSY is in close proximity to two large tributaries of the Chesapeake Bay, the York and James Rivers. The York River directly abuts NWSY and may be directly impacted by contamination migrating off site from NWSY. ATSDR assumed either recreational fishing or low-end subsistence ingestion rates in estimating exposure dose from the consumption of local fish from the York River. While the concentration of PCBs, arsenic, lead and mercury in some of the fish samples were above health-based screening values, the estimated doses for recreational and low-end subsistence fishers are below levels known to cause health effects. ATSDR encourages the consumption of fish as a part of the typical diet. This can be done by following safe fish consumption guidelines and by closely monitoring and adhering to fish consumption advisories posted by your local health department or other authorities. Populations such as pregnant women and children may be more susceptible to certain contaminants such as lead and mercury and should always follow the recommendations posted in public health advisories.

Background

Site Description and Operational History

Naval Weapons Station Yorktown (NWSY) covers 10,624-acres and is located on the Virginia peninsula in York and James City Counties and the City of Newport News (Figure 1). NWSY is located approximately 30 miles northwest of Norfolk, Virginia and 80 miles east of Washington D.C. The station is bounded on the northwest by the Naval Supply Center Cheatham Annex, the Virginia Emergency Fuel Farm, and land owned by the Department of Interior; on the northeast by almost 14 miles of the York River and the Colonial National Historic Parkway; on the southwest by Route 143 and Interstate 64; and on the southeast by Route 238 and the community of Lackey (Baker 2001a).

NWSY was originally commissioned on July 1, 1918 as the U.S. Mine Depot. The depot supported the laying of mines in the North Sea during World War I. For twenty years after World War I the depot received, reclaimed, stored and issued mines, depth charges, and related materials. During World Ward II the facility was expanded with three additional TNT loading plants and new torpedo overhaul facilities. A research and development laboratory for experimentation with high explosives was established in 1944 (NEESA 1984).

On August 7, 1959, the U.S. Mine Depot was redesignated NWSY. The primary mission of NWSY has been to provide the Fleet with ordnance maintenance production and storage. Since World War II, the station's primary objective was to manufacture, develop, and test new explosives and ammunitions. Other support facilities include those for administration of activities at the station and services for personnel, including medical, housing, and recreational facilities (NEESA 1984).

NWSY is divided into three basic land use areas:

- Explosive/ordnance storage;
- Ordnance loading/maintenance; and
- Non-explosive and support functions (includes housing and recreational areas)

An "explosive safety quantity distance (ESQD)" arc surrounds a large portion of the station limiting the land use for those areas that lie within the arc. The ESQD is restricted to authorized individuals having the proper clearance or Station passes (Baker 2001a).

Remedial and Regulatory History

The Navy Assessment and Control of Installation Pollutants (NACIP) Program was developed by the Department of the Navy during the early 1980s to identify and control environmental contamination from past use and disposal of hazardous wastes at Navy installations. The NACIP Program is part of the Department of Defense (DOD) Installation Restoration Program (IRP). Environmental investigations and remedial activities at NWSY are being conducted through the DOD's IRP.

An Initial Assessment Study (IAS) was conducted at NWSY in 1983. During the IAS a total of 19 potentially contaminated sites were identified at NWSY based on information from historical records, aerial photographs, field inspections, and personnel interviews (NEESA 1984). Numerous site investigations have been conducted since the IAS in order to characterize the nature and extent of contamination at NWSY.

In October 1992, NWSY was included on U.S. Environmental Protection Agency's (EPA's) National Priorities List (NPL) primarily due to the facility's proximity to wetlands and the potential impact on the surrounding environment. The United States Environmental Protection Agency (USEPA) Region III, the Virginia Department of Environmental Quality (VDEQ), and the United States Department of the Navy (DON) entered into a Federal Facilities Agreement (FFA) for NWSY in February 1995. The primary purpose of the FFA is to ensure that environmental impacts associated with past and present activities at NWSY are thoroughly investigated and, if needed, remedial actions are implemented as necessary to protect public health and the environment (Baker 2001b).

During the IRP process areas of contamination are designated as sites or site screening assessment (SSA) areas. Additionally, the multiple sites can be divided into a number of operable units (OUs). OUs may be grouped on the basis of geography, specific site-related issues, or initial phases of an action. OUs may also consist of any set of actions performed over time or any actions that are concurrent, but located in different parts of a site. There are currently a total of ten operable units (OUs) under investigation at NWSY. These OUs were specifically designated to address groundwater contamination across the station. Other media (e.g., soil, surface water, and sediment) were investigated within each area of concern (i.e., IRP Site or SSA). To date, a total of 30 IRP sites and 21 SSA areas have been identified at NWSY. Figure 2 shows the location of 16 IRP sites where further environmental investigations were recommended. Additional descriptive information and waste disposal activities for all of the IRP sites identified at NWSY are presented in Appendix A.

ATSDR Involvement

ATSDR conducted an initial site-scoping visit to NWSY in December 1992. The purpose of the initial visit was to tour the contaminated sites under investigation and identify whether any immediate public health hazards exist. During the site visit ATSDR met Navy clinic and occupational health personnel to inquire about any site-related health issues or concerns. ATSDR also met with other site personnel to gather information about hunting and fishing on site and other activities where people might come into contact with environmental contamination. ATSDR did not identify any completed exposure pathways that would be expected to result in health effects during the initial site visit. However, ATSDR did recommend that groundwater beneath Site 18 be investigated to better characterize the nature and extent of contamination and the potential for any off-site migration to nearby private wells.

In February 2005, ATSDR revisited NWSY and toured the facility and surrounding residential areas. The purpose of the visit was to conduct a follow-up assessment of site conditions and to collect the most current information for the PHA. During the site visit ATSDR toured on-site and off-site military housing areas and met with representatives from the day care and youth centers,

Natural Resources Division, Public Affairs Office, Housing, and the Environmental Compliance Group.

Demographics

ATSDR examines demographic information to identify the presence of sensitive populations, such as young children and the elderly, in the vicinity of a site. Demographics also provide details on residential history in a particular area, information that helps ATSDR assess time frames of potential human exposure to contaminants. Demographic information for the site and residential areas surrounding NWSY is presented in this section.

The major population centers near NWSY are Newport News, approximately 12 miles southeast of NWSY and Williamsburg, approximately 8 miles northwest of NWSY. The closest off-base residential area is the small community of Lackey, immediately southeast of the Station near the main gate (Gate Number 1). According to the 2000 U.S. Census, just over 180,000 people live in Newport News, more than 56,000 people live in York County and, approximately 12,000 residents reside in Williamsburg (Bureau of the Census 2001; YCPD 2003). The population of York County has been steadily increasing over the last 25 years with an estimated 2004 population count exceeding 62,000 (YCPD 2004).

There are approximately 1,200 enlisted military personnel at NWSY with an average tour of duty of 3 years. There are approximately 800 additional civilian employees and over 450 contractors employed at NWSY (Linda Cole, NAVFAC Regional Project Manager. Personal Communications. February 10, 2005). The nearest off-site military residential area is the Hamilton Redoubt Family Housing, commonly referred to as “Skiffes Creek.” This housing area consists of 232 units for enlisted personnel. These housing units are approximately 1.75 miles from Gate Number 1, in the southeast portion of the station.

NWSY has two on-base family housing areas, both of which are located near the station golf course. In addition, bachelor’s quarters are located near Gate 3 in the southern portion of the station. One housing area consists of nine homes, referred to as the Mason Row Family Housing, located along the York River in the northeastern portion of the Station. These homes are restricted to senior officers’ and their families. The other housing area, referred to as Kiskiak Village, consists of 19 multifamily dwellings approximately 0.5 miles upgradient from the Dudley Road Landfill (Site 1) and immediately south of the Mason Row housing area. The maximum capacity for this housing area is about 75 occupants (NWSY 2005).

Two childcare facilities are located on site: A Child development Center (CDC) and a Youth Center. The CDC has an enrollment of between 65 and 90 children between the ages of 6 weeks and 5 years. The Youth Center is located across the street from the CDC with an enrollment of approximately 35 students between the ages of 5 and 17 (Linda Stubbs, Child Development Center; Tina Mullen Youth Center, Personal Correspondence, February 9, 2005). There are no schools on NWSY property. Recreational fields and playgrounds are found on site, mostly near the on-base housing areas. The playgrounds appear to be in good condition and conform to current safety standards.

Topography, Land Use and Natural Resources

NWSY is located within York County on the York-James Peninsula, which is situated northwest of the mouth of the Chesapeake Bay. The York-James Peninsula occupies approximately 1,752 square miles. NWSY covers approximately 16 square miles of the peninsula. The peninsula is bordered on the southwest by the James River, on the northeast by the York River, and on the southeast by the confluence of the James River and the Chesapeake Bay (Baker 1995a). In addition to York County, the York-James Peninsula also includes James City County and the cities of Hampton, Newport News, Poquoson, and Williamsburg, all of which adjoin York County (YPCD 2004).

The elevation at NWSY ranges from sea level along the York River to approximately 90 feet above mean sea level on a few scattered hills in the southern portion of the Station. Of the approximately 10,500 acres that comprise NWSY, about 78 percent of this area (8,200 acres) is undeveloped, and is predominantly wooded. Marshes comprise approximately 400 acres, while lakes account for 150 acres (NEESA 1984).

The James and York Rivers are used for recreational activities such as boating and fishing and also supports commercial fishing and crabbing. Besides crabs, other shellfish found along the York River include oysters and hard and soft clams (Baker 1991). Fish species commonly found in the York River include several types of perch, catfish, bay anchovy, striped bass, and spotted hake. Some species are considered resident species while others inhabit the waters only seasonally (Baker 1993). Other activities within the James and York River watersheds include camping, hiking, and limited seasonal hunting in designated locations.

A large number of streams, creeks, and tributaries cut across NWSY. Wetlands are found along branches of the York River, along the York River shoreline, and are also located along freshwater streams, at the edges of freshwater ponds, and in seasonally flooded areas on site. The tidal reaches of the York River extend across much of the Station. The tributary creeks draining NWSY are tidal up to one mile inland from the riverbanks (Baker 1995b).

There are also several ponds located within the NWSY site boundary. The largest ponds located in the eastern portion of the station are Roosevelt and Lee ponds. Roosevelt Pond covers approximately 22 acres and is just west of the station eastern boundary and the York River. Roosevelt Pond drains into Bracken Pond, which empties into the York River. Lee Pond is approximately one mile from the eastern station boundary. Lee Pond discharges into Felgates creek (NEESA 1984). Three other manmade fishing ponds (Ponds # 10, 11, and 12) are located in the northwest portion of the station surrounding or in close proximity to the restricted Explosive Ordnance Disposal (EOD) area.

Both Roosevelt and Lee ponds provide habitat for numerous species of freshwater fish and fishing by NWSY personnel is allowed at both of these ponds; however there are signs posted around Lee Pond to only catch and release and not eat the fish. Fishing is also permitted at Ponds # 10, 11, and 12. The Federal Bureau of Fisheries stocks Bracken Pond with bass and pickerel. This pond is not on NWSY property and is operated by the Colonial National Historic Park.

At NWSY, there is more than 8,500 acres of land available for use as hunting grounds. Hunting permits are issued for both military personnel and civilians at designated portions of NWSY. However, hunting is only allowed on Saturdays and the permitted times hunting is allowed during the day are restricted (David Shield; Charles Wilson, NWSY Natural Resources, Personal Communication, February 9, 2005).

Hydrogeology

Ground Water: Ground water underneath NWSY occurs in three major aquifer systems. These are the water table aquifer, the upper artesian aquifer, and the principal artesian aquifer.

- Water Table Aquifer (Yorktown Shallow Aquifer) - This is the uppermost water-bearing unit, which is composed of fine to medium sand, silt, and in some places, gravel. It ranges in thickness from 20 feet at the western end of the peninsula to about 200 feet at the seaward end in the vicinity of NWSY. This aquifer is used as a source of domestic (individual home) non-drinking water supplies in parts of York County and some surrounding areas. The main discharge points are stream channels, swamps, and lower aquifers. Due to high salinity, this aquifer is not used as a potable water source.

- Upper Artesian Aquifer - This system consists of coarse sands, mollusk remains, and sandy clay deposits. The combined thickness of this aquifer ranges between 50 and 80 feet. The depth to the upper artesian aquifer is approximately 250 ft below mean sea level in the vicinity of NWSY. This aquifer is the major source of water for the 25 percent of York County residents that obtain water from private wells.

- Principal Artesian Aquifer – This is the deepest of the three aquifers and contains coarse sands, gravel, and some boulders deposited from the Cretaceous Age (NUS 1983). The aquifer consists of several discontinuous sand bodies mixed with silt and clay. The top of the aquifer is approximately 450 feet below mean sea level in the vicinity of NWSY. Recharge to the aquifer does not primarily occur near NWSY; rather it occurs through the outcrop in Henrico, Hanover, and western King William Counties. The direction of groundwater flow in this aquifer is predominantly east towards York River and Chesapeake Bay.

Groundwater investigations at NWSY indicate that the depth to the water table ranges from 10 to 30 feet and ground water flow direction in the aquifer tends to be towards the drainage creeks and the York and James Rivers (NEESA 1984; Baker 1993). Due to the groundwater flow direction and/or distance from the sources of contamination, it is unlikely that off-base private wells would be impacted by NWSY site-related contamination.

Surface water: NWSY has a large variety of surface water bodies, ranging from very small brooks and creeks to larger tributaries that feed into major river systems. The station lies within two drainage basins, the York River Basin to the north and the James River Basin to the south. Tributaries of the York River at the station are King Creek on the northwestern station boundary, Felgates Creek and Indian Field Creeks in the north-central and northeast portion of the station, and Ballards Creek on the eastern station boundary. The southern most drainage feature at

NWSY is Blows Mill Run. It drains into Skiffes Creek and eventually to the James River. Felgates Creek is the largest drainage feature at NWSY (Baker 1993).

Extensive wetlands are found along the tidal creeks draining the station and along some portions of the York River shoreline (NEESA 1984). In the southern portion of the station surface water runoff primarily discharges off-station into Skiffes Creek Reservoir, which drains southward through Skiffes Creek to the James River (Versar 1991). Other large water bodies on site include Roosevelt Pond in the northeast portion of the station, Lee Pond in the east-central portion of the station, and the three manmade ponds (Ponds No. 10, 11 and 12) in the northwest portion of the station.

Drinking Water Sources

In the past, NWSY had used three wells for its drinking water supply. These wells were abandoned during the 1970's. There are currently no drinking water wells at NWSY. Since the late 1970s drinking water has been supplied by the City of Newport News. NWSY uses approximately 4,900 gallons of water per day (gpd) from the Newport News Water System (NUS 1983). The Chickahominy River is the main source of water for Newport News. There are five reservoirs included in the Newport News water system (Diascund Creek; Little Creek; Skiffs Creek; Lee Hall; and Harwoods Mill) (NUS 1983).

Most residents living within a one-mile perimeter of NWSY receive their drinking water from municipal sources rather than private wells. It was noted in the Trip Report after ATSDR's original site visit to NWSY in 1992 that three off-site private residential wells were located near the station boundary in the town of Lackey (ATSDR 1993). It is not known what these three wells are specifically used for or what their current status is.

Quality Assurance and Quality Control

In preparing this PHA, ATSDR reviewed and evaluated information provided in the referenced documents. Documents prepared for the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program must meet standards for quality assurance and control measures for chain-of-custody, laboratory procedures, and data reporting. The environmental data presented in this PHA come from site characterization, remedial investigation, and monitoring reports prepared by NWSY (and there contractors) under CERCLA. Based on our evaluation, ATSDR determined that the quality of environmental data available for NWSY is adequate for making public health decisions.

Environmental Contamination, Human Exposure Pathways, and Public Health Implications

Introduction

In this section, ATSDR evaluates whether community members have been (past), are (current), or will be (future) exposed to harmful levels of chemicals. Figure 3 describes the exposure evaluation process used by ATSDR. ATSDR screens the concentrations of contaminants in environmental media (e.g., groundwater or soil) against health-based comparison values (CVs) (Appendix B). Because CVs are not thresholds of toxicity, environmental levels that exceed CVs would not necessarily produce adverse health effects. If a chemical is found in the environment at levels exceeding its corresponding CV, ATSDR estimates site-specific exposure and evaluates the likelihood of adverse health effects. *ATSDR emphasizes that a public health hazard exists only if exposure to a hazardous substance occurs at sufficient concentration, frequency, and duration for harmful effects to occur.*

What is meant by exposure?

ATSDR's PHAs are driven by evaluation of the potential for human exposure, or contact with environmental contaminants. Chemical contaminants released into the environment have the potential to cause adverse health effects. However, a release does not always result in human exposure. People can only be exposed to a contaminant if they come in contact with it—if they breathe, eat, drink, or come into skin contact with a substance containing the contaminant.

How does ATSDR determine which exposure concerns to evaluate?

ATSDR scientists evaluate site conditions to determine if people could have been, are, or could be exposed (i.e., exposed in a past scenario, a current scenario, or a future scenario) to site-related contaminants. When evaluating exposure pathways, ATSDR identifies whether exposure to contaminated media (soil, sediment, water, air, or biota) has occurred, is occurring, or will occur through ingestion, dermal (skin) contact, or inhalation.

