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PUBLIC HEALTH ASSESSMENT FOR PUBLIC COMMENT WITH TRANSMITTAL LETTER
NAS PENSACOLA FL
11/15/2005
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service
Agency for Toxic Substances and Disease Registry

Memorandum

Date November 15, 2005

From Division of Health Assessment and Consultation, ATSDR

Subject Public Health Assessment for Public Comment
Naval Air Station Pensacola

To Bob Safay
Senior Regional Representative, ATSDR, Region IV

Enclosed please find two copies of the November 15, 2005, Public Health Assessment for Public Comment on the following site prepared by the Agency for Toxic Substances and Disease Registry (ATSDR). **The Public Comment Period Ends on December 30, 2005.**

NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
EPA FACILITY ID: FL9170024567

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Please address correspondence to the Agency for Toxic Substances and Disease Registry (ATSDR) Records Center, 1600 Clifton Road, NE (E60), Atlanta, Georgia 30333.

Aaron Borrelli
Manager, Records Center

Enclosures
cc: B. Rogers, G. Campbell, L. Daniel, W. Cibulas, Jr., S. Isaacs

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ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
EPA FACILITY ID: FL9170024567
NOVEMBER 15, 2005

DECEMBER 30, 2005

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment-Public Comment Release 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. This document represents the agency's best efforts, based on currently available information, to fulfill the statutory criteria set out in CERCLA section 104 (i)(6) within a limited time frame. To the extent possible, it presents an assessment of potential risks to human health. Actions authorized by CERCLA section 104 (i)(11), or otherwise authorized by CERCLA, may be undertaken to prevent or mitigate human exposure or risks to human health. In addition, ATSDR will utilize this document to determine if follow-up health actions are appropriate at this time.

This document has previously been provided to EPA and the affected state in an initial release, as required by CERCLA section 104 (i) (6) (H) for their information and review. Where necessary, it has been revised in response to comments or additional relevant information provided by them to ATSDR. This revised document has now been released for a 30-day public comment period. Subsequent to the public comment period, ATSDR will address all public comments and revise or append the document as appropriate. The public health assessment will then be reissued. This will conclude 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.

Agency for Toxic Substances and Disease Registry .... Julie L. Gerberding, M.D., M.P.H., Administrator
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Use of trade names is for identification only and does not constitute endorsement by the Public Health Service or the U.S. Department of Health and Human Services.

Please address comments regarding this report to:

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

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PUBLIC HEALTH ASSESSMENT

NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

EPA FACILITY ID: FL9170024567

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, is an agency of the U.S. Public Health Service. Congress established this agency in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as the Superfund law. This law set up a fund to identify and clean up our country's hazardous waste areas. The U.S. Environmental Protection Agency (EPA) and the individual states regulate the investigation and clean up of the areas.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the areas 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. (The legal definition of a health assessment is included on the inside front cover.) 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.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at an area, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data. Instead, it 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 then evaluate whether or not there will be any harmful effects from these exposures. The report focuses on public health, or the health impact on the community as a whole, rather than on individual risks. Again, ATSDR generally makes use of existing scientific information, which can include the results of medical, toxicologic, and epidemiologic studies and the data collected in disease registries. The science of environmental health is still developing, and occasionally scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further research studies are needed.

Conclusions: The report presents conclusions about the level of health threat, if any, posed by an area. In its public health action plan, the report recommends ways to stop or reduce exposure. 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 to warn 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 area 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 an area, 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 comment. 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: ATSDR Records Center, 1600 Clifton Road, NE (MS E-60), Atlanta, GA 30333.

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List of Abbreviations

ATSDR	Agency for Toxic Substances and Disease Registry
BEQ	benzo(a)pyrene equivalent
BTEX	benzene, toluene, ethylbenzene, and xylenes
CDC	Centers for Disease Control and Prevention
CEL	cancer effect level
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	contaminant of concern
CREG	cancer risk evaluation guide (ATSDR)
CSF	cancer slope factor
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DHHS	U.S. Department of Health and Human Services
EMEG	environmental media evaluation guide (ATSDR)
EPA	U.S. Environmental Protection Agency
FDEP	Florida Department of Environmental Protection
FS	Feasibility Study
IARC	International Agency for Research on Cancer
IRP	Installation Restoration Program
IWTP	Industrial Wastewater Treatment Plant
kg	kilogram
LOAEL	lowest-observed-adverse-effect level
MCL	maximum contaminant level (EPA)
mg/L	milligrams per liter (same as ppm)
mg/kg	milligrams per kilogram (same as ppm)
mg/kg/day	milligrams per kilogram per day
MRL	minimal risk level (ATSDR)
NASP	Naval Air Station Pensacola
NEESA	Naval Energy and Environmental Support Activity
NFA	no further action
NOAA	National Oceanic Atmospheric Administration
NOAEL	no-observed-adverse-effects level
OU	operable unit
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene
ppb	parts per billion
ppm	parts per million
POL	petroleum, oil, and lubricant
RBC	risk-based concentration (EPA)
RCRA	Resource Conservation and Recovery Act
RfD	reference dose (EPA)
RI	Remedial Investigation

List of Abbreviations

RMEG	reference media evaluation guide (ATSDR)
ROD	Record of Decision
SI	Screening Investigation
SVOC	semi-volatile organic compound
SWMU	Solid Waste Management Units
TCE	trichloroethylene
UST	underground storage tank
VOC	volatile organic compound

Summary

Naval Air Station Pensacola (NASP) is located approximately 5 miles southwest of the city of Pensacola on a peninsula in the Florida panhandle. Naval operations began on Pensacola Bay in 1825, and expanded between 1828 and 1835. However, after several natural disasters in the early 1900s, the Navy Yard was forced into maintenance status for a three-year period. In 1914, the first U.S. Naval Air Station was established and became the primary training base for naval aviators. NASP is known as the "Cradle of Naval Aviation" because it is where every Naval Aviator, Naval Flight Officer, and enlisted air crewman begins flight training. It is also the Navy's premier location for enlisted aviation technical training.

ATSDR is required by law to conduct a public health assessment at each of the sites on the National Priorities List. EPA placed NASP on the National Priorities List in November 1989. Through the Installation Restoration Program, the Navy identified 46 sites as potential sources of contamination at NASP. ATSDR evaluated the potential for exposure to occur at each of the sites, and identified the following potential exposure situations for further discussion:

- *Surface water in Pensacola Bay and Bayou Grande.* The concentrations of environmental contaminants that were present throughout the bay and the bayou were too low to be of health concern for anyone incidentally ingesting surface water. Therefore, incidental exposure to surface water is not expected to result in harmful health effects.

- *Sediments in Pensacola Bay and Bayou Grande.* The concentrations that were present throughout the bay and the bayou were too low to be of health concern for anyone incidentally ingesting or contacting sediment. Therefore, incidental exposure to sediment is not expected to result in harmful health effects.

- *Fish in Bayou Grande.* The concentrations in game fish were too low to be of health concern for anyone eating up to 3.5 meals of fish a month. However, because the sampling is limited, it would be a prudent public health practice for people, particularly children and pregnant women, to follow the Florida Fish Consumption Advisories.

- *Blue crabs in Pensacola Bay and Bayou Grande.* The concentrations detected in edible blue crab samples were too low to be of health concern for anyone eating up to 3.5 meals of blue crab a month. Therefore, eating blue crab from Pensacola Bay and Bayou Grande is not expected to result in harmful health effects. However, because the blue crab hepatopancreas, or "mustard," samples contained higher concentrations of several chemicals and some of the estimated exposures approach levels of health concern, it would be a prudent public health practice to limit consumption of crab hepatopancreas.

- *Oysters in Bayou Grande.* The oyster sampling near NASP is limited—only one sample was collected in Bayou Grande. The results of that one sample do not indicate that eating oysters would be a health concern. The concentrations present in oysters collected from 22 additional locations throughout the Pensacola Bay area were also too low to be of health concern for anyone eating up to 3.5 meals of oyster a month. Therefore, eating oysters is not expected to result in harmful health effects.

Background

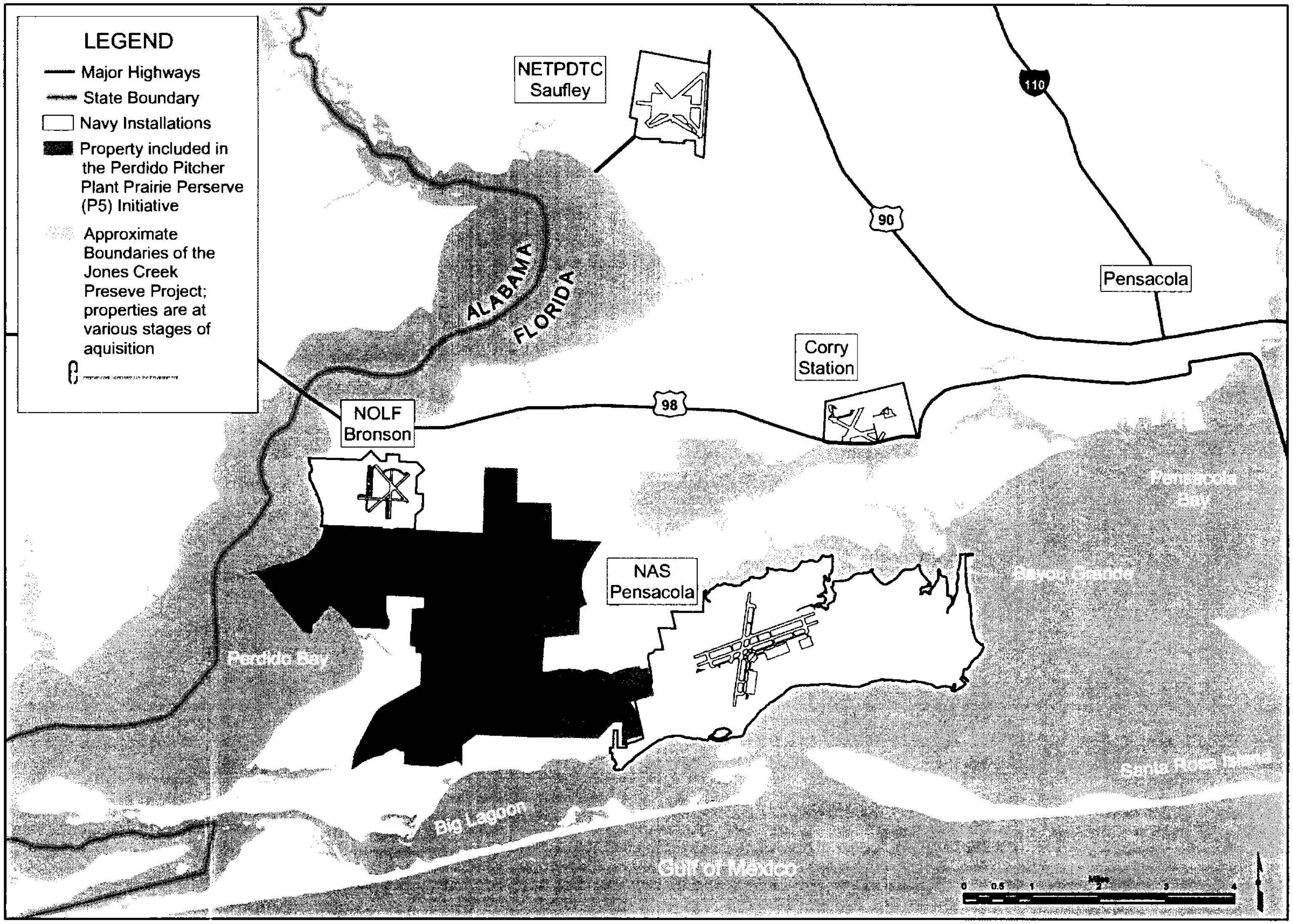
Site Description and Operational History

Naval Air Station Pensacola (NASP) is located on 5,800 acres on a peninsula in the Florida panhandle. The site is approximately 5 miles southwest of the city of Pensacola in southern Escambia County. NASP is surrounded by water on three sides—Bayou Grande to the north, Pensacola Bay to the east, and Big Lagoon and Pensacola Bay to the south (see Figure 1) (NASP 2001; Tetra Tech 2003).

Naval operations began on Pensacola Bay in 1825, when President John Quincy Adams and Secretary of the Navy, Samuel Southard, established "one of the best equipped naval stations in the country" (NASP 2001). As operations expanded between 1828 and 1835, the Navy acquired approximately 2,300 acres. After several natural disasters in the early 1900s, the Navy Yard was forced into maintenance status for a three-year period. In 1914, the first U.S. Naval Air Station (NAS) was established and became the primary training base for naval aviators (Tetra Tech 2003). NASP is known as the "Cradle of Naval Aviation" because it is where every Naval Aviator, Naval Flight Officer, and enlisted air crewman begins flight training. It is also the Navy's premier location for enlisted aviation technical training. In 1999, approximately 15,000 aviation personnel were trained at NASP (NASP 2001).

The Pensacola Naval Complex is comprised of NASP, the Naval Technical Training Center Corry Station, Outlying Landing Field Saufley, Outlying Landing Field Bronson, and Naval Air Station Whiting Field (see Figure 1). Of these, NASP and Naval Air Station Whiting Field are listed on the U.S. Environmental Protection Agency's (EPA) National Priorities List. This public health assessment addresses potential human exposure to environmental contamination at NASP. The Agency for Toxic Substances and Disease Registry (ATSDR) completed a public health assessment for Naval Air Station Whiting Field in September 2000, which is available at: http://www.atsdr.cdc.gov/HAC/PHA/whiting/whi_toc.html.

Figure 1. Location of Naval Air Station Pensacola



Source: NASP 2001

Figure 2. Installation Restoration Program Sites at Naval Air Station Pensacola

Source: EnSafe 1999a

- *Natural Resources Conservation Program.* This program includes forestry, land, and fish and wildlife management programs. The goal of the program is to stabilize and beautify the natural environment and provide outdoor recreation opportunities for base personnel.

- *Petroleum Program.* This program was developed to comply with State of Florida petroleum regulations. Under this program, NASP removed or replaced 219 underground storage tanks. The four remaining underground storage tanks were installed in 1991, in accordance with secondary containment standards.

ATSDR Involvement

ATSDR is required by law to conduct a public health assessment at each of the sites on the National Priorities List. As part of the public health assessment process, ATSDR conducted an initial site visit to NASP in February 1991. The visit's purpose was to collect information necessary to rank the site according to the potential public health hazard it represented and to identify public health issues related to environmental contamination. During the visit, ATSDR staff met base representatives, toured the installation and surrounding areas, and collected community health concerns. At that time, ATSDR identified past, current, and future exposure pathways and determined that no immediate or long-term public health hazards existed.

In January 2005, ATSDR revisited NASP to obtain updated information about ongoing environmental activities. Again, ATSDR met with base personnel and toured the site. Discussions, the site visit, and data reviews once again led ATSDR to conclude that there was little opportunity for public contact with site contaminants and no immediate threats to public health. ATSDR did, however, identify three potential exposure pathways for additional evaluation in this public health assessment:

- Exposure to site-related contaminants in Pensacola Bay and Bayou Grande surface water.
- Contact with site-related contaminants in Pensacola Bay and Bayou Grande sediment.
- Exposure from eating fish and shellfish caught in Pensacola Bay and Bayou Grande.

Demographics and Land Use

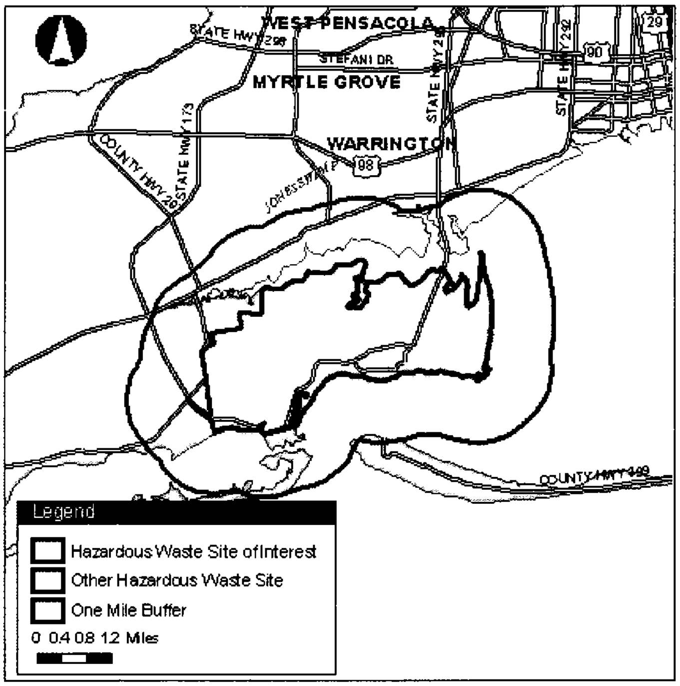
ATSDR examines demographic and land use data to identify sensitive populations, such as young children, the elderly, and women of childbearing age, and to determine whether these sensitive populations are exposed to any potential health risks. Demographics also provide details on population mobility and residential history in a particular area. This information helps ATSDR evaluate how long residents might have been exposed to contaminants.

NASP is located in southern Escambia County, which occupies about 661 square miles and has a population of about 294,000 (Bureau of the Census 2000). Pensacola is the county seat and the largest city in the county. According to the 2000 census, Pensacola is home to approximately 56,000 people—5.7% of whom are under the age of 5 years, 40% are women of childbearing age, and 17.2% are over 65 years. Figure 3 shows the demographics within one mile of NASP.

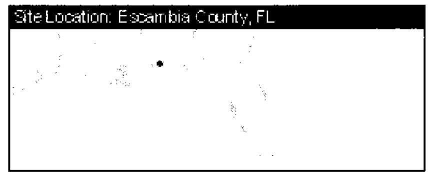
Figure 3. Demographics Within 1 Mile of Naval Air Station Pensacola

Pensacola Naval Air Station
Pensacola, FL
EPA Facility ID: FL9170024567

ATSDR CDC

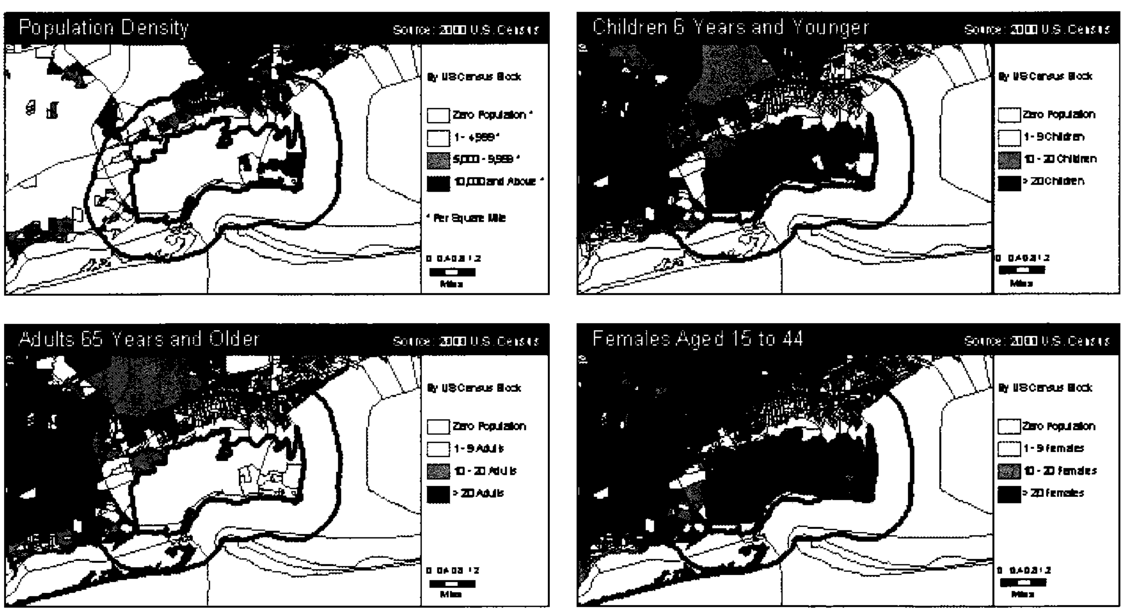


Base Map Source: Geographic Data Technology (DYNAMAP 2000), August 2002
Site Boundary Data Source: ATSDR Public Health GIS Program, August 2002
Coordinate System (All Panels): NAD 1983 UTM Zone 16N



Demographic Statistics Within One Mile of Site*	
Total Population	18,889
White Alone	15,102
Black Alone	2,052
Am. Indian & Alaska Native Alone	215
Asian Alone	420
Native Hawaiian & Other Pacific Islander Alone	40
Some Other Race Alone	584
Two or More Races	475
Hispanic or Latino**	1,301
Children Aged 6 and Younger	1,106
Adults Aged 65 and Older	1,280
Females Aged 15 to 44	3,101
Total Housing Units	4,720

Demographics Statistics Source: 2000 U.S. Census
* Calculated using an area-proportion spatial analysis technique
** People who identify their origin as Hispanic or Latino may be of any race.



GENERATED: 06-16-2005

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Approximately 23,000 military and civilian personnel live and/or work at NASP and contribute more than $1 billion annually to the local economy (Tetra Tech 2003). The Housing Department estimates that about 1,400 people currently live in the 577 housing units located at NASP. The average length of residence is two years, with a maximum of three years for enlisted employees (G. Wooten, NASP Housing Department, personal communication, January 2005). More than 25,000 military retirees and families live near NASP and contribute almost $500 million annually to the local economy. The local economy is comprised of large and small industry, agriculture, retail, and tourism (Tetra Tech 2003).

Various housing, training, and support facilities are located on NASP. Forrest Sherman Field occupies a large portion of the western end of the peninsula. Most industrial operations occurred on the eastern end (EnSafe 1995c; Tetra Tech 2003). Housing is located on the southern portion of the eastern end of NASP, in areas independent from the contaminated IRP sites. The Consolidated Training School was built along the bay on the eastern end of the peninsula.

Climate

The climate at NASP is mild, subtropical with an average annual temperature ranging from 50.5° Fahrenheit in the winter to 82° Fahrenheit in the summer. The average rainfall is approximately 60-63 inches per year, with the highest amount of rain falling in July and August. Moderate winds tend to prevail from the north during the winter and from the south during the summer (EnSafe 1999a; NASP 2001).

Even though Santa Rosa Island and Perdido Key protect NASP from direct hurricane hits, flooding and high wind velocities can cause severe damage during hurricanes (NASP 2001). In September 2004, Hurricane Ivan made landfall as a Category III hurricane about 30 miles west of NASP, and inflicted heavy damage to the station. Much of the destruction to the natural topography and buildings was still apparent when ATSDR visited the site in January 2005.

Quality Assurance and Quality Control

In preparing this public health assessment, ATSDR reviewed and evaluated information provided in the referenced documents. Documents prepared for the 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 public health assessment come from site characterization and remedial investigation reports prepared by NASP and its contractors under CERCLA and RCRA. ATSDR has found that the quality of environmental data available for NASP is adequate for making public health decisions.

Evaluation of Environmental Contamination and Potential Exposure Situations

Introduction

What is meant by exposure?

> An exposure pathway has five elements: (1) a source of contamination, (2) an environmental media, (3) a point of exposure, (4) a route of human exposure, and (5) a receptor population. The source is the place where the chemical or radioactive material was released. The environmental media (such as groundwater, soil, surface water, or air) transport the contaminants. The point of exposure is the place where people come into contact with the contaminated media. The route of exposure (for example, ingestion, inhalation, or dermal contact) is the way the contaminant enters the body. The people actually exposed are the receptor population.

ATSDR's public health assessments are driven by exposure to, or contact with, environmental contaminants. Contaminants released into the environment have the potential to cause harmful health effects. Nevertheless, *a release does not always result in exposure.* People can only be exposed to a contaminant if they come into contact with that contaminant—if they breathe, eat, drink, or come into skin contact with a substance containing the contaminant. If no one comes into contact with a contaminant, then no exposure occurs, and thus no health effects could occur. Often the general public does not have access to the source area of contamination or areas where contaminants are moving through the environment. This lack of access to these areas becomes important in determining whether people could come into contact with the contaminants.

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

How does ATSDR determine which exposure situations 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 to health-based comparison values. These are developed by ATSDR from available scientific literature related to exposure and health effects. Comparison values 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.

Comparison values are not thresholds for adverse health effects. ATSDR comparison values establish 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 comparison values, 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 comparison values used by ATSDR scientists include ATSDR's environmental media evaluation guides (EMEGs), reference dose media evaluation guides (RMEGs), and cancer risk evaluation guides (CREGs) and EPA's maximum contaminant levels (MCLs). EMEGs, RMEGs, and CREGs are non-enforceable, health-based comparison values 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 the ATSDR evaluation process by consulting Appendix C, contacting ATSDR at 1-888-42ATSDR, or reading ATSDR's Public Health Assessment Guidance Manual at http://www.atsdr.cdc.gov/HAC/HAGM/.

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 (how often) 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 and consult the toxicologic and epidemiologic literature for scientific information about the health effects from exposure to hazardous substances.

What potential exposure situations were evaluated for NASP?

Access to natural resource management areas at NASP for recreational purposes is limited to active duty and reserve military personnel, their dependents and guests; federal civilian employees, their dependents and guests; and military retirees. However, the general public is allowed access to several designated natural and cultural resource areas, such as National Park Service areas, the Pensacola Lighthouse, and the Bayou Grande Nature Trail.

Pensacola Bay and Bayou Grande are classified as Class II and Class III waters, meaning they are designated to support shellfish propagation and recreational and wildlife use (NASP 2001). Because of the warm climate and easy access to Pensacola Bay and Bayou Grande, outdoor recreational activities such as fishing, canoeing, sailing, and boating occur year-round (NASP 2001). However, due to the seasonal water temperatures, swimming is generally limited to May through September (EnSafe 1999a). Sherman Cove Marina offers many motorized and non-motorized boating opportunities. In addition, freshwater fishing is popular in Lake Frederic, a small 1.2-acre pond near Sherman Cove Marina that is stocked with catfish, sunshine bass, and bluegill (NPS 1999). Fishing in Lake Frederic was not considered a completed exposure pathway because no sources of contamination are near the small pond.

ATSDR identified the following three potential exposure situations for further evaluation:

1. Exposure to site-related contaminants in Pensacola Bay and Bayou Grande surface water.
2. Contact with site-related contaminants in Pensacola Bay and Bayou Grande sediment.
3. Exposure from eating fish and shellfish caught in Pensacola Bay and Bayou Grande.

Table 1 provides a summary of potential exposure situations evaluated in this public health assessment.

