Health Consultation

Evaluation of Volatile Organic Compounds (VOCs) in Indoor Air and Radiation in Soil

ALAMEDA NAVAL AIR STATION

ALAMEDA, CALIFORNIA

CA2170023236

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES Agency for Toxic Substances and Disease Registry Office of Community Health and Hazard Assessment Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation 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.

You may contact ATSDR toll free at 1-800-CDC-INFO or visit our home page at: <u>https://www.atsdr.cdc.gov</u> Final Alameda Naval Air Station Alameda, CA

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Prepared By:

U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry Office of Community Health and Hazard Assessment Atlanta, Georgia 30333

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Summary and Statement of Issues

INTRODUCTION	Naval Air Station (NAS) Alameda is a former military base located at the western end of Alameda Island, California. Military operations from 1940 to 1997 contributed to the release of hazardous substances from disposal, leaks, and spills into the environment. The former NAS Alameda is now called Alameda Point. Land use of the closed station is changing and is being redeveloped into mixed-use residential, commercial, recreational, and industrial areas. Cleanup of past leaks and spills has been ongoing since 1982 and continues in several areas. Land use controls and
	restrictions are in place to protect the safety of residents and people using the property until cleanup is complete and land use is unrestricted. Most areas of the former base have been cleared for unrestricted use.
	Since 1990, the Agency for Toxic Substances and Disease Registry (ATSDR) has worked closely with the Navy to address areas at NAS Alameda where people could come in contact with hazardous substances. In 1999, the U.S. Environmental Protection Agency (USEPA) added the NAS Alameda site to their National Priorities List (NPL), also called the Superfund List. In 2004, ATSDR released a public health assessment for public comment that identified seven areas for further evaluation. Each area presented no hazard because the Navy took actions to clean up those areas. The 2004 report also identified two issues that lacked sufficient data for ATSDR to evaluate at that time: volatile chemicals in indoor air and radiological contamination in soil. These two issues are evaluated in this updated report, using data collected since 2004. In addition, ATSDR reviewed basewide data and stands by our previous conclusions.
Questions	 In this report, we address the following questions: Could current or future residents or workers breathe harmful levels of volatile chemicals in indoor air from vapor intrusion movement from groundwater or soil into buildings (both existing and yet to be built)? Do radiological chemicals in soil present a risk for current or future recreational users?
Finding 1	Current and future workers (building occupants):
	Volatile chemicals in the indoor air of Building 360 currently are not expected to harm people's health.
	ATSDR cannot conclude whether breathing indoor air at other buildings near groundwater contamination at Alameda NAS may harm people's health.

Basis for Finding	Trichloroethylene (TCE) measured in indoor air of Operable Unit-(OU-) 2B Buildings 360, 163, and 163A show migration of groundwater contaminants into indoor air that are below harmful levels. However, measurements for Buildings 163 and 163A were taken only once and therefore data are too limited for ATSDR to make a public health determination. Additionally, TCE levels in groundwater near these buildings remain elevated and indicate the need for continued monitoring to protect public health.			
	Building 360			
	 TCE: The maximum detected TCE level in indoor air in Building 360 was 5.32 micrograms per cubic meter (mcg/m³) in December 2020. ATSDR estimated that breathing this level during typical work hours would be less than ATSDR's noncancer comparison value. ATSDR's estimated increased lifetime cancer risk resulting from this exposure (1.4 E-06) is not considered a concern for cancer risk. The maximum level of TCE in OU-2B buildings during several sampling 			
	events may not represent true indoor air exposure levels over time. Exposure levels over time may be higher or lower due to weather, tidal influence, or other variables.			
	• Benzene: The highest benzene level in indoor air (2020) at Building 360 (1.18 mcg/m3) was less than ATSDR's MRL of 9.6 mcg/m3 for chronic exposure duration and not expected to result in health effects. The effective exposure point concentration after adjusting for occupational use is 0.29 mcg/m3, which has an estimated cancer risk of 5.7E-7 that ATSDR does not consider a concern for cancer risk.			
	Buildings 163 and 163A			
	• TCE: TCE was detected in indoor air in Building 163 at 4.6 mcg/m ³ and in Building 163A at an estimated 0.15 mcg/m ³ in June 2009. From the single sampling event data, ATSDR cannot determine whether indoor air levels in Buildings 163 and 163A are of concern during different seasons. No winter samples were collected to assess seasonal variability.			
	Volatile chemicals in groundwater near other buildings			
	Volatile chemicals are present in groundwater at several other locations near buildings that are currently occupied or may be occupied in the future.			
	 TCE was detected in groundwater at OU-2B at levels ranging from 2,200 micrograms per liter (mcg/L) to 13,000 mcg/L between 2016 to 2018. The highest levels were near Building 162. 			

Next Steps	ATSDR recommends the Navy/owners and regulating partners:				
	 Reduce potential exposure to future occupants by continuing plans to install a vapor mitigation system throughout Building 360. Install active vapor mitigation measures, if needed, to reduce indoor vapors during times of low positive pressure within the building, e.g., less than 5 Pascals¹. 				
	 Continue routine monitoring of volatile chemicals in groundwater and indoor air in susceptible buildings that are or will be occupied. Consider using indicators, tracers, and surrogates (ITS) to support data quality assessment of indoor air samples² to provide an indication of the best times to sample indoor air. Take action to reduce indoor air VOC levels as needed to protect public health. 				
	 Work with future developers to ensure construction includes health protective measures and restrictions as needed such as methods that prevent vapors from coming indoors. Otherwise, alternate locations should be used for construction. 				
	 Test indoor air of new buildings constructed over and within 100 feet of contaminated groundwater plumes before occupancy. Sampling subslab gas and outdoor air concurrently with indoor air and using ITS provides lines of evidence to determine the source of indoor air contaminants. Implement vapor mitigation measures if hazardous indoor air levels are 				
	detected in any sampling or monitoring.				
	 Maintain land use restrictions, including compliance measures, and continue monitoring or sampling until levels are below unrestricted use levels. 				
	 Inform utility workers or others who may work below ground about the potential vapor intrusion hazards. 				
	 Store volatile chemicals in well ventilated areas according to manufacturer's instructions. 				
Finding 2	Current and future recreational users:				
	Radioactive contamination below ground at Landfills 1 and 2 does not present a hazard to recreational users who may touch the ground or walk or run on the paved trails along the landfills.				
Basis for Finding	 The Navy has cleaned up and removed radioactive contaminated material in the surface soil and installed barriers to prevent contact with subsurface material that may remain at Landfills 1 and 2. 				
	 Polyethylene membranes and clean fill prevent direct contact with radioactive material. Recreational users are allowed to walk and run on the paved trails. 				
	Radiation is not detectable at the surface.				
Next Steps	ATSDR recommends the Navy/owners and regulating partners:				
	 Continue inspections as specified in site regulatory agreements to be sure that landfill control mechanisms remain intact and hazardous waste remains out of reach by recreational users. 				
	 Maintain land use restrictions and controls. Continue 5-year reviews to ensure institutional controls remain in place and the remedy continues to be protective. 				