If exposure was, is, or could be possible, ATSDR scientists consider whether contamination is present at levels that might affect public health. ATSDR scientists select contaminants for further evaluation by comparing them against health-based comparison values (CVs). These are developed by ATSDR from available scientific literature related to exposure and health effects. CVs are derived for each of the different media and reflect an estimated contaminant concentration that is not likely to cause adverse health effects for a given chemical, assuming a standard daily contact rate (e.g., an amount of water or soil consumed or an amount of air breathed) and body weight.

If someone is exposed, will they get sick?

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

In almost any situation, there is considerable uncertainty about the true level of exposure to environmental contamination. To account for this uncertainty and to be protective of public health, ATSDR scientists typically use worst-case exposure level estimates as the basis for determining whether adverse health effects are possible. These estimated exposure levels usually are much higher than the levels that people are really exposed to. If the exposure levels indicate that adverse health effects are possible, ATSDR performs a more detailed review of exposure, also consulting the toxicologic and epidemiologic literature for scientific information about the health effects from exposure to hazardous substances.

Appendix C provides an overview of ATSDR's exposure evaluation process. To acquaint readers with terminology used in this report, a glossary is included in Appendix D.

About ATSDR's Comparison Values (CVs)

CVs are not thresholds for adverse health effects. ATSDR CVs represent contaminant concentrations many times lower than levels at which no effects were observed in experimental animals or human epidemiologic studies. If contaminant concentrations are above CVs, ATSDR further analyzes exposure variables (for example, duration and frequency of exposure), the toxicology of the contaminant, other epidemiology studies, and the weight of evidence for health effects. Some of the CVs used by ATSDR scientists include:

EMEGs: Environmental media evaluation guides

RMEGs: Reference dose media evaluation guides,

CREGs: Cancer risk evaluation guides, and

MCLs: EPA's maximum contaminant levels (MCLs).

EMEGs, RMEGs, and CREGs are non-enforceable, health-based CVs developed by ATSDR for screening environmental contamination for further evaluation. MCLs are enforceable drinking water regulations developed to protect public health.

You can find out more about CVs and the ATSDR evaluation process by reading ATSDR's Public Health Assessment Guidance Manual at:

http://www.atsdr.cdc.gov/HAC/HAGM/,

or contacting ATSDR at 1-888-42ATSDR.

What exposure concerns were evaluated for NWSY?

Following the strategy outlined above, ATSDR examined whether human exposure to harmful levels of contaminants from these pathways existed in the past, exists now, or could potentially exist in the future. ATSDR identified two exposure concerns at NWSY that required further evaluation:

- *The potential for contaminated groundwater (past, currently, or in the future) beneath Site 18 (Building 476 Discharge Area) to migrate off site and impact private wells.*

- *The potential for past, current, or future exposure from eating contaminated fish from on-site and nearby off-site surface water bodies.*

The term "exposure concern" is used to describe conditions and circumstances by which people could come into contact with contaminants. The use of the word "potential" indicates that given the known contamination at the site, ATSDR believes that further evaluation is warranted. However, it does not necessarily mean that people are being or have been exposed to harmful levels of contaminants or that there is necessarily a completed exposure pathway. Table 1 provides a summary of the potential exposure concerns evaluated in this PHA. Appendix C describes the evaluation process ATSDR used to identify and evaluate potential exposure concerns at NWSY.

ATSDR evaluated the potential for other environmental exposures associated with site-related contamination to pose a potential health hazard. Included in this evaluation were past, current, and potential future exposures to contaminated soil, and surface water and sediment at NWSY. We concluded that coming in contact with these other media did not pose a public health concern and were eliminated from further consideration. Appendix A provides a description of each of the IRP sites and explains whether a completed exposure pathway was/is likely.

Table 1. Potential Exposure Pathways Evaluated at NWSY

Exposure Concern	*Time Frame*	*Exposure:*	*Public Health Hazard*	*Actions Taken or Recommended*	*Comments*
1. Potential for contaminated groundwater beneath Site18 (Building 476 Discharge Area) to migrate off site and impact private wells.					
ATSDR evaluated the potential for off-site migration of contaminants to nearby private wells. The Building 476 Discharge area (Site 18) is a drainage ditch located immediately north of Building 476 in the southeastern portion of the station. This area was in use for approximately 20 years from the 1940s to the 1960s. Site 18 is situated near a small tributary leading to Lee Pond. The drainage discharge reportedly contained battery acid waste, consisting of dissolved metals such as lead, cadmium, nickel, and antimony. After the initial site visit to NWSY ATSDR recommended that nearby off-site private wells be tested if groundwater beneath Site 18 was shown to be migrating beyond the station boundary.	Past Current Future	Possible Unlikely Unlikely	This potential exposure situation does not represent a public health hazard. There does not appear to be a completed exposure pathway for residents living in the town of Lackey. Most people are connected to the municipal water supply. There may be a few individuals that rely on private wells for drinking water. However, groundwater samples collected on site do not contain harmful levels of contaminants. Additionally, groundwater flow direction is in the opposite direction of the station boundary and off-site migration of contaminated groundwater is not expected to occur.	Actions taken include: ❑ The Navy has not taken any remedial actions at this site. Contaminants have not been detected in groundwater or surface water at levels that would be of public health concern. ❑ A small number of samples were initially collected for soil, groundwater, and surface water and sediment. The Navy recommended a "no further action" based on the limited sampling. However, the regulatory agencies requested additional samples be collected. The 2004 Round Two RI provides the most current sampling results for Site 18 and support s the Navy's recommendation for "no further action."	There appears to be limited potential for off site migration since, according to site reports, the shallow groundwater appears to flow northward toward the stream draining to Lee Pond. Surface water also appears to flow northward towards the stream. There is one monitoring well located near the station boundary, approximately 600 feet from the southern boundary of Site 18. Contaminants have not been detected at levels of concern from this monitoring well. On the basis of the most recent environmental sampling at Site 18 and the low potential for off-site migration of contaminants from this source area, ATSDR does not recommend sampling of off-site private wells unless future sampling suggest other contaminant sources.

Exposure Situation	*Time Frame*	*Harmful Exposure: Yes/No*	*Public Health Hazard*	*Actions Taken or Recommended*	*Comments*
2. Potential exposures from eating contaminated fish from ponds and surface water bodies on– and off-site.					
▪ *On Site*: Fishing is allowed at some of the ponds on site at NWSY. ATSDR evaluated whether consuming contaminated fish caught from some of these ponds might result in harmful exposure to people.	Past Current Future	No No No	There is the potential for site-related contaminants released in the past to migrate from soil, sediment, groundwater, and surface water runoff to ponds and other surface water bodies at NWSY. The exposure hazard potential is likely low since people are not frequently eating fish caught on site. According to site personnel, most of the fishing at NWSY is recreational and more for sport than consumption.	❑ Signs are posted around the perimeter of Lee Pond stating that fish are only for catch and release and no fish from the pond should be consumed. ❑ No other signs or advisories have been issued regarding fishing on site. ❑ In 1992, the Navy conducted a focused biological sampling study for some selected surface water bodies at NWSY. In addition to sampling fish and shellfish the Navy also collected surface water and sediment samples from the same water bodies. ❑ EPA conducted independent fish tissue sampling from Lee Pond in April 1994.	Although fishing for consumption is allowed at some of the ponds, access is restricted and only authorized personnel are allowed to use these ponds for recreational fishing.

Exposure Situation	*Time Frame*	*Harmful Exposure: Yes/No*	*Public Health Hazard*	*Actions Taken or Recommended*	*Comments*
▪ *Off Site*: There are numerous surface water bodies (e.g., rivers, streams, and ponds) that may be impacted by contaminants originating from NWSY. ATSDR evaluated whether fish and shellfish from the two primary river basins (York and James Rivers) in close proximity to NWSY are safe to eat.	Past Current Future	No No No	There is the potential for site-related contaminants released in the past to migrate from soil, sediment, groundwater, and surface water runoff to off-site surface water bodies near NWSY. The exposure hazard potential is likely low since contaminant levels detected in fish from portions of the Yorktown and James Rivers in close proximity to the station are below levels believed to cause health effects in people.	The Virginia Department of Environmental Quality (VDEQ) routinely monitors contaminant levels in fish and shellfish from the York and James Rivers and other surface water bodies used for fishing across the state. The Virginia Department of Health uses the data generated by VDEQ to determine the need for fish consumption advisories. There is a current advisory for PCBs posted for the portion of the York River adjacent to the shoreline of NWSY. The VDEQ advisory covers the following geographic area: "York River from West Point downstream to the mouth near Tue Point and tidal portion of the following tributaries: King Creek, Queen Creek and Wormley Creek." The advisory recommends limiting the consumption of Croaker, gizzard shad, and spot to no more than two 8-ounce meals a month. For additional information about fish advisories for the York River you can access VDEQs "Fish Consumption Advisories" website at: http://www.vdh.state.va.us/HHControl/fishingadvisories.asp	As part of a previous PHA evaluation (Cheatham Annex, NWSY), ATSDR reviewed fish tissue data for fish samples collected and analyzed by VDEQ between the years 1997 and 2001 from a variety of waterways in the vicinity of NWSY. The sampling results showed that contaminants such as PCBs and some metals (i.e., arsenic and mercury) were detected mostly at low levels in fish fillet and blue crab samples. Some of the tissue concentrations exceeded ATSDR's health-based screening values. Upon further evaluation, the concentrations were determined to be below levels known to cause health effects in the toxicological literature. ATSDR also reviewed the most recent fish/shellfish monitoring data available. The results are similar to the earlier data with respect to PCBs and other organic compounds. The average concentrations of some metals such as lead and mercury were higher than previous sampling results. However, this may be due to a smaller sample size and one or two elevated tissue samples. Additional data will need to be reviewed to assess whether concentrations of lead and mercury are actually increasing.

Discussion

1. The potential for contaminated groundwater (past, currently, or in the future) beneath Site 18 (Building 476 Discharge Area) to migrate off site and impact private wells.

Characterization of the Issue

Site 18 is a one-quarter mile long drainage ditch located north of Building 476 in the southeastern portion of the station near the main gate (Gate Number 1). During ATSDR's initial site visit to NWSY, the Navy was in the process of installing monitoring wells to determine the nature and extent of groundwater contamination in the vicinity of Site 18. During the site visit, ATSDR became aware of three off-site private wells south of Site 18 in the small town of Lackey. ATSDR learned that most residents of Lackey obtained their drinking water from the municipal water system. However, it is possible that the three private wells may be used for potable water. In its Trip Report released in January 1993, ATSDR recommended that the three off-site private wells be sampled if on-site groundwater monitoring at Site 18 indicated high levels of contamination (ATSDR 1993). As a follow-up to the recommendation in the trip report, ATSDR reviewed the most current data and revisited this potential exposure situation to determine the likelihood of off-site migration and contamination of private well from Site 18.

Characterization of Potential Exposure Pathway

Site 18, located in the industrial area behind Building 476, was in use for approximately 20 years from the 1940s to the 1960s. During this period, battery acid waste (e.g., hydrochloric acid and calcium hydroxide) and dissolved metals including lead, cadmium, nickel, and antimony were reportedly discharged to the drainage area. Currently, the drainage ditch associated with Site 18 appears to be a natural stream in some areas and an excavated trench in others. The area to the south of Site 18 is paved and covered by Building 476. The non-paved surfaces include the wooded area north of Building 476 (Baker 2004).

Storm water runoff at Site 18 is primarily controlled by the storm water system in place and to a lesser extent from infiltration through the non-paved areas in the northern portion of the site. Runoff from paved surfaces that is not intercepted by the storm water system drains to an unlined drainage ditch located north of Building 476. The water within this drainage ditch flows northward into an unnamed stream that eventually drains into Lee Pond, which is contained entirely on NWSY property. The shallow groundwater underneath Site 18 is expected to flow north or northwest toward the stream draining to Lee Pond (Baker 1993; 2004).

Nature and Extent of Contamination

One groundwater sample was collected at Site 18 during the 1993 Round One RI and analyzed for VOCs, base/neutral and acid extractable organic compounds, total and dissolved metals, PCBs, pesticides, explosive compounds, nitrates, and total petroleum hydrocarbons (TPHs). No organic compounds (e.g., VOCs, TPHs, or pesticides) were detected in this sample. Beryllium (7.5 ppb-estimated), cadmium (12.6 ppb), chromium (294 ppb-estimated), and lead (260 ppb-estimated) were detected above EPA's maximum contaminant levels (MCL) for drinking water.

Low levels of other metals compounds were detected in the groundwater sample at levels below their respective health-based screening values (Baker 1993).

The Round Two RI was conducted during summer 1996 and winter 1997. During this investigation the Navy installed three monitoring wells, two shallow and one deep well. These wells were installed to evaluate the nature and extent of groundwater and to obtain site hydrogeology data. A total of three groundwater samples were collected from two of the new monitoring wells. Groundwater samples were analyzed for organics, metals (total and dissolved), nitrate, nitrite, bromide, chloride, orthophosphorous, sulfate, and dissolved methane. No organic compounds were detected in any of the groundwater samples collected. Low levels of metals were detected below health-based screening values (Baker 2004).

Evaluation of Potential Public Health Hazards

Groundwater and hydrogeological data associated with environmental investigations at Site 18 provides evidence that off-site contaminant migration is not occurring and has not occurred in the past. ATSDR's conclusion is based on the following information:

1) The overall groundwater and drainage flow pattern has been determined to be towards the northwest in the opposite direction of the station boundary, thereby minimizing any off-site migration of contaminants from Site 18; and

2) The relatively low levels of contamination detected in recent groundwater samples collected from monitoring wells installed at Site 18. A few metals were detected above health-based screening values in the one sample collected during the 1993 Round One RI. However, none of the Round Two samples contained contaminants that exceeded health-based screening values.

On the basis of the most currently available information, ATSDR concludes that off-site migration of contaminated groundwater at Site 18 is unlikely and there should be little or no impact from past site-related contamination on any off-site private wells that may still be in use. Therefore, with respect to concerns about Site 18 contamination and potential off-site groundwater migration, there does not appear to be a need to recommend sampling for any existing off-site private wells.

2. Potential for past, current, and future exposures from eating contaminated fish from on-site and nearby off-site surface water bodies.

Characterization of the Issue

NWSY covers a very large land area (10,500 acres) and has numerous ponds, creeks, and wetland drainage areas covering the property. The ponds and surface water bodies support a large variety of plant and animal life. A 1987 U.S. Fish and Wildlife Service fish survey identified 19 species of fish, with perch, sunfish, bluegill, striped bass, largemouth bass, and spotted sea trout among the most common varieties found. Sport or recreational fishers will catch and eat these common species. Some crustaceans and shellfish including crayfish, blue crab, oyster beds, and clams are also found in the water bodies near NWSY (NPS 2002).

Surface water runoff and groundwater discharge from the original contaminated source areas at NWSY may result in contaminant migration to the on-site ponds and creeks and tributaries that lead into the James and York Rivers. Fishing on site is permitted at certain designated locations for NWSY personnel. Residents are not allowed access to the fishing areas and it is unlikely that trespassing onto the Navy property is a significant problem because of security associated with the military installation. Two ponds used for fishing are located in the eastern third of the station, Roosevelt Pond and Lee Pond. Three ponds (# 10, 11, and 12) also used for fishing are located in the northwest portion of the station; a heavily vegetated remote part of the station that is in the opposite side of the industrial portions of the station. However, two of the three numbered ponds (# 11 and 12) border the current EOD area. Five classes of fishing permits are issued for NWSY ponds; 1) Active Duty Military; Retired Military; Reservists; DOD Civilians; and guests of groups listed above.

NWSY is in close proximity to two large tributaries of the Chesapeake Bay, the York and James Rivers. The potential for off-site contaminant migration from on-site sources to both rivers, which are used for recreation, fishing, and wildlife habitat, is also evaluated below. The next section describes the potential exposure pathways for the principle on- and off-site surface water bodies where people are most likely to fish.

Characterization of Potential Exposure Pathway

On Site: Since investigations began in the early 1980s, a total of 30 IRP sites have been investigated at NWSY and most of these have either been cleaned up, are currently undergoing remedial activities, or a record of decision (ROD) has been signed with a final determination of no further action (see Appendix A). In addition to IRP sites, the Navy is also investigating a number of SSAs that have been identified at NWSY. These SSAs are in the process of being prioritized for future investigations. Most, but not all, of the industrial activity at NWSY occurs in the eastern third of the station. In general, current operations at the station involve controlled releases of contaminants that are closely monitored and regulated. However, contaminant releases in the past were often not regulated and resulted in areas of soil, sediment, groundwater, and surface water contamination (see Text Box below). Ponds and other surface water bodies are depositional and can act as sinks (i.e., long-term storage areas) for contaminants.

Surface Water and Sediment —

In July/August 1992, surface water and sediment samples were collected from four different sampling locations at Lee Pond. VOCs and explosive compounds were detected in both surface water and sediment during this sampling event. The only compound that exceeded ATSDR's health-based screening value in surface water was 2,4,6-trinitrotoluene (2,4,6-TNT), which was detected at a maximum concentration of 190 ppb. This was detected in the sample collected in the extreme eastern portion of the pond, closest to Site 9, which is the original source area. No explosives were detected in any of the sediment samples collected (Baker 1993).