Table 1. Potential Exposure Pathways Evaluated at Naval Air Station Pensacola

Pathway	*Exposure Pathway Elements*					*Comments*
	Potential Sources of Contamination	*Environmental Media*	*Point of Exposure*	*Route of Exposure*	*Exposed Population*	
Surface Water	**Pensacola Bay** IRP sites 2, 3, 4, 13, 14, 17, 18, 28, 32, 33, 35, 36, 38, and 39 **Bayou Grande** IRP sites 1, 3, 9, 10, 11, 12, 15, 16, 29, 30, 32, 33, 35, 34, 36, and 38	▪ Surface Water	▪ Mustin Beach ▪ Bayou Grande Family Picnic Area ▪ Sailing Facility	▪ Incidental Ingestion	Recreational adults and children	Recreational exposures to Pensacola Bay and Bayou Grande surface water and sediment are not expected to cause harmful health effects.
Sediment		▪ Sediment		▪ Incidental Ingestion ▪ Dermal Contact	Recreational adults and children	
Fish and Shellfish		▪ Fish ▪ Blue crab ▪ Oysters	▪ Throughout Pensacola Bay and Bayou Grande	▪ Ingestion	Recreational fishers	People should follow the Florida Department of Health's Fish Consumption Advisories, and also limit consumption of crab hepatopancreas.

Sources: EnSafe 1995c, 1997, 1998a

Site Description and Use

Pensacola Bay

Pensacola Bay is a 54-square mile estuarine water body with a mean depth of 19.5 feet (NASP 2001). About 10 miles of the bay border NASP property where the mean water depth is 10 feet (EnSafe 1998a). Near the station, it is considered a "lower estuarine environment" with regular tidal flushing though the Pensacola Pass into the Intercoastal Waterway (EnSafe 1997b). Pensacola Bay is protected from the Gulf of Mexico by two barrier islands, Santa Rosa Island and Perdido Key. The U.S. Army Corps of Engineers periodically dredges Pensacola Bay to maintain a navigable channel for naval and commercial shipping (EnSafe 1995c).

Both the Navy and the Coast Guard monitor activity and boat traffic in Pensacola Bay. Fishing and crabbing occur on a daily basis in portions of the Pensacola Bay system—East Bay and Escambia Bay are conditionally classified for shellfish propagating and harvesting (EnSafe 1998a; FDACS 2005; FDEP 2004). Swimming near NASP is only allowed at Mustin Beach, which is west of the Coast Guard Station, and the swift currents of the shipping channel limit swimming in the bay. The only other swim activity occurs when students at the Rescue Training School participate in one activity in the bay during a single class (EnSafe 1997b, 1998a). Even though trespassing is possible, the occasional trespasser would likely be arrested (EnSafe 1998a).

Bayou Grande

Bayou Grande is a 1.7-square mile estuarine water body with a mean water depth of 6 feet (EnSafe 1999a; NASP 2001). It has approximately 20 miles of coastline, with about 8.5 miles bordering NASP property to the north. The majority of the land along the shore is residential property.

Neither commercial nor subsistence fishing occurs in Bayou Grande, and the area is not classified for shellfish harvesting (FDACS 2005; FDEP 2004). The Florida Marine Patrol Office reports that approximately 10 boats per day fish in the bayou from April through September and only one or two boats per day fish in the bayou from October through March (EnSafe 1999a, 2003). Most boats are reported to catch only one redfish or one trout per day. The general public can only access Bayou Grande by boat because NASP restricts access to the south, and private residents own the land on the west and north sides. Swimming is allowed at the Bayou Grande Family Picnic Area and at the Sailing Facility (EnSafe 1999a).

Note for Pensacola Bay and Bayou Grande: Since September 11, 2001, NASP and the Coast Guard enforce a 500-foot restricted area along the shoreline adjacent to NASP, which prohibits fishing in this area (EnSafe 2003). The area is marked with permanently stationed buoys that warn unauthorized boats to stay out of the "waterborne security zone" (EnSafe 2005b).

Environmental Sampling and Results

Pensacola Bay

The Pensacola Bay watershed has been impacted by both non-point source pollution (e.g., urban stormwater runoff and agricultural runoff) and point source pollution (e.g., wastewater treatments plants and industrial plants) (NASP 2001). Fourteen IRP sites (2, 3, 4, 13, 14, 17, 18, 28, 32, 33, 35, 36, 38, and 39) have been identified as potentially discharging or having previously discharged contaminants in Pensacola Bay (EnSafe 1995c). Three general areas of contaminant discharge are the southwest sewer discharge area, the eastern shore of Magazine Point and Chevalier Field, and Sherman Inlet and Sherman Cove (EnSafe 1995c).

In 1993, surface water samples were collected from five locations near Site 2 in Pensacola Bay. The samples were analyzed for metals, pesticides, PCBs, and organic compounds. Four metals and 12 semi-volatile organic compounds (SVOCs) were detected in the surface water. No pesticides, PCBs, or volatile organic compounds (VOCs) were detected in any of the surface water samples (EnSafe 1996e). In 1993, sediment samples were collected from 52 locations near Site 2 in Pensacola Bay. The samples were analyzed for metals, pesticides, PCBs, and organic compounds. Nine metals, two pesticides, two PCBs, and eight SVOCs were detected in the sediment. VOCs were not detected in the sediment samples (EnSafe 1996e). In 1994, 12–14 blue crabs were collected from each of six locations—five near Site 2 and one near the Coast Guard Station. The edible portion was analyzed for metals, pesticides, and organic compounds. Nine metals and seven pesticides were detected in the crab samples. No SVOCs or VOCs were detected in any of the samples (EnSafe 1996e).

The Navy sampled sediment from 141 locations along NASP property from October 1995 to January 1996 (see Figure 2) (EnSafe 1997b). Because surface water was not considered a significant route of exposure and seawater chemistry does not encourage the solution of contaminants, no surface water samples were collected (EnSafe 1998a). The sediment samples were analyzed for metals, pesticides, polychlorinated biphenyls (PCBs), and organic compounds. Twenty-three metals, 18 pesticides, 3 PCBs, 23 SVOCs, and 9 VOCs were detected in the sediment samples (EnSafe 1998a). The marine environment encourages the assimilation of these contaminants into sediment, which is transported by currents and deposited in areas unaffected by currents (EnSafe 1998a). Areas with the greatest level of contamination are the barge loading dock, Coast Guard Station, concrete seawall and quay, and the Industrial Wastewater Treatment Plant (EnSafe 1997b, 1998a). The sediment samples collected from Mustin Beach were lower in concentration than other areas, because of the strong surf and tidal currents in the area (EnSafe 1997b).

Bayou Grande

NASP is the primary industrial influence in Bayou Grande. Sixteen IRP sites (1, 3, 9, 10, 11, 12, 15, 16, 29, 30, 32, 33, 34, 35, 36, and 38) have been identified as potentially contributing or having contributed to contamination in Bayou Grande (EnSafe 1995c). Contaminants migrate to the bayou primarily through sediment migration and redistribution within the bayou, surface water drainage, and groundwater discharge (EnSafe 1999a). Two general areas of contaminant discharge are the yacht basin west of Magazine Point and the southcentral portion of Bayou Grande (EnSafe 1995c).

The Navy sampled sediment, surface water, and fish from Bayou Grande from 1995 to 1997 (see Figure 2) (EnSafe 1999a). Sediment was sampled from 143 locations along the NASP coastline. Only submerged sediment samples were collected because shoreline sediments "do not represent an environment conducive to deposition" (EnSafe 1999a). The shoreline sediments are chemically inert due to the grain size and are continually winnowed by wind and water. Surface water was collected from three locations. Two composite samples of prey fish (minnows) were collected from one location. The Navy then estimated concentrations of contaminants in game fish (e.g., red drum) from the concentrations detected in the prey fish samples (EnSafe 2003). Sediment, surface water, and fish tissue samples were analyzed for metals, pesticides, PCBs, and organic compounds (EnSafe 1999a). Twenty-three metals, 19 pesticides, three PCBs, 31 SVOCs, and five VOCs were detected in the sediment samples (EnSafe 1999a). One VOC, two pesticides, and 14 metals were detected in the surface water samples. No SVOCs or PCBs were detected in surface water (EnSafe 1999a). One metal, six pesticides, and 1 PCB were detected in the prey fish samples (EnSafe 1999a, 2003). Because mercury was not analyzed in the prey fish because of a sampling error, the Navy used a model to predict mercury concentrations in red drum from the mercury levels detected in the sediment in Bayou Grande (EnSafe 2003).

In 2003 and 2004, as part of an environmental health study of northwest Florida, the University of West Florida collected blue crabs and oysters from the bays and bayous in the Pensacola area, including locations in Bayou Grande (Karouna-Renier et al. 2005). One composite oyster sample comprised of at least 10 oysters was collected and two blue crab samples composited from at least seven crabs were collected from Bayou Grande. Oysters were collected from 22 additional locations throughout the Pensacola Bay area. The tissues were analyzed for metals, dioxin-like PCBs, and dioxins/furan compounds, which were all detected in the samples. The University of West Florida also recently sampled mullet fillets from Bayou Grande (N. Karouna-Renier, University of West Florida, personal communication, May 2005). Arsenic, mercury, PCBs, and dioxin/furan compounds were detected in the fillet samples.

Public Health Implications

Introduction

ATSDR evaluated recreational exposures to surface water and sediment in Pensacola Bay and Bayou Grande. In addition, ATSDR determined whether the fish and shellfish from the bay and bayou are safe to eat. To do so, ATSDR evaluated available data to determine whether contaminants were above ATSDR's comparison values. Comparison values are derived for each environmental media (water, soil, fish) and reflect an estimated contaminant concentration that is not expected to cause harmful health effects, assuming a standard daily contact rate (for example, the amount of water or soil consumed) and representative body weight. For chemicals above comparison values, ATSDR derived exposure doses (see text box for definition) and compared them against health-based guidelines. Health guidelines are estimates of daily human exposure to substances that are not expected to result in health effects over a specified duration. They have built in "uncertainty" or "safety" factors that make them much lower than levels at which health effects have been observed. ATSDR also reviewed relevant toxicologic data to obtain information about the toxicity of the chemicals of interest.

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

Issue 1. Exposure to site-related contaminants in Pensacola Bay and Bayou Grande surface water

ATSDR evaluated whether incidentally ingesting surface water while engaged in recreational activities, such as swimming, in Pensacola Bay and Bayou Grande could result in harmful health effects. The concentrations that were present throughout the bay and the bayou were too low to be of health concern for anyone incidentally ingesting surface water. Therefore, incidental exposure to surface water is not expected to result in harmful health effects.

Of the 16 metals, 12 SVOCs, one VOC, and two pesticides detected in Pensacola Bay and Bayou Grande surface water, only three metals and one SVOC had maximum concentrations higher than comparison values (see Table 2). However, it should be noted that arsenic and pentachlorophenol were only detected in one of 24 samples. ATSDR further evaluated the potential exposure to the four chemicals detected above comparison values by calculating exposure doses and comparing the doses to protective health guideline values. ATSDR assumed that adults and children swam at the designated swimming areas in the bay and bayou 150 days of the year (May through September; EnSafe 1999a). All adult and child exposure doses were below health effect levels reported in the scientific literature. Therefore, ATSDR does not expect that incidentally ingesting surface water while engaging in recreational activities in Pensacola Bay or Bayou Grande would cause harmful health effects. Please see Appendix C for more details on the methods and assumptions ATSDR used to estimate human exposure doses and determine health effects.

Table 2. Chemicals with Maximum Concentrations Exceeding Comparison Values in Pensacola Bay and Bayou Grande Surface Water

Chemical	*Number of Detections*	*Range of Detected Concentrations (ppb)*	*Comparison Value (ppb)*	*Comparison Value Type*
Metals				
Antimony	20/24	95.8–180	4	RMEG
Arsenic	1/24	2.5	0.02	CREG
Silver	18/24	6.3–144	50	RMEG
Semi-volatile Organic Compound				
Pentachlorophenol	1/24	5	0.3	CREG

Sources: EnSafe 1996e, 1999a

CREG = cancer risk evaluation guide
ppb = parts per billion
RMEG = reference media evaluation guide

Issue 2. Contact with site-related contaminants in Pensacola Bay and Bayou Grande sediment

ATSDR evaluated whether incidentally ingesting or dermally contacting sediments while engaged in recreational activities in Pensacola Bay and Bayou Grande could result in harmful health effects. The concentrations that were present throughout the bay and the bayou were too low to be of health concern for anyone incidentally ingesting or dermally contacting sediment. Therefore, incidental exposure to sediment is not expected to result in harmful health effects.

Of the 23 metals, 20 pesticides, three PCBs, 32 SVOCs, and nine VOCs detected in Pensacola Bay and Bayou Grande sediment, only four metals, five SVOCs, and one pesticide had maximum concentrations higher than comparison values (see Table 3). ATSDR further evaluated the potential exposure for these chemicals by calculating exposure doses and comparing the doses to protective health guideline values. ATSDR assumed that adults and children engage in recreational activities in the bay and bayou 150 days of the year (May through September; EnSafe 1999a). All adult and child exposure doses were below health effect levels reported in the scientific literature. Therefore, ATSDR does not expect that incidentally ingesting or dermally contacting sediment while engaging in recreational activities in Pensacola Bay or Bayou Grande would cause harmful health effects. Please see Appendix C for more details on the methods and assumptions ATSDR used to estimate human exposure doses and determine health effects.

Table 3. Chemicals with Maximum Concentrations Exceeding Comparison Values in Pensacola Bay and Bayou Grande Sediment

Chemical	Number of Detections	Range of Detected Concentrations (ppm)	Comparison Value (ppm)	Comparison Value Type
Metals				
Arsenic	250/336	0.12–22.3	0.5	CREG
Cadmium	68/336	0.2–24	10	Chronic EMEG
Chromium	256/336	0.39–238	200	RMEG (CrVI)
Iron	332/336	19.3–38,000	23,000	Residential RBC
Semi-volatile Organic Compounds				
Benzo(a)anthracene	77/336	0.021–44	0.87	Residential RBC
Benzo(a)pyrene	73/336	0.021–21	0.1	CREG
Benzo(b)fluoranthene	107/336	0.022–19	0.87	Residential RBC
Benzo(k)fluoranthene	62/336	0.021–16	8.7	Residential RBC
Indeno(1,2,3-cd)pyrene	46/336	0.021–7.5	0.87	Residential RBC
Pesticide				
Dieldrin	37/333	0.00011–0.099	0.04	CREG

Sources: EnSafe 1996e, 1997b, 1998a, 1999a

CrVI = hexavalent chromium
CREG = cancer risk evaluation guide
EMEG = environmental media evaluation guide
ppm = parts per million
RBC = risk-based concentration
RMEG = reference media evaluation guide

Issue 3. Exposure from eating fish and shellfish caught in Pensacola Bay and Bayou Grande

ATSDR evaluated whether eating fish caught in Bayou Grande could result in harmful health effects. The concentrations that were detected and estimated in game fish were too low to be of health concern for anyone eating up to 3.5 meals of fish a month. Therefore, eating fish from Bayou Grande is not expected to result in harmful health effects. However, because the sampling results were limited, it would be a prudent public health practice for people, particularly children and pregnant women, to follow the Florida Department of Health Fish Consumption Advisories.

ATSDR also evaluated whether eating blue crabs and oysters from Pensacola Bay and Bayou Grande could result in harmful health effects. The concentrations detected in edible blue crab samples were too low to be of health concern for anyone eating up to 3.5 meals of blue crab a month. Therefore, eating blue crab from Pensacola Bay and Bayou Grande is not expected to result in harmful health effects. Because the blue crab hepatopancreas, or "mustard," samples contained higher concentrations of several chemicals and some of the estimated exposures *approach levels of health concern, it would be a prudent public health practice to limit consumption of crab hepatopancreas. The oyster sampling near NASP is limited; however, the concentrations found in oysters throughout the Pensacola Bay area do not indicate that eating oysters would be a health concern.*

The available fish data is very limited. Only two composite samples of prey fish and one mullet sample were collected from Bayou Grande. No fish samples were collected from Pensacola Bay. Using the levels detected in the prey fish, the Navy estimated concentrations in game fish. The Navy also estimated the level of mercury in game fish using detected sediment concentrations. Eight of the detected contaminants were found at concentrations higher or were estimated to be at concentrations higher than comparison values (see Table 4). ATSDR further evaluated the potential exposure for these chemicals by calculating exposure doses and comparing the doses to protective health guideline values. Based on the recreational patterns observed by the Florida Marine Patrol Office (EnSafe 1999a, 2003), ATSDR assumed that people ate about 3.5 meals of fish each month (a meal was defined as 8 ounces for adults and 4 ounces for children). All adult and child exposure doses were below health effect levels reported in the scientific literature. Please see Appendix C for more details on the methods and assumptions ATSDR used to estimate human exposure doses and determine health effects. Based on the available data, ATSDR does not expect that eating fish from Bayou Grande would cause harmful health effects. However, given that the fish sampling is limited, it would be a prudent public health practice for people to follow the Florida Department of Health Fish Consumption Advisories, which can be found at http://www.doh.state.fl.us/environment/community/fishconsumptionadvisories/ and are provided in Appendix D. Pregnant women and children should be particularly cautious because fetuses and young children are more sensitive to certain contaminants.

Table 4. Chemicals with Maximum Concentrations Exceeding Comparison Values in Fish Caught in Bayou Grande

Chemical	Maximum Concentration in Prey Fish (ppm)	Maximum Concentration in Game Fish (ppm)	Comparison Value (ppm)	Comparison Value Type
Metals				
Arsenic	Not sampled	0.61 (measured)	0.0021	RBC
Mercury	Not sampled	0.26 (estimated)	0.14	RBC (MeHg)
Pesticides				
Aldrin	0.00066	0.00066 (estimated)	0.00019	RBC
DDE	0.012	0.043 (estimated)	0.0093	RBC
Dieldrin	0.0013	0.0014 (estimated)	0.0002	RBC
PCBs				
Aroclor-1260	0.1	0.37 (estimated)	0.0016	RBC
Total PCBs	Not sampled	0.0147 (measured)	0.0016	RBC
Dioxins				
Total dioxin TEQ	Not sampled	0.000001 (measured)	0.000000021	RBC

Sources: EnSafe 1999a, 2003; N. Karouna-Renier, University of West Florida, personal communication, May 2005

DDE = dichlorodiphenyldichloroethylene
MeHg = methylmercury
PCB = polychlorinated biphenyl
ppm = parts per million
RBC = risk-based concentration
TEQ = toxic equivalency quotient

Blue crabs were collected from six locations in Pensacola Bay and two locations in Bayou Grande. Seven of the detected contaminants were higher than comparison values (see Table 5). Oysters were collected from one location in Bayou Grande and 22 additional locations throughout the Pensacola Bay area. Five of the detected contaminants were higher than comparison values (see Table 5). ATSDR further evaluated the potential exposure for these chemicals by calculating exposure doses and comparing the doses to protective health guideline values. Based on the recreational patterns observed by the Florida Marine Patrol Office (EnSafe 1999a, 2003), ATSDR assumed that people ate about 3.5 meals of crab or oyster each month (a meal was defined as 8 ounces for adults and 4 ounces for children). All adult and child exposure doses were below health effect levels reported in the scientific literature. Please see Appendix C for more details on the methods and assumptions ATSDR used to estimate human exposure doses and determine health effects. Based on the available data, ATSDR does not expect that eating the muscle/tissue portions of crab and oysters from Pensacola Bay and Bayou Grande[1] would cause harmful health effects.

[1] Bayou Grande is not classified for shellfish propagating and harvesting (FDACS 2005; FDEP 2004).

Blue crab hepatopancreas from Bayou Grande were also analyzed. They contained higher concentrations of arsenic, cadmium, copper, and dioxins than the muscle/tissue samples (see Table 5). When assuming the same consumption rate (3.5 meals of crab hepatopancreas a month), some of the exposure doses approach levels of concern. Because contaminants tend to deposit in the hepatopancreas, it would be a prudent public health practice to limit consumption of crab hepatopancreas.

Table 5. Chemicals with Maximum Concentrations Exceeding Comparison Values in Shellfish Caught in Pensacola Bay and Bayou Grande

Chemical	*Maximum Concentration in Edible Portion of Crab* (ppm)*	*Maximum Concentration in Crab Hepatopancreas (ppm)*	*Maximum Concentration in Oyster Tissue§ (ppm)*	*Comparison Value (ppm)*	*Comparison Value Type*
Metals					
Arsenic	1.85	3.8	1.8	0.0021	RBC
Inorganic arsenic	0.024	0.076	0.018	0.0021	RBC
Cadmium	0.76	4.6	0.61	1.4	RBC
Copper	15.25	58	56	54	RBC
Mercury	0.21	0.14	0.017	0.14	RBC (MeHg)
Pesticides					
Aldrin	0.00093	Not sampled	Not sampled	0.00019	RBC
DDT	0.0096	Not sampled	Not sampled	0.0093	RBC
Heptachlor epoxide	0.0025	Not sampled	Not sampled	0.00035	RBC
Dioxins					
Total dioxin TEQ	0.0000047	0.000028	0.0000042	0.000000021	RBC

Sources: EnSafe 1996e; Karouna-Renier et al. 2005

*Edible portion of crab includes either the crab muscle alone or crab muscle with a portion of the hepatopancreas (calculated as 15% of the total edible mass; Karouna-Renier et al. 2005).
§Collected from the one location in Bayou Grande near NASP.
DDT = dichlorodiphenyltrichloroethane
MeHg = methylmercury
ppm = parts per million
RBC = risk-based concentration
TEQ = toxic equivalency quotient

Community Health Concerns

The Navy has kept the community informed about activities at NASP throughout the site's history (EnSafe 1998a). A Technical Review Committee with representatives from the Navy, EPA, the Florida Department of Environmental Protection (FDEP), and the community was established in 1989, to review recommendations for, and monitor progress of, the investigation and remedial activities at NASP. In 1995, a Restoration Advisory Board was formed to establish a forum for communication between the decision makers and the community (EnSafe 1998a). In addition, the NASP Public Affairs office established and maintained a mailing list of interested community members and organizations.

In 1990, the Navy conducted a series of interviews with "a variety of individuals representing diverse personal and institutional concerns and interests" (Tetra Tech 2003). Individuals interviewed included elected and appointed officials; local, county, and state representatives; businesspeople; people historically affiliated with the station; and local residents. The key concerns raised during the interviews were:

- Drinking water supplies
- Wetland protection
- Hazardous waste minimization
- Scout camping near an inactive landfill (Site 1)
- Air quality
- Health of Bayou Grande and Pensacola Bay

Drinking Water Supplies

NASP receives its potable water from wells at Corry Station, which is located about 1.5 miles west of Pensacola and 2.5 miles north of NASP. Potable groundwater in the Pensacola area is generally drawn from the sand-and-gravel aquifer (NASP 2001). The sand-and-gravel aquifer occurs from the ground surface to about 220 to 330 feet below ground surface, and is informally subdivided into the surficial zone, the low permeability zone, and the main producing zone (NFWMD 1995). The low permeability zone acts as a semiconfining layer that restricts the vertical flow of groundwater between the surficial zone and the main producing zone. The main producing zone is the main source of groundwater throughout the area (NFWMD 1995).

The current drinking water supply is safe. According to the 2003 Annual Drinking Water Quality Report, the drinking water meets all federal and state requirements. NASP routinely monitors for contaminants to supply a "safe and dependable supply of drinking water" (NASP 2003). Water from the wells at Corry Station is treated with chlorine for disinfection, sodium hydroxide for pH stabilization, aeration for carbon dioxide removal, zinc orthophosphate for corrosion control, granular activated carbon units for dieldrin removal, and fluoride for dental health purposes.

There were some issues with groundwater contamination affecting the Corry Station potable water wells in the past. In 1993, the Northwest Florida Water Management District conducted a site investigation to characterize the extent of the contamination and identify the source. Pesticides (dieldrin, chlordane, and heptachlor epoxide) and volatile organic compounds (mainly benzene, toluene, ethylbenzene, and xylenes [BTEX] and tetrachloroethylene [PCE]) were detected in the Corry Station wells (NFWMD 1995). ATSDR evaluated the contaminant concentrations detected during this investigation, and determined that exposure to the low levels found would not have resulted in harmful health effects for people drinking water from the Corry Station wells. Please see Appendix C for more details on the methods and assumptions ATSDR used to estimate human exposure doses and determine health effects.

Wetland Protection

Formal wetland delineations were performed in 1997. A large portion—about 250 acres—of NASP consists of wetlands (NASP 2001). Including all freshwater and brackish ponds and drainage ditches, 81 wetland areas were identified (Tetra Tech 2003). Two-thirds are located on the west side of the base where few IRP sites are located. About one-third of the wetlands are located east of Sherman Field, where most of the IRP sites are located. Ten drainage ditches and 12 wetlands are associated with IRP sites. Elevated levels of metals, pesticides, and polynuclear aromatic hydrocarbons (PAHs) have been detected in sediment; and elevated levels of metals have been detected in surface water. In 2005, the Navy finalized a Remedial Investigation for the site wetlands and concluded that only four needed further action (see EnSafe 2005b).

NASP has an "aggressive resource conservation program that includes protection of the wetlands as a major goal" (Tetra Tech 2003). In 2001, NASP established an Integrated Natural Resources Management Plan (INRMP). One of the primary objectives is to: "Continue existing, and establish new programs and procedures to monitor, maintain, and enhance wetlands and water quality" (NASP 2001).

The Navy has a policy of "no net loss" of wetlands. Part of the long-term management plan is to develop vegetative buffers around wetland areas, discourage pedestrian and pet access, plant vegetated filter strips to intercept the flow of runoff, and manage the use of pesticides and herbicides (NASP 2001).

Hazardous Waste Minimization

NASP established a Hazardous Waste Minimization Program to reduce the amount of hazardous waste generated at the base by streamlining operations and increasing the efficient use of resources. Some examples include:

- Modified the Industrial Wastewater Treatment Plant from industrial wastewater to domestic wastewater in January 1996.
- Established hazardous waste training programs.
- Established a pollution prevention program.

According to the Navy, the program has "significantly reduced the amount of hazardous materials" generated at NASP (Tetra Tech 2003).

Scout Camping Near an Inactive Landfill (Site 1)

A primitive camping area used by visiting Boy and Girl Scout troops is located near an inactive landfill that was used from the early 1950s until 1976, for disposal of solid and industrial wastes (Tetra Tech 2003). Access to the landfill is restricted to authorized personnel; however, the site is not fenced to prevent trespassing (EnSafe 1998b).