FOR MORE INFORMATION	This report explains ATSDR's findings in detail. If you have questions about this report, call ATSDR at 1-800-CDC-INFO and ask for information about the Alameda Naval Air Station (NAS) site. If you have concerns about the Alameda NAS site, please direct them to USEPA Region 9 Community Involvement toll-free at 1-866-372-9378.
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Background: About the Site

Naval Air Station (NAS) Alameda is a former military base located at the western end of Alameda Island, California (Figure 1). NAS Alameda is now known as Alameda Point. It is approximately 2 miles long from east to west, 1 mile wide from north to south, and occupies 2,634 acres: 1,734 acres of land and 1,108 acres of water. The former station is bordered on the north by the Oakland Inner Harbor; on the south and west by the San Francisco Bay; and on the east by a mixture of residential, commercial, light industrial, and public land in the city of Alameda [PRC 1996].

Military operations at NAS Alameda began in 1940 and ceased in 1997. NAS Alameda provided facilities and support for Naval aviation and fleet operations that included two runways, a deep-water port, aircraft, and ship maintenance facilities, 1,500 units of family and barracks-type housing, and industrial, retail, warehouse, and recreational facilities [CIP2018]. The majority of the former NAS Alameda property is being turned over to the city of Alameda for transfer and redevelopment to public and private entities. Some property has been transferred to



Figure 1. Location of NAS Alameda, Alameda Point, CA (ATSDR 2012)

other government agencies such as the Department of Veteran Affairs [Trevet 2021].

Past Use That Led to Contamination

Routine use, disposal, and accidental releases of hazardous materials by the Pacific Fleet and naval aviation operations have resulted in volatile chemical contamination of soil, groundwater, and indoor air and low-level radiological contamination in Landfills 1 and 2 (Figure 2) [Tetra Tech 1998]. Typical operations on NAS Alameda included metal plating, radium dial painting, paint removal, aircraft maintenance, fueling, engine testing, and missile reworking that used substances such as industrial solvents, acids, paint strippers, degreasers, caustic cleaners, metals, oils, fuels, asbestos, and radiological materials such as radium. There have been approximately 60 identified areas (35 Superfund or Comprehensive Environmental Response, Compensation, and Liability Act sites, (CERCLA) and 25 petroleum sites) where contaminants have been released to the environment (Figure 2) [Tetra Tech 2006]



Figure 2. NAS Alameda Operable Units, Installation Restoration Sites, and Areas of Concern Source: Trevet Environmental (2012)

Site Designation, Operable Units, and Areas

The Navy designated areas of contamination in the Superfund program as Installation Remediation (IR) Sites numbered 1 to 35 which they grouped into operable units (OUs) based on location designated as OUs- 1, 2A, 2B, 2C, 3, 4A, 4B, 4C, 5, and 6 to help focus investigations and cleanup. OU-6 has IR sites that are not clustered, and IR Site 35 includes non-adjacent locations that remained after environmental investigations and cleanup were well underway. Each site has been thoroughly investigated. Most have been cleaned up for unrestricted use. The Navy continues to sample, monitor, and clean up contaminated areas.

Agencies Involved with Environmental Testing and Cleanup

CERCLA requires that agencies identify hazardous substances used on the property and clean up any contamination before the property can be transferred outside of the federal government. The Navy is legally responsible and still actively involved with the monitoring, maintaining, or cleanup of all contaminated areas. USEPA has been the primary regulatory agency since the listing of NAS Alameda to the National Priorities List (NPL) in 1999. The California Department of Toxic Substances Control (DTSC) under California EPA and the San Francisco Bay Regional Water Quality Control Board (RWQCB) are also regulatory agencies actively involved in the environmental investigations and cleanup actions at NAS Alameda [ADANTA 2018].

Future Plans for Maintaining Hazards and Land Transfer

The Navy's Base Realignment and Closure (BRAC) Program Management Office West operates as the caretaker until most of the property is transferred to the city of Alameda. As of January 2021, the Navy has completed transfer of approximately 95 percent of Alameda Point to the city of Alameda and other entities. Approximately 266 additional acres will be transferred over the next several years to the city of Alameda as No-Cost Economic Development Conveyance pending completion of environmental cleanup. The remaining acreage (approximately 35 acres) consists of the former North Housing area, which will be conveyed via a combination of mechanisms including public benefit, homeless assistance, and public sale. The Navy will convey the remaining parcels after environmental cleanup is complete and a Finding of Suitability to Transfer (FOST) has been issued [ADANTA 2018]. A public benefit conveyance of the schools on the property was made to the Department of Education for ultimate use by Alameda Unified School District [ADANTA 2018].

Most parcels are clean, although some with subsurface soil or groundwater contamination, including OU-2B, require land use restrictions and other measures to protect public health. Additionally, OU-3 and OU-4A contain Landfills 1 and 2, which were transferred to the Department of Veterans Affairs for maintenance and monitoring.

ATSDR Involvement

Since 1990, ATSDR has completed six public health evaluations with recommendations to the Navy regarding human exposure to contaminants at the former NAS Alameda (Table 1). ATSDR documented past exposure hazards at several areas and worked with the Navy, USEPA, and other partners to stop harmful exposures.

In 2004, ATSDR completed for public comment a public health assessment (PHA) that evaluated each area where hazardous substances were released into the environment and the ways in which

people can come in contact with contamination. The PHA identified seven exposure situations that posed no public health hazards as the Navy took action to stop or sufficiently reduce exposures: (1) exposure to lead-contaminated soil from paint stripping of the antenna towers and water tanks, (2) exposure to PAH-containing soil in the West Housing Area, (3) exposure to volatile organic compounds (VOCs) in indoor air in Marina Village and North Housing, (4) exposure to contaminated soil in Estuary Park, (5) exposure to contaminants from the Marsh Crust, (6) exposure to contaminated fish at Seaplane Lagoon, and (7) occupational exposure to PCBs at Sites 14 and 15.

Community Concerns Prompted Further ATSDR Investigation

During the public comment release of the 2004 Public Health Assessment, the community expressed concerns about two additional situations: 1) volatile chemicals in indoor air from the movement of chemical vapors from groundwater and soil gas (known as vapor intrusion) and 2) low-level radiation in soil at Landfills 1 and 2 (and other areas) from use and disposal of radium paint and other radioactive chemicals. Both situations had limited data that were not sufficient for ATSDR to make a health determination in 2004.

In this document, based on sufficient data collected between 2004 and 2021, ATSDR focuses on the potential for exposure to volatile chemicals in indoor air from vapor intrusion and exposure to low-level radiation in soil. In addition, ATSDR reviewed basewide data collected since 2004 and stands by our previous conclusions.