In October 1992, a limited number of environmental samples were collected at Lee Pond as part of the Focused Biological Sampling and Preliminary Risk Evaluation report. In addition to fish tissue samples, two other samples, one surface water and one sediment, were collected from the pond during this investigation. The analytical results for the surface water sample did not identify contamination from organic compounds such as semi-volatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), or pesticides, and only low levels of metals were detected. Low levels of some organic compounds and metals were detected in the sediment sample, but at levels below health concern (Baker & Weston 1993).

During the Round Two RI for Sites 9 and 12, nitramines (RDX [6 ug/L] and 2,4,6-TNT [25 ug/L]) were detected in a surface water sample (9SWl l-01) located within the eastern inlet of Lee Pond closest to Site 9 (Baker 1997; Baker 2001a).

Fish Tissue —

In 1992, the Navy collected fish samples from two ponds, Lee Pond and Roosevelt Pond, and two creeks (Indian Field Creek and Felgates Creek) at NWSY as part of the Focused Biological Sampling Investigation. Three different fish species were sampled from Lee Pond and analyzed for SVOCs, pesticides, PCBs, and metals. Table 2 presents the analytical results of the fish tissue samples collected from Lee and Roosevelt Ponds. The compounds detected most frequently and in the highest concentration in fish tissue samples from Lee Pond were pesticides such as dieldrin, DDT/DDE, and chlordane. Dieldrin detected in bluegill (sunfish) and largemouth bass samples exceeded EPA's risk-based concentrations (RBC).[1] PCBs (i.e., Aroclor 1248) and most SVOCs were not detected above the sample quantitation limit[2]. It is important to note that this was a limited sampling event and the Navy did not analyze fish tissue samples for VOCs or nitramine compounds (e.g., 2,4,6-TNT and RDX), which were discharged at Site 9 and detected in surface water (Baker & Weston 1993).

1 EPA's RBCs represent a concentration above that which an unacceptable risk of exposure occurs. RBCs do not represent toxicity threshold levels and, therefore, people exposed to a chemical that exceeds its RBC will not necessarily cause adverse health effects. The likelihood that a person's exposure to a substance will cause health effects depends on many factors, including the bioavailability (i.e., extent to which a chemical substance is taken up and absorbed into the body – the less bioavailable a chemical is the less potential for toxicity) of the chemical, frequency and duration of exposure, and individual genetic susceptibility.

2 The quantitation limit of an individual analytical procedure is the lowest amount of analyte in a sample that can be quantitatively determined with suitable precision and accuracy.

Table 2. Results of 1992 Fish Tissue Sampling from Lee and Roosevelt Ponds at NWSY

Species	Chemical	Maximum Concentration of Detected Contaminants (ppb)		Number of samples[1, 2]
		Lee Pond	Roosevelt Pond	
Sunfish (Bluegill)	Dieldrin 4,4'-DDE 4,4'-DDT Alpha chlordane Aroclor 1248	0.98 4.40 2.50 J 1.50 ND (DL = 9.80)*	ND (DL = 0.28) 6.90 0.98 J ND (DL = 1.30) ND (DL = 9.90)*	Lee Pond: 1 (composite of 5 fish) Roosevelt Pond: 1 (composite of 10 fish)
Black Crappie	Dieldrin 4,4'-DDE 4,4'-DDT Alpha chlordane Aroclor 1248	1.40 5.30 3.40 2.90 ND (DL = 9.60)*	NS NS NS NS NS	Lee Pond: 1 (composite of 3 fish)
Largemouth Bass	Dieldrin 4,4'-DDE 4,4'-DDT Alpha chlordane Aroclor 1248	0.98 4.40 ND (DL = 3.90) 0.98 J ND (DL = 9.80)*	0.50 46.0 7.0 3.50 ND (DL = 10.0)*	Lee Pond: 1 (composite of 2 fish) Roosevelt Pond: 1 (composite of 4 fish)

All data presented are whole body "wet weight" samples.
ND = Not detected
NS = Not Sampled

1. Only includes samples where chemicals exceeded the analytical method detection limit
2. This also includes in parentheses the *number of individual fish used for each composite sample*

EPA's risk-based concentration (RBC) for fish tissue
Dieldrin = 0.2 ppb
4,4'-DDE, 4,4'-DDT, and Alpha Chlordane = 9 ppb
Aroclor 1248 = 1.6 ppb

* All the detection limits for Aroclor 1248 were above EPA's RBC of 1.6 ppb. It is not possible to tell whether any of the fish samples exceeded their RBC because of the analytical methods high detection limits.

All values in bold exceed their respective RBC

Notes:
Metals and selected semi-volatile organic compounds were also analyzed during the sampling effort. None of these compounds were detected in sufficient frequency or magnitude to include in the table.

Source: Baker. 1993. Focused Biological Sampling and Preliminary Risk Evaluation. July 1993.

In April 1994, EPA collected fish tissue samples from Lee Pond and presented the analytical results in the Lee Pond Independent Fish Sampling Report. A total of seven fish (3 largemouth bass, 2 black crappie, and 2 bluegill) were collected from Lee Pond, analyzed for selected metals, organics, pesticides, PCBs, and nitroaromatic (i.e., explosives) compounds, and reported on a whole body wet weight basis. The results of the sampling effort showed that the explosive compound 2,6-dinitrotoluene was detected in one of the seven fish samples at a maximum concentration of 83.6 ppb. Two metals, cadmium (1,100 ppb) and mercury (300 ppb), were detected above their RBCs. In addition, several pesticides (heptachlor epoxide [0.72 ppb], dieldrin [1.9 ppb], and chlordane [3.1 ppb]) were also detected above their respective RBCs (Black & Veatch 1995).

Roosevelt Pond: This pond receives storm water from the industrial area and adjacent sites such as SSA 4 (Weapons Casing/Drum Disposal Area) and SSA 5 (Bypass Road Landfill). Roosevelt Pond drains into Bracken Pond, which empties into the York River. Limited environmental sampling has been conducted at Roosevelt Pond. The results of available sampling data are presented below.

Surface Water and Sediment —

In 1992, the Navy collected two samples, one surface water and one sediment, from Roosevelt Pond during the Focused Biological Sampling investigation. Most organic (e.g. SVOCs and pesticides) compounds were not detected in either the surface water or sediment sample (Baker & Weston 1993). In 1994, VDEQ released its Bioaccumulation Initiative study, which presented some soil/sediment data for several locations at NWSY including Roosevelt Pond. Twelve soil/sediment samples were collected and low levels of PAHs and PCBs were detected (VDEQ 1994).

The most recent environmental sampling for Roosevelt Pond occurred during the 2001 SSA field sampling investigation. During this sampling effort fifteen surface water samples were collected from Roosevelt Pond and two surface water samples were collected from Bracken Pond, which is fed by Roosevelt Pond. One explosive compound, 3-Nitrotoluene, was detected at a concentration of 0.41 ppb in a surface water sample collected from Bracken Pond. This is below levels that are known to cause any human health effects. No other explosives were detected and only low levels of organics and metals were detected in surface water (Baker 2001a).

Fish Tissue —

During the 1992 Focused Biological Sampling effort, the Navy collected two different fish species from Roosevelt Pond and analyzed them for SVOCs, pesticides, PCBs, and metals. The pesticide 4,4-DDE was detected (46 ppb) above its RBC in a largemouth bass sample (Table 2). Most other chemicals were either detected at low concentrations below levels of health concern or were not detected above the method quantitation limit (Baker & Weston 1993).

Numbered Ponds: Ponds 11 and 12 surround the current and former EOD Burning/Disposal Area. Pond 10 is located about 1,500 feet northeast of Pond 11. The former EOD area (SSA 2) is located in the north end of the existing EOD range. A removal action at the former EOD area was conducted in 1994 and included the removal of scrap metal and miscellaneous ordnance materials, containers of lead, and live ordnance. The Beaver Road/Ponds 11 and 12 Drainage Area (SSA 19) encompasses the area surrounding the EOD range. SSA 19 comprises a small number of unlined settling ponds. Surface water runoff and effluent from these unlined ponds may discharge to Ponds 11 and 12. The Navy has conducted very limited environmental sampling at SSA 2 and SSA 19. VDEQ collected a small number of fish from the numbered ponds (10, 11, and 12) as part of its Bioaccumulation Initiative in Virginia's Coastal Zone Management Area study.

Surface Water and Sediment —

The Navy collected a total of eight sediment samples along the drainage ways from the EOD range (SSA19) and along King Creek, located just north of the former EOD range. Three surface water samples were also collected in selected locations. Low levels of organics, metals, and explosives were detected in sediment and surface water samples. However, none of the chemicals were detected at levels of health concern (Black & Veatch 1996).

Fish Tissue —

As part of its Bioaccumulation Initiative Study in 1994, VDEQ collected one fish sample from each of the numbered ponds and analyzed the samples for metals, explosives and organic compounds. The results of the analysis did not show any elevated levels of chemicals in fish collected from the numbered ponds (VDEQ 1994). This was a very small sampling effort and may not fully represent the nature and extent of contamination for these ponds.

Off Site: VDEQ routinely monitors contaminant levels in fish through its Fish Tissue and Sediment Contaminants Monitoring Program. VDEQ collects data that is used to assess the human health risks for individuals who may consume fish from state waters. The Virginia Department of Health uses the data generated by the program to determine the need for fish consumption advisories (VDEQ 2005).

In September 2004, ATSDR released its PHA for NWSY, Cheatham Annex (CAX). CAX is a storage facility that is adjacent to NWSY. Although CAX is under the same command structure of NWSY, it is considered an annex of the station and was designated as a separate CERCLA site by EPA. However, the two sites are adjacent to one another and surface water runoff from both sites flows to the same area wide drainage basins.

As part of the PHA for CAX, ATSDR reviewed fish tissue data for fish samples collected and analyzed by VDEQ between the years 1997 and 2001 from a variety of waterways in the vicinity of NWSY. Appendix E of the CAX PHA describes the objectives, methods, and results of the data review. A brief summary of ATSDR's findings is provided below. The PHA for CAX and the corresponding Appendix E are also available at the following URL: http://www.atsdr.cdc.gov/HAC/PHA/NavWeapsYorktown/navweapsyorktown-p9.html

The data showed that a variety of contaminants were detected in fish fillet and blue crab samples. The maximum detected concentration of PCBs (0.89 ppm – gizzard shad), arsenic (4.3 ppm – blue crab), lead (0.48 – fish fillet), and mercury (0.17 – fish fillet) were above health-based screening values. Table 3 on the next page presents summary statistics for the data set ATSDR used for its evaluation (ATSDR 2004).

ATSDR also reviewed the most recent sampling data available for 2003 for fish collected from the lower York River basin and the James River basin below the fall line in Richmond; these are the portions of the York and James Rivers that are closest to NWSY. A review of the data shows that the highest PCB levels from common edible fish species were detected in the James River Basin. The highest PCB level (3 ppm) was detected in a blue catfish sample collected from the James River. PCB concentrations in other species of catfish sampled were considerably lower. The 2003 PCB results are also reported parenthetically in Table 3.

With the exception of a couple of species sampled the 2003 data for PCBs in fish tissue are consistent with the 1997—2001 data reported in Appendix E of the Cheatham Annex PHA. The average and maximum PCB concentration in carp samples from 2003 were more than twice as elevated as the samples collected between 1997 and 2001. Conversely, the PCB concentrations measured in white perch during 2003 were less than half the concentrations reported between 1997 and 2001. This variation may be due to the smaller sample size for the 2003 dataset.

The 2003 data for metals is more difficult to interpret. The average concentration of arsenic appears to have declined in fish tissue samples, however, lead and mercury levels may have increased compared to the 1997—2001 data set. Again, since the 2003 data set is considerably smaller one or two samples with very high concentrations will have a greater influence on the average concentration. This is evident with lead detected in fish tissue samples collected during 2003. The maximum lead concentration reported during 2003 was 3.3 ppm, nearly ten times the maximum concentration reported in the 1997—2001 data set. During 2003, lead was detected in two samples above 3 ppm. Additional data will need to be reviewed to assess whether concentrations of lead and mercury are actually increasing in fish tissue.

Other compounds such as pesticides and PAHs were not detected above health-based screening values in fish tissue samples.

Table 3. Contaminants Detected in Fish and Crab Species Sampled by VDEQ

Chemical	Species	Number Sampled	Maximum Concentration[1] (ppm)	Average Concentration[1] (ppm)	Screening Value (ppm)
PCBs	Black Crappie	1 (3)	0.08 (0.02)	0.08 (0.01)	0.05 (VDEQ)[4]
	Blue Crab	35 (6)	0.13 (0.16)	0.05 (0.04)	
	Bluegill Sunfish	3 (1)	0.08 (0.05)	0.06 (0.05)	
	Channel Catfish	2 (8)	0.26 (0.32)	0.22 (0.24)	
	Common Carp	6 (23)	0.60 (1.4)	0.17 (0.49)	
	Gizzard Shad	25 (18)	0.89 (0.32)	0.38 (0.15)	
	Largemouth Bass	6 (10)	0.18 (0.17)	0.07 (0.05)	
	Striped Bass	6 (12)	0.26 (0.49)	0.21 (0.25)	
	White Perch	5 (8)	0.21 (0.04)	0.11 (0.02)	
Arsenic	All Fish Species	89 (59)	1.9 (0.70)	0.53 (0.06)	0.002
	Blue Crab	21 (6)	4.3 (0.47)	0.69 (0.13)	(EPA Region III RBC)
Lead	All Species	112[2] (65[3])	0.48 (3.3)	0.1 (0.23)	NA
Mercury	All Fish Species	89 (59)	0.17 (0.74)	0.03 (0.16)	0.14
	Blue Crab	21 (6)	0.04 (0.08)	0.02 (0.06)	(EPA Region III RBC)

[1] Values are rounded off and may not be exactly as presented in Appendix E, ATSDR 2004 PHA for NWSY-Cheatham Annex
[2] Lead was only detected in 2 of 112 samples collected
[3] Lead was detected in 10 of 65 samples collected
[4] VDEQ uses a concentration of 54 ppb (0.054 ppm) as the fish tissue screening value in its water quality assessment.

NA = Not Available

Values in parentheses represent the number sampled and contaminant concentrations (Maximum and Average) for fish tissue samples collected during 2003

Child Health Considerations

ATSDR recognizes that infants and children may be more sensitive to exposures than adults in communities with contamination in water, soil, air, or food. In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than are adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometimes engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than are adults; this means they breathe dust, soil, and vapors close to the ground. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus adults need as much information as possible to make informed decisions regarding their children's health. ATSDR is committed to evaluating their special interests at sites such as NWSY as part of the ATSDR Child Health Initiative.

ATSDR has attempted to identify populations of children in the vicinity of NWSY. According to the navy housing office, there are approximately 20 children under the age of 6 and a total of 61 children under the age of 18 who reside in on-site military housing at NWSY. These children do not have access to any of the IRP sites at the station. The CDC, which typically cares for between 65 and 90 children under the age of 5 years, is a relatively new facility with no apparent environmental hazards.

There are also additional off-site military housing areas where children reside. However, access to the station is restricted and there are no apparent exposure pathways to any of the source areas of contamination. Most of the housing units have been remodeled or were built after 1980. The Navy does distribute lead paint hazard fact sheets and informational materials for those families that occupy older dwellings.

On the basis of ATSDR's exposure evaluation, *ATSDR concludes that exposure to site contamination at NWSY does not pose unique health hazards for children.*

Conclusions

After evaluating available environmental information, ATSDR has reached the following conclusions regarding the identified exposure situations at NWSY. On the basis of the most currently available information, there are no past, current or future public health hazards associated with contaminants at NWSY. ATSDR's conclusions regarding the potential exposure pathways evaluated at are described below:

1. **Potential for past, current, or future off-site migration of contaminated groundwater beneath Site 18 (Building 476 Discharge Area)**

   Past Exposure: *ATSDR concludes that past exposures from off-site migration of contaminated groundwater beneath Site 18 posed no public health hazard.* Since ATSDR's initial site visit to NWSY investigations associated with Site 18 have determined that groundwater flow direction is toward the northwest, in the opposite direction of any off-site drinking water wells. Groundwater investigations have also characterized the nature and extent of contamination and although contaminants have been detected at mostly low concentrations in the aquifer beneath Site 18, they were not at levels that would be harmful under most exposure situations.

   Current and Future Exposure: *ATSDR concludes that current and future exposures from off-site migration of contaminated groundwater beneath Site 18 pose no public health hazard.* Given the groundwater flow direction, off-site migration of contaminated groundwater beneath Site 18 is not expected and ATSDR does not believe that a completed exposure pathway exists for any private well users near the boundary between NWSY and the town of Lackey.

2. **Potential past, current, and future exposures from eating contaminated fish from on-site ponds at NWSY and nearby off-site surface water bodies.**

   On Site:

   Past Exposure: Since access to NWSY has always been restricted and trespassing onto Navy property has not been an issue, ATSDR considered only locations on site where the Navy allows fishing. *ATSDR concludes that the consumption of fish from fishing ponds did not pose a past public health hazard.* A review of the available fish sampling data for the on-site ponds showed mostly low-level contamination below levels known to cause illness or health effects. In addition, access to the on-site ponds has always been restricted and NWSY personnel used the ponds for recreational fishing purposes. Therefore, we expect that any past exposures from consuming fish from on-site ponds occurred infrequently, would have been of limited duration, and would not have resulted in illness or health effects.