The Navy performed a human health risk assessment for a potential child trespasser scenario. The risks and/or hazards were within EPA and FDEP's generally acceptable ranges. Therefore, they concluded that there was little risk posed from contact with the surface soil (EnSafe 1998b). ATSDR reviewed the Navy's risk assessment and performed our own health evaluation. ATSDR concurs that the contaminant levels found in the landfill surface soil are too low to be of health concern for scouts camping near the landfill. Please see Appendix C for more details on the methods and assumptions ATSDR used to estimate human exposure doses and determine health effects. NASP is monitoring the conditions at the landfill and will notify area scout leaders if the adjacent area becomes unsuitable for camping (Tetra Tech 2003).

Air Quality

Air pollutant emissions at NASP are generated from surface coating, fuel storage and handling, fire-fighting training facilities, miscellaneous small stationary combustion sources, aircraft, motor vehicles, and ground support equipment (NASP 2001). Military aircraft operations are the largest source of air emissions at NASP. Prescribed burning can also contribute to high levels of particulate matter in the air. However, to avoid potential impacts on the regional air quality, NASP coordinates with Florida's Division of Forestry to stay within the guidelines for conducting prescribed burns (NASP 2001).

The Clean Air Act established National Ambient Air Quality Standards (NAAQS) for six criteria pollutants—respirable particulate matter, carbon monoxide, sulfur dioxide, nitrogen dioxide, lead, and ozone. The state of Florida adopted these standards into its air quality regulations to protect public health and welfare. EPA classifies the area around NASP as "in attainment" for all six NAAQS criteria pollutants (NASP 2001). None of the counties near NASP have air pollution levels that persistently exceed national air quality standards established by the Clean Air Act (EPA 2005b).

Health of Pensacola Bay and Bayou Grande

ATSDR evaluated whether incidentally ingesting the surface water or contacting the sediment while engaged in recreational activities, such as swimming, in Pensacola Bay and Bayou Grande would result in harmful health effects. The concentrations that were present throughout the bay and the bayou were too low to be of health concern. ATSDR also evaluated whether eating fish, crabs, and oysters from Pensacola Bay and Bayou Grande would be expected to result in harmful health effects. The concentrations found in the fish, crab muscle/tissue, and the oyster samples were too low to be of health concern for anyone eating up to 3.5 meals a month (a recreational fishing scenario). However, because the sampling is limited, it would be a prudent public health practice to follow the Florida Department of Health Fish Consumption Advisories. In addition, the crab hepatopancreas, or "mustard," samples contained higher concentrations of several chemicals and some of the estimated exposures approach levels of health concern, therefore, it would also be a prudent public health practice to limit consumption of crab hepatopancreas.

ATSDR does not evaluate ecological health. However, the Navy's ecological assessment is described below.

The Navy performed baseline risk assessments for Pensacola Bay and Bayou Grande to evaluate the potential health hazard and/or cancer risk to people and the environment from contamination at NASP (see EnSafe 1997b, 1999a). The objectives of the baseline risk assessment were to:

- Characterize the source media and determine chemicals of potential concern.
- Identify potential ecological and human receptors and quantify potential exposures.
- Evaluate the adverse effects associated with site-specific contaminants of potential concern.

The Navy determined that, in general, there is limited, low risk to ecological receptors in Pensacola Bay. However, the sediment sampled near the barge loading dock and Coast Guard Station presents a moderate risk to ecological receptors (EnSafe 1997b). No ecological risk was determined for Bayou Grande (EnSafe 1999a). There were some differences in benthic species diversity; however, the toxicity tests showed no effects from exposure to Bayou Grande sediment. Further, species indicative of a healthy environment were found. Surface water concentrations did not indicate that there would be impacts to the fish, and the fish concentrations were not at levels predicted to pose a risk to fish-eating birds. However, a model predicted that there could be a risk to upper trophic level fish.

The Navy concluded that no measurable risk could be attributed to eating crab from Pensacola Bay, the only complete exposure pathway identified (EnSafe 1997b). A human health risk was determined for subsistence fishers in Bayou Grande (EnSafe 1999a). However, this is an unrealistic exposure scenario. Neither commercial nor subsistence fishing occurs in Bayou Grande. The Florida Marine Patrol Office reported that prior to September 11, 2001, approximately 10 boats per day fished in the bayou from April through September and only one or two boats per day fished in the bayou from October through March. Most boats caught only one redfish or one trout per day (EnSafe 1999a, 2003). Since September 11, 2001, NASP and the Coast Guard enforce a 500-foot restricted area along the shoreline adjacent to NASP, which prohibits fishing in this area (EnSafe 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. This sensitivity is the result of a number of factors. Children are more likely to be exposed because they play outdoors and they often bring food into contaminated areas. Children are shorter than adults, which means they breathe dust, soil, and heavy vapors close to the ground. Children are also smaller, potentially resulting in higher doses of chemical exposure per unit body weight. The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. Most importantly, children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care. Therefore, ATSDR is committed to evaluating their special interests at sites such as NASP as part of the ATSDR Child Health Initiative.

According to the 2000 census, Pensacola is home to approximately 14,000 children (up to 19 years old), 6,700 who are under the age of 10 years (Bureau of the Census 2000). In addition, families with children live in on-site quarters at NASP. The maximum length of residency is three years (G. Wooten, NASP Housing Department, personal communication, January 2005). Housing is located on the southern portion of the eastern end of NASP, and many areas have playgrounds. A youth center and child care center are located near Duncan and Moffett Roads adjacent to the Cabaniss Crescent officer quarters and Area H townhouse enlisted quarters. None of these areas are co-located with contaminated IRP sites. Children who live on NASP attend school off base.

> In 1993, NASP initiated a blood lead monitoring program as part of the wellness physical. The majority of the pediatric blood lead levels were below the Centers for Disease Control and Prevention's (CDC) effects level of 10 micrograms per deciliter (µg/dl). Because a few of the exposures were above 10 µg/dl, NASP completely abated lead from housing units in 1998.
>
> (S. Forester, Industrial Hygiene Department, personal communication, January 2005)

Children could be exposed to site contamination while participating in recreational activities in Pensacola Bay or Bayou Grande. To evaluate whether children may experience adverse health effects from this exposure, ATSDR estimated potential doses specifically for children. To estimate these doses, ATSDR used protective assumptions that overestimate the levels of actual exposure. *ATSDR concluded that exposure to site contamination at NASP does not pose unique health hazards for children.* The level of contamination found in surface water and sediment collected from Pensacola Bay and Bayou Grande was too low to be of health concern for children exposed through recreational activities. Based on the available data, ATSDR does not expect that eating fish, the edible portion of crab, and oysters from Pensacola Bay and Bayou Grande would cause harmful health effects for children. However, given that the fish sampling is limited, it would be a prudent public health practice for children and pregnant women to be particularly cautious and follow the Florida Department of Health Fish Consumption Advisories, which can be found at http://www.doh.state.fl.us/environment/community/fishconsumptionadvisories/ and are provided in Appendix D. Due to the higher concentrations of contaminants found in the crab hepatopancreas, it would also be a prudent public health practice for children and pregnant women to avoid eating that portion of the crab.

Conclusions

On the basis of its evaluation of available environmental information, ATSDR has categorized exposures to contamination at NASP as *no apparent public health hazard*. This means that people may be exposed to environmental contamination, but not at levels which are expected to cause harmful health effects.

- ATSDR evaluated whether incidentally ingesting surface water while engaged in recreational activities in Pensacola Bay and Bayou Grande could result in harmful health effects. The concentrations that were present throughout the bay and the bayou were too low to be of health concern for anyone incidentally ingesting surface water. Therefore, incidental exposure to surface water is not expected to result in harmful health effects.

- ATSDR evaluated whether incidentally ingesting or contacting sediments while engaged in recreational activities in Pensacola Bay and Bayou Grande could result in harmful health effects. The concentrations that were present throughout the bay and the bayou were too low to be of health concern for anyone incidentally ingesting or contacting sediment. Therefore, incidental exposure to sediment is not expected to result in harmful health effects.

- ATSDR evaluated whether eating fish caught in Bayou Grande could result in harmful health effects. The concentrations in game fish were too low to be of health concern for anyone eating up to 3.5 meals of fish a month. However, because the sampling is limited, it would be a prudent public health practice for people, particularly children and pregnant women, to follow the Florida Department of Health Fish Consumption Advisories.

  ATSDR also evaluated whether eating blue crabs from Pensacola Bay and Bayou Grande could result in harmful health effects. The concentrations detected in edible blue crab samples were too low to be of health concern for anyone eating up to 3.5 meals of blue crab a month. Therefore, eating blue crab from Pensacola Bay and Bayou Grande is not expected to result in harmful health effects. However, because the blue crab hepatopancreas, or "mustard," samples contained higher concentrations of several chemicals and some of the estimated exposures approach levels of health concern, it would be a prudent public health practice to limit consumption of crab hepatopancreas.

  ATSDR evaluated whether eating oysters from Bayou Grande could result in harmful health effects. The oyster sampling near NASP is limited—only one sample was collected. The results of that one sample do not indicate that eating oysters would be a health concern. The concentrations present in oysters collected from 22 additional locations throughout the Pensacola area were also too low to be of health concern for anyone eating up to 3.5 meals of oysters a month. Therefore, eating oysters is not expected to result in harmful health effects.

Recommendations

Because the fish sampling is limited, it would be a prudent public health practice for people, particularly children and pregnant women, to follow the Florida Fish Consumption Advisories (available at http://www.doh.state.fl.us/environment/community/fishconsumptionadvisories/ and provided in Appendix D).

Public Health Action Plan

The Public Health Action Plan (PHAP) for NASP contains a description of actions taken and to be taken by ATSDR and the Navy subsequent to the completion of this public health assessment. The purpose of the PHAP is to ensure that this public health assessment not only identifies potential and ongoing public health hazards, but 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 are listed below.

Completed Actions

- The Navy established the IRP and identified 46 sites at NASP as potential sources of contamination. Records of Decision were submitted for 14 sites. Site Characterization Reports were submitted for 12 sites. Sixteen sites have obtained "no further action" status, and six additional sites are recommended for or are pending no further action. Nineteen sites are being investigated and remediated under the State of Florida Petroleum Program. Seven of these sites originated in the IRP, but were transferred when only petroleum-related contamination was found.

- The Navy also initiated the following RCRA and environmental programs: Groundwater Recovery System, Hazardous Waste Storage, Hazardous Waste Minimization, HAZMART, Natural Resources Conservation, and the Petroleum Program.

- The Navy has kept the community informed about activities at NASP throughout the site's history. In 1989, a Technical Review Committee was established, and in 1995, a Restoration Advisory Board was formed. In addition, the NASP Public Affairs office established and maintained a mailing list of interested community members and organizations.

- In February 1991, ATSDR conducted an initial site visit to NASP. In January 2005, ATSDR revisited NASP to obtain updated information about ongoing environmental activities.

Ongoing Actions

- The Navy is continuing to conduct IRP activities (such as collecting additional environmental sampling data and monitoring) at sites that have not obtained "no further action" status.

- A Remedial Investigation is ongoing at Site 2.

- The Navy is finalizing an Optimization Study Report for Site 1 and a Remedial Investigation Addendum for Operable Unit 2.

Planned Actions

- The Navy plans to conduct site investigations for IRP Sites 44, 45, and 46.

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Appendices

Appendix A. ATSDR Glossary of Environmental Health Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to 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 environmental 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. If you have 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].

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).

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.

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

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.

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]

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. This law was later amended by the Superfund Amendments and Reauthorization Act (SARA).

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.

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].

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

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.

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-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.

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 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.

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.

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

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

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

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.

Metabolism
The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite
Any product of metabolism.

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].

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.

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.

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).

Prevalence
The number of existing disease cases in a defined population during a specific time period [contrast with incidence].

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.

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 meeting
A public forum with community members for communication about a site.

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.

Risk
The probability that something will cause injury or harm.

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]

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.

Substance
A chemical.

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].

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)

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Appendix B. Installation Restoration Program Site Summaries

Site	Description and History	Investigation and Significant Findings	Corrective Action and Current Status	Site Access and Exposure Potential
Site 1 Inactive Landfill	The 80-acre site was used as the primary landfill for Naval Air Station Pensacola (NASP) from the early 1950s until 1976. The site received various wastes such as solvents, polychlorinated biphenyls (PCBs), plating solutions, pesticides, oils, paints, mercury, medical waste, pressurized cylinders, and asbestos.	Contaminants of concern (COCs) include iron discharge from groundwater to wetlands; and benzene, chlorobenzene, naphthalene, 1,1,2,2-tetrachloroethane, vinyl chloride, total xylene, aluminum, cadmium, chromium, iron, manganese, and nickel in groundwater.	In 1998, soil mixed with waste tar was removed. In 1999, the Navy installed a groundwater recovery and treatment system to control iron discharges to the wetlands. However, its effectiveness is under review. A final Optimization Study Report has been submitted to regulatory agencies for consideration and comments.	Exposure is limited because institutional controls are in place to restrict the use of groundwater within 300 feet of the site and restrict intrusive activities within the landfill boundary. Site access is restricted to authorized personnel only.
Site 2 Southeast Waterfront	Site 2 is the area of sediments on the southeastern shore of NASP, along Pensacola Bay. Industrial and hazardous wastes were discharged to Pensacola Bay for over 35 years. Potential sources of contamination include a metal plating shop, industrial wastewater treatment plant sewer line, and former paint stripping operations. Fish kills were common in the area during the 1940s, 1950s, and 1960s.	COCs include polynuclear aromatic hydrocarbons (PAHs) in sediment.	In 1973, the industrial waste stream was diverted to the Industrial Wastewater Treatment Plant (IWTP). A Remedial Investigation (RI) is ongoing. Remedial alternatives considered in the Feasibility Study (FS) include no action, capping, dredging, and monitoring.	Exposure to Pensacola Bay surface water, sediment, and crabs is evaluated in the PHA.
Site 3 Crash Crew Training Area	Site 3 is an open area of land about 900 feet by 2,300 feet, along the southwestern border of Forrest Sherman Field. Since 1955, it was used to train fire fighters for plane crash events and contains at least eight different burn areas.	Petroleum-related contaminants were found.	In May 1995, the site was transferred to Florida's Petroleum Program and was renamed underground storage tank (UST) 18.	Exposure is limited because the site is located in a fenced area, where a security code is needed to open the gate.

Site	Description and History	Investigation and Significant Findings	Corrective Action and Current Status	Site Access and Exposure Potential
Site 4 Army Rubble Disposal Area	This 150 by 800-foot area is located southeast of Forrest Sherman Field. Timber, pipes, mattresses, and other waste were disposed of in the early 1950s when the old U.S. Army barracks at Fort Barrancas were torn down.	In 1983, the Naval Energy and Environmental Support Activity (NEESA) inspected the site, reviewed historical records, and interviewed NASP personnel. They determined that no hazardous waste had been disposed of at Site 4. Contaminants above Preliminary Remediation Goals (PRGs) include arsenic and PAHs in soil; and aluminum and iron in groundwater. However, none are COCs.	A Screening Investigation (SI) was completed, resulting in a no further action (NFA) decision.	Exposure is limited because groundwater near this site is not used to supply drinking water.
Site 5 Borrow Pit	Site 5 is a long, shallow pit about 1 foot deep, southeast of Forrest Sherman Field. In 1976, soil was removed from the site for use elsewhere on NASP.	Aluminum, iron, lead, and manganese were detected above drinking water standards in groundwater.	An SI was completed, resulting in a NFA decision.	Exposure is limited because the site is located in a fenced area. Groundwater near this site is not used to supply drinking water.
Site 6 Fort Redoubt Disposal Area	This disposal area is located southeast of Forrest Sherman Field. Since 1973, the site has been used for the disposal of building demolition rubble and debris, which may have contained asbestos. There is no evidence that other hazardous materials were disposed here.	In 1983, NEESA reported that asbestos was the only hazardous material potentially disposed of at the site and concluded that the site did not pose a threat to human health.	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulations do not require further investigation.	Exposure is limited because the site is located in a fenced area.
Site 7 Firefighting School	The Firefighting Training School has been in operation since 1940. Training involving gasoline fires in open tanks of water reportedly occurred west, and east to southeast of Building 1713. There is no evidence of hazardous waste disposal.	Arsenic in soil is the only COC.	In 1998, arsenic-contaminated soil was removed from Site 7. An SI was completed, resulting in a NFA decision.	Exposure is limited because contaminated soil was removed and replaced with clean fill.

Site	Description and History	Investigation and Significant Findings	Corrective Action and Current Status	Site Access and Exposure Potential
Site 8 Rifle Range Disposal Area	From 1951 to 1955, Site 8 was reportedly used to burn and bury solid waste (primarily paper). Dry refuse was reportedly placed in a trench and burned overnight. Building 3561 and the paved area around the building now cover most of the excavated area. Construction personnel did not encounter refuse while constructing Building 3561.	Aldrin, benzo(a)pyrene, cadmium, and dieldrin exceeded PRGs in soil. Cadmium, manganese, and one isolated lead detection exceeded drinking water standards in groundwater.	In 2004, a removal action was completed to remove dieldrin- and cadmium-contaminated soil exceeding residential criteria.	Exposure is limited because much of Site 8 is covered by a building and parking lot, and surrounded by a chain link fence. Further, contaminated soil was removed from Site 8. Groundwater near this site is not used to supply drinking water.
Site 9 Navy Yard Disposal	The Navy Yard Disposal was also known as the Navy Yard Dump and the Warrington Village Dump. It was used from 1917 to the early 1930s, for disposal of trash and refuse. While trenching for the IWTP system in the late 1960s, part of the site was excavated and glass, scrap metal, and debris were found.	COCs include inorganics, PAHs, and pesticides in soil. Aluminum, iron, and manganese were detected above drinking water standards in groundwater.	The site was divided into Site 9A and Site 9B. In 1995, approximately 215 cubic yards of PAH-contaminated soil were removed from Site 9B. In 1998, 802 tons of lead- and PAH-contaminated soil were removed from Site 9A. The Record of Decision (ROD) identified that NFA is required.	Exposure is limited because Site 9 is currently beneath landscaped and paved areas of the Consolidated Training School. Further, contaminated soil was removed and replaced with clean fill. Groundwater near this site is not used to supply drinking water.
Site 10 Commodore's Pond	A small pond used to be located at Site 10. In the mid-19th century, ship builders stored shaped oak timbers under the pond's water to preserve the wood. Debris was unearthed while trenching for the IWTP system in the late 1960s. However, no hazardous materials were encountered.	Dieldrin in soil is the only COC.	In 1998, 8 cubic yards of dieldrin-contaminated soil were removed from Site 10. An SI was completed, resulting in a NFA decision.	A pond is no longer located at Site 10. Exposure is limited because dieldrin-contaminated soil was removed and replaced with clean fill.

Site	Description and History	Investigation and Significant Findings	Corrective Action and Current Status	Site Access and Exposure Potential
Site 11 North Chevalier Field Disposal Area	From the late 1930s to the mid-1940s, Site 11 was a low, swampy area where industrial wastes from aircraft engine overhauls, waste oil, lumber, and other ignitable materials were disposed. It is an 18-acre area next to an arm of Bayou Grande.	The primary pathways of concern at Site 11 are soil leaching to groundwater and groundwater migration to surface water. Soil and groundwater contamination consists primarily of metals, semi-volatile organic compounds (SVOCs), and volatile organic compounds (VOCs).	The site is being investigated as part of Operable Unit (OU) 2. Additional data was collected in 2003 to further define the contamination. An RI addendum for OU 2 was released in 2005.	Waste Site Study Area signs are posted at Site 11. Exposure is limited because groundwater near this site is not used to supply drinking water. Impacts to Bayou Grande surface water are evaluated in this PHA.
Site 12 Scrap Bins	From the early 1930s to the mid-1940s, about two truckloads per day of wet garbage from NASP were placed in scrap bins and stored until being hauled off for livestock feed. There is no evidence of hazardous material disposal at this site.	Soil, sediment, and groundwater contamination consists primarily of metals, VOCs, SVOCs, and PCBs.	The site is being investigated as part of OU 2. Additional data was collected in 2003, to further define the contamination. An RI addendum for OU 2 was released in 2005.	Exposure is limited because Site 12 is now the Defense Reutilization & Marketing Office (DRMO) Recyclable Materials Center. It is surrounded by a fence and covered with a large concrete pad where heavy equipment is stored. Groundwater near this site is not used to supply drinking water.
Site 13 Magazine Point Rubble Disposal Area	Site 13 is used for disposing of rubble. The first visible presence of rubble was in 1964, where it was most likely placed at Magazine Point to stabilize a narrow inlet to the north between Bayou Grande and Pensacola Bay. Since 1965, the disposal of construction debris at the south end of the site has created rubble piles higher than 6 feet. At the north end of the site, rubble has been placed to form a jetty that extends into Pensacola Bay. Construction materials include concrete blocks and slabs, asphalt, brick and mortar, clay and concrete culverts, metal pipes, wooden poles and lumber, and empty 55-gallon drums.	No COCs were identified.	An SI was completed, resulting in a NFA decision.	No harmful exposures are occurring because no contaminants were identified at levels of health concern.

Site	Description and History	Investigation and Significant Findings	Corrective Action and Current Status	Site Access and Exposure Potential
Site 14 Dredge Spoil Fill Area	Site 14 is located along the waterfront, east of Chevalier Field. It was formed in the late 1970s when Pensacola Bay was dredged for an aircraft carrier turning basin and port.	No COCs were identified.	An SI was completed, resulting in a NFA decision.	No harmful exposures are occurring because no contaminants were identified at levels of health concern.
Site 15 Pesticide Rinsate Disposal Area	Site 15 is located in the golf course maintenance area, near Bayou Grande. It includes a septic tank and drain field system. From 1964 to 1979, an unknown amount of water that was used to clean pesticide equipment was disposed at the site.	COCs include alpha-chlordane, arsenic, benzo(a)pyrene equivalents (BEQs), dieldrin, and gamma-chlordane in soil; and arsenic and dieldrin in groundwater.	In 2002, a soil removal action was performed to remove contaminants above industrial use standards. The ROD identified that NFA is required.	Exposure is limited because institutional controls restrict land use to industrial only, and potable groundwater use is restricted.
Site 16 Brush Disposal Area	Site 16 is northeast of Forrest Sherman Field. From the late 1960s to 1973, brush that was pruned and trimmed at NASP was disposed of at the site. In addition, the Army may have used part of the site to burn garbage and dispose of ash.	Arsenic, benzo(a)pyrene, and iron exceeded PRGs in soil. Aluminum, iron, and manganese were detected above drinking water standards in groundwater.	An SI was completed, resulting in a NFA decision.	The arsenic, benzo(a)pyrene, and iron concentrations in the soil are too low to be of health concern. Groundwater near this site is not used to supply drinking water.
Site 17 Transformer Storage Yard	Transformers containing PCBs as well as PCB-free transformers were stored at Site 17. High concentrations of PCBs and chlorinated hydrocarbons were detected in a black oily residue found on the pavement. PCBs were also found in the soil below the asphalt.	COCs include PCBs in soil.	In 1998, 6 tons of PCB-contaminated soil were removed. The ROD identified that NFA is required.	Exposure is limited because contaminated soil was removed from Site 17 and it is currently a paved area surrounded by a fence.

Site	Description and History	Investigation and Significant Findings	Corrective Action and Current Status	Site Access and Exposure Potential
Site 18 PCB Spill Area	In 1966, a transformer at Substation A reportedly failed and spilled about 50 gallons of transformer oil onto a paved area and a smaller gravel area. The transformer oil contained an unknown level of PCBs.	COCs include PCBs in soil. Aluminum, iron, and manganese were detected above drinking water standards in groundwater. Lead was also detected above its PRG, however, the lead contamination is not associated with Site 18 and will be evaluated in 2005, as Site 45.	In 1998, PCB-contaminated soil was removed from Site 18. An SI was completed, resulting in a NFA decision.	Exposure is limited because contaminated soil was removed and replaced with clean fill. Groundwater near this site is not used to supply drinking water.
Site 19 Fuel Farm Pipeline Leak Area	The fuel farm supplies fuel for aircraft at Forrest Sherman Field through an underground/aboveground double pipeline. The leak was reported to have occurred in 1958, in an area southwest of the field.	Petroleum-related contaminants were found in the soil and groundwater.	The site was transferred to the Florida Underground Storage Tank Program in 1994.	Exposure is limited because the site is located in a fenced area, where a security code is needed to open the gate.
Site 20 Allegheny Pier (Pier 303)	Site 20 is located about 0.25 mile south of Chevalier Field. It was formerly a berthing pier with fueling capabilities. A leak was discovered in the fuel pipeline leading to the pier in 1981.	Petroleum-related contaminants were found in the soil and groundwater.	Petroleum-contaminated soil was removed in 1981. The site was transferred to the Florida Underground Storage Tank Program in 1994.	Exposure is limited because the majority of the site is covered with asphalt or concrete and groundwater near this site is not used to supply drinking water.
Site 21 Sludge at Fuel Tanks Area	The site is a former sludge disposal area located near the intersection of Duncan Road and Radford Boulevard, about 400 feet north of Pensacola Bay. Five aviation gasoline aboveground storage tanks were used at the site from the 1940's through the 1960's. Approximately 360 cubic yards of sludge from the bottom of the tanks was removed and disposed of in the surrounding soil.	Petroleum-related contaminants were found in the groundwater.	The site was transferred to the Florida Underground Storage Tank Program in 1994. The Contamination Assessment Report recommended NFA for the soil, with groundwater monitoring.	Exposure is limited because groundwater near this site is not used to supply drinking water.