Groundwater Contamination and Vapor Intrusion

Annual groundwater testing is conducted under the Basewide Groundwater Monitoring Program for the following sites 1, 2, 3, 4, 6, 11, 13, 14, 21, 26, 27, and 28 (Figure 2). Groundwater is not used at the former station, but volatile chemicals present in the shallow groundwater can migrate into the soil spaces and into the air of overlying buildings. Groundwater flow is generally from the city of Alameda toward the station and from the station radially to the bay, lagoon, and harbor.

OU-2B presents the greatest concern for vapor intrusion because a plume of volatile chemicals including trichloroethene (TCE) and benzene have been detected in groundwater, soil gas, and indoor air at this OU. The Navy tested indoor air samples at Buildings 163, 163A, and 360. The Navy continues to

What is Trichloroethylene (TCE)?

- TCE is an industrial solvent used to degrease metal parts.
- For pregnant women, exposure to low levels, lasting several weeks to months during the first trimester, can increase the risk of heart-related defects in their babies.
- For people in general, low-level exposures over a few months can increase the risk of immune system effects.

[Reference: ATSDR 2019]

remediate the groundwater. The Navy has completed soil remediation beside and beneath existing buildings. OU-2B contains the following IR Sites:

• Site 3 Abandoned Fuel Storage Area (Cleanup complete)

- Site 4³ Building 360, Aircraft Engine Facility (Partial mitigation) and Buildings 163 and 163A
- Site 11 Building 14, Engine Test Cell
- Site 21 Building 162, Ship Fitting and Engine Repair

Low-level Radiation Near Landfills 1 and 2

The Navy has investigated low-level radiation in soil at Landfills 1 and 2 (and other areas) from disposal of radium paint and other radioactive chemicals. The Navy has conducted numerous cleanup events including soils removals, overlaying with clean fill, and landfill capping. A network of paved walking trails is adjacent to the landfills along the coastline. The new owner, the Department of Veterans Affairs, oversees the weekly inspections of both landfills.

Timeline

Table 1. Timeline of Historical Use and ATSDR Activities.

Date	Activity
1940 - 1997	The Navy operated NAS Alameda to provide facilities and support for fleet aviation activities and berthing for Pacific Fleet ships.
1990	The Navy requested ATSDR to evaluate a work plan for soil gas testing in an area planned for base housing. ATSDR recommended periodic sampling of indoor air to ensure safety and removal of the source of the groundwater contamination.
1992-1993	ATSDR reviewed the Navy's indoor air testing results of Marina Village Housing area. ATSDR found benzene levels posed an increased cancer risk and recommended exposures be stopped and regular air testing sooner than the proposed 5-year plan.
2000	ATSDR met with representatives from NAS Alameda, city of Alameda, Alameda Reuse and Redevelopment Authority, USEPA, California Environmental Protection Agency, Department of Toxic Substances Control, San Francisco Bay Regional Water Quality Control Board, and concerned citizens. ATSDR released a health consultation regarding the human exposure situations identified during our site visit.
2001	ATSDR issued a health consultation addressing health concerns from exposures at the fire fighter training areas. ATSDR found that firefighters using Sites 14 and 15 were not exposed to levels of contamination that would result in adverse health effects.
2004	ATSDR released the Public Health Assessment Draft for Public Comment. The PHA identified seven exposure situations posed no public health hazards.
2005	The community expressed concerns about two other situations: volatile chemicals in indoor air from the movement vapors from groundwater and soil gas and low-level radiation in surface soil. Both had limited data and could not be evaluated.
2016	ATSDR gathered and evaluated data collected after 2004 on potential exposure to vapors in indoor air and radiological chemicals in surface soil.
2021	ATSDR completed draft final Health Consultation.

³ OU-2B. The boundary between Sites 3 and 4 changed in 2006 when the curved road along the boundary was removed and a straighter boundary line was established.

Discussion - Exposure Overview

ATSDR evaluated the potential for exposure to current and future workers and residents because volatile chemicals are present at high levels in groundwater and soil which can volatilize into indoor air of existing buildings and buildings that will be constructed in the future.

Measures Taken to Reduce Potential Exposures to Air Contaminants

Volatile chemicals have been detected in groundwater, soil gas, and indoor air at levels that present a potential concern for public health. In response, the Navy has taken actions to reduce VOC levels in groundwater through various means such as peroxide and microbial injections (*in-situ* bioremediation). Additionally, the Navy has taken action to reduce vapors from migrating into buildings such as installing vapor barriers and ventilation systems. Appendix B contains detailed maps of buildings within a 100 ft buffer of contaminated groundwater.

Groundwater beneath the former NAS Alameda is present in two primary aquifers not used for drinking water⁴. The shallow water-bearing zone is found 4.5 to 20 feet below ground surface. Because it is so close to the ground surface and tidally influenced, the shallow groundwater provides the greatest concern for vapor intrusion. Water-soluble chemicals spilled on the ground can easily enter the shallow groundwater. Because groundwater flows from east to west and toward the bay, contamination found in groundwater may have traveled some distance from its source on the ground. Volatile chemicals such as trichloroethylene (TCE) and benzene can volatilize from the shallow groundwater beneath buildings and into indoor air.

Indoor Air Tested in Only a Few Buildings

Because there are a limited number of buildings that have indoor air tests, ATSDR includes information about buildings on the former station that have the potential for vapor intrusion. ATSDR screened soil gas and groundwater data within 100 feet as a buffer for vapor intrusion. Appendix B contains maps that show the highlighted areas indicating buildings within OUs above ATSDR comparison values from 2015-2017 database results. Appendix B maps detail each OU and the buildings of concern within those OU boundaries.

Radiation Contamination of Surface Soil Not Detected

Navy contractors reviewed historical records regarding the handling, storage, repair, and disposal of radioactive material, components, equipment, paint, devices, and drains at NAS Alameda [Weston 2007]. The Navy began using glow-in-the-dark (radioluminescent) devices and paint in the late 1930s. Dials and surfaces that needed to be illuminated were coated with a paint containing Radium-226. Radium waste was disposed of in the storm drain system leading from Buildings 5 and 400 and into the Seaplane Lagoon. Radium waste was also disposed of in Landfill 1, 1943-1956 Disposal Area, and into Landfill 2, West Beach Landfill, which operated from 1952 to 1978.

Site-specific cleanup including soil removal was conducted at all sites with radioactive contamination. Despite several removal actions, radium 226 was still present in Landfills 1 and 2 in

⁴ All tap drinking water for NAS Alameda and the city of Alameda is supplied by the East Bay Municipal Utility District (EBMUD), which primarily obtains its water supply from surface water bodies originating in the Sierra Mountains.

subsurface areas. The landfills received clean fill overlay and synthetic membrane caps. Radiation is not detectable at the surface. Walking trails were created on the western tip of NAS Alameda over the clean fill and polyethylene covered Landfills 1 and 2.

Former NAS Alameda On-Site Property Demographics

Public Conveyance - Housing for Homeless: In 1999, the Navy conveyed vacant military housing to the city of Alameda for the Alameda Point Collaborative, a non-profit agency. Alameda Point Collaborative leases more than 200 units on more than 34 acres of former military housing for over 500 formerly homeless and low-income residents.