Current and Future Exposure: *ATSDR concludes that the consumption of fish from fishing ponds does not pose a current or future public health hazard.* Low levels of contamination have been detected in some of the fish that have been sampled from the on-site ponds. However, consumption for recreational consumers should not result in any harmful exposures. Land use is not expected to change and access to fishing ponds will continue to be restricted to authorized personnel only. If land use were to change in the future due to unforeseen circumstances ATSDR would recommend that additional samples be collected and analyzed for metals and explosives.

Off Site:

Past, Current, and Future Exposure: ATSDR assumed either recreational fishing or low-end subsistence ingestion rates in estimating exposure dose from consumption of local fish from the York or James Rivers. While the concentration of PCBs, arsenic, lead and mercury in some of the fish samples were above health-based screening values, the estimated doses for recreational and low-end subsistence fishers are below levels known to cause health effects.

Fish and shellfish are good sources of protein and other essential nutrients and ATSDR encourages the consumption of these food sources as a part of the typical diet. This can be done by following safe fish consumption guidelines and by closely monitoring and adhering to fish consumption advisories posted by your local health department or other authorities. Populations such as pregnant women and children may be more susceptible to certain contaminants and should always follow the recommendations posted in public health advisories.

Recommendations

Based on the conclusions about potential exposure pathways at NWSY, ATSDR makes the following recommendation.

1. If future land use changes and access to the three fishing ponds (Ponds 10, 11, and 12) in close proximity to the EOD Range is no longer restricted, ATSDR recommends additional sampling of fish for explosives and metals in order to more thoroughly characterize the nature and extent of contamination.

2. ATSDR also recommends additional sampling of Roosevelt Pond for metals and explosive compounds if future access to this pond changes.

Public Health Action Plan

The Public Health Action Plan (PHAP) for NWSY contains a description of actions taken and to be taken by ATSDR, NWSY, EPA, and other state or local agencies subsequent to the completion of this PHA. The purpose of the PHAP is to ensure that this PHA not only identifies potential and ongoing public health hazards, but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. The public health actions that are completed, ongoing or planned, and recommended are listed below.

Completed Actions

Refer to Appendix A for specific remedial actions and investigations associated with each IRP site.

1. In 1974 and 1975, carbon adsorption towers were installed at Sites 6,7,8, and 9 to treat contaminated wastewater prior to discharge into the drainage way. In 1986, the effluent from these towers was diverted to the sanitary sewer and ultimately to the Hampton Roads Sanitation District (HRSD).

2. Since 1987, NWSY has conducted numerous remedial actions involving the removal of contaminated soil, sediment, solid waste removals (e.g., construction debris, empty drums, scrap metal, and batteries), transformers, liquid waste-filled drums, and fuel tanks. These actions were taken at specific sites to reduce the potential for human exposures and to mitigate ecological impacts from contamination.

3. In 1996, the Navy conducted a pilot study to evaluate a bioremediation method to address nitramine/nitroaromatic contamination. Approximately 1,200 cubic yards of explosives-contaminated soil was treated using an anaerobic bioslurry/biocell technology.

4. In 1997, the Navy, with guidance from VDEQ, agreed to place a soil cap consisting of a geosynthetic clay material across approximately two acres of land where lead-contaminated soil exceeded 400 ppm. In August through September 1997, the liner was installed and covered with 12 inches of cover soil and 6 inches of topsoil. As part of the remediation activity the incinerator building was demolished, the Area A stream channel was regraded and redirected, and a concrete revetment system was installed to control erosion. A long-term monitoring plan was established to ensure that the cover is adequately protective of human health and the environment, including Ballard Creek (U.S. Navy 1997).

5. In 1999, the Navy constructed the Daramend greenhouse/biocell at Site 24 to treat Site 6 soil and sediment. The biocell began operation in mid 1999 and continues in operation.

Ongoing and Planned Actions

1. The Navy is continuing groundwater investigations under the designated groundwater OUs at NWSY.

2. The Navy continues to investigate SSAs across NWSY and is working with state and federal regulators to determine whether any SSAs need additional sampling and/or remedial actions.

3. ATSDR supports the Navy's decision to post signs at Lee Pond advising personnel to only catch and release fish from the pond. The results of fish sampling conducted in 1992 and 1994 from Lee pond indicated elevated levels of some pesticides, explosives, and metals. Until follow-up sampling is conducted and the fish are considered safe, ATSDR agrees that fish should not be consumed from this pond.

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References

Agency for Toxic Substances and Disease Registry [ATSDR]. 1993. Trip Report: Site Visit, Naval Weapons Station Yorktown – December 7-9, 1992. January 7, 1993.

ATSDR. 1999a. Toxicological Profile for Mercury. March 1999.

ATSDR. 1999b. Toxicological Profile for Lead. July 1999.

ATSDR. 2000a. Toxicological Profile for Arsenic. September 2000.

ATSDR. 2000b. Toxicological Profile for Polychlorinated Biphenyls. November 2000.

ATSDR. 2004. Public Health Assessment for Naval Weapons Station Yorktown-Cheatham Annex. September 7, 2004.

Baker Environmental Inc. [Baker]. 1991. Final Community Relations Plan. September 1991.

Baker. 1993. Final Round 1 Remedial Investigation Report Sites 1-9, 11, 12, 16-19, and 21. July 1993.

Baker & Roy F. Weston [Weston], Inc. 1993. Focused Biological Sampling and Preliminary Risk Evaluation, NWSY. July 1993.

Baker. 1995a. Final Summary of Background Constituent Concentrations and Characterization of Biotic Community From the York River Drainage Basin. July 1995.

Baker. 1995b. Final Round Two Remedial Investigation and Baseline Risk Assessment for Site 16 and SSA 16, Vol. 1. July 21, 1995.

Baker. 1997. Final Round Two Remedial Investigation Report Sites 9 and 19. January 1997.

Baker 2001a Final Site Screening Process Report for Site Screening Areas 3, 4, 5, 9, 10, 20, 21, 22, 23, and 24. Volumes I and II. October 2001.

Baker. 2001b. Final Feasibility Study Weapons Naval Station Yorktown. April 2001

Baker. 2004. Final Round II Remedial Investigation Report Sites 2, 8, 18, and Site Screening Area 14, NWSY. June 2004.

Black & Veatch Waste Science, Inc. [Black & Veatch]. 1995. EPA Report: Lee Pond Independent Fish Sampling for Naval Weapons Station Yorktown, Virginia. January 1995.

Black & Veatch. 1996. Draft AOC 22, Site 12, SSA 2, SSA 19, and King Creek Independent Sampling and Risk Screening Report, NWSY. February 1996.

Bureau of the Census 2001
http://www.census.gov/popest/counties/tables/CO-EST2003-01-51.pdf

CRITFC (Columbia River Inter-Tribal Fish Commission). 1994. A Fish Consumption Survey of the Umatilla, Nez Perce, Yakama, and Warm Springs Tribes of the Columbia River Basin. CRITFC Technical Report #94-3. Portland, OR. Cited by EPA 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 2 Risk Assessment and Fish Consumption Limits, Third Edition. November 2000.

Harris, S.G., and B.L. Harper. 1997. A Native American exposure scenario. Risk Analysis 17(6):789-795. Cited by EPA 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 2 Risk Assessment and Fish Consumption Limits, Third Edition. November 2000.

National Park Service [NPS]. 2002. Draft Air Quality Management Plan for Colonial National Historic Park. July 25, 2002.

Navy Energy and Environmental Support Activity (NEESA). 1984. Initial Assessment Study Weapons Naval Station Yorktown. July 1, 1984.

NUS Corporation [NUS]. 1983. A Preliminary Assessment for U.S. Naval Weapons Station York Town. August 19, 1983.

Naval Weapons Station Yorktown [NWSY]. 2005. Housing Summary Sheets. February 2005.

U.S. Department of Agriculture, Agricultural Research Service [USDA]. 1998. 1994-1996 Continuing Survey of Food Intake by Individuals and 1994-1996 Diet and Health Knowledge Survey. CD-ROM, accession number PB-98-500457. Cited by EPA 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 2 Risk Assessment and Fish Consumption Limits, Third Edition. November 2000.

U.S. Environmental Protection Agency (EPA). 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 2 Risk Assessment and Fish Consumption Limits, Third Edition. EPA 823-B-00-008. November 2000.
Available at: http://www.epa.gov/ost/fishadvice/volume2/
Accessed on May 6, 2005.

U.S. Navy. 1997. Installation Restoration Program NWSY Site 12 Fact Sheet: remedial Action at Site 12, Barracks Road Landfill, Area A. Summer 1997.

U.S. Navy. 2005. Yorktown Weapons Station ATSDR Visit: February 2005.

Versar, Inc [Versar]. 1991. Remedial Investigation Interim Report. 1991.

The Virginia Department of Environmental Quality [VDEQ], Office of Environmental Research and Standards. 1994. Bioaccumulation Initiative in Virginia's Coastal Zone Management Area. March 31, 1994.

VDEQ. 2004. Draft 2004 305(b)/303(d) Water Quality Assessment Integrated Report. March 22, 2004.

VDEQ. 2005. Fish Tissue and Monitoring Program Background. Updated May 14, 2004. http://www.deq.virginia.gov/fishtissue/background.html

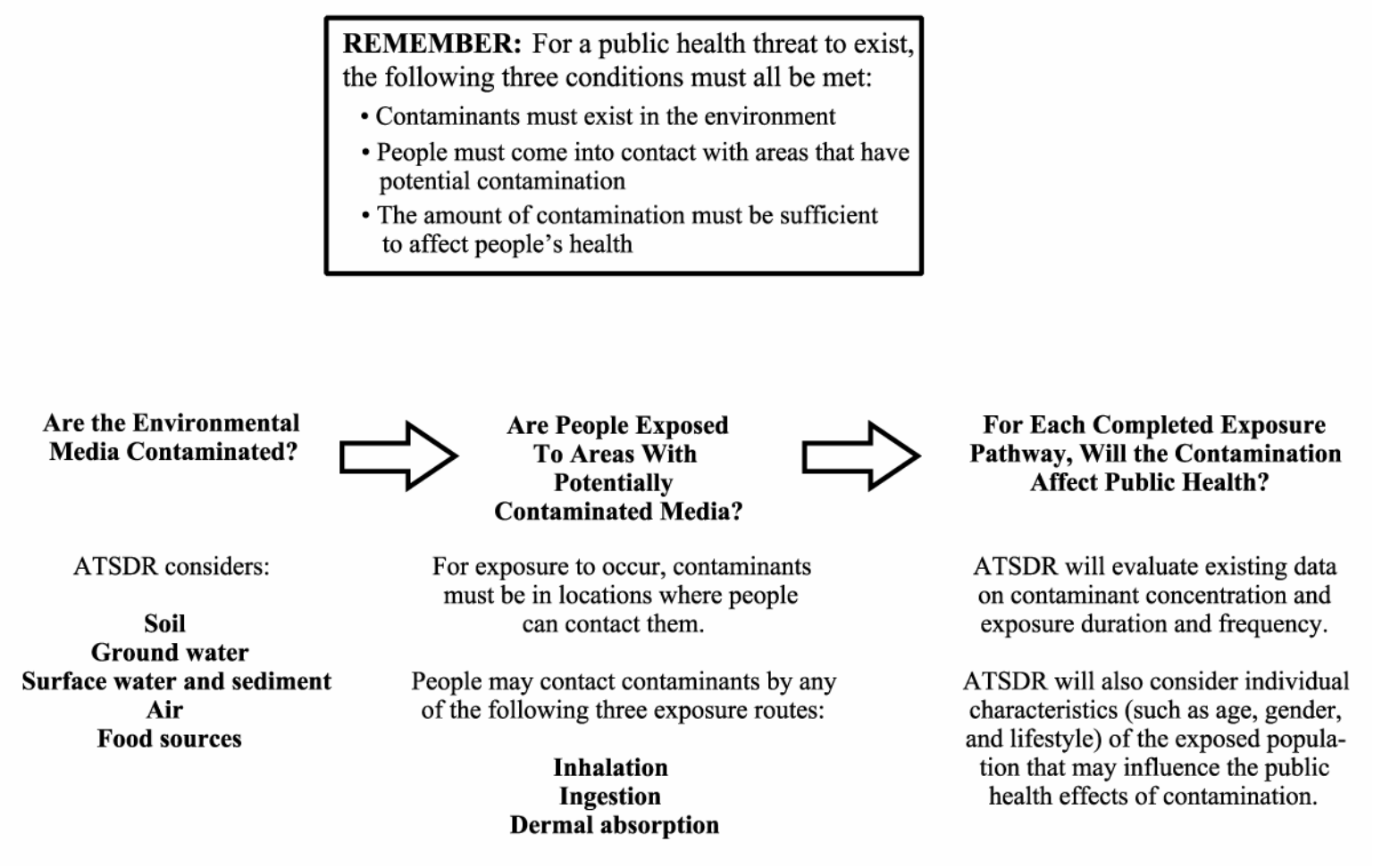
York County, Virginia, Planning Division [YCPD]. 2003. York County at a glance: 2000 census data. Available from URL: www.yorkcounty.gov/planning/statprofile/glance.htm [accessed February 17, 2005].

YCPD. 2004. Draft Demographic Profiles and Projections. November 30, 2004. URL: http://www.yorkcounty.gov/2025/document_maps/documents/Draft%20Demographics.pdf

The York Watershed Council. Updated August 1998. URL: http://www.yorkwatershed.org/old_2002_website_files/old_index.htm

FIGURES

Figure 3: ATSDR's Exposure Evaluation Process



Appendices

Appendix A. Site Summary Table

Appendix A: IRP Site Summaries and Exposure Potential of Source Areas of Contamination at Naval Weapons Station Yorktown (NWSY)				
Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 1 Dudley Road Landfill Site 1 is part of Groundwater Operable Unit (OU) I	Site 1 covers approximately 10 acres in the north central part of the installation. The landfill was active between 1965 and 1979 for general disposal. One area of the landfill received plastic lens grinding wastes until 1981. Wastes reportedly disposed at Site 1 included asbestos from insulation on steam piping, empty oil, grease, paint and residual solvents (e.g., trichloro-ethylene [TCE], trichloroethane [TCA], and acetone), explosive contaminated carbon, household appliances, scrap metal banding, construction rubble, plastic lens grinding wastes, packaging wastes, and electrical wires. It was estimated that 17 tons of wastes per year were placed in the landfill.	The results of the round one and round two confirmation studies are presented in the 1991 Remedial Investigation (RI) Interim Report. Round 1 and 2 sampling included the collection and analysis of groundwater, surface water and bottom sediment samples. Additional groundwater, surface water, and sediment samples were collected during the Round 1 and 2 RI and analyzed for VOCs, metals, base neutral acids (BNAs), cyanide, and explosives. The contaminants of concern (COCs) include: *Surface Soil* — Arsenic *Groundwater*— VOCs [Note: VOCs were only detected in one monitoring well – 1GW12-001]. *Surface Water— Metals* and Bis(2-ethylhexyl)phthalate	A Final Record of Decision (ROD) for Site 1 was signed in June 1999. The specified corrective action included the excavation and disposal of arsenic contaminated soil and reestablishment of the soil cover over the solid waste landfill portion of the site. The soil removal took place in 2000 and no other corrective actions are planned. Long-term monitoring of groundwater is in place. It is expected that VOC levels will be reduced through natural attenuation.	Access to the former landfill is restricted and any human contact by site personnel or visitors is infrequent. Groundwater underneath NWSY is not used as a source of drinking water. The high level of TCE appears to be very isolated, only being detected in one monitoring well. Exposure Potential - Low

Appendix A: IRP Site Summaries and Exposure Potential of Source Areas of Contamination at Naval Weapons Station Yorktown (NWSY)				
Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 2 Turkey Road Landfill Site 2 is part of Groundwater OU VI	Site 2 was a 5-acre landfill located east of Turkey Road in a wetland adjacent to the south fork of Felgates Creek. The site was reportedly created by pushing debris into adjacent wetlands and filling the low-lying area. The landfill began operating during the 1940's and was closed in 1981. Wastes reportedly disposed at Site 2 include mercury and zinc carbon batteries, construction rubble, missile hardware, electrical devices and unidentified types of drums or tanks. Approximately 8 tons of waste per year was placed in the landfill.	Environmental samples were collected during 1996 and again in late 1997 as part of the round one and round two confirmation studies. The combined results were reported in the 1991 RI Interim Report. The COCs include: *Groundwater*— PAHs and metals. *Surface water*— The pesticide delta-BHC.	A removal action took place in the summer of 1994. It included the excavation and removal of hard waste material primarily consisting of batteries and soil. Other wastes identified at Site 2 included concrete slabs, asphalt, HEPA filter drums, scrap metal, empty drums, construction/demolition debris, and unexploded ordnance (UXO). A ROD for Site 2 has not been signed as of February 2005. A final "hot spot" removal action is expected to take place in 2005.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent Ground- water underneath NWSY is not used as a source of drinking water. Exposure Potential - Low.