Site	Description and History	Investigation and Significant Findings	Corrective Action and Current Status	Site Access and Exposure Potential
Site 22 Refueler Repair Shop	Site 22 is located southwest of the intersection of Taylor and John Tower Roads. From 1958 to 1977, the area east-northeast of Building 1681 was used to dispose of about 19,000 gallons of aviation gasoline and jet fuel.	Petroleum-related contaminants were found in the groundwater.	In November 1996, the site was transferred to Florida's Petroleum Program and was renamed UST 26. Monitored natural attenuation was recommended for the site.	Exposure is limited because groundwater near this site is not used to supply drinking water.
Site 23 Chevalier Field Pipe Leak Area	In 1965, 1968, and 1969, the underground pipeline leaked and released an unknown amount of fuel near the southwest corner of Chevalier Field.	Petroleum–related contaminants were found in soil and groundwater, however no COCs were identified.	The site was transferred to the Florida Underground Storage Tank Program in 1994. The Site Assessment recommended NFA.	Exposure is limited because Site 23 is currently beneath a parking lot for the Consolidated Training School. Groundwater near this site is not used to supply drinking water.
Site 24 DDT Mixing Area	From the early 1950s to the early 1960s, Site 24 was used to mix diesel fuel with dichlorodiphenyltrichloroethane (DDT) for mosquito control. DDT was spilled when it was moved from drums to spray tanks.	Inorganic compounds, pesticides, and SVOCs exceeded PRGs in soil and groundwater.	The preferred remedial alternative for soil is no action, and the preferred remedial alternative for groundwater is monitoring with institutional controls.	Exposure is limited because Site 24 is now part of the Barrancas National Cemetery and groundwater near this site is not used to supply drinking water.
Site 25 Radium Spill Area	Site 25 is located east of the radium removal building (Building 780). A spill reportedly occurred in 1978, on the concrete-paved area when a rusted drum broke and spilled about 25 gallons of radioactive waste. The spill was reportedly properly cleaned up.	Contamination includes radioactive waste. COCs include PCBs in soil.	In 1998, PCB-contaminated soil was removed from Site 25. The site is being investigated as part of OU 2. Additional data was collected in 2003 to further define the contamination. An RI addendum for OU 2 was released in 2005.	Exposure is limited because Site 25 is a laboratory that is surrounded by a 7-foot high chain link fence with barb wire. Further, most of the site is paved or covered by the laboratory.

Site	Description and History	Investigation and Significant Findings	Corrective Action and Current Status	Site Access and Exposure Potential
Site 26 Supply Department Outside Storage	From 1956 until 1964, Site 26 was used as outside storage for industrial materials, (e.g., paint strippers and acids) by the NASP Supply Department. Containers were placed on steel matting, which allowed industrial chemicals to leak into the soil.	Soil and groundwater contamination consists primarily of metals, VOCs, and SVOCs.	The site is being investigated as part of OU 2. Additional data was collected in 2003, to further define the contamination. An RI addendum for OU 2 was released in 2005.	Exposure is limited because an 8-foot high chain link fence surrounds Site 26 and groundwater near this site is not used to supply drinking water.
Site 27 Former Radium Dial Shop	From the 1940s to 1976, instrument dials that had been painted with radium-containing paint were reworked in Building 709. Used cleaning solutions and luminous paint were routinely poured into the sanitary sewer system. The building was torn down in 1976, and the drainpipe was identified as having radiation above background levels.	The primary pathway of concern at Site 27 is soil leaching to groundwater. Contamination includes metals, radium, and phosphorous.	In 1976, the drainpipe was removed to a depth of 18 inches, and the remaining underground portion of the pipe was capped. The site is being investigated as part of OU 2. Additional data was collected in 2003, to further define the contamination. An RI addendum for OU 2 was released in 2005.	Exposure is limited because the building was demolished and the site now serves as a parking lot. Groundwater near this site is not used to supply drinking water.
Site 28 Site of Transformer Accident	In 1969, a transformer fell from a truck on Radford Boulevard, broke open, and spilled about 50 gallons of transformer oil onto the pavement. It is not known whether the oil contained PCBs. The oil was reportedly washed into a nearby storm sewer drain that emptied into Pensacola Bay.	Contamination includes transformer oil.	An SI was completed, resulting in a NFA decision.	Exposure is limited because the area of the spill is now under Radford Boulevard. The roadway was expanded from four to five lanes after the accident, and has been repaved over the years.
Site 29 Soil South of Building 3460	In 1981, workers removing soil beneath the concrete apron south of Building 3460 came in contact with a "black slimy liquid" that caused skin burns. The types of chemicals present and the extent of contamination are not known.	Dieldrin was detected above PRGs in subsurface soil. Aluminum, cyanide, iron, and manganese were detected above drinking water standards in groundwater.	In 1995, about 422 cubic yards of dieldrin-contaminated soil were removed. The ROD identified that NFA is required.	Exposure is limited because Site 29 is currently beneath the Consolidated Training School's south wing. Groundwater near this site is not used to supply drinking water.

Site	Description and History	Investigation and Significant Findings	Corrective Action and Current Status	Site Access and Exposure Potential
Sites 30 & 31 Buildings 648, 649, 755 and Industrial Sewer Line (TL 045/A north to IWTP)	Sites 30 and 31 were combined and consist of Building 648, Building 649, and Building 755. ▪ For about 15 years, waste paint, thinner, and paint sludges were poured onto the ground north of Building 648, which has been used for painting operations since 1949. ▪ Building 649 housed a tin/cadmium plating shop with 15 tanks, ranging in size from 200 to 500 gallons. These tanks, along with a 250-gallon tank of trichloroethylene, were routinely emptied into a ditch leading to a creek that drains into Bayou Grande. Acids, caustics, degreasers, and chromatic solutions were also emptied into this ditch. After 20 years, this operation was replaced with a magnesium treatment line, which operated for 10 years. ▪ Fifty tanks in Building 755 were used for 10 years for plating nickel, lead, tin, chromium, and other metals. These tanks, ranging from 50 to 200 gallons in size, were occasionally drained into a ditch that drains into Bayou Grande.	The primary pathways of concern at Sites 30 & 31 are soil leaching to groundwater and groundwater migration to surface water. Soil and groundwater contamination consists primarily of metals, SVOCs, and VOCs.	On October 14, 1992, the Petroleum Program transferred Tanks 648N, 647E, 647N, 649N, and 649W to the Installation Restoration Program. In August 1994, one waste-receiving structure in Wetland 5A was removed. The site is being investigated as part of OU 2. Additional data was collected in 2003, to further define the contamination. An RI addendum for OU 2 was released in 2005.	Although access to the site is unrestricted, it is unlikely that residents or trespassers would frequent the site due to its location and industrial use. Groundwater near this site is not used to supply drinking water.

Site	Description and History	Investigation and Significant Findings	Corrective Action and Current Status	Site Access and Exposure Potential
Site 32 IWTP Sludge Drying Beds	The IWTP sludge drying beds were used from 1971 to 1984, to receive hazardous waste sludges from the IWTP Treatment Pond (Site 33). An abandoned wastewater treatment plant that treated sanitary sewer wastes from 1941 to 1971 was grouped with Site 32 because of similar past activities and materials. However, industrial wastes from the plating operation in Building 649 may have also been disposed of through this plant. The site is being investigated as part of OU 10.	Soil contamination consists primarily of cyanide, dichlorobenzene isomers, heavy metals, PAHs, pesticides, and PCBs. Groundwater contamination consists primarily of metals, pesticides, PCBs, SVOCs, and VOCs.	The IWTP sludge drying beds underwent Resource Conservation and Recovery Act (RCRA) closure in 1989. Contents of the drying beds and an underlying layer of sand were removed to about 6 feet below land surface and disposed of as hazardous waste. The site was backfilled with clean sand and capped with high-density asphalt. Groundwater at the site will continue to be removed and monitored under the Hazardous and Solid Waste Amendments permit. The three main structures at the abandoned wastewater treatment plant (sedimentation tank, sludge drying beds, and chlorine contact chamber) were the subject of a removal action that began in September 1994. In 1997, about 200 cubic yards of PAH-contaminated soil were removed from OU 10.	Exposure is limited because access is restricted to authorized personnel only. A fence surrounds the IWTP proper, which includes Site 32. Further, contaminated soils were removed from OU 10, which is bounded by thick vegetation and trees to the north and south, and Pensacola Bay and Bayou Grande to the east and west. Groundwater near this site is not used to supply drinking water.

Site	Description and History	Investigation and Significant Findings	Corrective Action and Current Status	Site Access and Exposure Potential
Site 33 Wastewater Treatment Pond	Site 33 includes three surface ponds—the domestic polishing pond, phenol/stabilization pond, and industrial surge pond. In 1987, the U.S. Environmental Protection Agency (EPA) RCRA Compliance Branch determined that the polishing and stabilization ponds received hazardous waste from the treatment pond. Therefore, these ponds were taken out of service. The site is being investigated as part of OU 10.	The industrial treatment pond is suspected to be the prime contributor to IWTP groundwater contamination. Soil contamination consists primarily of PAHs, pesticides, and PCBs. Groundwater contamination consists primarily of metals, pesticides, PCBs, SVOCs, and VOCs.	From 1988 to 1989, the ponds underwent RCRA permitted "clean closures." The industrial surge pond was taken out of service and underwent closure in 1989. The treatment pond was removed to about 6 feet below land surface and disposed of as hazardous waste. The treatment pond's groundwater will continue to be removed and monitored under the Hazardous and Solid Waste Amendments permit. In 1997, about 200 cubic yards of PAH-contaminated soil were removed from OU 10.	Exposure is limited because access is restricted to authorized personnel only. A fence surrounds the IWTP proper, which includes Site 33. Further, contaminated soils were removed from OU 10, which is bounded by thick vegetation and trees to the north and south, and Pensacola Bay and Bayou Grande to the east and west. Groundwater near this site is not used to supply drinking water.
Site 34 Solvent North of Building 3557	A pipeline at the north end of Building 3557 leaked in May 1984. Reportedly, a detergent solution that contained 1.7% chlorinated solvents was released.	Primary contaminants included lead and naphthalene in soil and groundwater.	In 1995, about 1,100 cubic yards of lead- and naphthalene-contaminated soil were removed from the site. An SI was completed, resulting in a NFA decision.	Exposure is limited because Site 34 is currently beneath paved and landscaped areas of the Consolidated Training School's entry promenade. Groundwater near this site is not used to supply drinking water.

Site	Description and History	Investigation and Significant Findings	Corrective Action and Current Status	Site Access and Exposure Potential
Site 35 Miscellaneous IWTP Solid Waste Management Units (SWMUs)	Site 35 includes other units in the IWTP that may receive hazardous waste. Most are aboveground tanks that only require visual inspection for leaks, cracks, or other evidence of release. The rest are underground oil-sludge storage tanks and underground piping. The following are IWTP area SWMUs: ▪ Industrial Grit Chamber ▪ Primary Clarifier ▪ Oil-Water Separator ▪ Oil Storage Tanks ▪ Sludge Thickener ▪ Belt Filter Presses ▪ Parallel Flocculators ▪ Aeration (activated sludge) Tank ▪ Parallel Final Clarifiers ▪ Aerobic Sludge Digester ▪ Contact Chlorinator ▪ Ancillary Piping, Pumps, Junction Boxes, etc. The site is being investigated as part of OU 10.	Soil contamination consists primarily of PAHs, pesticides, and PCBs. However, 2-butanone, dichlorobenzenes, other PAHs, and xylenes were also found in the area surrounding the former waste oil UST. Groundwater contamination consists primarily of metals, pesticides, PCBs, SVOCs, and VOCs.	In 1997, about 200 cubic yards of PAH-contaminated soil were removed from OU 10.	Exposure is limited because access is restricted to authorized personnel only. A fence surrounds the IWTP proper. Further, contaminated soils were removed from OU 10, which is bounded by thick vegetation and trees to the north and south, and Pensacola Bay and Bayou Grande to the east and west. Groundwater near this site is not used to supply drinking water.

Site	Description and History	Investigation and Significant Findings	Corrective Action and Current Status	Site Access and Exposure Potential
Site 36 IWTP Sewer Line	The sewer line is about 5.5 miles long in an area about 1 mile wide by 1.5 miles long in the southeast part of NASP. The sewer line had both gravity and force lines and flowed to the IWTP. The sewer line has not been used since October 1995, when industrial operations were discontinued and the IWTP was transferred to domestic wastewater treatment only. The IWTP was built in 1948, and upgraded from a sewage treatment plant to the present industrial waste system in 1971. In 1973, Naval Air Rework Facility Pensacola operations were connected to the plant. Most wastes (including paint strippers, heavy metals, pesticides, low-level radioactive wastes, fuels, cyanide wastes, solvents, and waste oils) entered the IWTP sewer line without any pretreatment or segregation.	Soil contamination consists primarily of barium, cadmium, chromium, and PAHs. Groundwater contamination consists primarily of VOCs, SVOCs, dieldrin, and a few inorganics (antimony, iron, manganese, lead, and sodium).	In April 1995, 370 cubic yards of soil were excavated from Site 36. An additional 722 cubic yards were removed in December 1995/January 1996. In 1995, the IWTP sewer lines were pressure cleaned (flushed) and grouted to remove them as a source of contamination. An SI was completed, resulting in a NFA decision.	Exposure is limited because the IWTP sewer line is located 3 to 15 feet below ground surface. In addition, large portions of the land above the sewer line are covered with asphalt or concrete. Contaminated soil was removed and the sewer line was flushed and grouted in 1995.
Site 37 Sherman Field Former Fuel Farm	The 3.5-acre site is located southwest of Forrest Sherman Field. Equipment malfunctioned in 1983, causing approximately 48,000 gallons of jet fuel to be released. Initial efforts recovered 600–700 gallons of fuel.	Petroleum-related contaminants were found in the soil and groundwater.	The site was transferred to the Florida Underground Storage Tank Program and was renamed UST 24.	Exposure is limited because the site is fenced and groundwater near this site is not used to supply drinking water.

Site	Description and History	Investigation and Significant Findings	Corrective Action and Current Status	Site Access and Exposure Potential
Site 38 Buildings 71, 604, and Associated Industrial Sewer Lines	Building 71 was a storage area for hazardous waste. Soil testing identified hazardous materials related to aircraft painting and paint stripping (e.g., paint strippers, ketones, and trichloroethylene). Ten 550-gallon aboveground tanks were drained through underground lines to Pensacola Bay. The Initial Assessment Report identified a cyanide spill near Buildings 71 and 104, and the presence of cyanide in the nearby bay waters. From 1972 until 1995, Building 604 contained two primary types of operations—metalworking (including machine tooling, sheet-metal forming, welding, and inspection) and plating. Metalworking was phased out during the summer of 1995. Plating operations continue. In 1972, Building 604 was expanded to accommodate a larger plating operation. The previous shop operated three cadmium plating lines from about 1960 until 1968. The existing plating operation contains about 30 plating process tanks, ranging in size from 40 to 2,000 gallons. Before 1973, wastes (except cyanide) from Buildings 604 and 29 went into Pensacola Bay. After that, contents of the tanks flowed into the industrial waste sewer line that discharges into the IWTP. Cyanide was pumped into tank trucks and disposed of off base. In 1972, a cyanide pretreatment facility was installed to treat wastewaters before discharge to the sewer line.	Soil contamination includes inorganics, pesticides, PCBs, and SVOCs. Groundwater contamination includes inorganics, SVOCs, and VOCs. ***Description and History (continued)*** Waste from various types of operations used to enter the industrial sewer line without any pretreatment or segregation. Thus, the waste stream may have contained paint strippers, heavy metals, pesticides, fuels, cyanide wastes, solvents, and waste oils.	Monitored natural attenuation has been recommended as the appropriate remedial action.	Exposure is limited to the grassy median areas because asphalt, concrete, and/or a building cover the majority of Site 38. Groundwater near this site is not used to supply drinking water. Further, institutional controls restrict land and groundwater use to industrial only.

Site	Description and History	Investigation and Significant Findings	Corrective Action and Current Status	Site Access and Exposure Potential
Site 39 Oak Grove Campground Site	Site 39 is an area about 150 feet across that is littered with broken brick, concrete, tile, glass, coal, and nails. There is also a zone of stained soil several inches deep. Sampling in the stained area found low to moderate concentrations of petroleum products, which may be used oil or wood preservative. Records suggest that a saw mill was once located near this site.	Aluminum, arsenic, iron, pyrene, trichloroethane, and toluene exceeded PRGs in soil. Aluminum and iron were detected above secondary drinking water standards in groundwater.	In 1994, 864 tons of stained soil were removed from Site 39. The ROD identified that NFA is required.	Exposure is limited because surface soil at Site 39 was removed and replaced with clean fill. Groundwater near this site is not used to supply drinking water.
Site 40 Bayou Grande	Bayou Grande runs east to west for about 4 miles along NASP's north boundary. North and central parts of NASP as well as western areas of the City of Pensacola drain into Bayou Grande.	Metals, pesticides, PCBs, and SVOCs were detected across the bayou. However, concentrations were detected at levels considered acceptable by the Florida Department of Environmental Protection (FDEP), EPA, and the National Oceanic and Atmospheric Administration (NOAA).	The ROD identified that NFA is required.	Exposure to Bayou Grande surface water, sediment, and fish is evaluated in the PHA.
Site 41 NASP Pensacola Wetlands	All freshwater and brackish ponds and drainage ditches on NASP are considered to be wetlands. Eighty-one wetland areas were identified. Two-thirds are located on the west side of the base where few IRP sites are located. About one-third of the wetlands are located east of Sherman Field, where most of the IRP sites are located.	Elevated levels of metals, pesticides, and PAHs have been detected in sediment; and elevated levels of metals have been detected in surface water.	An RI identified four wetlands for an FS. Two wetlands were transferred to Florida's Petroleum Program. All other wetlands were recommended for NFA.	The wetlands are generally unused. Exposure is limited because homeland security restrictions and other issues limit access to most of the wetland areas.

Site	*Description and History*	*Investigation and Significant Findings*	*Corrective Action and Current Status*	*Site Access and Exposure Potential*
Site 42 Pensacola Bay	Pensacola Bay is part of the fourth-largest estuarine ecosystem in Florida. It is located along NASP's southern and eastern borders. Man-made drainage ways and storm drains feed into short intermittent streams that empty into Pensacola Bay and Bayou Grande. While no perennial streams enter or exit NASP, the wetlands and small lakes retain water throughout the year.	Contamination includes metals, pesticides, PCBs, SVOCs, and VOCs.	The ROD identified that NFA is required.	Exposure to Pensacola Bay surface water, sediment, and crabs is evaluated in the PHA.
Site 43 Buried Drum Site	Site 43 contains drums and other debris buried in an area near the corner of Murray and Taylor Roads.	COCs include metals in soil (antimony, arsenic, barium, copper, iron, lead, nickel, vanadium, and zinc) and groundwater (iron and aluminum).	An interim removal action was completed in 2002, and included removal of 657 cubic yards of soil and 25 rusted drums or metal parts. The site is pending a NFA decision.	Exposure is limited because the area was fenced in 1994, after a partially buried drum was discovered. The fence was removed just prior to the excavation of contaminated soil from Site 43 in 2002. Groundwater near this site is not used to supply drinking water.
Site 44 Building 3221 Solvent Site	Site 44 is near an active hangar (Building 3221) on Forrest Sherman Field, just north of the museum and west of Site 5. The museum currently uses the hangar to restore aircraft.	Florida's Petroleum Program detected chlorinated solvents in groundwater during their investigation.	Site investigation is scheduled for 2005.	Exposure is limited because asphalt, concrete, and/or buildings cover the majority of the area, and a fence surrounds the site. Groundwater near this site is not used to supply drinking water.
Site 45 Building 603 Lead Site	Lead in soil near Building 603 was discovered during the investigation of Site 18. The lead source is not known, but is not associated with Site 18.	COCs include lead in soil.	Site investigation is scheduled for 2005.	Exposure is limited because asphalt, concrete, and/or buildings cover the majority of the area.
Site 46 Former Building 72	While investigating Site 38, the detected lead concentrations appeared to be increasing further from the suspected source. In order to complete the other investigations at Site 38, the lead investigation for Site 38 was classified as Site 46.	COCs include metals in soil.	Site investigation is scheduled for 2005.	Exposure is limited because asphalt, concrete, and/or buildings cover the majority of the area.

Sources: Bechtel 1998a, 1998b; Campbell 1997, 1998a, 1998b, 1998c; CH2MHILL 2002, 2004; Ecology and Environment 1991a, 1991b, 1991c; EnSafe 1994, 1995a, 1995b, 1995d, 1995e, 1995f, 1995g, 1996a, 1996b, 1996c, 1996d, 1997a, 1997c, 1997d, 19997e, 1997f, 1997g, 1997h, 1998b, 1998c, 1998d, 1998e, 1999a, 1999b, 1999c, 2000, 2005a, 2005b; Navy 2004a, 2004b; NASP IRP 2004; NAS Pensacola Tier 1 Partnering Team 2004; Tetra Tech 2001, 2002, 2003 ***Notes are continued on the next page.***

Notes:

BEQ	benzo(a)pyrene equivalent
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	contaminant of concern
DDT	dichlorodiphenyltrichloroethane
EPA	U.S. Environmental Protection Agency
FDEP	Florida Department of Environmental Protection
FS	Feasibility Study
IWTP	Industrial Wastewater Treatment Plant
NASP	Naval Air Station Pensacola
NEESA	Naval Energy and Environmental Support Activity
NFA	no further action
NOAA	National Oceanic Atmospheric Administration
OU	Operable Unit
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyls
POL	petroleum, oil, and lubricant
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
SI	Screening Investigation
SVOC	semi-volatile organic compound
SWMU	Solid Waste Management Units
TCE	trichloroethylene
UST	underground storage tank
VOC	volatile organic compounds

Appendix C. Overview of ATSDR's Methodology for Evaluating Potential Public Health Effects

Methodology

Comparing Environmental Data to Comparison Values

> A comparison value is used by ATSDR to screen chemicals that require additional evaluation.
>
> ATSDR uses the term "conservative" to refer to values that are protective of public health in essentially all situations. Values that are overestimated are considered to be conservative.

For this public health assessment, the Agency for Toxic Substances and Disease Registry (ATSDR) selected contaminants for further evaluation by comparing the maximum environmental contaminant concentrations against conservative health-based comparison values. Comparison values are developed by ATSDR from available scientific literature concerning exposure and health effects. Comparison values are derived for each environmental media (water, soil, and air) and reflect an estimated contaminant concentration that is not expected to cause harmful health effects, assuming a standard daily contact rate (for example, the amount of water or soil consumed) and representative body weight. Because the concentrations reflected in comparison values are much lower than those that have been observed to cause adverse health effects, comparison values are protective of public health in essentially all exposure situations. As a result, concentrations detected at or below ATSDR's comparison values are not considered for further evaluation.

ATSDR's comparison values include the cancer risk evaluation guides (CREGs), environmental media evaluation guides (EMEGs), and reference dose media evaluation guides (RMEGs). These are nonenforceable, health-based comparison values developed for screening environmental contamination for further evaluation. The U.S. Environmental Protection Agency's (EPA) risk-based concentration (RBC) is a health-based comparison value developed to screen sites not yet on the National Priorities List, respond rapidly to citizens' inquiries, and spot-check formal baseline risk assessments.

> Essential nutrients (e.g., calcium, magnesium, phosphorous, potassium, and sodium) are important minerals that maintain basic life functions; therefore, certain doses are recommended on a daily basis. Because these chemicals are necessary for life, screening guidelines do not exist for them. They are found in many foods, such as milk, bananas, and table salt.

While concentrations at or below the relevant comparison value can reasonably be considered safe, it does not automatically follow that any environmental concentration exceeding a comparison value would be expected to produce adverse health effects. Comparison values are not thresholds for harmful health effects. ATSDR comparison values represent contaminant concentrations that are many times lower than levels at which no effects were observed in studies on experimental animals or in human epidemiologic studies. The likelihood that adverse health outcomes will actually occur depends on site-specific conditions, individual lifestyle, and genetic factors that affect the route, magnitude, and duration of actual exposure. An environmental concentration alone will not cause an adverse health outcome. If contaminant concentrations are above comparison values, ATSDR further analyzes exposure variables (such as site-specific exposure, duration, and frequency) for health effects, including the toxicology of the contaminant and other epidemiology studies.

Comparing Estimated Doses to Health Guideline Values

> An exposure dose, expressed in milligrams per kilogram per day (mg/kg/day), represents the amount of contaminant that an individual is assumed to ingest (in milligrams), divided by the body weight of the individual (in kilograms) each day.

If chemical concentrations are above comparison values, ATSDR further evaluates the chemical and potential exposure. ATSDR does this by calculating exposure doses and comparing the doses to protective health guideline values, including ATSDR's minimal risk levels (MRLs) and EPA's reference doses (RfDs). Estimated exposure doses that are less than health guideline values are not considered to be of health concern. ATSDR's MRLs and EPA's RfDs are estimates of the daily human exposure to hazardous substances that are likely to be without appreciable risk of adverse noncancer health effects over a specified duration of exposure.

When estimating exposure doses, health assessors evaluate chemical concentrations to which people could have been exposed, together with the length of time and the frequency of exposure. Collectively, these factors influence an individual's physiological response to chemical exposure and potential outcomes. Where possible, ATSDR used site-specific information regarding the frequency and duration of exposures. When site-specific information was not available, ATSDR employed several conservative assumptions to estimate exposures.

MRLs and RfDs are generally based on the most sensitive end point considered to be of relevance to humans. While estimated doses that are less than these values are not considered to be of health concern, exposure to levels above the MRL or RfD does not automatically mean that adverse health effects will occur. To maximize human health protection, they have built-in uncertainty or safety factors, making these values considerably lower than levels at which health effects have been observed. The result is that even if a dose is higher than the health guideline, it does not necessarily follow that harmful health effects will occur. Rather, it is an indication that ATSDR should further examine the harmful effect levels reported in the scientific literature and more fully review exposure potential.

In addition, to screen for cancer effects, estimated chronic-exposure doses were multiplied by EPA's cancer slope factors (CSFs) to measure the relative potency of carcinogens. This calculation estimates a theoretical excess cancer risk expressed as the proportion of a population that may be affected by a carcinogen during a lifetime of exposure. For example, an estimated cancer risk of 1×10^{-6} predicts the probability of one additional cancer over background levels in a population of 1 million. Because conservative models are used to derive CSFs, the doses associated with these estimated hypothetical risks may be orders of magnitude lower than doses reported in the toxicology literature to cause carcinogenic effects. As such, a low cancer risk estimate (risk estimates less than 1×10^{-5}) indicates that the toxicology literature would support a finding that no excess cancer risk is likely. A higher cancer risk estimate, however, indicates that ATSDR should carefully review the toxicology literature before making conclusions about potential cancer risks.

Comparing Estimated Doses to Health Effects Levels

If the MRLs or RfDs are exceeded, ATSDR examines the health effects levels discussed in the scientific literature and more fully reviews exposure potential. ATSDR reviews available human studies as well as experimental animal studies. This information is used to describe the disease-causing potential of a particular chemical and to compare site-specific dose estimates with doses shown in applicable studies to result in illness (known as the margin of exposure). This process enables ATSDR to weigh the available evidence in light of uncertainties and offer perspective on the plausibility of harmful health outcomes under site-specific conditions.