New residential development: The former East Housing Area (EHA) occupied 68 acres. The area is bounded by Ralph Appezzato Memorial Parkway, Atlantic Avenue on the south, Willie Stargell Avenue on the north, 5th Avenue on the east, and Main Street on the west. EHA had two-story apartment buildings and single-story homes which covered approximately 20 to 25 percent of the area. The balance of the site consisted of open space, paved roads, parking lots, and grassy or landscaped recreation areas. EHA had always been used for residential purposes under the Navy's operation. Land was transferred from the Navy to the City of Alameda, and then sold for private redevelopment.

Between 2004 and 2007, approximately 473 single family two-story homes (\$1.3 million mean) and 52 apartments were built in the Bayport community as part of the redevelopment [Zillow 2019, City-data 2019]. Demographic information indicates 58% White, 32% Asian, 5% Black, and 5% Other.

Environics Analytics estimated the City of Alameda population as of January 2018 to be 80,293 (32,775 households). Demographic data for the Alameda population include (Environics Analytics 2018)[CIP 2018].

- > Forty eight percent of the population is male, and 52 percent is female.
- > The median age is 42.6 years, and the average age is 41.8.
- > The median value of owner-occupied housing is \$814,829.
- Thirty two percent of the population over age 25 have earned a bachelor's degree, and 20 percent have a master's, professional, or doctorate degree.
- Employment in Alameda is 72% "white collar," 12% "blue collar," and 15% "service and farming."
- The average household income is \$135,677 per year, and the median household income is \$96,477.
- > Families below the poverty level constitute 6.4 percent of the population.

Exposure Overview Table

Table 2. How people could be exposed to chemicals from NAS Alameda				
Who	Doing What	Where/When	Health Risk	Next Steps
Current and future workers (building occupants)	Breathing VOC vapors in indoor air from soil and groundwater (vapor intrusion)	Building locations within 100 feet of the identified groundwater plumes in OU- 2B	No Hazard: People are not being exposed to indoor vapors at levels of concern. Groundwater contamination remains near Buildings 360 and 163 at levels that require actions to protect public health.	 ATSDR recommends the Navy/owners and regulating partners: Install vapor mitigation systems inside the entire Building 360 as a precautionary measure and perform seasonal confirmation sampling to ensure that volatile chemicals that moved from groundwater into indoor air do not reach hazardous levels for building occupants. Continue routine monitoring of volatile chemicals in groundwater and indoor air. Use ITS to determine if indoor air samples are collected during active or dormant vapor intrusion. Work with future developers to ensure construction includes health protective measures and restrictions as needed. Test indoor air of buildings constructed over and within 100 feet of contaminated groundwater plumes before occupancy. If hazardous indoor air levels are detected in any sampling or monitoring, implement vapor mitigation measures. Maintain land use restrictions until levels are below unrestricted use levels. Conduct confirmation sampling of occupied spaces. Inform utility workers or others who work below ground about potential vapor intrusion hazards.
Current and future recreational users	Walking, running, recreational activities on trails along Landfills 1 and 2.	Near Landfills 1 and 2	No hazard: People are not being exposed to low-level radiation in the subsurface areas below the cap, clean fill, near areas used for recreation.	 ATSDR recommends the Navy/owners and regulating partners: Continue visual inspections as specified in site regulatory agreements to be sure that landfill control mechanisms remain intact and hazardous waste remains out of reach by recreational users. Maintain land use restrictions and controls. Continue 5-year reviews to ensure institutional controls remain in place and the remedy continues to be protective.

Data Review

Data Review Process

As part of the ATSDR public health assessment process, we generally review data provided by other agencies, then compare the chemical data to find out which chemicals could harm people's health. For those chemicals, we estimate the amount of contact people could have with the chemical at the site. Then we compare our estimate with the health effects levels from scientific studies. For this site we reviewed data provided by the Navy and USEPA.

Extensive environmental sampling at NAS Alameda

ATSDR reviewed reports on the source of contamination, source removal, groundwater data, soil gas data, and indoor air data. The Navy, through use of various contractors, performed extensive environmental sampling at NAS Alameda. Millions of environmental test results from NAS Alameda are contained within thousands of reports available at the State of California's Department of Toxic Substances Control Envirostor electronic repository at the following link:

https://www.envirostor.dtsc.ca.gov/public/profile report?global id=01970005.

ATSDR obtained electronic data from the Navy's NAS Alameda consolidated database containing most of the sampling results since 1991 of groundwater, soil gas, wellhead, and ambient/indoor air testing at several thousand sites at NAS Alameda. The database contains 1.9 million data points and provides a good representation of site conditions at the time of sample collection.

ATSDR Evaluated Basewide Groundwater Contamination as follows:

- Reviewed basewide groundwater contamination levels and performed screening using ATSDR's Public Health Assessment Screening Tool (PHAST) for each OU.
- Reviewed the exposure potential at each OU. OUs with no structures and land use controls preventing future buildings were eliminated from further evaluation (OUs 3, 4a, 4b,4c, and Sites 17 Seaplane Lagoon, Site 20, Site 24 Piers, Sites 29, 32, and 33).
- Reviewed OUs with high contamination levels prior to 2014 for groundwater remediation efforts. OUs where cleanup successfully reduced chemical levels to below health concern were also eliminated (OU-2c and Site 34).
- ATSDR reviewed data from 2015 and 2017 and identified 109 potential buildings within 100 feet of groundwater that exceeded ATSDR's vapor intrusion comparison values (Appendix B). Many of these buildings have special issues that may be considered in future evaluations of vapor intrusion potential in buildings such as short-term occupancy, storage buildings, or workshops expected to have large bay doors or good ventilation while some buildings may not be occupied.
- ATSDR retained OU-2B for further evaluation of indoor air samples and vapor intrusion potential.

Indoor Air Samples Show Levels Above Comparison Values OU-2B Site 4 Building 163 and 163A

The Navy sampled Indoor air, outdoor air, and soil gas sampling at Buildings 163 and 163A in June 2009 to evaluate whether VOC concentrations present in groundwater and soil gas beneath the buildings have impacted indoor air at levels greater than comparison values. The results of indoor air sampling in these buildings indicated that TCE was present in indoor air because of a release from groundwater to indoor air [SES-TECH, 2010]. No further indoor air sampling was performed after the June 2009 event.

Key Results of 2009 Indoor Air Testing of Buildings 163 and 163A

Limitations: Samples of groundwater, soil gas, and indoor air were not collected during the same sampling event which would have allowed for more accurate identification of background indoor sources. Maximum detected levels may not represent actual maximum indoor air levels. Too few samples were collected to calculate 95% Upper Confidence Limits so maximum values were used for exposure point concentrations. Data does not include a temporal winter sample. Soil vapor has been documented beyond 100 feet from sources in some studies [ATSDR 2016].