Appendix A: IRP Site Summaries and Exposure Potential of Source Areas of Contamination at Naval Weapons Station Yorktown (NWSY)				
Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 3 Group 16 Magazines Landfill Site 3 is part of Groundwater OU 1	Site 3 is a 2-acre wooded area behind the Group 16 Magazines. Operation was from 1940 to 1970. Wastes disposed of in this area include solvents, sludge from boiler cleaning operations, grease trap wastes, and waste oils. Approximately 3 tons per year were reportedly disposed of at this site.	Environmental samples were collected during 1986 and again in late 1987 as part of the round one and round two confirmation studies. The combined results were reported in the 1991 RI Interim Report and included the collection and analysis of groundwater, surface water and bottom sediment samples. During the 1992 Round 1 and 1997 Round 2 RI additional groundwater, surface water, and sediment samples were collected and analyzed for VOCs, metals, base neutral acids (BNAs), cyanide, and explosives. The COCs include: *Groundwater*— B2EHP, VOCs, and metals (lead and chromium). *Surface Water and Sediment:* See results presented for Site 1.	A Final ROD for this site was signed in the summer of 1999. The ROD specified debris removal excavation of a polycyclic aromatic hydrocarbon (PAH) hot- spot and off-site disposal of a small volume of soil. The corrective action took place in 2000 and approximately 3,000 tons of waste materials were removed.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. Groundwater underneath NWSY is not used as a source of drinking water. Exposure Potential - Low

Appendix A: IRP Site Summaries and Exposure Potential of Source Areas of Contamination at Naval Weapons Station Yorktown (NWSY)				
Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 4 Burning Pad Residue Landfill Site 4 is part of Groundwater OU IV	Site 4 is a 4-acre area adjacent to the explosive burning facility south of West Road. The landfill was used between 1940 and 1975. Waste materials reportedly included batteries from unspecified weapons, burning pad residues (possibly containing aluminum, cyclotri-methylene trinitramine [RDX], trinitrotoluene [TNT], and 2,4-dinitrotoluene [2,4-DNT]), fly ash from coal-fired boilers, mine casings, electrical equipment, and transformers. The landfill received an estimated seventeen tons of waste per year.	Environmental samples were collected during 1986 and again in late 1987 as part of the round one and round two confirmation studies. The combined results were reported in the 1991 Remedial Investigation (RI) Interim Report. Round 1 and 2 sampling included the collection and analysis of groundwater, surface water and bottom sediment samples. As part of a site wide dioxin sampling effort, two surface soil samples were collected in the vicinity of the former ash pile and analyzed for dioxin. Dioxin sampling was conducted at Site 4 because of the historic burning of explosives and waste materials that may have contained residual chlorinated solvents such as TCE. The COCs include: *Surface Soil*— Explosives, PAHs, and PCBs. *Groundwater*— TCE. Surface Water— Explosives.	A removal action was conducted at Site 4 during the summer of 1994. Excavated wastes consisted of batteries and explosives containing ash residue. Several suspect UXO devices also were encountered and identified as inert. Other wastes were encountered during the removal action including large concrete slabs, empty drums, steel cables, construction debris, asphalt and slate shingles, and scrap metal. Approximately 7,300 tons of material was removed from the site The Ash Pit, Disposal Areas 1, 2, and 3, and the additional battery excavations were backfilled, seeded, and graded. A second removal was initiated in 2003. Specific information regarding the nature and volume of removed wastes was not available as of February 2005. A ROD for Site 4 has not been signed as of February 2005.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. Contamination of the water-table aquifer is possible since sediments are permeable. A marsh along the eastern branch of Felgates Creek receives surface water runoff from the site. This marsh and the adjacent creek are regarded as nursery areas for fish. Exposure Potential - Low

Appendix A: IRP Site Summaries and Exposure Potential of Source Areas of Contamination at Naval Weapons Station Yorktown (NWSY)				
Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 5 Surplus Transformer Storage Area	Site 5 is located near Barracks Road in the northeastern portion of the Station, adjacent to the south end of Building 76. The area comprises approximately 1,000 square feet and was used from 1940 to 1981 as a storage area for surplus PCB -containing transformers. Approximately 300 pounds of PCB-containing oil was estimated to have leaked from used transformers. The area is currently fenced and the area is no longer used to store transformers.	PCB (Aroclor 1260) was detected near Building 76 at a concentration of 17 parts per million (ppm) during a clean-up effort in December 1982. Environmental samples were collected during 1986 as part of the round one Confirmation Study. The results were reported in the 1991 Remedial Investigation (RI) Interim Report.. During the Confirmation Study, ten soil samples were collected at a depth of 0 to 12 inches below ground surface (bgs) and analyzed for PCB congeners and dioxin (2,3,7,8-tetrachlorodibenzo-p-dioxin [TCDD]). Additional investigations were conducted at Site 5 in 1992 and were presented in the Round 1 RI report. During the investigation 24 near-surface soil samples were collected; eighteen samples were collected at depths of 0 to 12 inches; and six were collected at depths of 12 to 24 inches. The COCs include: *Surface Soil*— PCBs (Aroclor 1260).	In December 1982, PCB-contaminated soil was removed from Site 5. However, the success of this removal effort was not documented (i.e., there was no information on the amount of soil removed, verification samples, and type and source of backfill used). Building 76 was demolished around 1998/1999. The Round One RI completed in 1993 confirmed that the contaminated soil was successfully removed during this effort. Based on the results of the Risk Evaluation and limited confirmatory sampling by USEPA Region III, a “No Further Action ROD” was finalized for Site 5 in September 1994.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. Site 5 drains into York River. It is possible for leachate and runoff from the site to migrate to the river. Exposure Potential - Low

Appendix A: IRP Site Summaries and Exposure Potential of Source Areas of Contamination at Naval Weapons Station Yorktown (NWSY)				
Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 6 Explosive Contaminated Wastewater Impoundment	Site 6 is a 3-acre surface impoundment located in the north-central portion of the station. The site received explosive and solvent contaminated wastewaters from the Explosive Reclamation Facilities at Building 109 and loading operations at Building 110. The site was used from 1942 to 1975. The wastewaters discharged to this site contained TNT, RDX, trichloroethylene, trichloroethane, and cyclohexanone.	Environmental samples were collected during 1986 and again in late 1987 as part of the round one and round two Confirmation Studies. The combined results were reported in the 1991 Remedial Investigation (RI) Interim Report. Round 1 and 2 confirmation study sampling included the collection and analysis of groundwater, surface water and bottom sediment samples. Additional soil, groundwater, surface water, and sediment samples were collected during the Round One RI (1993) and Round Two RI (1998). The COCs include: *Surface Soil*— 2,4,6-Trinitrotoluene (TNT) Groundwater— VOCs and explosives (RDX) *Surface Water*— Explosives, VOCs, and lead *Sediment*— Explosives and PAHs.	In 1975, a carbon adsorption tower was installed to treat the contaminated wastewater prior to discharge into the drainage way. A National Pollutant Discharge Elimination System (NPDES) permit was granted by EPA Region III to allow the discharge of treated effluent from the carbon adsorption tower containing relatively low concentrations of nitramines and nitroaromatics. In 1986, the effluent from the tower was diverted to the sanitary sewer and ultimately to the Hampton Roads Sanitation District (HRSD). Currently, the impoundment collects only surface runoff from the area between Buildings 109 and 110. A ROD for Site 6 was signed in October 1998 and specifies the removal of contaminated soil and sediment, backfilling of the impacted areas, long-term monitoring of the groundwater, impoundment area surface water, and sediment. Treated soil and sediment will be reused at the site or elsewhere at the Station. Remediation at Site 6 is ongoing. The removal has not taken place as of May 2005.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. Exposure Potential - Low

Appendix A: IRP Site Summaries and Exposure Potential of Source Areas of Contamination at Naval Weapons Station Yorktown (NWSY)				
Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 7 Plant 3 Explosive Contaminated Wastewater Discharge Area	Site 7 is located southeast of Building 375 in the north-central portion of the station. The site was used from 1945 to 1975. It received explosive contaminated wastewater from Loading Plant 3. The wastewaters discharged to this site contained TNT and RDX generated in Plant 3, and trichloroethylene and cyclohexane.	Environmental samples were collected during 1986 and again in late 1987 as part of the round one and round two Confirmation Studies. The combined results were reported in the 1991 Remedial Investigation (RI) Interim Report. Round 1 and 2 sampling included the collection and analysis of groundwater, surface water and bottom sediment samples. Additional soil, groundwater, surface water, and sediment samples were collected during the Round One RI (1993) and Round Two RI (1998). The COCs include: *Surface Soil*— Explosives Groundwater— RDX *Sediment*— B2EHP	In 1975, a carbon adsorption tower was installed to treat the contaminated wastewater prior to discharge into the drainage way. An NPDES permit was granted by EPA Region III to allow this discharge. In 1986, the effluent from the tower was diverted to the sanitary sewer and ultimately to HRSD. This area has been excavated to provide soil/sediment for a full-scale pilot study of nitramine/ nitroaromatic contamination of bioremediation that was conducted in 1996. The Final ROD for Site 7 was signed in October 1998 and specifies “no further action” since the removal of contaminated soil and sediment used in the bioremediation full-scale pilot study eliminated the potential exposure pathway.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. Exposure Potential - Low

Appendix A: IRP Site Summaries and Exposure Potential of Source Areas of Contamination at Naval Weapons Station Yorktown (NWSY)				
Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 8 Naval Explosives Development Engineering Department (NEDED) Explosive Contaminated Wastewater Discharge Area	Site 8 is a 300-foot long wastewater discharge area that covers approximately 2 acres. The site received wastewater from the NEDED complex Building No. 456 between 1940 and 1975. The wastewater discharged at Site 8 contained unspecified solvents, spent/ neutralized acids, explosive residues, trichloroethylene, acetone and cyclohexane.	Environmental samples were collected during 1986 and again in late 1987 as part of the round one and round two Confirmation Studies. The combined results were reported in the 1991 Remedial Investigation (RI) Interim Report. Round 1 and 2 sampling included the collection and analysis of groundwater, surface water and bottom sediment samples. A final RI report was completed in June 2004. The COCs include: *Groundwater*— RDX and TCE	In 1974, a carbon adsorption tower was installed to treat the contaminated wastewater prior to discharge into the drainage area. EPA granted a NPDES permit for the wastewater discharged. In 1986, the effluent from the tower was diverted to the sanitary sewer and ultimately to HRSD. A removal of explosives-contaminated soil and sediment is scheduled for fiscal year 2005. A ROD for Site 8 has not been signed as of February 2005.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. The site is currently a natural drainage area and empties into Felgates Creek. Exposure Potential - Low

Appendix A: IRP Site Summaries and Exposure Potential of Source Areas of Contamination at Naval Weapons Station Yorktown (NWSY)				
Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 9 Plant 1 Explosive Contaminated Wastewater Discharge Drainage Area [Note: This site is currently designated OU VII for groundwater investigations]	Site 9 is an approximately 600-foot long drainage area in the eastern portion of the station; it is directly northwest of Building 10 extending to Bollman Road and the edge of Lee Pond. It was reportedly in use from the late 1930's to 1975. It has been used as the drainage way for Plant 1 (Building 10) explosive contaminated wash waters and possibly substantial quantities of organic solvents. Solvents such as TCE may have been discharged from Plant 1 with the explosives wash water. The Initial Assessment Study (IAS) reported that an estimated 5,200 pounds of TNT and RDX and 1,600 pounds of HMX were discharged to the site.	Environmental samples were collected during 1986 and again in late 1987 as part of the round one and round two Confirmation Studies. The combined results were reported in the 1991 Remedial Investigation (RI) Interim Report. Round 1 and 2 sampling included the collection and analysis of groundwater, surface water and bottom sediment samples. The COCs include: *Surface Soil*— 2,4,6-Trinitrotoluene (2,4,6-TNT) *Groundwater*— 2,4,6-TNT *Surface Water*— 2,4,6-TNT was detected in the ditch and near the point of discharge into Lee Pond.	In 1975, a carbon adsorption tower was installed to treat the contaminated waste prior to discharge into the drainage area. In 1986, the effluent from the tower was diverted to the Hampton Roads Sewer District municipal wastewater treatment system. A limited removal action for Site 9 occurred in 1994. Two types of waste were removed from the contaminated area, ordnance consisting primarily of depth charges and railroad ties. A Final ROD for Site 9 was finalized for soil, surface water and sediment in March of 1998. Groundwater at this site will be evaluated under OU VII.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. Contaminants from Plant 1 may have migrated into Lee Pond via surface flow or through soil migration. Lee Pond, the primary receptor, empties into Felgates Creek, which in turn flows to the York River. TNT, RDX, and HMX may be present in the surface sediments in the drainage way or in the bottom sediments of Lee Pond. Exposure Potential – Low / Medium (possibly through ingestion of contaminated fish from Lee Pond). Signs are posted around Lee Pond to not eat the fish.

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Site 10 Felgates Crossing Fill Area.	Site 10 consists of fill materials comprising approximately 2 acres in a marsh adjacent to Felgates Creek. The area was filled to provide a bridge foundation sometime in the 1940s. The site contains inert materials such as plaster-filled mines and containers, ordnance steel and other kinds of inactive military hardware. Site 10 contains an estimated 261,400 cubic feet of fill material.	Site 10 was identified during the 1984 IAS. No contaminants of concern were identified at this site.	No corrective actions have been conducted for this site.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. No further action was recommended because of the non-hazardous, inert nature of the wastes. Exposure Potential – Low

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Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 11 Abandoned Explosives Burning Pits	Site 11 consists of 0.5-acres located east of Dudley Road, immediately before it branches off from Main Road. The site is the former location of the Explosives Burning Pits. The site was in operation from 1930 to 1950 and was used for burning ordnance and ordnance-contaminated wastes. Ashes and residues from open burning explosive-related wastes (e.g., TNT, RDX, and HMX wastes), contaminated wastes, and contaminated sludge are thought to be present at the site. It is estimated that, over the twenty years of operation, about 200 pounds of explosive waste residues may have been deposited at the site.	Environmental samples were collected during 1986 and again in late 1987 as part of the round one and round two Confirmation Studies. The combined results were reported in the 1991 Remedial Investigation (RI) Interim Report. Round 1 and 2 sampling included the collection and analysis of groundwater, surface water and bottom sediment samples. During the 1992 Round 1 RI sampling effort additional groundwater, surface water, and sediment samples were collected and analyzed for VOCs, metals, base neutral acids (BNAs), cyanide, and explosives. The Round Two RI field investigation for Site 11 was initiated in October 1996. A baseline human health risk assessment (RA) was conducted as part of the Round Two RI. The COCs include: *Groundwater*— B2EHP and TCE *Sediment*— See results presented for Site 1 *Surface Water*— See results presented for Site 1.	The Final ROD was signed in summer 2000 and a remedial action for Site 11 included the removal of approximately 40 cubic yards of soil containing mercury and copper contamination. The soil removal took place in May through August 2000 and no other corrective actions are planned.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. Flow of contaminated surface water into Indian Field Creek is the primary Pathway for migration off site. Exposure Potential – Low

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Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 12 Barracks Road Landfill	Site 12 covers approximately 2 to 3 acres situated east of Barracks Road. This site was probably the original landfill at NWSY and was in operation from about 1925 to the mid 1960s. Site 12 actually consists of three separate disposal locations, Area A, Area B/C, and the Wood/Debris Disposal Area. Area A is the largest disposal area and was the primary focus of environmental investigations by the Navy. Approximately 35 tons of wastes per year were disposed of at Site 12. Wastes include mostly garbage, refuse and scrap wood. However, explosive contaminated packaging was also disposed of here. Site 12 preceded the Dudley Road Landfill (Site 11) and is likely that similar wastes to those identified at Site 1, including solvents, were disposed at the Barracks Road Landfill. Two incinerators (SWMU 142 and SWMU 143) were located adjacent to the landfill. The incinerators were formerly used to burn a variety of waste; both industrial and non-industrial. Incineration ash from incineration activities was disposed on the hillside behind the incinerator buildings.	Environmental samples were collected during 1986 and again in late 1987 as part of the round one and round two Confirmation Studies. The combined results were reported in the 1991 Remedial Investigation (RI) Interim Report. Round 1 and 2 sampling included the collection and analysis of groundwater, surface water and bottom sediment samples. An Independent Sampling and Site Screening investigation was conducted at Site 12 in 1995. A total of 13 sediment or soil samples and three surface water samples were collected in the Site 12 Incinerator area. The COCs include: *Surface Soil*— Lead, B2EHP, and some PAHs.	A ROD was finalized for Site 12 in May 1997 and remediation of Area A was completed in November 1997. Miscellaneous debris at Area B/C was removed in May and June of 1998.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. Surface water drainage is toward Ballards Creek and the adjacent wetlands. Groundwater contamination is also possible since the soil is permeable and chemical contaminants may migrate to the water table aquifer. Exposure Potential – Low

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Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 13 Building Rubble Disposal Site	Site 13 is located north of Barracks Road near Gate # 2 covering approximately 22,500 square feet (i.e., 150 by 150 feet) in an area formerly occupied by the Marine Barracks. The barracks building was built in the 1920's and demolished around 1977. The rubble, including asbestos containing insulation, was disposed of off base. Asbestos insulation is the only hazardous material known to be present at the site. Less than 100 pounds of asbestos is estimated to remain.	The 1984 IAS did not recommended Site 13 for a confirmation study. However, additional investigations were conducted after further review of site conditions. Other than asbestos, no COCs were found at this site.	The barracks basement, which contained asbestos insulated pipes was filled in. No other corrective actions have been conducted for Site 15.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns Asbestos typically occurs as solid particles, migrating in air or in surface water runoff. As long as the site remains covered and undisturbed, the potential for asbestos migration is very small. Exposure Potential – Low