Sources for Health-based Guidelines

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

ATSDR

Table C-1. Noncancer Health Guidelines and Cancer Slope Factors Used in this Public Health Assessment

Chemical	*Health Guideline (mg/kg/day)*	*Cancer Slope Factor (mg/kg/day)$^{-1}$*	*Source*
Metals			
Antimony	4.0×10^{-4}	NA	EPA's Chronic Oral RfD: http://www.epa.gov/iris/subst/0006.htm
Arsenic	3.0×10^{-4}	1.5	ATSDR's Chronic Oral MRL: http://www.atsdr.cdc.gov/toxprofiles/tp2.html EPA's CSF: http://www.epa.gov/iris/subst/0278.htm
Cadmium	2.0×10^{-4}	NA	ATSDR's Chronic Oral MRL: http://www.atsdr.cdc.gov/toxprofiles/tp5.html
Chromium	3.0×10^{-3}	NA	EPA's Chronic Oral RfD for Chromium VI: http://www.epa.gov/iris/subst/0144.htm
Copper	4.0×10^{-2}	NA	EPA's Chronic Oral RfD: EPA, Office of Research and Development. Health Effects Assessment Summary Tables (HEAST). July 1997.
Iron	3.0×10^{-1}	NA	EPA's Chronic Oral RfD: EPA-NCEA provisional value
Lead	2.0×10^{-2}	NA	Acute LOAEL (human): http://www.atsdr.cdc.gov/toxprofiles/tp13.html
Mercury	3.0×10^{-4}	NA	ATSDR's Chronic Oral MRL for Methylmercury: http://www.atsdr.cdc.gov/toxprofiles/tp46.html
Silver	5.0×10^{-3}	NA	EPA's Chronic Oral RfD: http://www.epa.gov/iris/subst/0099.htm
Zinc	3.0×10^{-1}	NA	EPA's Chronic Oral RfD: http://www.epa.gov/iris/subst/0426.htm
Volatile and Semi-volatile Organic Compounds			
Benzene	4.0×10^{-3}	0.055	EPA's Chronic Oral RfD: http://www.epa.gov/iris/subst/0276.htm EPA's CSF: http://www.epa.gov/iris/subst/0276.htm
Benzo(a)anthracene	NA	0.73	EPA's CSF: EPA-NCEA provisional value
Benzo(a)pyrene	NA	7.3	EPA's CSF: http://www.epa.gov/iris/subst/0136.htm
Benzo(b)fluoranthene	NA	0.73	EPA's CSF: EPA-NCEA provisional value
Benzo(k)fluoranthene	NA	0.073	EPA's CSF: EPA-NCEA provisional value
Indeno(1,2,3-cd)pyrene	NA	0.73	EPA's CSF: EPA-NCEA provisional value
Pentachlorophenol	1.0×10^{-3}	0.12	ATSDR's Chronic Oral MRL: http://www.atsdr.cdc.gov/toxprofiles/tp51.html EPA's CSF: http://www.epa.gov/iris/subst/0086.htm

Table C-1. Noncancer Health Guidelines and Cancer Slope Factors Used in this Public Health Assessment (continued)

Chemical	*Health Guideline (mg/kg/day)*	*Cancer Slope Factor $(mg/kg/day)^{-1}$*	*Source*
Pesticides			
Aldrin	3.0×10^{-5}	17	ATSDR's Chronic Oral MRL: http://www.atsdr.cdc.gov/toxprofiles/tp1.html EPA's CSF: http://www.epa.gov/iris/subst/0130.htm
Chlordane	6.0×10^{-4}	0.35	ATSDR's Chronic Oral MRL: http://www.atsdr.cdc.gov/toxprofiles/tp31.html EPA's CSF: http://www.epa.gov/iris/subst/0142.htm
DDE	NA	0.34	EPA's CSF: http://www.epa.gov/iris/subst/0328.htm
DDT	5.0×10^{-4}	0.34	EPA's Chronic Oral RfD: http://www.epa.gov/iris/subst/0147.htm EPA's CSF: http://www.epa.gov/iris/subst/0147.htm
Dieldrin	5.0×10^{-5}	16	ATSDR's Chronic Oral MRL: http://www.atsdr.cdc.gov/toxprofiles/tp1.html EPA's CSF: http://www.epa.gov/iris/subst/0225.htm
Heptachlor epoxide	1.3×10^{-5}	9.1	EPA's Chronic Oral RfD: http://www.epa.gov/iris/subst/0160.htm EPA's CSF: http://www.epa.gov/iris/subst/0160.htm
PCBs			
Aroclor-1260	2.0×10^{-5}	2	ATSDR's Chronic Oral MRL for Aroclor-1254: http://www.atsdr.cdc.gov/toxprofiles/tp17.html EPA's CSF for PCBs: http://www.epa.gov/iris/subst/0294.htm
Total PCBs	2.0×10^{-5}	2	ATSDR's Chronic Oral MRL for Aroclor-1254: http://www.atsdr.cdc.gov/toxprofiles/tp17.html EPA's CSF for PCBs: http://www.epa.gov/iris/subst/0294.htm
Dioxins			
TCDD	1.0×10^{-9}	150,000	ATSDR's Chronic Oral MRL: http://www.atsdr.cdc.gov/toxprofiles/tp104.html EPA's CSF: EPA, Office of Research and Development. Health Effects Assessment Summary Tables (HEAST). July 1997.

CSF = cancer slope factor
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
EPA = U.S. Environmental Protection Agency
mg/kg/day = milligram per kilogram per day
MRL = minimal risk level
NA = not available
NCEA = National Center for Environmental Assessment
PCB = polychlorinated biphenyl
RFD = reference dose
TCDD = tetrachlorodibenzo-p-dioxin

Pensacola Bay and Bayou Grande Surface Water

The maximum concentrations for the majority of the chemicals detected in Pensacola Bay and Bayou Grande surface water were below their respective health-based comparison values. Concentrations below these levels are considered safe in essentially all exposure situations. The four chemicals with maximum concentrations that exceeded comparison values are listed in Table C-2. Remember that it does not automatically mean that an environmental concentration which exceeds a comparison value is expected to produce harmful health effects. Comparison values are not thresholds of toxicity. They simply indicate to ATSDR that further evaluation is warranted. Therefore, ATSDR continued to evaluate exposures to Pensacola Bay and Bayou Grande surface water for those chemicals listed in Table C-2. As the next step in the screening process, ATSDR calculated exposure doses using the following equation to estimate incidental ingestion of chemicals in the surface water when swimming:

$$\text{Estimated exposure dose} = \frac{C \times IR \times EF \times ED}{BW \times AT}$$

where:

- C: Concentration in milligrams per liter (mg/L)
- IR: Intake Rate: 0.15 L/day (the amount of water consumed during a 3-hour swim; EPA 1997)
- EF: Exposure Frequency: 150 days/year (swimming from May through September; EnSafe 1999a)
- ED: Exposure Duration: adult = 30 years, child = 6 years
- BW: Body Weight: adult = 70 kilograms (kg), child = 15.4 kg (mean body weight for a child 1 to 5 years old; EPA 1997)
- AT: Averaging Time: noncancer = ED*365 days/year; cancer/lifetime = 70 years*365 days/year

ATSDR applied this equation to the maximum concentration for the four contaminants measured above comparison values. Using these protective assumptions, only the child exposure dose for antimony exceeded the health guideline value (see following evaluation). The resulting exposure doses for all other chemicals were below noncancer health guidelines and cancer screening levels; and therefore, not of health concern (see Table C-2).

Table C-2. Exposure Doses for Chemicals with Maximum Concentrations Exceeding Comparison Values in Pensacola Bay and Bayou Grande Surface Water

Chemical	*Maximum Concentration (ppm)*	*Exposure Doses (mg/kg/day)*		*Health Guideline (mg/kg/day)*	*Cancer Slope Factor* $(mg/kg/day)^{-1}$	*Cancer Risk*
		Adult	*Child*			
Metals						
Antimony*	0.180	1.6×10^{-4}	**7.2×10^{-4}**	4.0×10^{-4}	NA	NA
Arsenic	0.0025	2.2×10^{-6}	1.0×10^{-5}	3.0×10^{-4}	1.5	1.4×10^{-6}
Silver	0.144	1.3×10^{-4}	5.8×10^{-4}	5.0×10^{-3}	NA	NA
Semi-volatile Organic Compound						
Pentachlorophenol*	0.005	4.4×10^{-6}	2.0×10^{-5}	1.0×10^{-3}	0.12	2.3×10^{-7}

Sources: EnSafe 1996e, 1999a

Bold text indicates that the exposure dose exceeded the health guideline for that chemical and/or the theoretical cancer risk exceeded 1×10^{-5}.
*These chemicals were only detected in one of 24 samples.
Doses were calculated using the following formulas:
child dose = ((maximum concentration)*0.15 liters/day*150 days/year*6 years)/(15.4 kg*(365 days/year*6 years))
adult dose = ((maximum concentration)*0.15 liters/day*150 days/year*30 years)/(70 kg*(365 days/year*30 years))
Cancer risk was calculated using the following formula:
risk = (cancer slope factor)*((maximum concentration)*0.15 liters/day*150 days/year*30 years)/(70 kg*(365 days/year*70 years))
mg/kg/day = milligrams per kilogram per day
NA = not applicable
ppm = parts per million

Antimony

Antimony is a silvery white metal that is naturally found in the environment. A few hours after entering the body, a small amount enters the bloodstream and mostly distributes to the liver, lungs, intestines, and spleen. Antimony then leaves the body in urine and feces over several weeks. Ingesting large quantities (19 parts per million; ppm) may induce vomiting, which prevents most of the antimony from entering the bloodstream (ATSDR 1992).

Only the child exposure dose for antimony exceeded the health guideline value. The exposure dose for an adult was below the health guideline; and therefore, not of health concern. The oral health guideline for antimony is based on a study in which health effects were seen in rats exposed to 3.5×10^{-1} milligrams per kilogram per day (mg/kg/day) of antimony in their drinking water (Schroeder et al. 1970). The estimated exposure dose for children incidentally ingesting surface water (7.2×10^{-4} mg/kg/day; see Table C-2) is about 500 times lower than this health effects level. Further, ATSDR assumed that people are being exposed to the maximum concentration of antimony (even though it is highly unlikely that anyone would be consistently exposed to the maximum concentration[2]) in the surface water for 150 days a year. Given these highly protective assumptions, ATSDR does not expect that incidentally ingesting surface water containing the detected levels of antimony while swimming in Pensacola Bay or Bayou Grande would cause harmful health effects.

Pensacola Bay and Bayou Grande Sediment

The maximum concentrations for the majority of the chemicals detected in Pensacola Bay and Bayou Grande sediment were below their respective health-based comparison values. Concentrations below these levels are considered safe in essentially all exposure situations. The 10 chemicals with maximum concentrations that exceeded comparison values are listed in Table C-3. Remember that it does not automatically mean that an environmental concentration which exceeds a comparison value is expected to produce harmful health effects. Comparison values are not thresholds of toxicity. They simply indicate to ATSDR that further evaluation is warranted. Therefore, ATSDR continued to evaluate exposures to Pensacola Bay and Bayou Grande sediment for those chemicals listed in Table C-3. As the next step in the screening process, ATSDR calculated exposure doses using the following equation to estimate incidental ingestion of chemicals in the sediment:

$$\text{Estimated exposure dose} = \frac{C \times IR \times EF \times ED}{BW \times AT}$$

where:

- C: Concentration in milligrams per kilogram (mg/kg)
- IR: Intake Rate: adult = 50 mg/day, child = 100 mg/day; 1 mg = 10^{-6} kg
- EF: Exposure Frequency: 150 days/year (swimming from May through September; EnSafe 1999a)
- ED: Exposure Duration: adult = 30 years, child = 6 years
- BW: Body Weight: adult = 70 kilograms (kg), child = 15.4 kg (mean body weight for a child 1 to 5 years old; EPA 1997)
- AT: Averaging Time: noncancer = ED*365 days/year; cancer/lifetime = 70 years*365 days/year

ATSDR applied this equation to the maximum concentration for the 10 contaminants measured above comparison values. Using these protective assumptions, none of the estimated doses exceeded the noncancer health guidelines. Only the theoretical cancer risk for benzo(a)pyrene exceeded cancer screening levels (see following evaluation). The resulting exposure doses for all other chemicals were below noncancer health guidelines and cancer screening levels; and therefore, not of health concern (see Table C-3).

[2] The mean concentration reported in EnSafe 1999a is 0.1379 ppm of antimony (antimony was not detected in EnSafe 1996e). Exposure to this mean concentration would result in a child dose of 5.5×10^{-4} mg/kg/day, which is over 600 times lower than the health effects level reported in the toxicologic literature.

Table C-3. Exposure Doses for Chemicals with Maximum Concentrations Exceeding Comparison Values in Pensacola Bay and Bayou Grande Sediment

Chemical	Maximum Concentration (ppm)	Exposure Doses (mg/kg/day)		Health Guideline (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Cancer Risk
		Adult	Child			
Metals						
Arsenic	22.3	6.5×10^{-6}	6.0×10^{-5}	3.0×10^{-4}	1.5	4.2×10^{-6}
Cadmium	24	7.0×10^{-6}	6.4×10^{-5}	2.0×10^{-4}	NA	NA
Chromium	238	7.0×10^{-5}	6.4×10^{-4}	3.0×10^{-3}	NA	NA
Iron	38,000	1.1×10^{-2}	1.0×10^{-1}	3.0×10^{-1}	NA	NA
Semi-volatile Organic Compounds						
Benzo(a)anthracene	44	1.3×10^{-5}	1.2×10^{-4}	NA	0.73	4.0×10^{-6}
Benzo(a)pyrene	21	6.2×10^{-6}	5.6×10^{-5}	NA	7.3	**1.9×10^{-5}**
Benzo(b)fluoranthene	19	5.6×10^{-6}	5.1×10^{-5}	NA	0.73	1.7×10^{-6}
Benzo(k)fluoranthene	16	4.7×10^{-6}	4.3×10^{-5}	NA	0.073	1.5×10^{-7}
Indeno(1,2,3-cd)pyrene	7.5	2.2×10^{-6}	2.0×10^{-5}	NA	0.73	6.9×10^{-7}
Pesticide						
Dieldrin	0.099	2.9×10^{-8}	2.6×10^{-7}	5.0×10^{-5}	16	2.0×10^{-7}

Sources: EnSafe 1996e, 1999a

Bold text indicates that the exposure dose exceeded the health guideline for that chemical and/or the theoretical cancer risk exceeded 1×10^{-5}.
Doses were calculated using the following formulas:
child dose = ((maximum concentration)*0.0001 kg/day*150 days/year*6 years)/(15.4 kg*(365 days/year*6 years))
adult dose = ((maximum concentration)*0.00005 kg/day*150 days/year*30 years)/(70 kg*(365 days/year*30 years))
Cancer risk was calculated using the following formula:
risk = (cancer slope factor)*((maximum concentration)* 0.00005 kg/day*150 days/year*30 years)/(70 kg*(365 days/year*70 years))
mg/kg/day = milligrams per kilogram per day
NA = not applicable
ppm = parts per million

Benzo(a)pyrene

Benzo(a)pyrene is one of 100 different polycyclic aromatic hydrocarbons (PAHs) that are formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances, such as tobacco and charbroiled meat (ATSDR 1995). PAHs usually occur naturally, but they can be manufactured as individual compounds for research purposes. Absorption is generally slow when PAHs are swallowed. They can enter all the tissues of the body that contain fat; however, they tend to be stored mostly in the kidneys, liver, and fat. PAHs are changed by all tissues in the body into many different substances. Results from animal studies show that PAHs do not tend to be stored in a person's body for a long time. Most PAHs that enter the body leave within a few days (ATSDR 1995).

Both adult and child exposure doses were below noncancer health guidelines. Therefore, ATSDR does not expect that people who incidentally ingest Pensacola Bay and Bayou Grande sediment would experience adverse noncancer health effects. The theoretical cancer risk indicated that ATSDR should carefully review the toxicology literature to evaluate potential cancer effects. DHHS has determined that benzo(a)pyrene is a known animal carcinogen. IARC has determined that benzo(a)pyrene is probably carcinogenic to humans and EPA has determined that benzo(a)pyrene is a probable human carcinogen (ATSDR 1995). Mice exposed to 2.6 and 33.3 mg/kg/day of benzo(a)pyrene developed tumors and carcinomas. These CELs are more than a million times higher than the estimated lifetime dose for benzo(a)pyrene (2.6×10^{-6} mg/kg/day). Further, the lifetime dose is based on exposure to the maximum concentration[3], which is an unrealistic exposure scenario. As such, no excess cancers from exposures to PAHs are expected from incidental ingestion of Pensacola Bay and Bayou Grande sediment.

Dermal Exposure to Sediments

Dermal exposure to chemicals detected below comparison values should not cause harmful health effects. In essentially all exposure situations, including dermal contact, comparison values are derived using conservative exposure assumptions that are protective of public health. Therefore, only those chemicals detected above comparison values are evaluated for exposure through dermal contact (see Table C-3).

Unlike the evaluation for incidental ingestion, dermal contact is not evaluated quantitatively through deriving exposure doses. Rather, this evaluation is a qualitative discussion of the chemical's potential to be absorbed into the body through the skin. Considerable uncertainty exists for quantitatively estimating dermal exposure, especially for contact with sediment because there is very little chemical-specific data available and the predictive techniques have not been well validated (EPA 1992).

In general, unless the skin is damaged, metals are not readily absorbed through the skin. PAHs can be absorbed through the skin and could lead to an increase in overall dose. However, even if it is conservatively assumed that the doses expected to result from dermal exposure are equal to the doses from incidental ingestion, the cumulative exposure doses are still well below levels of health concern. Pesticides, such as dieldrin, can also be absorbed through the skin, but in much smaller amounts than what is absorbed through the stomach. Exposure to dieldrin through dermal contact results in doses much lower than those estimated in Table C-3. Therefore, dermal exposure to the chemicals detected in Pensacola Bay and Bayou Grande sediment is also not expected to result in harmful health effects.

Pensacola Bay and Bayou Grande Biota

The maximum concentrations for the majority of the chemicals detected in Pensacola Bay and Bayou Grande fish, crabs, and oysters were below their respective health-based comparison values. Concentrations below these levels are considered safe in essentially all exposure

[3] The average concentration reported in EnSafe 2003, which reported the maximum concentration, was 0.687 ppm. Exposure to this mean concentration would result in a lifetime dose of 8.6×10^{-8} mg/kg/day, which is 30 million times lower than the CELs reported in the toxicologic literature.

situations. The chemicals with maximum concentrations that exceeded comparison values are listed in Table C-4 for fish and Table C-5 for shellfish. Remember, it does not automatically mean that an environmental concentration which exceeds a comparison value is expected to produce harmful health effects. Comparison values are not thresholds of toxicity. They simply indicate to ATSDR that further evaluation is warranted. Therefore, ATSDR continued to evaluate exposures from eating fish and shellfish caught in Pensacola Bay and Bayou Grande for those chemicals listed in Table C-4 and Table C-5. As the next step in the screening process, ATSDR calculated exposure doses using the following equation:

$$\text{Estimated exposure dose} = \frac{C \times IR \times EF \times ED}{BW \times AT}$$

where:

- C: Concentration in milligrams per kilogram (mg/kg)
- IR: Intake Rate: adult = 0.026 kg/day, child = 0.013 kg/day (95^{th} percentile recommendation for Gulf Coast recreational marine anglers; EPA 1997)
- EF: Exposure Frequency: 365 days/year
- ED: Exposure Duration: adult = 30 years, child = 6 years
- BW: Body Weight: adult = 70 kg, child = 15.4 kg (mean body weight for a child 1 to 5 years old; EPA 1997)
- AT: Averaging Time: noncancer = ED*365 days/year; cancer/lifetime = 70 years*365 days/year

Game Fish in Bayou Grande

ATSDR applied this equation to the maximum concentration (either measured or estimated) for those contaminants detected above comparison values in fish. Using these protective assumptions, only arsenic, polychlorinated biphenyls (PCBs), and dioxins exceeded the screening guidelines (see following evaluations). The resulting exposure doses for all other chemicals were below noncancer health guidelines and cancer screening levels; and therefore, not of health concern (see Table C-4).

Table C-4. Exposure Doses for Chemicals with Maximum Concentrations Exceeding Comparison Values in Game Fish Caught in Bayou Grande

Chemical	Maximum Concentration (ppm)	Exposure Doses (mg/kg/day)		Health Guideline (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Cancer Risk
		Adult	Child			
Metals						
Arsenic*	0.61 (measured)	4.5×10^{-5}	1.0×10^{-4}	3.0×10^{-4}	1.5	**2.9×10^{-5}**
Mercury	0.26 (estimated)	9.7×10^{-5}	2.2×10^{-4}	3.0×10^{-4}	NA	NA
Pesticides						
Aldrin	0.00066 (estimated)	2.5×10^{-7}	5.6×10^{-7}	3.0×10^{-5}	17	1.8×10^{-6}
DDE	0.043 (estimated)	1.6×10^{-5}	3.6×10^{-5}	NA	0.34	2.3×10^{-6}
Dieldrin	0.0014 (estimated)	5.2×10^{-7}	1.2×10^{-6}	5.0×10^{-5}	16	3.6×10^{-6}
PCBs						
Aroclor-1260	0.37 (estimated)	**1.4×10^{-4}**	**3.1×10^{-4}**	2.0×10^{-5}	2	**1.2×10^{-4}**
Total PCBs	0.0147(measured)	5.5×10^{-6}	1.2×10^{-5}	2.0×10^{-5}	2	4.7×10^{-6}
Dioxins						
Total dioxin TEQ	0.000001 (measured)	3.7×10^{-10}	8.4×10^{-10}	1.0×10^{-9}	150,000	**2.4×10^{-5}**

Sources: EnSafe 1999a, 2003; N. Karouna-Renier, University of West Florida, personal communication, May 2005

*When calculating exposure doses, ATSDR assumed that 20% of the total arsenic detected was inorganic arsenic.
Bold text indicates that the exposure dose exceeded the health guideline for that chemical and/or the theoretical cancer risk exceeded 1×10^{-5}.
Doses were calculated using the following formulas:
child dose = ((maximum concentration)*0.013 kg/day*365 days/year*6 years)/(15.4 kg*(365 days/year*6 years))
adult dose = ((maximum concentration)*0.026 kg/day*365 days/year*30 years)/(70 kg*(365 days/year*30 years))
Cancer risk was calculated using the following formula:
risk = (cancer slope factor)*((maximum concentration)* 0.026 kg/day*365 days/year*30 years)/(70 kg*(365 days/year*70 years))
DDE = dichlorodiphenyldichloroethylene
mg/kg/day = milligrams per kilogram per day
NA = not applicable
PCB = polychlorinated biphenyl
ppm = parts per million
TEQ = toxic equivalency quotient

Arsenic

Although elemental arsenic sometimes occurs naturally, arsenic is usually found in the environment in two forms—inorganic (arsenic combined with oxygen, chlorine, and sulfur) and organic (arsenic combined with carbon and hydrogen). The organic forms of arsenic are usually less toxic than the inorganic forms (ATSDR 2000a). Once in the body, the liver changes some of the inorganic arsenic into the less harmful organic form (i.e., by methylation). This process is effective as long as the dose of inorganic arsenic remains below 5.0×10^{-2} mg/kg/day (ATSDR 2000a). Both inorganic and organic forms of arsenic leave the body in urine. Studies have shown that 45–85 percent of the arsenic is eliminated within one to three days (Buchet et al. 1981; Crecelius 1977; Mappes 1977; Tam et al. 1979); however, some will remain for several months or longer.

Because inorganic arsenic is much more harmful than organic arsenic, ATSDR based its health assessment on the levels of inorganic arsenic that are present. In fish, generally about 1–20% of the total arsenic is in the more harmful inorganic form (ATSDR 2000a; Francesconi and Edmonds 1997; NAS 2001b; FDA 1993). The United States Food and Drug Administration proposes that 10% of the total arsenic be estimated as inorganic arsenic (FDA 1993). To be conservative, ATSDR used a conversion factor of 20% in the numerator of the dose equation to calculate the estimated dose from exposure to inorganic arsenic (i.e., ATSDR conservatively assumed that 20% of the total arsenic detected was inorganic arsenic).

Both adult and child exposure doses were below noncancer health guidelines. Therefore, ATSDR does not expect that people who eat fish caught in Bayou Grande would experience adverse noncancer health effects. The theoretical cancer risk indicated that ATSDR should carefully review the toxicology literature to evaluate potential cancer effects. DHHS, IARC, and EPA have all independently determined that inorganic arsenic is carcinogenic to humans (ATSDR 2000a). Skin cancer was reported for people exposed to 1.4×10^{-2} mg/kg/day of arsenic in their water for more than 45 years (Tseng et al. 1968). However, there is much uncertainty surrounding the reported dose. Specifically, the full extent of arsenic intake from dietary sources and the health status of the study population are not well documented. Because estimates of water intake and dietary arsenic are highly uncertain in this and similar studies, some scientists argue that this CEL may be underestimated (i.e., doses associated with cancer may actually be higher). Additional CELs in the literature generally ranged from 1.0×10^{-2}–5.0×10^{-2} mg/kg/day (ATSDR 2000a). The estimated lifetime dose (1.9×10^{-5} mg/kg/day) is over five hundred times below these levels of health concern for cancer effects. As such, no excess cancers from arsenic exposures are expected from recreationally eating fish caught in Bayou Grande. Further, the metabolism of arsenic has been well-studied in people and the estimated exposure doses for eating fish from Bayou Grande are within the body's capability to metabolize arsenic; therefore, ATSDR does not expect that people who eat the fish would experience adverse health effects.

Polychlorinated Biphenyls

PCBs are a group of synthetic organic chemicals that can cause a number of different harmful effects. There are no known natural sources of PCBs in the environment. Because they don't burn easily and are good insulating materials, PCBs were used widely as coolants and lubricants in transformers, capacitors, and other electrical equipment. The manufacture of PCBs stopped in the United States in August 1977, because there was evidence that PCBs build up in the environment and may cause harmful effects (ATSDR 2000b).

PCBs enter the environment as mixtures containing a variety of individual chlorinated biphenyl components, known as congeners. There are 209 possible PCB congeners. Aroclors are commercial PCB mixtures, containing different congener compositions. Aroclors widely used in the United States were 1016, 1232, 1242, 1248, 1254, and 1260. The first two digits indicate the type of mixture and second two digits reveal how much chlorine by weight is in the mixture.