- The highest measured TCE level in indoor air of Building 163 (4.6 mcg/m³) was above ATSDR's intermediate and chronic Minimal Risk Level (MRL) of 2.1 mcg/m³.
- The highest measured TCE level in indoor air of Building 163A (estimated at 0.15 mcg/m³) was lower than ATSDR's MRL.
- ATSDR cannot make a health conclusion based on the single 2009 summer sampling event for Buildings 163 and 163A.

OU-2B, Site 4 Building 360

In 2019, the Navy installed a vapor mitigation system (VMS) in Building 360 to reduce the level of volatile chemicals that move from groundwater and soil into indoor air. The VMS consists of a retrofit vapor barrier system, Retro-Coat[™] applied to the floor slab and existing walls, a barrier wall (Shaver Teflon-coated Glass Curtain), a positive pressure heating, ventilation, and air conditioning system in a portion of the building prior to it being occupied for commercial tenants [Langan 2019]. After installation, the Navy began quarterly sampling of indoor air and soil gas in both the portions of the building with and without VMS. Air samples were collected using passive summa cannisters [Astra 2020]. The Navy and regulating partners plan for the entire building to have vapor mitigation in the future. Groundwater in this area is found at a depth of 4.5 feet below ground surface [Rouxx 2018].

Key Results of 2019-2020 Indoor Air Testing of Building 360

Limitations: Samples of groundwater, soil gas, and indoor air were not collected during the same sampling event which would have allowed for more accurate identification of background indoor sources. Maximum detected levels may not represent actual maximum indoor air levels. Too few samples were collected to calculate 95% Upper Confidence Limits so maximum values were used for exposure point concentrations. Soil vapor has been documented beyond 100 feet from sources in some studies [ATSDR 2016].

- Indoor air samples were taken at 8 locations in Building 360. They show that vapor intrusion is occurring.
- Samples 1-4 were taken in the area with VMS. Samples 5-8 were taken in the area without VMS.
- TCE levels were highest in two of the eight locations, both in the area without VMS.
- VOC levels were highest in winter months and lowest in April.
- Indoor air levels of volatile chemical do not show a decreasing trend, only seasonal fluctuations over the two-year sampling period.
- Sample location 8 had the highest VOC levels.
- The highest measured TCE level in indoor air (2020) at Building 360 (5.32 mcg/m³) was above ATSDR's Minimal Risk Level (MRL) of 2.1 mcg/m³ for intermediate and chronic duration. The effective exposure point concentration after adjusting⁵ for occupational use (8.5 hours per day for 5 days per week) is 1.34 mcg/m³, which is less than ATSDR's MRL and therefore, not expected to result in health effects. ATSDR's estimated cancer risk resulting from this exposure is 1.4E-6, which ATSDR does not consider a concern for cancer risk.
- The highest benzene level in indoor air (2020) at Building 360 (1.18 mcg/m³) was less than ATSDR's MRL of 9.6 mcg/m³ for chronic exposure duration and not expected to result in health effects. The effective exposure point concentration after adjusting for occupational use⁶ (8.5 hours per day for 5 days per week) is 0.29 mcg/m³, which has anestimated cancer risk of 5.7E-7 that ATSDR does not consider a concern for cancer risk.

⁵ The adjustment assumes occupants are in the building 8.5 hours out of 24 hours each day for 5 days out of 7 days each week (factor of 0.252 multiplied by the concentration in air). For TCE, 5.32 mcg/m³ multiplied by 0.252 = 1.34. Cancer risk estimates assumed 50 out of 52.4 weeks per year for 20 out of a 78-year estimated lifetime. See Appendix C.

⁶ For benzene, 1.18 mcg/m³ multiplied by 0.252 = 0.29.

Chemical	Maximum Concentration, (micrograms per cubic meter)	Comparison Value	Does comparison indicate further evaluation is needed?
TCE	5.32	2.10 nc* 0.21 c [∓]	Yes
Benzene	1.18	9.60 nc* 0.13 c [∓]	Yes
		1	

Table 3. Measured Indoor Air Samples in OU-2B, Site 4, Building 360 (2019-2020)

(Data Source: Astra 2021)

*Noncancer (nc) Comparison Value - ATSDR Minimum Risk Level (MRL) an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse noncancer health effects over a specified duration of exposure.

<u>for TCE</u> Intermediate and Chronic duration 14 days to greater than 365 days = 2.1 mcg/m^3

for Benzene Intermediate duration 14 days to 364 days = 19 mcg/m³, Chronic duration greater than 365 days = 9.6 mcg/m³

Ŧ Cancer (c) Screening Comparison Value – Cancer Risk Evaluation Guides (CREGs) media-specific comparison values used to identify concentrations of cancer-causing substances that are unlikely to result in an increase of cancer rates in an exposed population.

for TCE CREG 0.21 mcg/m³

for Benzene CREG 0.13 mcg/m³

Table 4. Sampling results of indoor air samples at location 8 in Building 360

Date Sampled (Month-Year)	Benzene Indoor Air Level (mcg/m ³)	TCE Indoor Air Level (mcg/m ³)	Does comparison indicate further evaluation is needed?
April 2019	0.16	0.05	Yes
April 2019	0.78	0.10	Yes
May 2019	0.16	0.05	Yes
Nov 2019	0.72	4.49	Yes
Mar 2020	0.40	0.08	Yes
May 2020	0.19	0.05	Yes
Aug 2020	1.18	1.79	Yes
Dec 2020	0.43	5.32	Yes

Bold = Levels above Comparison Values. mcg/m³ = micrograms per cubic meter (Data Source: Astra 2021)



Figure 3. Graph showing the sampling results of indoor air samples at location 8 in building 360. (Data Source: Astra 2021)

The map below shows the sampling locations. ATSDR modified the map by adding text boxes that contain the max indoor air concentrations of TCE and benzene. The yellow area shows the location with VMS, the white area without VMS, and the blue area encased blue dash lines indicates the estimated location of the VOC groundwater plumes.



Figure 4. Map showing Building 360 sampling locations and select data Modified from Astra Q4 Monitoring Report Data Submittal December 2020.

Radiation Data

The Navy contractors performed several radiological surveys. The first survey, in 1996, was a manual survey, which identified some radioactive items that had been disposed of at various locations in the landfill. The next three surveys (in 1998/1999, 2004, and 2007) were comprehensive high-density surveys. Several radioactive chemicals have been detected from various sources including equipment use and disposal. The Navy has removed and remediated radioactive chemicals from all areas of NAS Alameda. Low levels of radiation, mainly from Radium 226 used in glow-in-the-dark paint dials, remain buried deep within a small area of both Landfills 1 and 2 and Seaplane Lagoon despite several removal actions. Clean fill and membrane caps cover the areas which are closely monitored.