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Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 14 Aviation Field	Site 14 is a 30-acre area located in the north central portion of the station bounded on the north by Bellfield Road. It is a large open area with storage sheds along its southern border. This site was originally an aviation field in use before the 1930s. Shortly after the station changed from a naval air station to the Mine Depot, the aviation field began to be used for storage of bulk material. It has been reported that after World War I, munitions were stored at the aviation field in caches. The explosives were dug up and used during World War I and no explosives are currently buried at the aviation field. The site is currently used for bulk storage (e.g., mine casings, rocket containers, rocket parts, empty Otto fuel tanks, etc.) with some material stored in open-ended sheds and other material stored in open pallets. According to site documents, the area near the helicopter landing pad may have been used as a burning area for explosive contaminated waste for a short period during the 1930s.	An IAS was conducted and Site 14 was not recommended for a confirmation study because available data indicated there were no known or suspected hazardous wastes present. No COCs were identified at this site.	Site 14 was removed from the RI program because no potential environmental hazards were identified. No corrective activities are anticipated for this site.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. Exposure Potential – Low

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Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 15 Electrical Shop Disposal Area	Site 15 is a 1-acre fill area located behind the electrical shop near the eastern portion of the station. The area was reportedly filled in approximately 1973. A parking lot was then built on the site. Prior to being used as a fill area the site was a ravine. In 1983, several metal cylinders were observed in the ravine behind the parking lot. It is estimated that 430,000 cubic feet of fill was used at this site. Reported fill materials at the site included copper and other types of wire, concrete gravel, telephone poles and hardware, and nuts and bolts. The materials were generally inert.	The 1984 IAS did not recommended Site 15 for a confirmation study. No COCs were identified at this site.	No corrective actions have been conducted for Site 15.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. Any migration of waste from the site would be via the surface waters to Roosevelt Pond and to the water table aquifer through permeable sediments. However, only inert material was placed in the fill. Exposure Potential – Low

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Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 16 West Road Landfill	Site 16 is located behind Building 402 and is approximately 100 yards wide and 400 yards long. The landfill operated during the 1950s through the early 1960s. Wastes released into this landfill included carbon batteries, pressure transmitting fluid (possibly containing PCB), and 55-gallon drums containing unidentified substances. Another waste area was also identified beneath one of the drum piles. This waste area consisted of glass containers, cans, and newspapers. It is estimated that approximately nine tons of wastes per year were buried at this site.	Environmental samples were collected during 1986 and again in late 1987 as part of the round one and round two Confirmation Studies. The combined results were reported in the 1991 Remedial Investigation (RI) Interim Report. Round 1 and 2 sampling included the collection and analysis of soil, groundwater, sediment, and surface water samples. An additional RI was conducted in two phases: Round I (1992) and Round II (1994). The Round I RI was conducted before the Removal Action took place. The Round II RI included collecting and analyzing surface soil, subsurface soil, groundwater, surface water, sediment, and biological samples to supplement the Round I Remedial Investigation samples. The COCs include: *Surface Soil*— Aroclor 1260.	In September 1992, a removal action was initiated to clear scrap metal from the surface along the northeastern section of Site 16. The area was also backfilled with soil and revegetated. The removal actions for Site 16 were completed during the summer of 1994 after additional surface debris (e.g., scrap metal, batteries, drums, and construction debris) were removed. In addition, a number of ordnance items (e.g., bombs, mines, torpedo sections) were also removed from the site. All ordnance items were certified inert. Surface soil samples were collected to confirm the success of the removal action. The results Of the confirmatory analyses met state and federal clean-up standards. A "No Further Remedial Action with Institutional Controls" ROD was finalized for Site 16 in September 1995.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. The landfill is upgradient of a marsh adjacent to Felgates Creek (fish nursery area). Remedial actions should minimize any potential groundwater and surface water contamination from debris leachate. Exposure Potential – Low

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Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 17 Holm Road Landfill	Site 17 is an area located south of Holm Road covering approximately 250 yards x 100 yards. The site was operated for approximately 10 years during the 1950s and 1960s. Wastes reportedly disposed at this site include acid batteries from underwater weapons, hydraulic fluids from used torpedoes, drums from either the Public Works Department or ordnance production shops, and scrap metal. An estimated six tons per year were reportedly dumped in the landfill, including approximately 200 drums and several thousand batteries.	Environmental samples were collected during 1986 and again in late 1987 as part of the round one and round two Confirmation Studies. The combined results were reported in the 1991 Remedial Investigation (RI) Interim Report. Round 1 and 2 sampling included the collection and analysis of groundwater, surface water and bottom sediment samples. During the 1993 Round 1 RI sampling effort surface soil, groundwater, surface water, and sediment samples were collected and analyzed for VOCs, metals, base neutral acids (BNAs), cyanide, and explosives. The Round Two RI field investigation for Site 17 was initiated in October 1996. A baseline human health risk assessment (RA) was conducted as part of the Round Two RI The COCs include: *Surface Soil*— PAHs (Benzo-a-pyrene) *Groundwater*— B2EHP *Sediment*— See results presented for Site 1. *Surface water*— See results presented for Site 1.	The Final ROD was signed in summer of 2000 and the remedial action for Site 17 consisted of removing approximately 1,300 cubic yards of PAH-contaminated soil. The removal took place in May through August 2000 and no further actions are planned for this site.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. Surface drainage contamination may have migrated to Indian Field Creek, which is a fish nursery area. Underlying sediments are permeable and contaminants could also migrate to the water-table aquifer. Exposure Potential – Low

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Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 18 Building 476 Discharges	Site 18 is an unlined drainage ditch located north of Building 476. The site received battery acid discharges from Building 476 during the1940s through the 1960s. The battery acid waste discharged is reported to have contained mercury, nickel, cadmium, and lead. Approximately 100 to 200 pounds of battery acid wastes may have entered the ditch during the discharge period. Battery acid waste is no longer discharged from Building 476 into this drainage way.	Environmental samples were collected during 1986 and again in late 1987 as part of the round one and round two Confirmation Studies. The combined results were reported in the 1991 Remedial Investigation (RI) Interim Report. Round 1 and 2 sampling included the collection and analysis of groundwater, surface water and bottom sediment samples. Additional samples were collected during the Round Two RI conducted in 1997. The COCs include: Groundwater— Lead.	No corrective actions have been identified for this site.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. The drainage ditch flows toward an intermittent stream which drains into Lee Pond. Migration of contaminants occurred primarily by sediment transport during surface water runoff. Contamination of soils underlying the drainage ditches may also have occurred as a result of infiltration. Exposure Potential – Low

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Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 19 Conveyor Belt Soils at Building 10	Site 19 is located in the eastern portion of the station directly east of Lee Pond. The site consists of a 500-foot long soil strip located beneath and around Building 10, approximately 300 feet from Site 9 and connected to Site 9 via a drainage channel. TNT contaminated soils have been reported around the conveyor belt between Buildings 10 and 98. Although some soil was removed in 1973/1974, later tests indicate that contamination remains.	The 1984 IAS recommended Site 19 for a confirmation study based on the confirmed presence of TNT at the site and apparent migration of explosive wastes to Lee Pond. Environmental samples were collected during 1986 and again in late 1987 as part of the round one and round two Confirmation Studies. The combined results were reported in the 1991 Remedial Investigation (RI) Interim Report. Round 1 and 2 sampling included the collection and analysis of groundwater, surface water and bottom sediment samples. The COCs include: Soil and sediment —Explosives (TNT and RDX).	In 1998, the conveyor belt was dismantled and residual explosives were removed. Asbestos components of the conveyor belt were double bagged and sent to a special waste landfill. Soil from beneath the conveyor belt (approximately 1,000 cubic yards) was excavated and treated on site (at Site 22). The former site of the conveyor belt has been revegetated.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. It is likely that contamination from the site migrated via surface water runoff toward Lee Pond. Ground water also flows toward the pond. Analyses have confirmed TNT contamination in be Pond. Exposure Potential – Low/ Medium. Ingestion of fish from Lee pond could result in low-level exposures. Signs are posted around Lee Pond not to eat the fish.

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Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 20 Otto Fuel Spill (OFS) Site	The OFS Site is located at the Mark 48 Torpedo Support Facility (TSF), Building No. 1816. An 8,000-gallon underground fuel oil tank was located adjacent to the waste Otto fuel sump. TSF activities involve the generation of waste Otto fuel. Waste Otto fuel contains a mixture of Otto fuel used in torpedoes and water which may also contain oils, denatured ethyl alcohol, detergent, and trace amounts of cyanide, halogenated hydrocarbons (methylene chloride, trichloroethane, Freon) and heavy metals. Prior to offsite disposal, waste Otto fuel was temporarily stored at the TSF in a 2,500-gallon capacity, epoxy-coated concrete sump. Associated with the sump is a network of drainage pipes. Expansion of the TSF necessitated closure of the sump. The active ingredient in Otto fuel (propylene glycol dinitrate [PGDN]) was detected during monitoring associated with sump closure activities.	Site 20 was not one of the original 19 sites identified in the IAS. A Contamination Assessment was initiated in February 1986 at the OFS Site. Since a building construction project was proposed for the area adjacent to this site, there was a need to more fully describe the occurrence and distribution of contamination at this site prior to commencement of construction activities. The COCs include: *Groundwater*— PGDN was detected in a well located immediately adjacent to the waste Otto fuel sump. Low concentrations of PGDN were detected in wells located at approximate distances of 250 and 200 feet, respectively, from the sump. Soil— PGDN was detected in the shallow (IO-foot depth) soil sample.	No corrective actions have been identified for this site.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns.

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Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 21 Battery and Drum Disposal Area	Site 21 is a 1-acre area located south of West Road, adjacent to the ravine that separates Site 21 from Site 4. Wastes reportedly identified at this Disposal site include various sized cans and drums, dry carbon-zinc batteries, empty solvent containers, and scrap metal. Seven drums of unspecified oils were also identified.	Site 21 was not one of the original 19 sites identified in the IAS. In November 1990, an additional site (Site 21) that had not been included in the previous investigations was identified. A Site Investigation (SI) was conducted in October 1991. During this investigation groundwater and surface and subsurface soil samples were collected. The results of this investigation were presented in the Draft Final Site Inspection Report, Site 21-Battery and Drum Disposal Area. Samples were collected during the Round I and Round II RIs. As part of a site wide dioxin sampling effort, two surface soil samples were collected and analyzed for dioxin. Dioxin sampling was conducted at Site 21 because of the historic burning of explosives and waste materials that may have contained residual chlorinated solvents such as TCE. No COCs were detected in soil and groundwater.	A removal action was conducted at Site 21 during the summer of 1994 and included the removal of batteries, soil, debris, and four drums of hazardous waste liquids The areas impacted by the removal have been revegetated. Confirmatory samples were collected.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. Exposure Potential – Low

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Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 22 Burn Pad	Site 22 is a 9-acre area located in the central portion of the Station between Sites 4 and 21. A circular array of 11 steel burning pans was used for burning waste plastic explosives and spent solvents. The site became an area used for a treatability study for the treatment of explosive-contaminated soil in 1996.	Site 22 was not one of the original 19 sites identified in the IAS. In 1996, samples were collected as part of the Round Two RI activities to assess the nature and extent of contamination at the Site. As part of a site wide dioxin sampling effort, four surface soil samples were collected in the vicinity of the former ash pile and analyzed for dioxin. The COCs include: Surface Soil— Lead, PAHs, and explosives. Groundwater— TCE, RDX.	In 1996, contaminated soil and sediment was treated using a biocell that was constructed on site. Use of the biocell ended in 1998 and the biocell was demolished. The Navy conducted a non-time-critical-removal action in the summer of 2002. Soil exceeding state cleanup levels for metals and explosives was removed from the site. A "no further action" ROD was signed in September 2003.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. Exposure Potential – Low

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Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 23 Building 428 Teague Road Disposal Area (a portion of former SSA 1)	Site 23 is a partially fenced 2.8-acre area located northeast of Building 428, in the northeast portion of the Station along the Station boundary. Disposal activities reportedly began in 1940 and ceased in 1960. A pier fire occurred in the mid 1950s and debris from this fire was disposed in this area (1955 to 1957). Aerial photography suggests that past waste storage occurred at Site 23 (primarily in 1945). From 1960 to the present there is no evidence of additional waste storage or release. However, a land survey, conducted in the fall of 1993 as part of a removal action, indicated discrete piles of debris that appear to have been dumped on top of native soil, while other areas of debris appear to be partially buried. The debris was identified as concrete rubble; scrap metal; wooden pilings and railroad ties; empty fuel cans; empty corroded drums; asbestos pipe insulation; and shingles.	Site 23 was not one of the original 19 sites identified in the IAS. A Draft Final RI for Site 23 was released in July 2002. Contaminants of potential concern at Site 23 include PAHs that may be associated with former disposal activities. The COCs include: Surface Soil— PAHs.	A removal action was conducted at Site 23 during the summer and early fall of 1994 to remove surface debris. Items removed included two 55-gallon drums of paint, wooden creosote timbers (remains of the burnt pier), non-hazardous debris, asbestos-related debris and materials, recyclable metal, and a small number of automobile batteries. In addition, ash and soils contaminated with TNT and trinitrobenzene were removed from an area north of the railroad tracks at the northeast portion of the site. A second removal action was conducted in 2003. This involved removing contaminated surface and subsurface soil exceeding residential remediation levels.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. Exposure Potential – Low

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Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 24 Aviation Field (a portion of former SSA 6)	Site 24 covers approximately 15 acres near the helicopter-landing pad, immediately south of Bellfield Road. PCB-related contamination was discovered in the subsurface soil. Historically, the area was used as an aviation field until 1927, after which it was used for storage of munitions in underground caches. Aerial photography indicates that peak storage activity on the ground surface occurred in 1968. No storage of liquid or hazardous waste was reported or observed. In addition, this area may also have been used briefly as an explosives burning area although available data do not indicate the presence of nitramines/nitroaromatics. A helicopter pad and an air control tower are now present at this site.	Site 24 was not one of the original 19 sites identified in the IAS. A Draft Final RI for Site 24 was released in July 2002.	The Daramend greenhouse/biocell was constructed in 1999 at Site 24 to treat Site 6 soil and sediment. The Biocell is no longer operating. A soil removal action may be conducted in the future at this site.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. Exposure Potential – Low

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Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 25 Building 373 Rocket Plant (a portion of former SSA 7)	Site 25,is approximately 0.14 acres in size located immediately northwest of Building 373. Site 25 consists of a 500-gallon pre-cast concrete pipe, used as an underground storage tank (UST). Prior to the 1960s wash/rinse water from the cleanup of formulation/ pouring equipment drained into a settling basin for suspended solids located within the building. The solids were open burned at Site 4 (Burning Pad Residue Landfill) and the wash/rinse water was discharged into Felgates Creek. The discharge line to the creek was replaced in the early 1960s by a 500-gallon UST, which was installed to contain the wash/rinse water. From the 1960s to 198Os, the UST received batch wastes from NEDED assembly operations of 2.75-inch rockets as well as the wash/rinse waters. Once the tank was filled, the water was filtered through a carbon unit and discharged to the sanitary sewer system. The UST was closed in the early 1980s when the current aboveground storage tank (AST) was installed.	Site 25 was not one of the original 19 sites identified in the IAS. A Draft Final RI for Site 25 was released in July 2002.	A removal action was conducted in June/July 1996 to remove the 500-gallon UST and associated piping. During the removal action, the bottom section was heavily stained. The soil from beneath and around the UST was removed. In addition, a 500-gallon fuel oil UST was removed from the area in 1998 under a separate department of defense (DOD) contract. The area around the 500-gallon fuel oil UST is not considered to be a part of Site 25.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. Exposure Potential – Low

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Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 26 Building 1816 Mark 48 Waste Otto Fuel (formerly SSA 18)	Site 26 covers approximately 6.7 acres located in the central portion of the Station at Building 1816, immediately north of Sharpe Road. A 2,500-gallon concrete UST formerly used to store waste Otto fuel along with its associated drainage pipes were found within this area. This fuel consists of a mixture of Otto fuel and water, which may have also contained oil, denatured ethyl alcohol, detergent, and trace amounts of cyanide, halogenated hydrocarbons, and heavy metals. In late 1987, waste Otto fuel was discovered leaking from the tank. The fuel was removed, the tank was cleaned, and a RCRA closure permit was filed.	Site 26 was not one of the original 19 sites identified in the IAS. A "Soil assessment" was conducted in April 1994 to determine weather soils immediately north and northwest of Building 1816 were suitable for the construction of an addition to the existing building. No contaminants of concern were detected during the 1994 Soil Assessment.	In late 1987 product was removed, the tank was cleaned, and a RCRA closure permit was filed with VDEQ. In March 1995, the 2,500-gallon UST was removed along with an 8,000-gallon UST located in the vicinity.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. Exposure Potential – Low

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Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 27 Building 1751 Chemistry Laboratory Neutralization Unit and Drainage Area (formerly SSA 9)	Site 27 consists of approximately 1.9 acres and is adjacent to Building 1751 in the north central portion of the Station (near Site 8). Acids from the Chemistry Lab were reportedly discharged into a cylindrical container for neutralization. The unit was in operation from 1969 to early 1995. The process was diverted to the sanitary sewer and ultimately to HRSD in 1995. In addition, there are four underground septic tanks in the area.	Site 27 was not one of the original 19 sites identified in the IAS. In 2005, the Round One RI Report for Sites 27-30 was released. Samples were collected in subsurface soil, surface water and sediment, and groundwater. COCs included: Subsurface Soil — Toluene and metals occurring at low concentrations below human health concern. Groundwater — VOCs and metals at low concentrations. No other site-related COCs were identified.	No corrective actions have been identified at this site.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. Exposure Potential – Low