Both adult and child exposure doses were above the noncancer health guideline. The oral health guideline for PCBs is based on a study in which health effects were observed in female rhesus monkeys chronically exposed to 5.0×10^{-3} mg/kg/day of Aroclor-1254 (Arnold et al. 1993a; Tryphonas et al. 1989, 1991). This is the lowest-observed-adverse-effect-level (LOAEL) identified in the scientific literature for chronic exposure to PCB mixtures. The exposure doses ATSDR estimated using the maximum concentration of Aroclor-1260 (1.4×10^{-4} mg/kg/day for adults and 3.1×10^{-4} mg/kg/day for children, see Table C-4) are an order of magnitude below the lowest health effect level reported in the scientific literature. Because the exposure doses are below the LOAEL and based on people regularly catching and consuming fish with the maximum concentration of Aroclor-1260, ATSDR does not expect harmful noncancer health effects to occur from eating fish from Bayou Grande.

The theoretical cancer risk indicated that ATSDR should carefully review the toxicology literature to evaluate potential cancer effects. DHHS has stated that PCBs may reasonably be anticipated to be carcinogens. Both EPA and IARC have determined that PCBs are probably carcinogenic to humans. Cancer incidence was studied in cohorts of fishermen from the Swedish east and west coasts, who had high intakes of PCBs in fish (Svensson et al. 1995). There was an indication that the incidence of stomach cancer was elevated, however, the results were confounded by exposure to other contaminants in the fish. The estimated lifetime exposure dose from ingesting Bayou Grande fish (5.9×10^{-5} mg/kg/day) is well below the CELs reported in the literature (CELs ranged from 1.0–5.4 mg/kg/day in animals; no CELs exist for humans; ATSDR 2000b). As such, no excess cancers from PCB exposures are expected from recreational consumption of fish caught in Bayou Grande.

Further, ATSDR estimated doses based on the maximum concentration of Aroclor-1260 *estimated* from prey fish. The actual measured total PCB concentration in game fish caught from Bayou Grande was more than an order of magnitude lower (see Table C-4).

Dioxins

Dioxins are a family of 75 different compounds that have varying harmful effects. They are divided into eight groups based on the number of chlorine atoms, which can be attached to the dioxin/furan molecule at any one of eight positions. The name of each dioxin or furan indicates both the number and the positions of the chlorine atoms. For example, the dioxin with four chlorine atoms at positions 2, 3, 7, and 8 on the molecule is called 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), which is one of the most toxic of the dioxins to mammals and has received the most attention (ATSDR 1998).

The most common way for dioxins to enter the body is through eating food contaminated with dioxins. In general, absorption of dioxins is vehicle-dependent and congener-specific—about 87 percent of TCDD was absorbed in one human volunteer who ingested a single dose (Poiger and Schlatter 1986). Dioxins are lipophilic, meaning that they are attracted to lipids (fats) and tend to accumulate in body parts that have more fat, such as the liver. They can also concentrate in maternal milk. The body can store dioxins in the liver and body fat for many years before eliminating them.

A toxic equivalency factor (TEF) approach to evaluating health hazards has been developed for dioxins (see ATSDR 1998 for more details). In short, the TEF approach compares the relative potency of individual dioxins and furans with that of TCDD, the best-studied member of this chemical class. The concentration or dose of each dioxin and furan is multiplied by its TEF to arrive at a toxic equivalent (TEQ), and the TEQs are added to give the total toxic equivalency. The total toxic equivalency is then compared to reference exposure levels for TCDD expected to be without significant risk for producing health hazards.

Both adult and child exposure doses were below the noncancer health guideline. Therefore, ATSDR does not expect that people who eat fish from Bayou Grande would experience adverse noncancer health effects. The theoretical cancer risk indicated that ATSDR should carefully review the toxicology literature to evaluate potential cancer effects. DHHS has determined that it is reasonable to expect that TCDD may cause cancer. IARC has determined that TCDD can cause cancer in people, but that it is not possible to classify other dioxins as to their carcinogenicity to humans. EPA has determined that TCDD is a probable human carcinogen (ATSDR 1998). However, the estimated lifetime exposure dose from ingesting Bayou Grande fish (1.6×10^{-10} mg/kg/day) is over a million times below the CELs reported in the literature (CELs ranged from 0.0071–0.36 mg/kg/day; ATSDR 1998). As such, no excess cancers from dioxin exposures are expected from recreationally eating fish caught in Bayou Grande.

Shellfish in Pensacola Bay and Bayou Grande

ATSDR applied the same equation for fish to the maximum concentration for those contaminants measured above comparison values in shellfish. Using these protective assumptions, arsenic, cadmium, copper, zinc, and dioxins exceeded the screening guidelines (see following evaluations). The resulting exposure doses for all other chemicals were below noncancer health guidelines and cancer screening levels; and therefore, not of health concern (see Table C-5).

Table C-5. Exposure Doses for Chemicals with Maximum Concentrations Exceeding Comparison Values in Shellfish Caught in Pensacola Bay and Bayou Grande

Chemical	*Maximum Concentration (ppm)*			*Exposure Doses (mg/kg/day)*						*Health Guideline (mg/kg/day)*
	*Edible Portion of Crab**	*Crab Hepato-pancreas*	*Oyster Tissue*[§]	*Edible Portion of Crab**		*Crab Hepatopancreas*		*Oyster Tissue*[§]		
				Adult	*Child*	*Adult*	*Child*	*Adult*	*Child*	
Metals										
Arsenic	1.85	3.8	1.8	**6.9×10^{-4}**	**1.6×10^{-3}**	**1.4×10^{-3}**	**3.2×10^{-3}**	**6.7×10^{-4}**	**1.5×10^{-3}**	3.0×10^{-4}
Inorganic arsenic	0.024	0.076	0.018	8.9×10^{-6}	2.0×10^{-5}	2.8×10^{-5}	6.4×10^{-5}	6.7×10^{-6}	1.5×10^{-5}	3.0×10^{-4}
Cadmium	0.76	4.6	0.61	**2.8×10^{-4}**	**6.4×10^{-4}**	**1.7×10^{-3}**	**3.9×10^{-3}**	**2.3×10^{-4}**	**5.1×10^{-4}**	2.0×10^{-4}
Copper	15.25	58	56	5.7×10^{-3}	1.3×10^{-2}	2.2×10^{-2}	**4.9×10^{-2}**	2.1×10^{-2}	**4.7×10^{-2}**	4.0×10^{-2}
Mercury	0.21	0.14	0.017	7.8×10^{-5}	1.8×10^{-4}	5.2×10^{-5}	1.2×10^{-4}	6.3×10^{-6}	1.4×10^{-5}	3.0×10^{-4}
Zinc	59.1	46	1,000	2.2×10^{-2}	5.0×10^{-2}	1.7×10^{-2}	3.9×10^{-2}	**3.7×10^{-1}**	**8.4×10^{-1}**	3.0×10^{-1}
Pesticides										
Aldrin	0.00093	NS	NS	3.5×10^{-7}	7.9×10^{-7}	NS	NS	NS	NS	3.0×10^{-5}
DDT	0.0096	NS	NS	3.6×10^{-6}	8.1×10^{-6}	NS	NS	NS	NS	5.0×10^{-4}
Heptachlor epoxide	0.0025	NS	NS	9.3×10^{-7}	2.1×10^{-6}	NS	NS	NS	NS	1.3×10^{-5}
Dioxins										
Total dioxin TEQ	4.7×10^{-6}	2.8×10^{-5}	4.2×10^{-6}	**1.8×10^{-9}**	**4.0×10^{-9}**	**1.0×10^{-8}**	**2.4×10^{-8}**	**1.6×10^{-9}**	**3.6×10^{-9}**	1.0×10^{-9}

Sources: EnSafe 1996e; Karouna-Renier et al. 2005

*Edible portion of crab includes either the crab muscle alone or crab muscle with a portion of the hepatopancreas (calculated as 15% of the total edible mass; Karouna-Renier et al. 2005).

§Collected from one location in Bayou Grande near NASP.

Bold text indicates that the exposure dose exceeded the health guideline for that chemical and/or the theoretical cancer risk exceeded 1×10^{-5}.

Doses were calculated using the following formulas:

child dose = ((maximum concentration)*0.013 kg/day*365 days/year*6 years)/(15.4 kg*(365 days/year*6 years))

adult dose = ((maximum concentration)*0.026 kg/day*365 days/year*30 years)/(70 kg*(365 days/year*30 years))

DDT = dichlorodiphenyltrichloroethane
NA = not applicable
ppm = parts per million
mg/kg/day = milligrams per kilogram per day
NS = not sampled
TEQ = toxic equivalency quotient

Table C-5. Exposure Doses for Chemicals with Maximum Concentrations Exceeding Comparison Values in Shellfish Caught in Pensacola Bay and Bayou Grande (continued)

Chemical	*Maximum Concentration (ppm)*			*Cancer Risk*			*Cancer Slope Factor (mg/kg/day)$^{-1}$*
	*Edible Portion of Crab**	*Crab Hepatopancreas*	*Oyster Tissue§*	*Edible Portion of Crab**	*Crab Hepatopancreas*	*Oyster Tissue§*	
Metals							
Arsenic	1.85	3.8	1.8	**4.4×10^{-4}**	**9.1×10^{-4}**	**4.3×10^{-4}**	1.5
Inorganic arsenic	0.024	0.076	0.018	5.7×10^{-6}	**1.8×10^{-5}**	4.3×10^{-6}	1.5
Cadmium	0.76	4.6	0.61	NA	NA	NA	NA
Copper	15.25	58	56	NA	NA	NA	NA
Mercury	0.21	0.14	0.017	NA	NA	NA	NA
Zinc	59.1	**46**	1,000	NA	NA	NA	NA
Pesticides							
Aldrin	0.00093	NS	NS	2.5×10^{-6}	NS	NS	17
DDT	0.0096	NS	NS	5.2×10^{-7}	NS	NS	0.34
Heptachlor epoxide	0.0025	NS	NS	3.6×10^{-6}	NS	NS	9.1
Dioxins							
Total dioxin TEQ	4.7×10^{-6}	2.8×10^{-5}	4.2×10^{-6}	**1.1×10^{-4}**	**6.7×10^{-4}**	**1.0×10^{-4}**	150,000

Sources: EnSafe 1996e; Karouna-Renier et al. 2005

*Edible portion of crab includes either the crab muscle alone or crab muscle with a portion of the hepatopancreas (calculated as 15% of the total edible mass; Karouna-Renier et al. 2005).
§Collected from one location in Bayou Grande near NASP.
Bold text indicates that the exposure dose exceeded the health guideline for that chemical and/or the theoretical cancer risk exceeded 1×10^{-5}.
Cancer risk was calculated using the following formula:
risk = (cancer slope factor)*((maximum concentration)* 0.026 kg/day*365 days/year*30 years)/(70 kg*(365 days/year*70 years))
DDT = dichlorodiphenyltrichloroethane
mg/kg/day = milligrams per kilogram per day
NA = not applicable
NS = not sampled
ppm = parts per million
TEQ = toxic equivalency quotient

Arsenic

Although elemental arsenic sometimes occurs naturally, arsenic is usually found in the environment in two forms—inorganic (arsenic combined with oxygen, chlorine, and sulfur) and organic (arsenic combined with carbon and hydrogen). The organic forms of arsenic are usually less toxic than the inorganic forms (ATSDR 2000a). Once in the body, the liver changes some of the inorganic arsenic into the less harmful organic form (i.e., by methylation). This process is effective as long as the dose of inorganic arsenic remains below 5.0×10^{-2} mg/kg/day (ATSDR 2000a). Both inorganic and organic forms of arsenic leave the body in urine. Studies have shown that 45–85 percent of the arsenic is eliminated within one to three days (Buchet et al. 1981; Crecelius 1977; Mappes 1977; Tam et al. 1979); however, some will remain for several months or longer.

All of the estimated exposure doses for arsenic exceeded the health guideline value. However, the metabolism (i.e., how it is broken down in the body) of inorganic arsenic has been extensively studied in humans and animals, and all of the estimated doses (6.7×10^{-6}–3.2×10^{-3} mg/kg/day; see Table C-5) are below those that inhibit the body's ability to detoxify or change arsenic to non-harmful forms (doses greater than 5.0×10^{-2} mg/kg/day inhibit detoxification). Therefore, normal metabolic processes in the body should control the amount of arsenic that a person consumes in shellfish from Pensacola Bay and Bayou Grande.

There is some indication in the scientific literature, however, that dermal health effects could result from ingesting a lower dose of arsenic—hyperkeratosis and hyperpigmentation were reported in humans exposed to 1.4×10^{-2} mg/kg/day of arsenic in their drinking water for more than 45 years (Tseng et al. 1968). However, there is much uncertainty surrounding the reported dose. Because estimates of water intake and dietary arsenic are highly uncertain in this and similar studies, some scientists argue that reported effects may actually be associated with doses higher than 1.4×10^{-2} mg/kg/day. Specifically, the full extent of arsenic intake from dietary sources and the health status of the study population are not well documented.

Given the fact that the metabolism of arsenic has been well-studied in people and the estimated exposure doses for eating shellfish from Pensacola Bay and Bayou Grande are within the body's capability to metabolize arsenic, ATSDR does not expect that people who eat crabs or oysters would experience adverse noncancer health effects.

The theoretical cancer risk indicated that ATSDR should carefully review the toxicology literature to evaluate potential cancer effects. DHHS, IARC, and EPA have all independently determined that inorganic arsenic is carcinogenic to humans (ATSDR 2000a). Skin cancer was reported for people exposed to 1.4×10^{-2} mg/kg/day of arsenic in their water for more than 45 years (Tseng et al. 1968). However, as noted above, there is much uncertainty surrounding the reported dose. Because estimates of water intake and dietary arsenic are highly uncertain in this and similar studies, some scientists argue that this CEL may be underestimated (i.e., doses associated with cancer may actually be higher). Additional CELs in the literature generally ranged from 1.0×10^{-2}–5.0×10^{-2} mg/kg/day (ATSDR 2000a). The estimated lifetime doses (2.9×10^{-6}–2.9×10^{-4} mg/kg/day) are a hundred times below these levels of health concern for cancer effects. As such, no excess cancers from arsenic exposures are expected from recreationally eating crabs or oysters caught in Pensacola Bay and Bayou Grande.

Cadmium

Cadmium is an element that occurs naturally in the earth's crust. It is not usually present in the environment as a pure metal, but as a mineral combined with other elements such as oxygen (cadmium oxide), chlorine (cadmium chloride), or sulfur (cadmium sulfate, cadmium sulfide) (ATSDR 1999b). Generally, the main sources of cadmium exposure are through smoking cigarettes and, to a lesser extent, eating foods contaminated with cadmium. However, only about 5 to 10% of ingested cadmium is actually absorbed by the body; the majority is passed out of the body in feces (McLellan et al. 1978; Rahola et al. 1973). Cadmium that is absorbed goes to the kidneys and liver. Once absorbed, cadmium tends to remain in the body for years. The body changes most of the cadmium into a form that is not harmful, but if too much cadmium is absorbed, the liver and kidneys cannot convert all of it into the harmless form (Kotsonis and Klaassen 1978; Sendelbach and Klaassen 1988).

All of the estimated exposure doses for cadmium exceeded the health guideline value. The oral health guideline for cadmium is based on a study of people who ate contaminated rice for up to 70 years and experienced no adverse health effects at doses of 2.1×10^{-3} mg/kg/day (Nogawa et al. 1989). The estimated exposure doses for eating crab muscle and oysters are below this health effects level (2.3×10^{-4}–6.4×10^{-4} mg/kg/day; see Table C-5). However, the estimated dose for children eating crab hepatopancreas (3.9×10^{-3} mg/kg/day) exceeded this no-observed-adverse-effects level (NOAEL). Even though estimated doses that slightly exceed the NOAEL do not indicate that an adverse health effect will occur because NOAELs indicate a level in which **no** adverse health effects were observed, it would be a prudent public health practice for children to limit their intake of crab hepatopancreas.

Copper

Copper is a naturally occurring metal. Once ingested, it is absorbed by the stomach and small intestines, enters the bloodstream, and is distributed throughout the body. However, the body has homeostatic mechanisms that effectively block high levels from entering the bloodstream (ATSDR 2002b). Several factors affect the absorption of copper, including competition with other metals, such as cadmium, iron, and zinc; the amount of copper in a person's diet; and age (ATSDR 2002b).

Copper is essential for good health. It is required for normal functioning of at least 30 enzymes (ATSDR 2002b) and aids in the absorption and utilization of iron and in the production of hemoglobin, which transports oxygen in the body. However, even though the body is very good at regulating how much copper enters the bloodstream, excessive intakes can cause harmful health effects (ATSDR 2002b).

Only the child exposure doses for copper exceeded the health guideline value. The exposure doses for an adult were below the health guideline; and therefore, not of health concern. Very few toxicological and epidemiological studies are available for copper, and those that are available suffer from design flaws and involve only a few subjects (NAS 2001a). The National Academy of Sciences reports that no adverse effects were observed at doses of 10 mg/day (NAS 2001a). Therefore, for comparison, ATSDR calculated a daily consumption from exposure to the maximum concentration of copper in shellfish using a modification of the dose equation (Dose = Conc. x IR); and compared this daily dose to the level determined by the National Academy of Sciences to be safe (10 mg/day).

Eating crab muscle, crab hepatopancreas, and oysters from Pensacola Bay and Bayou Grande would increase a child's daily consumption of copper by about 0.2 mg/day, 0.7 mg/day, and 0.8 mg/day, respectively. The median copper intake in the United States from food is approximately 1.0–1.6 mg/day (NAS 2001a). Therefore, the relatively small daily increases in consumption (from eating shellfish) are not likely to increase a child's daily dose above the National Academy of Sciences' NOAEL of 10 mg/day. Therefore, copper concentrations in shellfish from Pensacola Bay and Bayou Grande are not expected to cause adverse health effects.

Zinc

Zinc is an essential nutrient that is needed by the body for normal growth, bone formation, brain development, behavioral response, reproduction, fetal development, sensory function, immune function, membrane stability, and wound healing. Too little zinc can lead to poor health, reproductive problems, and a lowered resistance to disease (ATSDR 2003). Zinc absorption in humans (8–81%) varies with the amount of zinc ingested and the amount and kind of food eaten (ATSDR 2003). The body uses a homeostatic mechanism to control zinc absorption in the gastrointestinal tract (Davies 1980). People with adequate nutritional levels of zinc tend to absorb 20–30% of ingested zinc, whereas people with zinc deficiencies absorb more (Johnson et al. 1988; Spencer et al. 1985).

Only the exposure doses for eating oysters exceeded the health guideline value. The exposure doses for eating crab muscle and hepatopancreas were below the health guideline; and therefore, not of health concern. The oral health guideline for zinc is based on a study in which hematological health effects were observed when people were given doses of 0.83 mg/kg/day of zinc in capsule form for 10 weeks (Yadrick et al. 1989) and is supported by several other studies that investigated effects from zinc supplementation (see EPA 2005c). The estimated exposure doses for adults (0.37 mg/kg/day) eating oysters from Bayou Grande are below this health effects level. Even though the estimated dose for children (0.84 mg/kg/day) is slightly above this level, ATSDR does not expect that eating oysters will result in harmful health effects. These doses are based on only one sample collected from Bayou Grande, which happened to be the second highest concentration detected in the study. When exposure doses are calculated using the average concentration of zinc from all 23 samples collected throughout the Pensacola Bay area (326 ppm), the resulting doses (0.12 mg/kg/day for adults and 0.28 mg/kg/day for children) are below the health effect level.

Dioxins

Dioxins are a family of 75 different compounds that have varying harmful effects. They are divided into eight groups based on the number of chlorine atoms, which can be attached to the dioxin/furan molecule at any one of eight positions. The name of each dioxin or furan indicates both the number and the positions of the chlorine atoms. For example, the dioxin with four chlorine atoms at positions 2, 3, 7, and 8 on the molecule is called TCDD, which is one of the most toxic of the dioxins to mammals and has received the most attention (ATSDR 1998).

The most common way for dioxins to enter the body is through eating food contaminated with dioxins. In general, absorption of dioxins is vehicle-dependent and congener-specific—about 87 percent of TCDD was absorbed in one human volunteer who ingested a single dose (Poiger and Schlatter 1986). Dioxins are lipophilic, meaning that they are attracted to lipids (fats) and tend to accumulate in body parts that have more fat, such as the liver. They can also concentrate in maternal milk. The body can store dioxins in the liver and body fat for many years before eliminating them.

A TEF approach to evaluating health hazards has been developed for dioxins (see ATSDR 1998 for more details). In short, the TEF approach compares the relative potency of individual dioxins and furans with that of TCDD, the best-studied member of this chemical class. The concentration or dose of each dioxin and furan is multiplied by its TEF to arrive at a TEQ, and the TEQs are added to give the total toxic equivalency. The total toxic equivalency is then compared to reference exposure levels for TCDD expected to be without significant risk for producing health hazards.

Consuming shellfish from Pensacola Bay and Bayou Grande would result in exposure doses ranging from 2.4×10^{-8} to 1.6×10^{-9} mg/kg/day (see Table C-5). The oral health guideline for the most toxic dioxin, TCDD, is based on a study in which health effects were observed in female Rhesus monkeys fed a diet containing 1.2×10^{-7} mg/kg/day of TCDD (Schantz et al. 1992). The estimated exposure doses for crab muscle and oysters are two orders of magnitude lower than this health effects level. Further, dioxins are a well-studied family of compounds, and this dose is the lowest health effects level reported in the 33 chronic-duration studies on TCDD. Therefore, ATSDR does not expect that eating crab muscle and oysters with the detected levels of dioxin would cause harmful noncancer health effects. However, the estimated exposure doses for crab hepatopancreas are within an order of magnitude of this health effects levels. Therefore, it would be a prudent public health practice to limit consumption of crab hepatopancreas.

The theoretical cancer risk indicated that ATSDR should carefully review the toxicology literature to evaluate potential cancer effects. DHHS has determined that it is reasonable to expect that TCDD may cause cancer. IARC has determined that TCDD can cause cancer in people, but that it is not possible to classify other dioxins as to their carcinogenicity to humans. EPA has determined that TCDD is a probable human carcinogen (ATSDR 1998). However, the estimated lifetime exposure doses from ingesting Pensacola Bay and Bayou Grande shellfish (6.7×10^{-10}–4.5×10^{-9} mg/kg/day) are over a million times below the CELs reported in the literature (CELs ranged from 0.0071–0.36 mg/kg/day; ATSDR 1998). As such, no excess cancers from dioxin exposures are expected from recreationally eating crabs and oysters caught in Pensacola Bay and Bayou Grande.

Drinking Water Supplies

In 1993, pesticides and volatile organic compounds (VOCs) were detected in the Corry Station wells (NFWMD 1995). Of these, only dieldrin, chlordane, heptachlor epoxide, and benzene had maximum concentrations higher than comparison values (see Table C-6). Remember, it does not automatically mean that an environmental concentration which exceeds a comparison value is expected to produce harmful health effects. Comparison values are not thresholds of toxicity. They simply indicate to ATSDR that further evaluation is warranted. Therefore, ATSDR continued to evaluate past exposure to contaminants in the Corry Station wells for those chemicals listed in Table C-6. As the next step in the screening process, ATSDR calculated exposure doses using the following equation to estimate ingestion of chemicals in the water:

$$\text{Estimated exposure dose} = \frac{C \times IR \times EF \times ED}{BW \times AT}$$

where:

- C: Concentration in mg/L (ppm)
- IR: Intake Rate: adult = 2 liter, child = 1 liter
- EF: Exposure Frequency: 365 days/year
- ED: Exposure Duration: adult = 30 years, child = 6 years
- BW: Body Weight: adult = 70 kg, child = 10 kg
- AT: Averaging Time: noncancer = ED*365 days/year; cancer/lifetime = 70 years*365 days/year

ATSDR applied this equation to the maximum concentration for the four contaminants measured above comparison values. Using these protective assumptions, only dieldrin exceeded the screening guidelines (see following evaluation). The resulting exposure doses for all other chemicals were below noncancer health guidelines and cancer screening levels; and therefore, not of health concern (see Table C-6).

Table C-6. Exposure Doses for Chemicals with Maximum Concentrations Exceeding Comparison Values in Corry Station Wells

Chemical	Maximum Concentration (ppm)	Comparison Value (ppm)	Exposure Doses (mg/kg/day)		Health Guideline (mg/kg/day)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Cancer Risk
			Adult	Child			
Pesticides							
Chlordane	0.00023	0.0001 CREG	6.6×10^{-6}	2.3×10^{-5}	6.0×10^{-4}	0.35	9.9×10^{-7}
Dieldrin	0.0013	0.000002 CREG	3.7×10^{-5}	**1.3×10^{-4}**	5.0×10^{-5}	16	**2.5×10^{-4}**
Heptachlor epoxide	0.000035	0.000004 CREG	1.0×10^{-6}	3.5×10^{-6}	1.3×10^{-5}	9.1	3.9×10^{-6}
Volatile Organic Compound							
Benzene	0.0061	0.0006 CREG	1.7×10^{-4}	6.1×10^{-4}	4.0×10^{-3}	0.055	4.1×10^{-6}

Source: NFWMD 1995

Bold text indicates that the exposure dose exceeded the health guideline for that chemical and/or the theoretical cancer risk exceeded 1×10^{-5}.
Doses were calculated using the following formulas:
child dose = ((maximum concentration)*1 liter/day*365 days/year*6 years)/(10 kg*(365 days/year*6 years))
adult dose = ((maximum concentration)*2 liters/day*365 days/year*30 years)/(70 kg*(365 days/year*30 years))
Cancer risk was calculated using the following formula:
risk = (cancer slope factor)*((maximum concentration)*2 liters/day*365 days/year*30 years)/(70 kg*(365 days/year*70 years))
CREG = cancer risk evaluation guide
mg/kg/day = milligrams per kilogram per day
ppm = parts per million

Dieldrin

Dieldrin is a man-made chemical that was used as an insecticide until 1970, when the U.S. Department of Agriculture canceled all uses. Although EPA approved the use of dieldrin for killing termites in 1972, in 1987, the manufacturer voluntarily canceled the registration (ATSDR 2002a). Studies in animals show that dieldrin enters the body quickly after exposure and is stored in fat. It stays in fat tissue for a long time and can change to other products. It can take many weeks or years for dieldrin and its breakdown products to leave a person's body. Animals or fish that eat other animals have levels of dieldrin in their fat many times higher than animals or fish that eat plants (ATSDR 2002a).

The child exposure dose for dieldrin exceeded the health guideline value, which is based on a study in which rats were fed diets containing dieldrin for two years and experienced no adverse health effects at doses of 5.0×10^{-3} mg/kg/day (Walker et al. 1969). The estimated exposure dose for children drinking water is below this health effects level (1.3×10^{-4} mg/kg/day; see Table C-6). Further, ATSDR assumed that children would drink the maximum dieldrin concentration every day (even though it is highly unlikely that anyone would be consistently exposed to the maximum concentration). Given these highly protective assumptions, ATSDR does not expect that drinking water from the Corry Station wells containing the detected levels of dieldrin would cause harmful health effects.