Key Results of Radiation Data

- Radium-226 was frequently detected in IR Site 1 Landfill, IR Site 2 Landfill, Seaplane Lagoon Sediments, Buildings 5 and 400, and their outfall drains.
- The Navy conducted surface soil removal near walking trails of Landfills 1 and 2.
- Additional cleanup and removal of Seaplane Lagoon sediments and drain lines from Buildings 5 and 400 were completed in 2016 and 2017. However, sediments in Seaplane Lagoon were above health guidelines and require land use controls to prevent exposure. No exposure is occurring.
- People are not likely exposed to radiological chemicals in surface soil or structures at NAS Alameda. Therefore, no health evaluation is needed.

What is Radium?

- Radium is a naturally occurring silvery-white radioactive metal that can exist in several forms called isotopes.
- From the 1930s until the 1960s, radium-226 was added to paint to create a glow-in-the-dark effect for aviation and fleet instrument panels.
- Measurements given in picocuries (pCi) tells the radioactivity of a substance, while a measure in millirem per year (mrem/yr) tells the amount of energy that a radioactive source deposits on living tissue.

[Reference: ChaduxTt 2013, ATSDR 1990]

Chemical	Concentration in Surface Soil (pCi/g)*	Background Soil (pCi/g)*	Estimated Dose mrem/yr±	Health Guideline mrem/yr±
Radium-226 Landfill 1	1.00	1 - 3	14.59	<u><</u> 15 mrem
Radium-226 Landfill 2	1.42	1 - 3	15.0	<u><</u> 15 mrem

Table 5. Radium 226 Concentrations and Exposure Doses at NAS Alameda

The resulting dose is based on modeling using RESRAD Version 6.3

*Picocuries per gram.

 \pm Millirem per year. Estimated doses for recreational users \leq 15 mrem in any one year.

Health Evaluation

For chemicals detected at levels greater than our comparison values, we estimate the amount of contact people could have with the chemical at the site. Then, we compare our estimates with health effects levels from scientific studies and examine the evidence to decide whether the chemicals could harm people's health.

Exposure Assumptions

Evaluations of exposure to air contaminants are based on indoor air concentrations. Because there were few samples, we estimated exposures using maximum concentration as our exposure point concentration.

Key Results

Limitations: The maximum level of TCE measured in OU-2B buildings may not be the actual maximum indoor air levels. Levels could be higher for various reasons including weather, tidal influence, temperature, and other variables. Toxicological evidence extrapolated from oral exposures of rodents to air exposures to humans contains uncertainties.

- TCE was detected in indoor air in Building 360 at 5.32 mcg/m³ in 2020 and in Building 163 at 4.6 mcg/m³ in 2009. ATSDR's comparison value, 2.1 mcg/m³ is based on toxicological studies by Johnson in 2003 that found increased fetal heart malformations and Keil 2009 study of immune effects in rats exposed to TCE orally. Using a physiologically based pharmacokinetic (PBPK) modeling of human and animal data, and benchmark dose, ATSDR estimated a human equivalent concentration for air of 20 mcg/m³.
- The effective exposure point concentration of TCE after adjusting for occupational use (8.5 hours per day for 5 days per week) is 1.34 mcg/m³, which is less than ATSDR's noncancer comparison value for TCE and therefore, not expected to result in health effects⁷.
- TCE associated fetal heart malformations may occur over an exposure period as short as three weeks during the first trimester of pregnancy. The short exposure duration supports the need for continued monitoring and characterization of variability of contaminant levels in buildings potentially susceptible to vapor intrusion.
- ATSDR's estimated increased lifetime cancer risk based on workers assumed to be exposed for 20 years is 1.4E-6, which ATSDR does not consider a concern for cancer risk. See Appendix C for greater details.

⁷ The adjustment assumes workers are in the building 8.5 hours out of 24 hours each day for 5 days out of 7 days each week (factor of 0.252 multiplied by the concentration in air). For TCE, 5.32 mcg/m³ multiplied by 0.252 = 1.34.

Health Findings and Next Steps

Finding 1	Current and future workers (building occupants):					
	Volatile chemicals in the indoor air of Building 360 currently are not expected to harm people's health.					
	ATSDR cannot conclude whether breathing indoor air at other buildings near groundwater contamination at Alameda NAS may harm people's nealth.					
Basis for Finding	Trichloroethylene (TCE) measured in indoor air of Operable Unit-(OU-) 2B Buildings 360, 163, and 163A show migration of groundwater contaminants into indoor air that are below harmful levels. However, measurements for Buildings 163 and 163A were taken only once and are therefore too limited for ATSDR to make a public health determination. Additionally, levels in groundwater near these buildings remain elevated and indicate the need for continued monitoring to protect public health.					
	Building 360					
	 TCE: The maximum detected TCE level in indoor air in Building 360 was 5.32 micrograms per cubic meter (mcg/m³) in December 2020. ATSDR estimated that breathing this level during typical work hours would have an estimated exposure (exposure point concentration) of 1.34 mcg/m³ which would be less than ATSDR's noncancer comparison value of 2.1 mcg/m³. ATSDR's estimated increased lifetime cancer risk from this exposure (1.4 E-06) is not a concern for cancer risk. 					
	 The maximum level of TCE in OU-2B buildings during several sampling events may not represent true indoor air exposure levels over time. Exposure levels over time may be higher or lower due to weather, tidal influence, or other variables. 					
	• Benzene: The highest benzene level in indoor air (2020) at Building 360 (1.18 mcg/m3) was less than ATSDR's MRL of 9.6 mcg/m ³ for chronic exposure duration and not expected to result in health effects. The effective exposure point concentration after adjusting for occupational use is 0.29 mcg/m ³ . ATSDR's estimated increased lifetime cancer risk from this exposure (5.7E-07) is not a concern for cancer risk.					
	Buildings 163 and 163A					
	• TCE: TCE was detected in indoor air in Building 163 at 4.6 mcg/m ³ and in Building 163A at an estimated 0.15 mcg/m ³ in June 2009. From the single sampling event data, ATSDR cannot determine whether indoor air levels in Buildings 163 and 163A are of concern during different seasons. No winter samples were collected to assess seasonal variability.					

	Volatile chemicals in groundwater near other buildings
	Volatile chemicals are present in groundwater at several other locations near buildings that are currently occupied or may be occupied in the future.
	 TCE was detected in groundwater at OU-2B at levels ranging from 2,200 micrograms per liter (mcg/L) to 13,000 mcg/L between 2016 to 2018. The highest levels were near Building 162.
Next Steps	ATSDR recommends the Navy/owners and regulating partners:
	• Reduce potential exposure to future occupants by continuing plans to install a vapor mitigation system throughout Building 360. Install active vapor mitigation measures, if needed, to reduce indoor vapors during times of low positive pressure within the building, e.g., less than 5 Pascals ⁸ .
	 Continue routine monitoring of volatile chemicals in groundwater and indoor air in susceptible buildings that are or will be occupied. Consider using indicators, tracers, and surrogates (ITS) to support data quality assessment of indoor air samples⁹ to provide an indication of the best times to sample indoor air.
	• Work with future developers to ensure construction includes health protective measures and restrictions as needed such as methods that prevent vapors from coming indoors. Otherwise, alternate locations should be used for construction.
	• Test indoor air of new buildings constructed over and within 100 feet of contaminated groundwater plumes before occupancy. Sampling subslab gas and outdoor air concurrently with indoor air and using ITS provides lines of evidence to determine the source of indoor air contaminants.
	 Implement vapor mitigation measures if hazardous indoor air levels are detected in any sampling or monitoring.
	 Maintain land use restrictions, including compliance measures, and continue monitoring or sampling until levels are below unrestricted use levels.
	 Inform utility workers or others who may work below ground about the potential vapor intrusion hazards.
	 Store volatile chemicals in well ventilated areas according to manufacturer's instructions.