Appendix A: IRP Site Summaries and Exposure Potential of Source Areas of Contamination at Naval Weapons Station Yorktown (NWSY)				
Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 28 Building 28 X-Ray Facility Tank Drain Field	Site 28, formerly SSA 10, is located at Building 28 in the south central portion of the Station and occupies an area of approximately 5.8 acres. The X-ray process began in the late 1960s. Before silver recovery units were installed, the tanks may have stored hazardous wastes. The area consists of a septic tank drain field that receives sanitary wastewater from the X-Ray Facility at Building 28. It was assumed that wastewater would be diverted to the sanitary sewer and ultimately to HRSD by the end of fiscal year 1997. This was accomplished in the later part of 1998. Site 28 was investigated in 2000 and a draft RI report has been prepared and will be submitted in early summer 2001.	Site 28 was not one of the original 19 sites identified in the IAS. In 2005, the Round One RI Report for Sites 27-30 was released. Samples were collected in subsurface soil, surface water and sediment, and groundwater. Silver has been detected in multiple media at Site 28, at levels below human health concern. No COCs have been identified at Site 28.	No corrective actions have been identified at this site.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. Exposure Potential – Low

Appendix A: IRP Site Summaries and Exposure Potential of Source Areas of Contamination at Naval Weapons Station Yorktown (NWSY)				
Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 29 Lee Pond (Formerly SSA 20)	Site 29 is a 4.1-acre pond located in the east central portion of the Station. The pond receives drainage from Building 10 at Site 9 located due east of the pond. The drainage area is approximately 500 to 600 feet in length. Site 29 also receives storm water runoff from the industrial area and other nearby sites (e.g., Sites 18 and 19). Lee Pond empties into a channel, which in turn flows around the Site lG/SSA 16 study area into Felgates Creek. Water levels in Lee Pond are raised and lowered during summer and winter respectively for support of the local ecology. The SSP Report (Baker, 1998a) for Lee Pond indicated that additional RI/FS activities are necessary to address the site and area groundwater as an operable unit. Site 29 was investigated in 2000 and a draft RI report has been prepared.	Site 29 was not one of the original 19 sites identified in the IAS. In 1994, the state of Virginia conducted a Focused Biological Sampling and Preliminary Risk Evaluation. In 2005, the Round One RI Report for Sites 27-30 was released. Samples were collected in subsurface soil, surface water and sediment, and groundwater. The COCs include: Surface water and sediment— Pesticides, explosives, and metals Fish — Pesticides, explosives, and metals	A limited removal action was conducted in 1994.	Access to Lee Pond is only allowed for authorized personnel for recreational fishing. There are signs posted warning people to only catch and release and not to eat fish from the pond. Exposure Potential – Low As long as personnel adhere to the catch and release advisories posted along the shoreline of the pond.

Appendix A: IRP Site Summaries and Exposure Potential of Source Areas of Contamination at Naval Weapons Station Yorktown (NWSY)				
Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Site 30 Bracken Road Incinerator and Environs (Formerly SSA 24)	Site 30 is a 0.1-acre area located north of Site 5 (Surplus Transformer Storage Area), northeast of a cooling pond (76A), and south of the railroad tracks.	Site 30 was not one of the original 19 sites identified in the IAS. The USEPA collected samples and detected metals and nitramine compounds exceeding regulatory screening levels. Additional investigation under the site screening process (SSP) was therefore necessary to determine potential human health risks associated with this area. In 2005, the Round One RI Report for Sites 27-30 was released. Samples were collected in subsurface soil, surface water and sediment, and groundwater. COCs include: Surface soil — metals	No corrective actions have been identified fort his site.	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. Exposure Potential – Low

Appendix A: IRP Site Summaries and Exposure Potential of Source Areas of Contamination at Naval Weapons Station Yorktown (NWSY)				
Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential
Other Sources of Contamination				
Site screening assessment (SSAs) Areas Sixteen SSAs are listed in the 2001 Site Management Plan.	SSA investigations have also been conducted at NWSY. Since 1994 the following SSAs have been identified: SSAs 1, 3, 6, 7, 12, and 15 were investigated during 1994; SSAs 2, 17, 18, and 19 were investigated in early 1995; SSAs 8, 11, 12, and 13 were investigated in early 1996; and SSAs 3, 4, 5, 9, 10, 20, 21, 22, and 24 were investigated in 1997.	Environmental media including surface soil, subsurface soil, groundwater, surface water, and sediment were investigated at those SSAs having potential impacts on the environment.	SSAs 3,4,5,17,19,2 1, and 22 have been removed from the RI/FS process because they did not pose an unacceptable human health risk. Long-term monitoring at SSA 2 has been included in a RCRA Part B - Permit Application. SSA 15 was combined with another investigation area (Site 12).	Access to this site is restricted and any human contact by site personnel or visitors is infrequent and would not pose any health concerns. Exposure Potential – Low

Appendix A: IRP Site Summaries and Exposure Potential of Source Areas of Contamination at Naval Weapons Station Yorktown (NWSY)				
Sites	Site Description/ Waste Disposal History	Investigations and Significant Findings	Corrective Actions	Site Access and Exposure Potential

Sources:
NEESA 1984. Initial Assessment Study. July 1984.
Dames & Moore. 1986. Confirmation Study: Step 1A (Verification), Round 1. June 11, 1986.
Dames & Moore. 1988. Contamination Assessment, Mark 48 Torpedo Support Facility. November 1988.
Dames & Moore. 1988. Mark 48 Torpedo Support Facility, NWSE. November 1988.
Dames & Moore (Revised by Versar, Inc.). 1991. RI Interim Report NWSE. July 1, 1991.
Baker Environmental, Inc. 1993. Final Round One RI Report Sites 1-9, 11, 12, 16-19, and 21 NWSE. 1993.
Baker Environmental, Inc. 1994. Final Risk Evaluation Site 5, Surplus Transformer Storage Area, NWSY. June 3, 1994.
Baker Environmental, Inc. 1996. Final 1996-1997 Site Management Plan, NWSY. March 6, 1996.
Baker Environmental, Inc. 1997. Final Round Two RI Report Sites 9 and 19, NWSY. January 1997.
Baker Environmental, Inc. 1998a. Round Two RI Report Sites 1 and 3 NWSY. May 1998.
Baker Environmental, Inc. 1998b. Round Two RI Report Sites 6 and 7 NWSY. May 22, 1998.
Baker Environmental, Inc. Final ROD OU X and XI: Site 11 – Abandoned Explosives Burning Pits and Site 17 – Holm Road Landfill, NWSY. September 2000.
Baker Environmental, Inc. 2001. Final 2001-2002 Site Management Plan NWSE. June 14, 2001.

Appendix B. List of Comparison Values Used by ATSDR

Comparison Values

ATSDR comparison values are media-specific concentrations that are considered to be safe under default conditions of exposure. They are used as screening values in the preliminary identification of site-specific "contaminants of concern." The latter term should not be misinterpreted as an implication of "hazard." As ATSDR uses the phrase, a "contaminant of concern" is a chemical substance detected at the site in question and selected by the health assessor for further evaluation of potential health effects. Generally, a chemical is selected as a "contaminant of concern" because its maximum concentration in air, water, or soil at the site exceeds one of ATSDR's comparison values.

Nevertheless, it must be emphasized that comparison values are not thresholds of toxicity. Although concentrations at or below the relevant comparison values could 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. The principal purpose behind conservative, health-based standards and guidelines is to enable health professionals to recognize and resolve potential public health hazards before they become actual public health consequences. Thus comparison values are designed to be preventive—rather than predictive—of adverse health effects. The probability that such effects will actually occur does not depend on environmental concentrations alone, but on a unique combination of site-specific conditions and individual lifestyle and genetic factors that affect the route, magnitude, and duration of actual exposure.

Listed and described below are the various comparison values that ATSDR uses to select chemicals for further evaluation, as well as other non-ATSDR values that are sometimes used to put environmental concentrations into perspective.

CREG	=	Cancer Risk Evaluation Guides
MRL	=	Minimal Risk Level
EMEG	=	Environmental Media Evaluation Guides
IEMEG	=	Intermediate Environmental Media Evaluation Guide
RMEG	=	Reference Dose Media Evaluation Guide
RfD	=	Reference Dose
RfC	=	Reference Dose Concentration
RBC	=	Risk-Based Concentration
MCL	=	Maximum Contaminant Level

Cancer Risk Evaluation Guides (CREGs) are estimated contaminant concentrations expected to cause no more than one excess cancer in a million persons exposed over a lifetime. CREGs are calculated from EPA's cancer slope factors, or cancer potency factors, using default values for exposure rates. That said, however, neither CREGs nor cancer slope factors can be used to make realistic predictions of cancer risk. The true risk is always unknown and could be as low as zero.

Minimal Risk Levels (MRL) are estimates of daily human exposure to a chemical (doses expressed in mg/kg/day) that are unlikely to be associated with any appreciable risk of deleterious non-cancer effects over a specified duration of exposure. MRLs are calculated using data from human and animal studies and are reported for acute (≤14 days), intermediate (15-364 days), and chronic (≥365 days) exposures. MRLs for specific chemicals are published in ATSDR toxicological profiles.

Environmental Media Evaluation Guides (EMEGs) are concentrations that are calculated from ATSDR minimal risk levels by factoring in default body weights and ingestion rates.

They factor in body weight and ingestion rates for acute exposures (Acute EMEGs — those occurring for 14 days or less), for intermediate exposures (Intermediate EMEGs — those occurring for more than 14 days and less than 1 year), and for chronic exposures (Chronic EMEGs — those occurring for one year [365 days] or greater).

Reference Dose Media Evaluation Guides (RMEGs) represent the concentration of a contaminant in air, water, or soil that corresponds to EPA's RfD for that contaminant when default values for body weight and intake rates are taken into account.

Reference Dose (RfD) is an estimate of the daily exposure to a contaminant unlikely to cause noncarcinogenic adverse health effects. Like ATSDR's MRL, EPA's RfD is a dose expressed in mg/kg/day.

Reference Concentrations (RfC) is a concentration of a substance in air that EPA considers unlikely to cause noncancer adverse health effects over a lifetime of chronic exposure.

Risk-Based Concentrations (RBC) are media-specific concentrations derived by Region III of the Environmental Protection Agency from RfD's, RfC's, or EPA's cancer slope factors. They represent concentrations of a contaminant in tap water, ambient air, fish, or soil (industrial or residential) that are considered unlikely to cause adverse health effects over a lifetime of chronic exposure. RBCs are based either on cancer ("c") or noncancer ("n") effects.

Maximum Contaminant Levels (MCLs) represent contaminant concentrations in drinking water that EPA deems protective of public health (considering the availability and economics of water treatment technology) over a lifetime (70 years) at an exposure rate of 2 liters of water per day.

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/. A hard copy can be obtained by contacting the ATSDR information line toll-free at (888) 422-8737.

Appendix C. ATSDR's Methods, Assumptions, and Calculations

Contaminant Data Evaluation

In public health assessments, ATSDR addresses the likelihood that exposure to contaminants, using the maximum or average concentrations detected, would result in adverse health effects. While the relative toxicity of a chemical is important, the response of the human body to a chemical exposure is determined by several additional factors, including the concentration (how much), the duration of exposure (how long), and the route of exposure (breathing, eating, drinking, or skin contact). Lifestyle factors (i.e., occupation and personal habits) also have a major impact on the likelihood, magnitude, and duration of exposure. Individual characteristics such as age, sex, nutritional status, overall health, and genetic constitution affect how a human body absorbs, distributes, metabolizes, and eliminates a contaminant. A unique combination of all these factors will determine the individual's physiologic response to a chemical contaminant and any adverse health effects the individual could suffer as a result of the chemical exposure.

ATSDR has determined levels of chemicals that can reasonably (and conservatively) be regarded as harmless, based on the scientific data the agency has collected in its toxicological profiles. The resulting comparison values and health guidelines, which include ample safety factors to ensure protection of sensitive populations, are used to screen contaminant concentrations at a site and to select substances ("chemicals of concern") that agency environmental health scientists and toxicologists scrutinize more closely.

It is a point of key importance that ATSDR's (as well as state and federal regulatory agency) comparison values, screening numbers and health guidelines define very conservative and protective levels of environmental contamination and are not thresholds of toxicity. This means that although concentrations at or below a comparison value could reasonably be considered safe, it does not automatically follow that any concentration above a comparison value will necessarily produce toxic effects. To the contrary, ATSDR's comparison values are intentionally designed to be much lower, usually by at least two or three orders of magnitude, than the corresponding no-effect levels (or lowest-effect levels) determined from scientific studies. ATSDR uses comparison values (regardless of source) solely for the purpose of screening individual contaminants. In this highly conservative procedure, ATSDR may decide that a compound warrants further evaluation if the highest single recorded concentration of that contaminant in the medium in question exceeds that compounds lowest available comparison value (e.g., cancer risk evaluation guides or other chronic exposure values) for the most sensitive, potentially exposed individuals (e.g., children or pica children). This conservative process results in the selection of many contaminants as "chemicals of concern" that will not, upon closer scrutiny, be judged to pose any hazard to human health. Still, ATSDR judges it prudent to use a screen that "lets through" many harmless contaminants rather than one that overlooks even a single potential hazard to public health. Even those contaminants of concern that are ultimately labeled in the toxicologic evaluation as potential public health hazards are so identified solely on the basis of the maximum concentration detected. The reader should keep in mind the protective nature of this approach when considering the potential health implications of ATSDR's evaluations.

Because a contaminant must first enter the body before it can produce any effect on the body, adverse or otherwise, the toxicologic discussion in public health assessments focuses primarily on completed pathways of exposure, i.e., contaminants in media to which people are known to have been, or are reasonably expected to have been, exposed. Examples are water that could be used for drinking, and air in the breathing zone.

To determine whether people were, or continue to be, exposed to contaminants originating from a site, ATSDR evaluates the factors that lead to human exposure. These factors or elements include (1) a source of contamination, (2) transport through an environmental medium, (3) a point of exposure, (4) a route of human exposure, and (5) an exposed population. Exposure pathways fall into one of three categories:

- *Completed Exposure Pathway*. ATSDR calls a pathway "complete" if it is certain that people are exposed to contaminated media. Completed pathways require that the five elements exist and indicate that exposure to the contaminant has occurred, is occurring, or will occur.

- *Potential Exposure Pathway.* Potential pathways are those in which at least one of the five elements is missing but could exist. Potential pathways indicate that exposure to a contaminant could have occurred, could be occurring, or could occur in the future. Potential exposure pathways refer to those pathways where (1) exposure is documented, but there is not enough information available to determine whether the environmental medium is contaminated, or (2) an environmental medium has been documented as contaminated, but it is unknown whether people have been, or could be, exposed to the medium.

- *Eliminated Exposure Pathway*. In an eliminated exposure pathway, at least one of the five elements is missing and will never be present. From a human health perspective, pathways can be eliminated from further consideration if ATSDR is able to show that (1) an environmental medium is not contaminated, or (2) no one is exposed to contaminated media.

Exposure Dose Estimation Methodology

This section details the methods, assumptions, and calculations that ATSDR used to estimate potential exposure doses from the consumption of contaminated fish at ponds located at NWSY or in surface water bodies in close proximity to the station. ATSDR used realistic exposure assumptions to estimate a reasonable maximum exposure level. This estimate is an average daily exposure dose in milligrams of contaminant per kilogram body weight per day (mg/kg/day).

Deriving Exposure Doses

As noted above, exposure doses are typically expressed in milligrams per kilogram per day (mg/kg/day). When estimating exposure doses, health assessors evaluate chemical concentrations to which people could be exposed, together with the frequency (i.e., number of days per year) and duration (total number of years) of exposure. Collectively, these factors influence an individual's physiological response to chemical exposure and potential outcomes. ATSDR used previously published information about ingestion rates of different types of fishing populations. Table C1presents four different categories of fish consumers from low-end recreational consumers to high-end subsistence consumers.

Table C-1. Typical Fish Consumption Ingestion Rates

Fish Consumer Population	Fish Consumption (grams / day)	Fish Consumption (ounces / day)	Number of 8-Ounce Fish Meals
Recreational[1]	17.5	0.6	~ One meal every 12 days
Low-end Subsistence Fishers[1]	142	5	~ One meal every day or two
Native American[2] (99th Percentile)	390	14	~ Two meals per day
Native American High-end Subsistence Fishers[3]	540	19.4	~ Two and one-half meals per day

Sources: USDA 1998; Harris and Harper 1997; CRITFC 1994, Cited in EPA 2000. Full citations are included in the references section in the main document.

[1] Fish ingestion rates are based on a continuing survey (1994-1996) of food intake by individuals (CSFII).
[2] Ingestion rate is based on a survey of the Umatilla, Nez Perce, Yakama, and Warm Springs Tribes (CRITFC 19940.
[3] Ingestion rate is based on a survey of members of the Confederated Tribes of the Umatilla Indian Reservation (Harris and Harper 1997).

Calculating exposure dose from eating fish from on-site ponds at NWSY

ATSDR used health-protective assumptions about the frequency and consumption patterns of past, current, and future fish consumers.