The theoretical cancer risk indicated that ATSDR should carefully review the toxicology literature to evaluate potential cancer effects. DHHS and IARC have determined that dieldrin is not classifiable as to its carcinogenicity to humans (ATSDR 2002a). EPA has determined that dieldrin is a probable human carcinogen because orally administered dieldrin produced significant increases in tumor responses in seven different strains of mice (EPA 2005c). However, drinking water with the maximum concentration of dieldrin found in the Corry Station wells is not expected to result in an increase in cancer because the expected lifetime dose (1.6×10^{-5} mg/kg/day) is over twenty thousand times lower than the CELs reported in the scientific literature (CELs ranged from 0.33–1.3 mg/kg/day; ATSDR 2002a). As such, no excess cancers from dieldrin exposures are expected from drinking water from the Corry Station wells.

Scout Camping Near an Inactive Landfill (Site 1)

The Navy identified eight chemicals of potential concern in the surface soil of the landfill (Site 1) (EnSafe 1998b). Of these, only two metals had maximum concentrations higher than comparison values (see Table C-7). Remember, it does not automatically mean that an environmental concentration which exceeds a comparison value is expected to produce harmful health effects. Comparison values are not thresholds of toxicity. They simply indicate to ATSDR that further evaluation is warranted. Therefore, ATSDR continued to evaluate potential trespassing exposures to landfill surface soil for those chemicals listed in Table C-7. As the next step in the screening process, ATSDR calculated exposure doses using the following equation to estimate incidental ingestion of chemicals in the surface soil:

$$\text{Estimated exposure dose} = \frac{C \times IR \times EF \times ED}{BW \times AT}$$

where:

- C: Concentration in mg/kg
- IR: Intake Rate: adult = 100 mg/day, child = 200 mg/day; 1 mg = 10^{-6} kg
- EF: Exposure Frequency: 90 days/year (3 months of summer)
- ED: Exposure Duration: adult = 30 years, child = 10 years
- BW: Body Weight: adult = 70 kg, child = 15.4 kg (mean body weight for a child 1 to 5 years old; EPA 1997)
- AT: Averaging Time: noncancer = ED*365 days/year; cancer/lifetime = 70 years*365 days/year

ATSDR applied this equation to the maximum concentration for the two contaminants measured above comparison values. Using these protective assumptions, only the child exposure dose for cadmium exceeded the health guideline value (see following evaluation). The resulting exposure doses for lead and adult exposure dose for cadmium were below health guidelines; and therefore, not of health concern (see Table C-7).

Table C-7. Exposure Doses for Chemicals with Maximum Concentrations Exceeding Comparison Values in Surface Soil at the Landfill (Site 1)

Chemical	*Maximum Concentration (ppm)*	*Comparison Value (ppm)*	*Exposure Doses (mg/kg/day)*		*Health Guideline (mg/kg/day)*
			Adult	*Child*	
Cadmium	99	10 Chronic EMEG	3.5×10^{-5}	**3.2×10^{-4}**	2.0×10^{-4}
Lead	441	400 SSL for play areas	1.6×10^{-4}	1.4×10^{-3}	2.0×10^{-2}

Source: EnSafe 1998b

Bold text indicates that the exposure dose exceeded the health guideline for that chemical.
Doses were calculated using the following formulas:
child dose = ((maximum concentration)*0.0002 kg/day*90 days/year*10 years)/(15.4 kg*(365 days/year*10 years))
adult dose = ((maximum concentration)*0.0001 kg/day*90 days/year*30 years)/(70 kg*(365 days/year*30 years))
Lead was also evaluated by calculating a cumulative blood lead level (see ATSDR 1999a for details). The resulting blood lead level from exposure to the maximum concentration (3.0 µg/dl) was below the Centers for Disease Control and Prevention's (CDC's) effects level of 10 µg/dl.
EMEG = environmental media evaluation guide
mg/kg/day = milligrams per kilogram per day
ppm = parts per million
SSL = soil screening level

Cadmium

Cadmium is an element that occurs naturally in the earth's crust. It is not usually present in the environment as a pure metal, but as a mineral combined with other elements such as oxygen (cadmium oxide), chlorine (cadmium chloride), or sulfur (cadmium sulfate, cadmium sulfide) (ATSDR 1999b). Generally, the main sources of cadmium exposure are through smoking cigarettes and, to a lesser extent, eating foods contaminated with cadmium. However, only about 5 to 10% of ingested cadmium is actually absorbed by the body; the majority is passed out of the body in feces (McLellan et al. 1978; Rahola et al. 1973). Cadmium that is absorbed goes to the kidneys and liver. Once absorbed, cadmium tends to remain in the body for years. The body changes most of the cadmium into a form that is not harmful, but if too much cadmium is absorbed, the liver and kidneys cannot convert all of it into the harmless form (Kotsonis and Klaassen 1978; Sendelbach and Klaassen 1988).

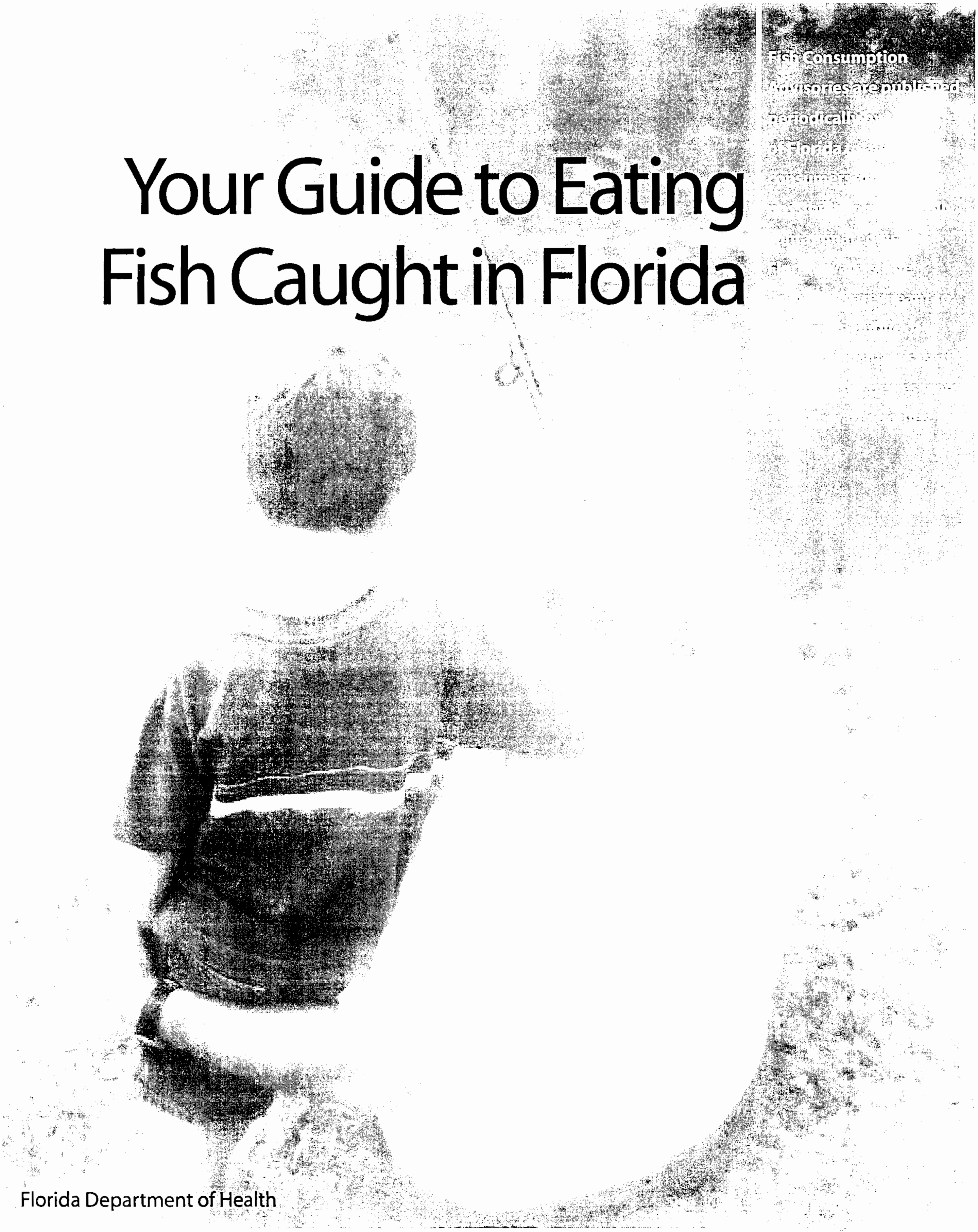
Only the child exposure dose for cadmium exceeded the health guideline value. The exposure dose for an adult was below the health guideline; and therefore, not of health concern. The oral health guideline for cadmium is based on a study of people who ate contaminated rice for up to 70 years and experienced no adverse health effects at doses of 2.1×10^{-3} mg/kg/day (Nogawa et al. 1989). The estimated exposure dose for children incidentally ingesting soil is below this health effects level (3.2×10^{-4} mg/kg/day; see Table C-7). Further, the exposure potential is limited to children who trespass on the landfill and ATSDR assumed that children would be exposed to the maximum soil concentration for 90 days, over 10 years (even though it is highly unlikely that anyone would be consistently exposed to the maximum concentration[4]). Given these highly protective assumptions, ATSDR does not expect that incidentally ingesting surface soil from the landfill containing the detected levels of cadmium would cause harmful health effects. Dermal exposure to cadmium is not known to affect human health because under normal conditions, virtually no cadmium can enter the body through the skin (less than 0.2% from soil; Wester et al. 1992).

[4] Cadmium was only detected in 3 of 27 samples. The reasonable maximum exposure concentration (defined as the 95th percentile for reported concentrations) is 2.7 ppm (EnSafe 1998b). Exposure to this reasonable maximum concentration would result in a child dose of 8.8×10^{-6} mg/kg/day, which is over 200 times lower than the health effects level reported in the toxicologic literature.

Appendix D. Florida Fish Consumption Advisories

[Insert Fish_consumption_guide.pdf.]

Your Guide to Eating Fish Caught in Florida



Florida Department of Health

Prepared in cooperation with Florida Department of Environmental Protection and Florida Fish and Wildlife Conservation Commission

Eat Healthy, Eat Smart

Eating Fish is an important part of a healthy diet. Rich in vitamins and low in fat, fish contains protein we need for strong bodies. It is also an excellent source of nutrition for proper growth and development. In fact, the American Heart Association recommends that you eat two meals of fish or seafood every week.

At the same time, most Florida seafood has low to medium levels of mercury. Depending on the age of the fish, the type of fish, and the condition of the water the fish lives in, the levels of mercury found in fish are different.

While mercury in rivers, creeks, ponds, and lakes can build up in some fish to levels that can be harmful, most fish caught in Florida can be eaten without harm.

Florida specific guidelines make eating choices easier. To lower the risk of harm from mercury found in fish caught in Florida, guidelines based on tests of various freshwater, marine and estuarine water bodies are enclosed. This information should be used by everyone to determine the type and amount of fish to eat or avoid.

Extra guidelines for women and young children. **For most people, the risk of eating fish exposed to mercury is not a health concern.** However, developing fetuses and young children are more sensitive to the harmful effects mercury has on the brain than other people. As a result, women of childbearing age and young children should eat less fish than all others to avoid the higher health risks.

Eating fish from commercial, untested or unknown sources. Some fish you eat may not have been caught from water bodies tested for mercury. In cases where women of childbearing age, and young children do not know if the fish has been tested, or when it has been purchased from a store or restaurant, they should:

- Not eat Shark, Swordfish, King Mackerel, or Tilefish because they contain high levels of mercury.
- Eat up to 12 ounces a week of a variety of fish and shellfish that are lower in mercury. Commonly eaten seafood that are low in mercury include Shrimp, canned Light Tuna, Salmon, Pollock, and Catfish OR
- Only eat one 6 ounce meal per month of Largemouth Bass, Bowfin and Gar OR
- Eat up to 6 ounces of Albacore Tuna per week and a second meal of a fish low in mercury, since Albacore ("White Tuna") has more mercury than canned Light Tuna OR
- Eat up to 6 ounces of fish per week from local water bodies not listed in the brochure.

How much fish is considered a meal portion? A meal is 6 ounces of cooked fish.

How would I determine the maximum amount of fish to eat each month? Based on recommendations in the charts, the amount of fish eaten from each water body should be added together to figure the maximum amount of fish to eat monthly. Fish from commercial, untested, or unknown sources should also be included when figuring the total amount of fish consumed each month.

Most freshwater fish caught in Florida can be eaten without harm. Bream (such as Bluegill, Redear Sunfish, Redbreast Sunfish or Spotted Sunfish) and marine fish such as Mullet, Snappers, Pompano, Flounder , and Dolphin are generally low in mercury. Review the list of water bodies in this brochure to learn which fish can be consumed regularly and which should be avoided.

AVOID PUFFER OR SUFFER

Do not eat puffer fish caught in the Indian River Lagoon and from waters in Volusia, Brevard, Indian River, St. Lucie and Martin Counties. These include the southern puffer, northern puffer, marbled puffer, bandtail puffer, checkered puffer and least puffer. Eating Puffer fish (also called Blowfish) can cause saxitoxin poisoning which can lead to neurological symptoms such as tingling, burning, numbness, drowsiness, incoherent speech and difficulty breathing. In severe cases, the poisoning can cause death. **Cooking or cleaning the fish will not destroy the toxin.** This toxin also has no taste, color or smell. If you experience any of the symptoms mentioned, contact your physician or visit the emergency room immediately.

The Florida Fish and Wildlife Conservation Commission prohibits the harvesting of puffer fish from the Indian River Lagoon and all other Florida waters of Brevard, Martin, Indian River, Volusia, and St. Lucie Counties. For more information go to **http://www.floridamarine.org/features/search_results.asp**

Table [illegible]: Eating Guidelines for Fresh Water Fish from Florida Waters

LOCATION	COUNTY	SPECIES	Women of childbearing age, young children NUMBER OF MEALS*	All other individuals NUMBER OF MEALS
Alafia River	Hillsborough, Polk	Largemouth Bass, Bowfin, Gar	One per month	One per week
Alapaha River	Hamilton	Redear Sunfish	One per week	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
Alligator Lake	Osceola	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
		Bluegill, Redear Sunfish	One per month	Two per week
Anclote River	Pasco	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Apalachicola River	Calhoun, Franklin, Gadsden, Gulf, Jackson, Liberty	Flathead Catfish	One per month	Two per week
		Largemouth Bass, Bluegill, Bowfin, Gar	One per month	One per week
Aucilla River	Jefferson, Madison, Taylor	Largemouth Bass, Bowfin, Gar, Spotted Sunfish	One per month	One per week
Barron River and Canal	Collier	Largemouth Bass less than 14 inches, Bowfin, Gar	One per month	Two per week
Bear Lake	Orange	Redear Sunfish	One per week	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
Bethel Lake	Volusia	Largemouth Bass, Bowfin, Gar	One per month	One per week
		Bluegill, Redear Sunfish	Two per week	Two per week
Big Cypress Preserve	Collier	Largemouth Bass less than 14 inches	DO NOT EAT	One per month
		Largemouth Bass more than 14 inches, Bowfin, Gar	DO NOT EAT	DO NOT EAT
		Warmouth	One per month	One per week
Black Creek Canal (C-1)	Miami-Dade	Butterfly Peacock	One per month	One per week
		Largemouth Bass, Bowfin, Gar	DO NOT EAT	DO NOT EAT
Blackwater River	Santa Rosa	Chain Pickerel, Shadow Bass	DO NOT EAT	One per month
		Largemouth Bass, Bowfin, Gar	One per month	One per week
		Bluegill, Spotted Sunfish, Warmouth	One per month	Two per week
		Long Ear Sunfish, Redear Sunfish	One per week	Two per week
Blue Cypress Lake	Indian River	Bluegill, Redear Sunfish, White Catfish	One per month	Two per week
		Largemouth Bass, Black Crappie, Bowfin, Gar	One per month	One per week
Bonnet Lake	Polk	Largemouth Bass, Bowfin, Gar	One per month	Two per week
Brick Lake	Osceola	Chain Pickerel	DO NOT EAT	DO NOT EAT
		Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
		Bluegill, Warmouth	One per month	One per week
Buck Lake	Brevard	Bluegill	One per month	Two per week
		Redear Sunfish	One per week	Two per week
		Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month

* All other individuals can eat one meal per week of Largemouth bass, Bowfin and Gar caught from Florida waters not listed in this brochure.

Table 1. Eating Guidelines for Fresh Water Fish from Florida Waters

LOCATION	COUNTY	SPECIES	Women of childbearing age, young children NUMBER OF MEALS*	All other individuals NUMBER OF MEALS
Butler Chain of Lakes (Lakes Down, Butler, Bessie, Louise, Palmer, Chase, Tibet Butler, Sheen, Pocket, and Little Fish)	Orange	Largemouth Bass, Bowfin, Gar	One per month	One per week
South New River Canal (C-11)	Broward	Largemouth Bass less than 14 inches	One per month	Two per week
		Largemouth Bass 14 inches or more, Bowfin, Gar	DO NOT EAT	DO NOT EAT
Aerojet Canal (C-111, C-110)	Miami-Dade	Largemouth Bass less than 14 inches	DO NOT EAT	DO NOT EAT
		Largemouth Bass 14 inches or more, Bowfin, Gar	DO NOT EAT	DO NOT EAT
L-31W Canal	Miami-Dade	Largemouth Bass less than 14 inches	DO NOT EAT	One per month
		Largemouth Bass 14 inches or more, Bowfin, Gar	DO NOT EAT	DO NOT EAT
Cypress Creek Canal (C-14)	Broward	Largemouth Bass less than 14 inches	One per month	One per week
		Largemouth Bass 14 inches or more, Bowfin, Gar	DO NOT EAT	DO NOT EAT
C-17 (Earman Canal)	Palm Beach	Largemouth Bass less than 14 inches, Bowfin, Gar	One per week	Two per week
Loxahatchee Slough Canal (C-18)	Palm Beach	Largemouth Bass, Bowfin, Gar	One per month	One per week
Tamiami Canal (C-4) (East of SR 997 [Chrome Ave.])	Miami-Dade	Largemouth Bass less than 14 inches	One per month	One per week
		Largemouth Bass 14 inches or more, Bowfin, Gar	DO NOT EAT	DO NOT EAT
West Palm Beach Canal (C-51)	Palm Beach	Largemouth Bass less than 14 inches	One per month	Two per week
		Largemouth Bass 14 inches or more, Bowfin, Gar	One per month	Two per week
Caloosahatchee River	Glades, Hendry, Lee	Largemouth Bass, Bowfin, Gar	One per month	Two per week
Cherry Lake	Lake	Bluegill, Brown Bullhead	One per month	Two per week
		Redear Sunfish	Two per week	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
Cherry Lake	Madison	Warmouth	One per month	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
		Bluegill	One per week	Two per week
Chipola River	Calhoun, Gulf, Jackson	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Choctawhatchee River	Bay, Holmes, Walton, Washington	Largemouth Bass, Bowfin, Gar	One per month	One per week
		Bluegill, Redbreast Sunfish, Redear Sunfish, Spotted Sunfish, Warmouth	One per month	Two per week

* All other individuals can eat one meal per week of Largemouth bass, Bowfin and Gar caught from Florida waters not listed in this brochure.

Eating Guidelines for Fresh Water Fish from Florida Waters

LOCATION	COUNTY	SPECIES	Women of childbearing age, young children NUMBER OF MEALS*	All other individuals NUMBER OF MEALS
Compass Lake	Taylor	Largemouth Bass, Bowfin, Gar	One per month	One per week
Corbett WMA	Palm Beach	Largemouth Bass, Bowfin, Gar	DO NOT EAT	DO NOT EAT
Cowpen Lake	Putnam	Redear Sunfish	One per month	Two per week
		Bluegill	One per month	One per week
		Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Crescent Lake	Flagler, Putnam	Redbreast Sunfish	Two per week	Two per week
		Bluegill	One per week	Two per week
		Largemouth Bass, Black Crappie, Bowfin, Gar	One per month	Two per week
Crooked Lake	Polk	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Crooked River	Franklin	Largemouth Bass, Bowfin, Gar	DO NOT EAT	DO NOT EAT
Crystal River	Citrus	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Cue Lake	Putnam	Largemouth Bass, Bowfin, Gar	One per month	One per week
Dead Lake	Flagler	Largemouth Bass, Bowfin, Gar	One per month	Two per week
Deer Point Lake	Bay	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Dinners Lake	Highlands	Redear Sunfish	One per week	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
Double Pond	Holmes	Largemouth Bass, Bowfin, Gar	One per month	One per week
East Lake Tohopekaliga	Osceola	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
		Black Crappie, Bluegill, Redear Sunfish, Warmouth	One per month	One per week
Econfina River	Taylor	Redbreast Sunfish, Spotted Sunfish	One per month	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
Econlockhatchee River	Orange, Seminole	Largemouth Bass, Bowfin, Gar	DO NOT EAT	DO NOT EAT
Edward Medard Reservoir	Hillsborough	Largemouth Bass, Bowfin, Gar	One per week	Two per week
Emeralda Marsh Wildlife Management Area	Lake	Largemouth Bass, Bowfin, Gar	One per week	Two per week
Equaloxic Creek	Liberty	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Escambia River	Escambia, Santa Rosa	Largemouth Bass, Bowfin, Gar	One per month	One per week
		Bluegill, Redear Sunfish	One per month	Two per week
Everglades National Park north and west of SR 9336 (Shark River Slough)	Miami-Dade, Monroe	Mayan Cichlid, Redear Sunfish	One per month	One per week
		Largemouth Bass, Bowfin, Bluegill, Gar	DO NOT EAT	DO NOT EAT
		Spotted Sunfish, Yellow Bullhead	Do not eat	One per month

* All other individuals can eat one meal per week of Largemouth bass, Bowfin and Gar caught from Florida waters not listed in this brochure.

Table 1: Eating Guidelines for Fresh Water Fish from Florida Waters

LOCATION	COUNTY	SPECIES	Women of childbearing age, young children NUMBER OF MEALS*	All other individuals NUMBER OF MEALS
Faka Union Canal	Collier	Redear Sunfish	Two per week	Two per week
		Mayan Cichlid	One per month	Two per week
		Largemouth Bass, Bluegill, Bowfin, Gar, Warmouth	One per month	One per week
Gadsden Park	Hillsborough	Bluegill	One per week	Two per week
		Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Grasshopper Lake	Marion	Bluegill	One per month	One per week
		Largemouth Bass, Bowfin, Gar	DO NOT EAT	DO NOT EAT
Grassy Lake	Highlands	Bluegill, Redear Sunfish	One per week	Two per week
		Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Halfmoon Lake	Marion	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Hillsboro Canal (G-08)	Palm Beach	Largemouth Bass, Bowfin, Gar	One per month	One per week
Hillsborough River	Hillsborough	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Holeyland WMA	Palm Beach	Largemouth Bass less than 14 inches	One per month	Two per week
		Largemouth Bass 14 inches or more, Bowfin, Gar	DO NOT EAT	DO NOT EAT
Holmes Creek	Washington	Largemouth Bass, Bowfin, Gar	One per month	One per week
Hungryland WEA	Palm Beach	Largemouth Bass, Bowfin, Gar	DO NOT EAT	DO NOT EAT
Hunters Lake	Hernando	Redear Sunfish	Two per week	Two per week
		Black Crappie	DO NOT EAT	One per month
Jacks Lake	Lake	Largemouth Bass, Bowfin, Gar	One per month	One per week
Johns Lake	Lake	Largemouth Bass, Bowfin, Gar	One per month	One per week
		Bluegill, Redear Sunfish	One per week	Two per week
Kenansville Lake	Brevard	Largemouth Bass, Bowfin, Gar	Two per week	Two per week
Kissimmee River	Highlands, Okeechobee, Osceola, Polk	Largemouth Bass, Black Crappie, Bluegill, Bowfin, Gar	One per month	One per week
Lake Agnes	Polk	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Alto	Alachua	Bluegill	One per month	One per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Annie	Highlands	Largemouth Bass, Bowfin, Gar	DO NOT EAT	DO NOT EAT
Lake Apopka	Lake, Orange	**See Table 3 For Additional Advisories**		
		Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Arbuckle	Polk	Bluegill	One per week	Two per week
		Warmouth	One per month	Two per week
		Black Crappie	One per month	One per week
		Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month

* All other individuals can eat one meal per week of Largemouth bass, Bowfin and Gar caught from Florida waters not listed in this brochure.

Table 1: Eating Guidelines for Fresh Water Fish from Florida Waters

LOCATION	COUNTY	SPECIES	**Women of childbearing age, young children** NUMBER OF MEALS*	**All other individuals** NUMBER OF MEALS
Lake Ashby	Volusia	Bluegill	One per week	Two per week
		Redear Sunfish	One per month	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
		Black Crappie	DO NOT EAT	One per month
Lake Baldwin	Orange	Largemouth Bass, Bowfin, Gar	One per month	Two per week
Lake Bessie	Orange	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Bryant	Marion	Black Crappie	One per week	Two per week
		Bluegill, Redear Sunfish	Two per week	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	Two per week
Lake Buffum	Polk	Bluegill	One per week	Two per week
		Black Crappie	One per month	Two per week
		Redear Sunfish	Two per week	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Butler	Union	Black Crappie, Redear Sunfish, Bluegill	One per week	Two per week
Lake Butler	Orange	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Charlotte	Highlands	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Lake Chase	Orange	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Clinch	Polk	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Conway	Orange	Bluegill, Redear Sunfish	Two per week	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Crosby	Bradford	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Cypress	Osecola	Bluegill, Redear Sunfish	Two per week	Two per week
		Chain Pickerel	One per month	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Daugherty	Volusia	Bluegill, Redear Sunfish,	One per week	Two per week
		Black Crappie, Warmouth	One per month	One per week
		Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Lake Deaton	Sumter	Largemouth Bass, Bowfin, Gar	One per week	Two per week
Lake Delancy	Marion	Black Crappie	One per month	One per week
		Bluegill	One per week	Two per week
		Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Lake Delevoe	Broward	Largemouth Bass, Bowfin, Gar	One per month	Two per week
Lake Dextor	Polk	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Dias	Volusia	Largemouth Bass, Bowfin, Gar	One per month	Two per week
Lake Disston	Flagler	Black Crappie, Bluegill, Redear Sunfish, Warmouth	One per month	One per week
		Largemouth Bass, Bowfin, Gar	DO NOT EAT	DO NOT EAT

* All other individuals can eat one meal per week of Largemouth bass, Bowfin and Gar caught from Florida waters not listed in this brochure.