⁸ <u>https://www.epa.gov/sites/default/files/2019-12/documents/region5-superfund-vapor-intrusion-guidebook-201010-323pp.pdf</u>

⁹ https://iavi.rti.org/assets/docs/Radon_methods_fact_sheet_int.pdf, https://iavi.rti.org/assets/docs/Temp_Measurement_Fact_Sheet_int.pdf, https://iavi.rti.org/assets/docs/Pressure_Measurement_Fact_Sheet_Int.pdf

Finding 2	Current and future recreational users:
	Radioactive contamination below ground at Landfills 1 and 2 does not present a hazard to recreational users who may touch the ground or walk or run on the paved trails along the landfills.
Basis for Finding	 The Navy has cleaned up and removed radioactive contaminated material in the surface soil and installed barriers to prevent contact with subsurface material that may remain at Landfills 1 and 2.
	 Polyethylene membranes and clean fill prevent direct contact with radioactive material. Recreational users are allowed to walk and run on the paved trails.
	 Radiation is not detectable at the surface.
Next Steps	ATSDR recommends the Navy/owners and regulating partners:
	 Continue visual inspections as specified in site regulatory agreements to be surethat landfill control mechanisms remain intact and hazardous waste remains out of reach by recreational users.
	 Maintain land use restrictions and controls. Continue 5-year reviews to ensure institutional controls remain in place and the remedy continues to be protective.

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Appendix A. Status of Transfer of NAS Alameda Property as of 2021.

218-DDD VManadathip-baharatath_Donmulty_invAnime_Park 1_Paratures_AlanteABC attornations

Appendix B. Maps and list of buildings in each operable unit within 100 feet of groundwater plume

Figure B1. Map of Alameda Point operable units and buildings near groundwater measurements exceeding ATSDR comparison values for vapor intrusion, 2015-2017.

Alameda Point

Operable units and buildings near ground water measurements exceeding CVs, 2015-2017



and Disease Registry

Geospatial Research, Analysis, and Services Program

Figure B2. Map of buildings in operable unit 1 within 100 feet of groundwater contamination that exceeds ATSDR's comparison values for vapor intrusion.

OU-1

Buildings within 100 feet of ground water samples which exceeded CV, 2015-2017



Table B1. Buildings in operable unit 1 within 100 feet of groundwater contamination that exceeds ATSDR screening values for vapor intrusion.

ου	Building number	Building name	Status	Year built
1	608	Automotive Hobby Shop	Present	1979
1	338H-1	Storage Facilities and Office Space	Present	1948
1	338H-2	Storage Facilities and Office Space	Present	1948
1	608A	Vehicle Service Bays (Shed 1)	Present	1979
1	608B	Vehicle Service Bays (Shed 2)	Present	1979
1	FID 1384		Present	Unknown
1	FID 1385		Present	Unknown
1	FID 1392		Present	Unknown
1	FID 1393		Present	Unknown
1	FID 1394		Present	Unknown
1	FID 1395		Present	Unknown
1	FID 1396		Present	Unknown
1	FID 1397		Present	Unknown
1	FID 1398		Present	Unknown
1	FID 1400		Present	Unknown
1	FID 1401		Present	Unknown
1	FID 1402		Present	Unknown
1	FID 1403		Present	Unknown
1	OTH168-			Between 1981 and
-	4	Paint Booth	Present	1990
1	FID 22		Undetermined	Unknown

Figure B3. Map of buildings in operable unit 2A within 100 feet of groundwater contamination that exceeds ATSDR's comparison values for vapor intrusion.





Table B2. Buildings in operable unit 2A within 100 feet of groundwater contamination that exceeds ATSDR screening values for vapor intrusion.

OU	Building number	Building name	Status	Year built
2A	530	Missile Rework Facility (NARF)	Present	1973
2A	MS-01	Navy Exchange Mini-Storage (19 buildings total)	Present	Unknown
2A	MS-02	Navy Exchange Mini-Storage (19 buildings total)	Present	Unknown
2A	MS-03	Navy Exchange Mini-Storage (19 buildings total)	Present	Unknown
2A	MS-04	Navy Exchange Mini-Storage (19 buildings total)	Present	Unknown
2A	MS-05	Navy Exchange Mini-Storage (19 buildings total)	Present	Unknown
2A	MS-06	Navy Exchange Mini-Storage (19 buildings total)	Present	Unknown
2A	MS-07	Navy Exchange Mini-Storage (19 buildings total)	Present	Unknown
2A	MS-08	Navy Exchange Mini-Storage (19 buildings total)	Present	Unknown
2A	MS-09	Navy Exchange Mini-Storage (19 buildings total)	Present	Unknown
2A	MS-10	Navy Exchange Mini-Storage (19 buildings total)	Present	Unknown
2A	MS-11	Navy Exchange Mini-Storage (19 buildings total)	Present	Unknown
2A	MS-12	Navy Exchange Mini-Storage (19 buildings total)	Present	Unknown

Figure B4. Map of buildings in operable unit 2B within 100 feet of groundwater contamination that exceeds ATSDR's comparison values for vapor intrusion.





Table B3. Buildings in operable unit 2B within 100 feet of groundwater contamination that exceeds ATSDR screening values for vapor intrusion.