The following equation was used to estimate human exposure from consuming fish:

$$\text{Estimated exposure dose (mg/kg/day)} = \frac{C \times IR \times EF \times ED}{BW \times AT}$$

See Table C-2 for explanation of equation abbreviations and the assumptions used in calculating dose.

Table C-2. Dose Assumptions: Exposure to Fish

Parameter	*Abbreviation*	*Child*	*Adult*
Chemical Concentration in Fish	C	On Site: Maximum Concentration (ppm) Off Site: Average Concentration (ppm)	On Site: Maximum Concentration (ppm) Off Site: Average Concentration (ppm)
Ingestion Rate	IR	<u>On Site</u> Species: Largemouth bass Recreational Fisher: 8.75 g/day <u>Off Site</u> Species: Mercury – all fish species Lead – all fish species Recreational Fisher: 8.75 g/day Low-end Subsistence Fisher: 71 g/day	<u>On Site</u> Species: Largemouth bass Recreational Fisher: 17.5 g/d <u>Off Site</u> Species: Mercury – all fish species Lead – all fish species Recreational Fisher: 17.5 g/day Low-end Subsistence Fisher: 142 g/day
Exposure Frequency	EF	Recreational Fisher: 50 days/year Low-end Subsistence Fisher: 350 days/year	Recreational Fisher: 50 days/year Low-end Subsistence Fisher: 350 days/year
Exposure Duration	ED	On Site: 4 years Off Site: 6 years	On Site: 4 years Off Site: 30 years
Body Weight	BW	16.8 kg (37 pounds)	70 kg (154 pounds)
Averaging Time Cancer effects	AT	N/A	25550 (70 years x 365 days/year)
Averaging Time Non-cancer effects	AT	2190 (6 years x 365 days/year)	10950 (30 years x 365 days/year)

Table C-3. Estimated Exposure Dose from Eating Fish (On Site) at NWSY

Type of fish (Contaminant)	*Maximum Conc. (mg/kg)*	*Adult Dose (mg/kg/day)*	*Child Dose (mg/kg/day)*	*Reference Value[1] (mg/kg/day)*
DDT[2]	0.004	1.4×10^{-7}	2.9×10^{-7}	5×10^{-4}
Dieldrin	0.001	3.1×10^{-8}	6.5×10^{-8}	5×10^{-5}
Chlordane	0.004	1.1×10^{-7}	2.3×10^{-7}	5×10^{-4}

[1] EPA's Reference Doses (RfDs) and ATSDR's MRLs are based on Non-cancer Health effects
[2] The RfD for DDE is used since no RfD is available for DDT
Conc = Concentration
MRL = Minimal Risk Level (oral, chronic)
mg/kg = parts per million (ppm)

Table C-4a. Estimated Exposure Dose from Eating Fish (Off Site-Recreational) at NWSY

Type of fish (Contaminant)	*Average Conc. (mg/kg)*	*Adult Dose (mg/kg/day)*	*Child Dose (mg/kg/day)*	*Reference Value[1] (mg/kg/day)*
All Fish (Lead)	0.23	7.9×10^{-6}	1.6×10^{-5}	6×10^{-4}*
All Fish (Mercury)	0.16	1.3×10^{-5}	2.8×10^{-5}	1×10^{-4}
Striped Bass/Channel catfish (PCBs)	0.22	7.5×10^{-6}	1.6×10^{-5}	2×10^{-5}

[1] EPA's Reference Doses (RfDs) and ATSDR's MRLs are based on Non-cancer Health effects
Conc = Concentration
MRL = Minimal Risk Level (oral, chronic)
mg/kg = parts per million (ppm)
NA = Not Available
* Refer to page C-8 (Providing Exposure Dose perspective) for an explanation of the derivation of the reference dose for lead.

Table C-4b. Estimated Exposure Dose from Eating Fish (Off Site-Low-end Subsistence) at NWSY

Type of fish (Contaminant)	*Average Conc. (mg/kg)*	*Adult Dose (mg/kg/day)*	*Child Dose (mg/kg/day)*	*Reference Value[1] (mg/kg/day)*
All Fish (Lead)	0.23	4.5×10^{-4}	9.3×10^{-4}	6×10^{-4}*
All Fish (Mercury)	0.16	9.4×10^{-5}	2.0×10^{-4}	1×10^{-4}
Striped Bass/Channel catfish (PCBs)	0.22	1.8×10^{-4}	8.9×10^{-4}	2×10^{-5}

[1] EPA's Reference Doses (RfDs) and ATSDR's MRLs are based on Non-cancer Health effects
Conc = Concentration
MRL = Minimal Risk Level (oral, chronic)
mg/kg = parts per million (ppm)
NA = Not Available
* Refer to page C-8 (Providing Exposure Dose perspective) for an explanation of the derivation of the reference dose for lead.

Providing Exposure Dose Perspective

On the basis of ATSDR's estimated dose calculations, two contaminants, lead and PCBs, were found to exceed their respective MRL or reference value. As mentioned previously in this report, ATSDR's MRL and EPA's RfD are not meant to represent a threshold of toxicity. However, if an estimated dose does exceed its MRL or respective reference value ATSDR looks more closely at the potential for harmful effects. We have provided additional perspective for the two chemicals that exceeded their reference values.

Lead: There is no MRL comparison value for lead. However, the FDA has published a provisional tolerable total intake level (PTTIL) for lead based on the lowest level of lead exposures associated with adverse health effects (FDA 1993). This guidance was used as the basis for ATSDR's evaluation. ATSDR used a reference value of 0.0006 mg/kg/day based on the PTTIL for the most susceptible population – children 6 years or younger[3]. The estimated doses for lead do not exceed this reference value in either adults or children for off-site recreational fish consumers. For of-site low-end subsistence consumers the estimated child dose does exceed the reference value (see Table C-4b). Lead was only detected in 10 of the 65 samples collected (18%) and the average concentration was skewed higher by a couple of samples with lead concentrations above 3 ppm. Based on the sampling data, most of the fish from the portions of the York and James Rivers near NWSY do not contain harmful levels of lead. However, to be safe, ATSDR recommends limiting children's portions of fish from these areas to recreational consumption levels (i.e., approximately one 4oz meal every couple of weeks).

PCBs: The MRL for PCBs is 0.00002 mg/kg/day. The estimated PCB dose for both adults and children exceeded this value by about a factor of 10 for adults and a factor of 40 for children. MRLs are estimates of human exposure to a chemical that are unlikely to be associated with any appreciable risk of non-cancer effects. Although some epidemiological studies have been conducted to assess the health effects of PCBs, animal studies comprise the largest body of toxicological data for PCBs. Under chronic exposure situations subtle health effects (referred to as less serious - lowest observed adverse effect levels [LOAEL]) occurred at doses of 0.005 mg/kg/day or greater in animals. These low-level exposures were most typically associated with immunological and developmental effects. The estimated doses for children and adults are about 6 to 10 times lower than any observed non-cancer health effects in the literature. PCB doses associated with cancer in animal studies are generally greater than 1 mg/kg/day, about 3 orders of magnitude higher than the estimated doses from consuming fish from the portions of the York and James Rivers closest to NWSY (ATSDR 2000b).

3 The PTTIL for this population is 0.006 mg/day and assumed body weight of 10 kg (26 pounds). In order to obtain the reference dose divide 0.006 mg/day by 10 kg = 0.0006 mg/kg/day.

Appendix D: Glossary of Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency in Atlanta, Georgia, with 10 regional offices in the United States. ATSDR serves the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases from toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces laws to protect the environment and human health. This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. For additional questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

Absorption
The process of taking in. For a person or an animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute
Occurring over a short time [compare with chronic].

Acute exposure
Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with intermediate duration exposure and chronic exposure].

Additive effect
A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with antagonistic effect and synergistic effect].

Adverse health effect
A change in body function or cell structure that might lead to disease or health problems

Aerobic
Requiring oxygen [compare with anaerobic].

Ambient
Surrounding (for example, ambient air).

Anaerobic
Requiring the absence of oxygen [compare with aerobic].

Analyte
A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Analytic epidemiologic study
A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

Antagonistic effect
A biologic response to exposure to multiple substances that is less than would be expected if the known effects of the individual substances were added together [compare with additive effect and synergistic effect].

Background level
An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Bioavailability
The degree to which chemicals can be taken up by organisms

Biodegradation
Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).

Biologic indicators of exposure study
A study that uses (a) biomedical testing or (b) the measurement of a substance [an analyte], its metabolite, or another marker of exposure in human body fluids or tissues to confirm human exposure to a hazardous substance [also see exposure investigation].

Biologic monitoring
Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic monitoring.

Biologic uptake
The transfer of substances from the environment to plants, animals, and humans.

Biomedical testing
Testing of persons to find out whether a change in a body function might have occurred because of exposure to a hazardous substance.

Biota
Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

Body burden
The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.

CAP [see Community Assistance Panel.]

Cancer
Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.

Cancer risk
A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen
A substance that causes cancer.

Case study
A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

Case-control study
A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

CAS registry number
A unique number assigned to a substance or mixture by the American Chemical Society Abstracts Service.

Central nervous system
The part of the nervous system that consists of the brain and the spinal cord.

CERCLA [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980]

Chronic
Occurring over a long time [compare with acute].

Chronic exposure
Contact with a substance that occurs over a long time (more than 1 year) [compare with acute exposure and intermediate duration exposure]

Cluster investigation
A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

Community Assistance Panel (CAP)
A group of people from a community and from health and environmental agencies who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

Comparison value (CV)
Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see exposure pathway].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. The Superfund Amendments and Reauthorization Act (SARA) later amended this law.

Concentration
The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant
A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Delayed health effect
A disease or an injury that happens as a result of exposures that might have occurred in the past.

Dermal
Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact
Contact with (touching) the skin [see route of exposure].

Descriptive epidemiology
The study of the amount and distribution of a disease in a specified population by person, place, and time.

Detection limit
The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Disease prevention
Measures used to prevent a disease or reduce its severity.

Disease registry
A system of ongoing registration of all cases of a particular disease or health condition in a defined population.

DOD
United States Department of Defense.

DOE
United States Department of Energy.

Dose (for chemicals that are not radioactive)
The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose (for radioactive chemicals)
The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Dose-response relationship
The relationship between the amount of exposure [dose] to a substance and the resulting changes in body function or health (response).

Environmental media
Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism
Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The environmental media and transport mechanism is the second part of an exposure pathway.

EPA
United States Environmental Protection Agency.

Epidemiologic surveillance [see Public health surveillance].

Epidemiology
The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure
Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

Exposure assessment
The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure-dose reconstruction
A method of estimating the amount of people's past exposure to hazardous substances. Computer and approximation methods are used when past information is limited, not available, or missing.

Exposure investigation
The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

Exposure pathway
The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Exposure registry
A system of ongoing followup of people who have had documented environmental exposures.

Feasibility study
A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Geographic information system (GIS)
A mapping system that uses computers to collect, store, manipulate, analyze, and display data. For example, GIS can show the concentration of a contaminant within a community in relation to points of reference such as streets and homes.

Grand rounds
Training sessions for physicians and other health care providers about health topics.

Groundwater
Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with surface water].

Half-life ($t_{½}$)
The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other chemical processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half life is the amount of time necessary for one half the initial number of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

Hazard
A source of potential harm from past, current, or future exposures.

Hazardous Substance Release and Health Effects Database (HazDat)
The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

Hazardous waste
Potentially harmful substances that have been released or discarded into the environment.

Health consultation
A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with public health assessment].

Health education
Programs designed with a community to help it know about health risks and how to reduce these risks.

Health investigation
The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to evaluate the possible association between the occurrence and exposure to hazardous substances.

Health promotion
The process of enabling people to increase control over, and to improve, their health.

Health statistics review
The analysis of existing health information (i.e., from death certificates, birth defects registries, and cancer registries) to determine if there is excess disease in a specific population, geographic area, and time period. A health statistics review is a descriptive epidemiologic study.

Indeterminate public health hazard
The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Incidence
The number of new cases of disease in a defined population over a specific time period [contrast with prevalence].

Ingestion
The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].

Inhalation
The act of breathing. A hazardous substance can enter the body this way [see route of exposure].

Intermediate duration exposure
Contact with a substance that occurs for more than 14 days and less than a year [compare with acute exposure and chronic exposure].

In vitro
In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with in vivo].

In vivo
Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with in vitro].
Lowest-observed-adverse-effect level (LOAEL)
The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.
Medical monitoring
A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.
Metabolism
The conversion or breakdown of a substance from one form to another by a living organism.
Metabolite
Any product of metabolism.
mg/kg
Milligram per kilogram.
mg/cm^2
Milligram per square centimeter (of a surface).
mg/m^3
Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.
Migration
Moving from one location to another.
Minimal risk level (MRL)
An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].
Morbidity
State of being ill or diseased. Morbidity is the occurrence of a disease or condition that alters health and quality of life.
Mortality
Death. Usually the cause (a specific disease, a condition, or an injury) is stated.
Mutagen
A substance that causes mutations (genetic damage).
Mutation
A change (damage) to the DNA, genes, or chromosomes of living organisms.
National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)
EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.
National Toxicology Program (NTP)
Part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.

No apparent public health hazard
A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.
No-observed-adverse-effect level (NOAEL)
The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.
No public health hazard
A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.
NPL [see National Priorities List for Uncontrolled Hazardous Waste Sites]
Physiologically based pharmacokinetic model (PBPK model)
A computer model that describes what happens to a chemical in the body. This model describes how the chemical gets into the body, where it goes in the body, how it is changed by the body, and how it leaves the body.
Pica
A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.
Plume
A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.
Point of exposure
The place where someone can come into contact with a substance present in the environment [see exposure pathway].
Population
A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).
Potentially responsible party (PRP)
A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.
ppb
Parts per billion.
ppm
Parts per million.
Prevalence
The number of existing disease cases in a defined population during a specific time period [contrast with incidence].
Prevalence survey
The measure of the current level of disease(s) or symptoms and exposures through a questionnaire that collects self-reported information from a defined population.
Prevention
Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

Public availability session
An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.
Public comment period
An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.
Public health action
A list of steps to protect public health.
Public health advisory
A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.
Public health assessment (PHA)
An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with health consultation].
Public health hazard
A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects.
Public health hazard categories
Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard, and urgent public health hazard.
Public health statement
The first chapter of an ATSDR toxicological profile. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.
Public health surveillance
The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.
Public meeting
A public forum with community members for communication about a site.
Radioisotope
An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.
Radionuclide
Any radioactive isotope (form) of any element.
RCRA [see Resource Conservation and Recovery Act (1976, 1984)]
Receptor population
People who could come into contact with hazardous substances [see exposure pathway].

Reference dose (RfD)
An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.
Registry
A systematic collection of information on persons exposed to a specific substance or having specific diseases [see exposure registry and disease registry].
Remedial investigation
The CERCLA process of determining the type and extent of hazardous material contamination at a site.
Resource Conservation and Recovery Act (1976, 1984) (RCRA)
This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.
RFA
RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.
RfD [see reference dose]
Risk
The probability that something will cause injury or harm.
Risk reduction
Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.
Risk communication
The exchange of information to increase understanding of health risks.
Route of exposure
The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].
Safety factor [see uncertainty factor]
SARA [see Superfund Amendments and Reauthorization Act]
Sample
A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.
Sample size
The number of units chosen from a population or an environment.
Solvent
A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).
Source of contamination
The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.
Special populations
People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Stakeholder
A person, group, or community who has an interest in activities at a hazardous waste site.
Statistics
A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.
Substance
A chemical.
Substance-specific applied research
A program of research designed to fill important data needs for specific hazardous substances identified in ATSDR's toxicological profiles. Filling these data needs would allow more accurate assessment of human risks from specific substances contaminating the environment. This research might include human studies or laboratory experiments to determine health effects resulting from exposure to a given hazardous substance.
Superfund [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)]
Superfund Amendments and Reauthorization Act (SARA)
In 1986, SARA amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.
Surface water
Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].
Surveillance [see public health surveillance]
Survey
A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see prevalence survey].
Synergistic effect
A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see additive effect and antagonistic effect].
Teratogen
A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.
Toxic agent
Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.
Toxicological profile
An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology
The study of the harmful effects of substances on humans or animals.
Tumor
An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).
Uncertainty factor
Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a safety factor].
Urgent public health hazard
A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.
Volatile organic compounds (VOCs)
Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.
Other glossaries and dictionaries:
Environmental Protection Agency (http://www.epa.gov/OCEPAterms/)
National Center for Environmental Health (CDC)
(http://www.cdc.gov/nceh/dls/report/glossary.htm)
National Library of Medicine (NIH)
(http://www.nlm.nih.gov/medlineplus/mplusdictionary.html)
For more information on the work of ATSDR, please contact:
Office of Policy and External Affairs
Agency for Toxic Substances and Disease Registry
1600 Clifton Road, N.E. (MS E-60)
Atlanta, GA 30333
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APPENDIX E: ATSDR'S RESPONSE TO PUBLIC COMMENTS

The Agency for Toxic Substances and Disease Registry released the Naval Weapons Station Yorktown (NWSY) Public Health Assessment (PHA) for public review and comment on December 30, 2005. The public comment period ended on February 15, 2006. The PHA was made available for public comment at the following location:

Newport News City Public Library
Virgil I. Grissom Branch
366 Deshazor Dr
Newport News, VA 23506
(757)886-7896

ATSDR did not receive any public comments for this PHA during the public comment period.