Table 1: Eating Guidelines for Fresh Water Fish from Florida Waters

LOCATION	COUNTY	SPECIES	Women of childbearing age, young children NUMBER OF MEALS*	All other individuals NUMBER OF MEALS
Lake Dorr	Lake	Bluegill, Redear Sunfish	One per week	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	Two per week
Lake Down	Orange	Largemouth Bass, Bowfin, Gar	One per month	One per week
		Bluegill	One per week	Two per week
Lake Eaton	Marion	Bluegill	One per week	Two per week
		Largemouth Bass, Bowfin, Gar, Redear Sunfish	One per month	Two per week
Lake Eldorado	Lake	Largemouth Bass, Bowfin, Gar	**DO NOT EAT**	One per month
Lake Estelle	Orange	Largemouth Bass, Bowfin, Gar,	One per month	One per week
Lake Eustis	Lake	Largemouth Bass, Bowfin, Gar	One per week	Two per week
Lake Francis	Highlands	Largemouth Bass, Bowfin, Gar	**DO NOT EAT**	One per month
Lake Frederica	Orange	Largemouth Bass, Bowfin, Gar	**DO NOT EAT**	One per month
Lake Garfield	Polk	Largemouth Bass, Bowfin, Gar	One per month	Two per week
Lake Gentry	Osceola	Bluegill	One per month	Two per week
		Redear Sunfish	One per week	Two per week
		Warmouth	One per month	One per week
		Largemouth Bass, Bowfin, Gar	**DO NOT EAT**	**DO NOT EAT**
Lake George (Part of St. Johns River)	Volusia	Redear Sunfish, Bluegill	One per week	Two per week
		Black Crappie, Largemouth Bass, Bowfin, Gar	One per month	Two per week
		Redbreast Sunfish, Warmouth	One per month	One per week
Lake Georges	Putnam	Largemouth Bass, Bowfin, Gar	**DO NOT EAT**	One per month
Lake Glenada	Highlands	Largemouth Bass, Bowfin, Gar	One per month	Two per week
Lake Glona	lake	Largemouth Bass, Bowfin, Gar	**DO NOT EAT**	One per month
Lake Griffin	Lake	Largemouth Bass, Bowfin, Gar	One per month	Two per week
Lake Hamilton	Polk	Redear Sunfish	Two per week	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Hampton	Bradford	Largemouth Bass, Bowfin, Gar	**DO NOT EAT**	One per month
Lake Harney	Seminole	See St. Johns River		
Lake Harris	Lake	Largemouth Bass, Bowfin, Gar	One per month	Two per week
Lakes Hart & Mary Jane	Orange	Bluegill	One per month	Two per week
		Redear Sunfish	One per month	One per week
		Largemouth Bass, Black Crappie, Bowfin, Gar Warmouth	**DO NOT EAT**	One per month
Lake Hatchineha	Osceola	Redear Sunfish	Two per week	Two per week
		Bluegill	One per week	Two per week
		Black Crappie	One per month	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week

* All other individuals can eat one meal per week of Largemouth bass, Bowfin and Gar caught from Florida waters not listed in this brochure.

LOCATION	COUNTY	SPECIES	Women of childbearing age, young children NUMBER OF MEALS*	All other individuals NUMBER OF MEALS
Lake Hellen Blazes	Brevard	SEE ST. JOHNS RIVER		
Lake Hicpochee	Glades	Largemouth Bass, Bowfin, Gar	One per month	Two per week
Lake Huntley	Highlands	Largemouth Bass, Bowfin, Gar	DO NOT EAT	DO NOT EAT
Lake Iamonia	Leon	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Ida, Lake Osborne, E-4 Canal	Broward, Palm Beach	Largemouth Bass, Bowfin, Gar	One per week	Two per week
Lake Istokpoga	Highlands	Black Crappie	One per month	One per week
Lake Ivanhoe	Orange	Largemouth Bass, Bowfin, Gar	Two per week	Two per week
Lake Jackson	Walton	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Lake Jessup	Seminole	Black Crappie, Bluegill	Two per week	Two per week
		Redear Sunfish	One per week	Two per week
		Largemouth Bass, Bowfin, Gar, Warmouth	One per month	One per week
Lake Joanna	Lake	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Josephine	Highland	Redear Sunfish	One per week	Two per week
		Black Crappie	One per month	Two per week
		Largemouth Bass, Bluegill, Bowfin, Gar	One per month	One per week
Lake June-in-Winter	Highlands	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Lake Juniper	Walton	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Kerr	Marion	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Lake Kissimmee	Osceola, Polk	Black Crappie, Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Lancaster	Orange	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Lillian	Highlands	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Little Fish	Orange	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Livingston	Polk	Largemouth Bass, Bowfin, Gar	One per month	One per week
		Warmouth, Bluegill	One per month	Two per week
Lake Lorna Doone	Orange	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Lake Louise	Orange	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Lowery	Polk	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Lucien	Orange	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Margaret	Putnam	Bluegill	One per month	Two per week
		Largemouth Bass, Bowfin, Gar	DO NOT EAT	DO NOT EAT
		Redear Sunfish	One per month	One per week
Lake Marian	Osceola	Bluegill, Redear Sunfish	Two per week	Two per week
		Largemouth Bass, Bowfin, Gar, Black Crappie	One per month	Two per week

* All other individuals can eat one meal per week of Largemouth bass, Bowfin and Gar caught from Florida waters not listed in this brochure.

LOCATION	COUNTY	SPECIES	Women of childbearing age, young children NUMBER OF MEALS*	All other individuals NUMBER OF MEALS
Lakes Hart & Mary Jane	Orange	Bluegill	One per month	Two per week
		Redear Sunfish	One per month	One per week
		Largemouth Bass, Bowfin, Gar, Black Crappie, Warmouth	DO NOT EAT	One per month
Lake Miccosukee	Jefferson, Leon	Bluegill	Two per week	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	Two per week
Lake Minneola	Lake	Bluegill, Redear Sunfish	One per week	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Miona	Sumter	Bluegill, Redear Sunfish	Two per week	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	Two per week
Lake Monroe (part of St. Johns River)	Volusia, Seminole	Redear Sunfish, Bluegill	One per week	Two per week
		Largemouth Bass, Bowfin, Black Crappie, Gar	One per month	Two per week
		Redbreast Sunfish, Warmouth	One per month	One per week
Lake Munson	Leon	Largemouth Bass, Bowfin, Gar, Black Crappie, Redear Sunfish	One per month	One per week
Lake Norris	Marion	Redear Sunfish, Warmouth	One per month	One per week
		Bluegill	One per week	Two per week
		Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Lake Octahatchee	Hamilton	Bluegill	One per month	Two per week
		Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Lake Okahumpka	Sumter	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Lake Okeechobee	Glades, Hendry, Martin, Okeechobee, Palm Beach	Largemouth Bass, Bowfin, Gar	One per month	Two per week
		Black Crappie, Bluegill, Redear Sunfish, White Catfish	One per month	One per week
Lake Olivia	Highlands	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Lake Osborne	Palm Beach	Largemouth Bass, Bowfin, Gar	One per week	Two per week
Lake Palmer	Orange	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Panasoffkee	Sumter	Bluegill, Redear Sunfish	Two per week	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Parker	Polk	Largemouth Bass, Bowfin, Gar	Two per week	Two per week
Lake Pasadena	Pasco	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Pierce	Polk	Bluegill, Redear Sunfish	Two per week	Two per week
		Black Crappie	One per month	One per week
		Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Lake Placid	Highlands	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Lake Poinsett	Brevard, Orange, Osceola	SEE ST. JOHNS RIVER		
Lake Renfroe (St Marks Wildlife Refuge)	Wakulla	Largemouth Bass, Bowfin, Gar	One per month	Two per week

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LOCATION	COUNTY	SPECIES	Women of childbearing age, young children NUMBER OF MEALS*	All other individuals NUMBER OF MEALS
Lake Rousseau	Citrus, Levy	Redear Sunfish, Bluegill	Two per week	Two per week
		Warmouth	One per week	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Rowell	Bradford	Largemouth Bass, Bowfin, Gar	One per week	Two per week
Lake Russell	Osceola	Black Crappie	DO NOT EAT	One per month
		Largemouth Bass, Bowfin, Bluegill, Gar, Redear Sunfish	One per month	One per week
Lake Sampson	Bradford	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Lake Santa Fe	Alachua	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Sawgrass	Brevard	SEE ST. JOHNS RIVER		
Lake Sebring	Highlands	Black Crappie, Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Seminole (Jim Woodruff Reservoir)	Jackson	Largemouth Bass, Bowfin, Gar	One per month	Two per week
Lake Sheen	Orange	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Sylvan	Seminole	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Lake Talquin	Gadsden, Leon	Largemouth Bass, Bowfin, Gar	One per month	One per week
		Black Crappie, Redear Sunfish	One per month	Two per week
		Bluegill	One per week	Two per week
Lake Tarpon	Pinellas	Black Crappie	One per week	Two per week
		Bluegill, Redear Sunfish	Two per week	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	Two per week
Lake Tibet Butler	Orange	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Thonotosassa	Hillsborough	Largemouth Bass, Bowfin, Gar	One per week	Two per week
Lake Tohopekaliga	Osceola	Bluegill, Redear Sunfish	One per week	Two per week
		Largemouth Bass, Black Crappie, Bowfin, Gar	One per month	One per week
Lake Tozour	St. Lucie	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Lake Trafford	Collier	Largemouth Bass less than 14 inches, Bowfin, Gar	One per month	One per week
Lake Wales	Polk	Largemouth Bass, Bowfin, Gar	One per month	Two per week
Lake Walk-In-Water	Polk	Largemouth Bass, Bowfin, Gar	One per month	One per week
		Bluegill, Redear Sunfish	One per week	Two per week
Lake Wauberg	Alachua	Largemouth Bass, Bowfin, Gar	One per month	Two per week
Lake Weir	Marion	Largemouth Bass, Bowfin, Gar	One per month	One per week
Lake Wilson	Hillsborough	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Lake Winder	Brevard, Osceola	SEE ST. JOHNS RIVER		

* All other individuals can eat one meal per week of Largemouth bass, Bowfin and Gar caught from Florida waters not listed in this brochure.

Table 1 Eating Guidelines for Fresh Water Fish from Florida Waters

LOCATION	COUNTY	SPECIES	Women of childbearing age, young children NUMBER OF MEALS*	All other individuals NUMBER OF MEALS
Woodruff National Wildlife Refuge (Lake Woodruff)	Lake, Volusia	Brown Bullhead, Redear Sunfish, White Catfish	Two per week	Two per week
		Black Crappie, Bluegill, Yellow Bullhead	One per week	Two per week
		Largemouth Bass, Bowfin, Gar, Warmouth	One per month	Two per week
Lake Yale	Lake	Largemouth Bass, Bowfin, Gar	One per month	Two per week
Little Manatee River	Hillsborough	Largemouth Bass, Bowfin, Gar	One per month	One per week
Loxahachee National Wildlife Refuage	Palm Beach	Largemouth Bass less than 14 inches, Bluegill, Redear Sunfish	One per week	Two per week
		Largemouth Bass 14 inches or more, Bowfin, Gar, Mayan Cichlid, ,	One per month	One per week
		Warmouth	One per month	Two per week
Middle Lake	Pasco	Bluegill	Two per week	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	Two per week
Milldam Lake	Marion	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Moore Lake	Leon	Largemouth Bass, Bowfin, Gar	One per month	One per week
Myakka River	Sarasota	Bluegill, Spotted Sunfish, Warmouth	One per month	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
		Redear Sunfish	One per week	Two per week
Mystic Lake	Liberty	Largemouth Bass, Bowfin, Gar	One per month	One per week
New River, North Fork	Broward	Black Mullet, Blue Tilapia, Snook, Spotted Tilapia	Two per week	Two per week
		Big Mouth Sleeper, Mayan Cichlid	One per week	Two per week
Newnans Lake	Alachua	Largemouth Bass, Bowfin, Gar	One per month	One per week
Nine Mile Pond (Everglades National Park)	Miami-Dade	Largemouth Bass less than 14 inches	One per month	One per week
		Largemouth Bass 14 inches or more, Bowfin, Gar	One per month	One per week
Ocean Pond	Baker	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Ocheesee Pond	Jackson	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
		Bluegill	One per month	Two per week
Oklawaha River	Lake, Marion	Spotted Sunfish, Redear Sunfish	One per week	Two per week
		Bluegill	Two per week	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
Ochlockonee River	Gadsden, Franklin, Leon, Liberty, Wakulla	Redbreast Sunfish	One per month	Two per week
		Redear Sunfish	One per month	One per week
		Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Palestine Lake	Union	Bluegill	One per month	Two per week

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* All other individuals can eat one meal per week of Largemouth bass, Bowfin and Gar caught from Florida waters not listed in this brochure.

LOCATION	COUNTY	SPECIES	**Women of childbearing age, young children** NUMBER OF MEALS*	**All other individuals** NUMBER OF MEALS
Peace River	Hardee	Largemouth Bass, Bowfin, Gar	One per month	One per week
Perdido River	Escambia	Largemouth Bass, Bowfin, Gar	One per month	One per week
		Bluegill, Redear Sunfish	One per month	Two per week
Piney Z Lake	Leon	Bluegill, Brown Bullhead	One per week	Two per week
		Redear Sunfish, Warmouth	Two per week	Two per week
Pocket Lake	Orange	Largemouth Bass, Bowfin, Gar	One per month	One per week
Porter Lake	Washington	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
		Bluegill	One per month	Two per week
Puzzle Lake	Seminole, Volusia	See St. Johns River		
Red Beach Lake	Highlands	Largemouth Bass, Bowfin, Gar	DO NOT EAT	DO NOT EAT
Rodman Reservoir	Putnam	Largemouth Bass, Bowfin, Gar	One per month	Two per week
Sand Hammock Pond	Holmes	Largemouth Bass, Bowfin, Gar	One per month	One per week
Santa Fe River	Alachua, Bradford, Columbia, Gilchrist, Union	Redear Sunfish	One per week	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
Shoal River	Okaloosa, Walton	Chain Pickerel, Largemouth Bass, Bowfin, Gar	One per month	One per week
		Bluegill, Redear Sunfish	One per month	Two per week
		Long Ear Sunfish	One per week	Two per week
Smith Lake	Marion	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Sopchoppy River	Franklin	Largemouth Bass, Bowfin, Gar	One per month	Two per week
Spring Lake	Seminole	Largemouth Bass, Bowfin, Gar	One per month	One per week
St. Augustine Fish Management Area	Duval	Largemouth Bass, Bowfish, Gar	One per week	Two per week
St. Johns River North of SR 415 to Green Cove Springs, including Lakes George & Monroe	Clay, Flagler, Lake, Marion, Putnam, Seminole St. Johns, Volusia	Redear Sunfish, Bluegill	One per week	Two per week
		Black Crappie, Largemouth Bass, Bowfin, Gar	One per month	Two per week
		Redbreast Sunfish, Warmouth	One per month	One per week
St. Johns River South of SR 415, including Lakes Harney, Puzzle, Poinsett, Winder, Washington, Sawgrass & Hellen Blazse	Brevard, Orange, Osceola Seminole, Volusia	Largemouth Bass, Bowfin, Gar	One per month	One per week
		Black Crappie, Bluegill	One per month	Two per week
		Redear Sunfish	One per week	Two per week
		White Catfish	Two per week	Two per week
St. Marks River (St Marks Wildlife Refuge)	Leon, Wakulla	Redbreast Sunfish, Bluegill	Two per week	Two per week
		Redear Sunfish	One per week	Two per week
		Largemouth Bass, Black Crappie, Bowfin, Gar, Spotted Sunfish, Warmouth	One per month	Two per week
St. Mary's River	Baker, Nassua	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
		Redbreast Sunfish	One per week	Two per week
Steinhatchee River	Dixie, Lafayette, Taylor	Spotted Sunfish	One per month	Two per week
		Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month

* All other individuals can eat one meal per week of Largemouth bass, Bowfin and Gar caught from Florida waters not listed in this brochure.

Table 1: Eating Guidelines for Fresh Water Fish from Florida Waters

LOCATION	COUNTY	SPECIES	Women of childbearing age, young children NUMBER OF MEALS*	All other individuals NUMBER OF MEALS
Suwannee River system, including Santa Fe, Alapaha and Withlacoochee Rivers	Alachua, Bradford, Columbia, Dixie, Gilchrist, Hamilton, Lafayette, Levy, Madison, Suwannee, Union	Redear Sunfish	One per week	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
Sweet Water Creek	Calhoun, Liberty	Largemouth Bass Bowfin, Gar	DO NOT EAT	One per month
Tamiami Canal (WCA3) (West of SR 997 [Chrome Ave.] to county line)	Miami-Dade	Bluegill, Redear Sunfish, Warmouth	One per month	Two per week
		Largemouth Bass less than 14 inches, Mayan Cichild, Yellow Bullhead	One per month	One per week
		Largemouth Bass 14 inches or more, Bowfin, Gar	DO NOT EAT	DO NOT EAT
Tiger Lake	Polk	Bluegill, Redear Sunfish	One per week	Two per week
		Largemouth Bass, Black Crappie, Bowfin, Gar	One per month	Two per week
Trout Lake	Lake	Largemouth Bass, Bowfin, Gar	One per month	Two per week
Turner River Canal	Collier	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Waccasassa River	Levy	Largemouth Bass, Bowfin, Gar	DO NOT EAT	One per month
Wakulla River (St Marks Wildlife Refuge)	Wakulla	Redear Sunfish	One per week	Two per week
		Bluegill, Redbreast Sunfish	Two per week	Two per week
		Largemouth Bass, Black Crappie, Bowfin, Gar, Spotted Sunfish, Warmouth	One per month	Two per week
Water Conservation Area 2	Broward, Palm Beach	Largemouth Bass less than 14 inches, Black Crappie	One per month	One per week
		Largemouth Bass 14 inches or more, Bowfin, Gar	DO NOT EAT	DO NOT EAT
		Mayan Cichild	Two per week	Two per week
		Bluegill, Redear Sunfish, Spotted Sunfish, Warmouth	One per month	Two per week
Water Conservation Area 3, Alligator Alley (I-75), from L-28 Canal to SR 27	Broward, Miami-Dade	Redear Sunfish, Warmouth	One per month	Two per week
		Bluegill	One per month	One per week
		Largemouth Bass less than 14 inches	DO NOT EAT	One per month
		Largemouth Bass 14 inches or more, Bowfin, Gar	DO NOT EAT	DO NOT EAT
Water Conservation Area 3 Except Alligator Alley (I-75)	Broward, Miami-Dade	Bluegill, Redear Sunfish, Spotted Sunfish, Warmouth	One per month	Two per week
		Largemouth Bass less than 14 inches, Mayan Cichild, Yellow Bullhead	One per month	One per week
		Largemouth Bass 14 inches or more, Bowfin, Gar	DO NOT EAT	DO NOT EAT

* All other individuals can eat one meal per week of Largemouth bass, Bowfin and Gar caught from Florida waters not listed in this brochure.

LOCATION	COUNTY	SPECIES	Women of childbearing age, young children NUMBER OF MEALS*	All other individuals NUMBER OF MEALS
Wekiva River	Lake, Orange, Seminole	Spotted Sunfish	One per month	Two per week
		Bluegill, Redear Sunfish Largemouth Bass, Bowfin, Gar, Warmouth	One per month	One per week
Whitsell Lake	Pinellas	Bluegill	One per month	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
Wildcat Lake	Lake	Largemouth Bass, Bowfin, Gar	One per month	One per week
		Bluegill	One per month	Two per week
		Warmouth	DO NOT EAT	One per month
Withlacoochee River	Hamilton, Madison	Redear Sunfish	One per week	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
Withlacoochee River	Citrus, Hernando, Levy, Marion, Pasco, Polk, Sumter	Bluegill	One per month	Two per week
		Largemouth Bass, Bowfin, Gar	One per month	One per week
Wolf Lake	Highlands	Bluegill	One per month	Two per week
Woodbine Spring Lake	Santa Rosa	Largemouth Bass, Bowfin, Gar, Redear Sunfish	DO NOT EAT	DO NOT EAT
		Bluegill	One per month	Two per week
Yellow River	Escambia, Okaloosa, Santa Rosa	Bluegill, Redear Sunfish	One per month	Two per week
		Largemouth Bass, Bowfin, Gar, Chain Pickerel	One per month	One per week
		Long Ear Sunfish	One per week	Two per week

* All other individuals can eat one meal per week of Largemouth bass, Bowfin and Gar caught from Florida waters not listed in this brochure.

Table 2: **Eating Guidelines for Marine and Estuarine Fish From Florida Waters**

WATER BODY	SPECIES	Women of childbearing age, young children NUMBER OF MEALS*	All other individuals NUMBER OF MEALS
All coastal waters	**Almaco Jack**	One per month	One per week
All coastal waters	**Atlantic Croaker**	Two per week	Two per week
All coastal waters	**Atlantic Spadefish**	One per week	Two per week
All coastal waters	**Atlantic Stingray**	One per month	One per week
All coastal waters	**Atlantic Thread Herring**	One per week	Two per week
All coastal waters	**Atlantic Weakfish**	One per week	Two per week
All coastal waters	**Black Drum**	One per week	Two per week
All coastal waters	**Black Grouper**	One per month	One per week
All coastal waters	**Blackfin Tuna**	DO NOT EAT	One per month
All coastal waters	**Bluefish**	One per month	One per week
All coastal waters	**Bluntnose Sting Ray**	One per week	Two per week
All coastal waters	**Bonefish**	One per month	One per week
Florida Bay, Biscayne Bay, and Florida Keys	**Crevalle Jack**	DO NOT EAT	One per month
Remaining coastal waters	**Crevalle Jack**	One per month	One per week
All coastal waters	**Cobia**	DO NOT EAT	One per month
All coastal waters	**Dolphin**	One per week	Two per week
All coastal waters	**Fantail Mullet**	Two per week	Two per week
All coastal waters	**Florida Pompano**	One per week	Two per week
All coastal waters	**Gafftopsail Catfish**	One per month	One per week
All coastal waters	**Gag**	One per month	One per week
Florida Bay, Biscayne Bay, and Florida Keys	**Gray Snapper**	One per month	Two per week
Remaining coastal waters	**Gray Snapper**	One per week	Two per week
All coastal waters	**Greater Amberjack**	One per month	One per week
Florida Bay, Biscayne Bay, and Florida Keys	**Great Barracuda**	DO NOT EAT	One per month
Remaining coastal waters	**Great Barracuda**	One per month	Two per week
All coastal waters	**Gulf Flounder**	One per month	Two per week
All coastal waters	**Hardhead Catfish**	One per week	Two per week
All coastal waters	**Hogfish**	One per week	Two per week
All coastal waters	**King Mackerel less than 31 inches fork length**	DO NOT EAT	One per month
All coastal waters	**King Mackerel 31 or more inches fork length**	DO NOT EAT	DO NOT EAT
All coastal waters	**Ladyfish**	One per month	One per week
All coastal waters	**Lane Snapper**	One per month	Two per week
All coastal waters	**Little Tunny**	DO NOT EAT	One per month
All coastal waters	**Lookdown**	One per week	Two per week
All coastal waters	**Mutton Snapper**	One per month	Two per week
All coastal waters	**Pigfish**	One per week	Two per week
All coastal waters	**Pinfish**	One per month	Two per week
Florida Bay, Biscayne Bay, and Florida Keys	**Red Drum**	One per month	One per week
Remaining coastal waters	**Red Drum**	One per month	Two per week
All coastal waters	**Red Grouper**	One per month	Two per week
All coastal waters	**Red Snapper**	One per week	Two per week
All coastal waters	**Sand Seatrout**	One per month	One per week
All coastal waters	**Scamp**	One per month	Two per week
All coastal waters	**Shark, all species less than 43 inches**	DO NOT EAT	One per month
All coastal waters	**Shark, all species 43 inches or more**	DO NOT EAT	DO NOT EAT
All coastal waters	**Sheepshead**	One per month	Two per week

Table 2: **Eating Guidelines for Marine and Estuarine Fish From Florida Waters**

WATER BODY	SPECIES	Women of childbearing age, young children NUMBER OF MEALS*	All other individuals NUMBER OF MEALS
All coastal waters	**Silver Perch**	One per month	Two per week
All coastal waters	**Skipjack Tuna**	One per month	Two per week
Florida Bay, Biscayne Bay, and Florida Keys	**Snook**	One per month	One per week
Remaining coastal waters	**Snook**	One per month	Two per week
All coastal waters	**Snowy Grouper**	One per month	One per week
All coastal waters	**Southern Flounder**	One per week	Two per week
All coastal waters	**Spanish Mackerel**	One per month	One per week
All coastal waters	**Spot**	One per week	Two per week
Florida Bay, Biscayne Bay, and Florida Keys	**Spotted Seatrout**	One per month	One per week
Remaining coastal waters	**Spotted Seatrout**	One per month	Two per week
All coastal waters	**Striped Mullet**	Two per week	Two per week
All coastal waters	**Striped Mojarra**	Two per week	Two per week
All coastal waters	**Tarpon**	One per week	Two per week
Florida Bay, Biscayne Bay, and Florida Keys	**Tripletail**	One per month	Two per week
Remaining coastal waters	**Tripletail**	One per week	Two per week
All coastal waters	**Vermillion Snapper**	One per week	Two per week
All coastal waters	**Wahoo**	One per month	Two per week
All coastal waters	**White Grunt**	One per month	Two per week
All coastal waters	**White Mullet**	Two per week	Two per week
All coastal waters	**Yellow-edge Grouper**	One per month	Two per week
All coastal waters	**Yellowfin Tuna**	One per month	Two per week
All coastal waters	**Yellowtail Snapper**	One per week	Two per week

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Table 3: **Eating Fish from Florida Waters with Dioxin, Pesticide, or Saxitoxin Contamination**

Water body	Contaminant	County	Everyone
Emeralda Marsh Area 7	Pesticides	Lake	DO NOT EAT Largemouth Bass, Brown Bullhead Catfish
	Pesticides	Lake	ONE MEAL PER MONTH Black Crappie
Lake Apopka	Pesticides	Orange, Lake	DO NOT EAT Brown Bullhead Catfish
Wagner Creek	Dioxin	Miami-Dade	DO NOT EAT Checker Puffer Fish or Stripped Mojarra
Indian River Lagoon & all marine waters of the listed counties	Saxitoxin	Brevard, Indian River, Martin, St. Lucie & Volusia	DO NOT EAT All Puffer Fish

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