OU	Building number	Building name	Status	Year built
2B	14	Engine Test Cell	Present	1940
2B	71	Mounted A-7 Aircraft	Present	1987
2B	113	A/C Parts Shipping Container Overhaul	Present	1943
2B	162	Ship and Aircraft Maintenance Shop	Present	1945
2B	170	Aviation Equipment Storage and Packaging	Present	1957
2B	175	Transformer House	Present	1943
2B		Aircraft Engine and Air Frame Overhaul		
20	360	Facility	Present	1953
2B	372	Turbo Prop Test Cell	Present	1953
2B	398	Turbine Accessories Shop	Present	1957
2B	399	NADEP Compressor Support	Present	1957
2B	414	Hazardous Material Storehouse	Present	1957
2B	552	Electrical Substation Main	Present	1973
2B	610	High Speed Grind Shelter	Present	1979
2B	627	Engine Components Facility	Present	1986
2B	163 FID 1429	Equipment Maintenance (Plant Service A/C)	Present	1939
2B	163 FID 804	Equipment Maintenance (Plant Service A/C)	Present	1939
2B	163 shed FID			
20	1430	Equipment Maintenance (Plant Service A/C)	Present	1939
2B	163 shed FID		- .	
	1431	Equipment Maintenance (Plant Service A/C)	Present	1939
	ELECTRICAL			
2B				
			Procent	Unknown
			Fresent	UTKIOWI
2B	TRANSFORMER			
	FID 777		Present	Unknown
2B	FID 823		Present	Unknown
2B	RISER FID 836		Present	Unknown
2B	RISER FID 845		Present	Unknown
חר	Silo Air			
ZB	Cleaners		Present	Unknown
2B	FID 740		Undetermined	Unknown
2B	FID 779		Undetermined	Unknown
2B	FID 781		Undetermined	Unknown
2B	FID 785		Undetermined	Unknown
2B	FID 867		Undetermined	Unknown

Figure B5. Map of buildings in operable unit 3 within 100 feet of groundwater contamination that exceeds ATSDR's comparison values for vapor intrusion.





Table B4. Buildings in operable unit 3 within 100 feet of groundwater contamination that exceeds ATSDR screening values for vapor intrusion.

OU	Building number	Building name	Status	Year built
3	133	Air Traffic Control Radio Facility	Present	1945
3	594	Physical Section Reaction Force Facility	Present	1976
3	FID 25		Undetermined	Unknown
3	FID 6		Undetermined	Unknown
3	FID 8		Undetermined	Unknown

Figure B6. Map of buildings in operable unit 5 within 100 feet of groundwater contamination that exceeds ATSDR's comparison values for vapor intrusion.



OU-5 Buildings within 100-Foot Buffer

Table B5. Buildings in operable unit 5 within 100 feet of groundwater contamination that exceeds ATSDR screening values for vapor intrusion.

OU	Building number	Building name	Status	Year built
5	FH-1024		Present	1969
5	FH-1025		Present	1969
5	FH-1026		Present	1969
5	FH-1027		Present	1969
5	FH-1029		Present	1969
5	FH-1030	2000 MAYPORT CIRCLE	Present	1969
5	FH-1140	4076 SEAHORSE	Present	1991
5	FH-1141	4078 SEAHORSE	Present	1991
5	FH-150	3033 MARS	Present	1991
5	FH-151	3035 MARS	Present	1991
5	FH-155	3036 MARS	Present	1991
5	FH-156	3034 MARS	Present	1991
5	FH-164	3063 KANSAS CITY	Present	1991
5	FH-165	3070 WICHITA	Present	1991
5	FH-183	4012 NIMITZ	Present	1991
5	FH-184	4010 NIMITZ	Present	1991
5	FH-185	4008 NIMITZ	Present	1991
5	FH-188	4019 ROARK	Present	1991
5	FID 1410		Present	Unknown
5	FID 1411		Present	Unknown
5	FID 1412		Present	Unknown
5	FH- FID 321		Undetermined	Unknown
5	FH- FID 331		Undetermined	Unknown
5	FH- FID 332		Undetermined	Unknown
5	FH- FID 347		Undetermined	Unknown
5	FH- FID 351		Undetermined	Unknown
5	FH- FID 362		Undetermined	Unknown
5	FH- FID 382		Undetermined	Unknown
5	FH- FID 383		Undetermined	Unknown
5	FH- FID 391		Undetermined	Unknown

Figure B7. Map of buildings in operable unit 6 (north) within 100 feet of groundwater contamination that exceeds ATSDR's comparison values for vapor intrusion.





Figure B8. Map of buildings in operable unit 6 (south) within 100 feet of groundwater contamination that exceeds ATSDR's comparison values for vapor intrusion.

OU-6 South Buildings within 100-Foot Buffer



Table B6. Buildings in operable unit 6 within 100 feet of groundwater contamination thatexceeds ATSDR screening values for vapor intrusion.

OU	Building number	Building name	Status	Year built
6	20	Landplane Maintenance Hangar	Present	1941
6	68	Waterfront Maintenance Shop	Present	1988
6	168	Warehouse/Storehouse	Present	1946
6		Control & Access Panels for Sewage Lift Station		
0	449	#5	Present	1954
6	554	Electrical Substation #7	Present	1973
6	582	Aircraft Wash Rack (SE corner of Bldg 20)	Present	1975
6	FID 895		Undetermined	Unknown
6	FID 898		Undetermined	Unknown
6	FID 899		Undetermined	Unknown
6	FID 900		Undetermined	Unknown
6	FID 901		Undetermined	Unknown

Contaminant Name	CASRN	Conc	Unit	Above or Equal to Recommended ATSDR CV?	Above or Equal to Other CV?	CREG	Chronic EMEG	Int EMEG	RMEG	Acute EMEG
Trichloroethylene	79-01-6	5.32	µg/m³	Yes [1]	Yes [2]	0.21 [1]	2.1 [2]	2.1 [2]	2.0 [2]	NA
Benzene	71-43-2	1.18	µg/m³	Yes [1]	No	0.13 [1]	9.6	19	30	29

Appendix C. Screening and Estimated Cancer Risk

- [#] Recommended ATSDR CV.
- [1] Recommended ATSDR CV met or exceeded.
- [2] Additional ATSDR CV met or exceeded.
- [3] Acute ATSDR CV met or exceeded.
- [4] Non-ATSDR value met or exceeded.

Estimated Cancer Risk

ATSDR estimated the excess cancer risk for TCE and benzene using USEPA's Inhalation Unit Risk (IUR). The IUR is defined as the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of $1 \mu g/m3$ in air. Inhalation unit risk toxicity values are expressed in units of (mcg/m3)-1. ATSDR's estimated increased lifetime cancer risk for inhalation of these chemicals in indoor air was not considered to be a concern for cancer risk.

Risk = IUR x EC x ED Where:

IUR (mcg/m³)⁻¹ = Inhalation Unit Risk EC (mcg/m³) = Exposure Concentration ED= Exposure Duration for Workers (8.5 hours/24 hours/day x 5 days/7 days/week x 50 weeks/52.4 weeks/year x 20 years/78 years/ lifetime = 0.062)

TCE - Inhalation Unit Risk - IUR = $4.1E-06 (mcg/m^3)^{-1}$ Health endpoint - Renal cell carcinoma, non-Hodgkin's lymphoma, and liver tumors

Benzene - Inhalation Unit Risk - IUR = 7.8E-06 (mcg/m³)⁻¹ Health endpoint - Lymphoma

Table 6. Estimated Cancer Risk of Indoor Air Samples in Building 360

Chemical	IUR (mcg/m ³) ⁻¹	Indoor Air Maximum Concentration	Occupational Exposure Duration	Estimated Cancer Risk
Benzene	7.80E-06	1.18	0.062	5.7 E-07
TCE	4.10E-06	5.32	0.062	1.4 E-06